SOLAR ENERGY CORPORATION OF INDIA LTD.
NEW DELHI

PREPARATORY STUDIES FOR FLOATING SOLAR PHOTOVOLTAIC POWER PROJECT AT GETALSUD DAM IN JHARKHAND, INDIA

Environmental and Social Impact Assessment (ESIA)

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LIST OF ACRONYMS

AAQ	:	Ambient Air Quality
AC	:	Alternating Current
AP	:	Action Plan
As	:	Arsenic
Ba	:	Barium
BIS	:	Bureau of Indian Standard
BOD	:	Biological Oxygen Demand
BOQ	:	Bill of Quantities
CEA	:	Central Electricity Authority
CO	:	Carbon Monoxide
COD	:	Chemical Oxygen Demand
CPCB	:	Central Pollution Control Board
CPSU	:	Central Public Sector Unit
Cd	:	Cadmium
Cr	:	Chromium
CTE	:	Consent to Establish
CTO	:	Consent to Operate
Cu	:	Copper
dB	:	Decibel
DC	:	Direct Current
DG	:	Diesel Generator Set
DO	:	Dissolved Oxygen
DPM	:	Disaster Management Plan
DPR	:	Detailed Project Report
DSL	:	Dead Storage Level
E&S	:	Environmental & Social
EHS	:	Environment, Health and Safety
EIA	:	Environmental Impact Assessment
EMP	:	Environmental Management Plan
EPA	:	Environment Protection Act
EPFIs	:	Equator Principle Financial Institutions
EPC	:	Engineering Procurement and Contracts
EPP	:	Emergency Preparedness Plan
ESIA	:	Environmental and Social Impact Assessment
ESHS	:	Environmental, Social, Health and Safety
ESMP	:	Environmental and Social Management Plan
ESO	:	Environment and Social Officer
ESS	:	Environmental and Social Standards
Fe	:	Iron
FRL	:	Full Reservoir Level
FSPV	:	Floating Solar Photovoltaic
GCF	:	Green Climate Fund
GDP	:	Gross Domestic Product

GO	:	Government Order
GoI	:	Government of India
GoJ	:	Government of Jharkhand
GW	:	Ground Water / Giga Watt
GWh	:	Giga Watt Hour
Ha	:	Hectare
HC	:	Hydrocarbons
HDPE	:	High Density Polyethylene
Hg	:	Mercury
H_2S	:	Hydrogen Disulphide
IBAT	:	Integrated Biodiversity Assessment Tool
ICUN	:	International Union for Conservation of Nature
IEE	:	Initial Environmental Examination
IMD	:	India Meteorological Department
INDC	:	Intended Nationally Determined Contributions
INTACH	:	Indian National Trust for Art and Cultural Heritage
IPP	:	Indigenous Peoples Plan
IS	:	Indian Standard
JBVNL	:	Jharkhand Bijli Vitran Nigam Limited
JNNSM	:	Jawaharlal Nehru National Solar Mission
JSPCB	:	Jharkhand State Pollution Control Board
Km	:	Kilometre
KV	:	Kilo Volt
KWh	:	Kilo Watt Hour
M	:	meter
MCF	:	Million Cubic Feet
MCM	:	Million Cubic Meter
MDDL	:	Minimum Drawdown Level
MNRE	:	Ministry of New and Renewable Energy
Mn	:	Manganese
MoEF&CC	:	Ministry of Environment, Forests and Climate Change (Government of India)
MoU	:	Memorandum of Understanding
MSL	:	Mean Sea Level
N	:	Nitrogen
NABL	:	National Accreditation Board for Testing and Calibration Laboratories
NGO	:	Non-Governmental Organization
NH	:	National Highway
NH_3	:	Ammonia
Ni	:	Nickel
NO_x	:	Oxides of Nitrogen
NQ	:	Noise Quality
O_3	:	Ozone
O&G	:	Oil & Grease
OECD	:	Organisation for Economic Co-operation and Development
OHS	:	Occupational Health and Safety

OPD	:	Out Patient Department
P	:	Phosphorus
PAF	:	Project Affected Family
Pb	:	Lead
PAP	:	Project Affected Person
PE	:	Polyethylene
pH	:	Hydrogen ion concentration (Alkaline / Acidic)
PM	:	Particulate Matter
PMC	:	Project Management Consultant
PPE	:	Personal Protective Equipment
PV	:	Photovoltaic
PSU	:	Public Sector Unit
RAP	:	Resettlement Action Plan
RE	:	Renewable Energy
RFCTLARR	:	Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act
ROW	:	Right of Way
R&R	:	Resettlement and Rehabilitation
SC	:	Scheduled Caste
SECI	:	Solar Energy Corporation of India Limited.
SO_2	:	Sulphur Dioxide
SPCB	:	State Pollution Control Board
ST	:	Scheduled Tribes
SQ	:	Soil Quality
SW	:	Surface Water
ToR	:	Terms of Reference
TDS	:	Total Dissolved Solids
TPH	:	Total Petroleum Hydrocarbons
TSS	:	Total Suspended Solids
TOR	:	Terms of References
WB	:	The World Bank
WHO	:	World Health Organization
Zn	:	Zinc

EXECUTIVE SUMMARY

By 2021, India had surpassed the 100 GW mark of installed renewable energy capacity, which included a mix of solar, wind, biomass, and small hydro projects.India had expressed aspirations to substantially increase its renewable energy capacity to 450 GW by 2030.). The increase in energy demand driven by an aspiring society provides the growing need to consider economy based out of renewable energy sources. In addition, the climate change challenge poses a major threat to the depleting natural resources like coal and oil. This has led the global businesses to focus on clean, locally available, and cost-efficient energy solutions such from renewable energy sources.

Floating solar PV plants provide options for meeting the increasing demand of solar energy generating capacity, specifically where high population density and land are the major constraints. The advantage of obtaining potentially better energy yields due to environmental and operational factors are added advantages over conventional ground-mounted PV plants in areas where use of land and constructability are the major concerns.

In India, Solar Energy Corporation of India Ltd. (SECI) has taken initiative to promote and expand solar energy generating capacity throughout the country through floating solar power plants at the Getalsud reservoir (Ormanjhi CD block in the Ranchi Sadar subdivision of Ranchi district) in the eastern state of Jharkhand (29°07’15” N, 79°17’39” E) in India across Subarnarekha River, 40 km east of Ranchi in India.

Tractebel has been engaged as the technical consultant (hereinafter, the “Consultant” or Tractebel) to conduct Environmental and Social Impact Assessment (ESIA) Survey along with Resettlement Action Plan (RAP) for the proposed floating solar project, which would be adopted for implementation at Getalsud reservoir in the state of Jharkhand. Further, subsequent revisions were undertaken by SECI team. This document presents the ESIA study conducted and the related findings and recommendations for mitigation measures.

Summary

Solar PV projects in India are exempt from the purview of Environmental Clearance process of the Ministry of Environment, Forests and Climate Change (MoEFCC) of the Government of India. However, in compliance with the requirements of international financing agencies, an Environmental and Social Impact Assessment (ESIA) Study has been carried out separately for the proposed FSPV Project in accordance with the World Bank/ SECI’s guidelines and policies, and the applicable environmental regulatory framework of the Government of India.

Both primary and secondary data on environmental and social attributes in the study area have been collected as part of the ESIA study. The area contained within a 5km radius from the periphery of the Project site and a 500m corridor along the proposed transmission line has been taken as the study area in this ESIA study.

In all, through the ESIA, potential impacts on the environment and society which may arise at different stages of the Project and its mitigation measure were identified. However, the assessment of the identified risks highlights that none is considered as major show-stoppers or red-flag items. Recommendations were included for each identified potential Project risk in the main body of this report.

The Project is not located close to any protected areas such as a National Park or a wildlife Sanctuary. The Betla National Park, which is the nearest and the only national park in Jharkhand, is located at a distance of 140 kms from the Getalsud reservoir, where the FSPV is to be installed. The Hazaribagh wildlife sanctuary is at a distance of 70 kms from the reservoir. There is a zoological park at Irba which is nearly 10 kms from the site. Aquatic and terrestrial surveys were conducted as part of the ESIA study to determine the proximity of the Project to any priority biodiversity hotspots/ critical habitats within the proposed Project area that may be affected by the installation of the FSPV Project and associated facilities. No component of the Project is located close to any ecologically sensitive area.

No land is required for the installation of the floating solar units as these will be installed over the Getalsud reservoir over 172 Ha of reservoir surface. The total numbers of affected persons and families are 2869 and 635 respectively. Total land requirement for the pylon and stringing of wires for the Project has been worked out to be 73.38 Ha which will be partially affected through restrictions on certain types of crops and loss of access to a very small area of land. Most of the area comes under private land and belongs to 572 families. 4.88 Ha of private agricultural land for pylon owned by 63 families and 0.50 Ha land for substation are required. The land identified for the plant substation is privately owned agricultural land. Details regarding ownership of land required for transmission lines has been provided in Resettlement Action Plan (RAP) report, prepared separately for this Project.

Based on the study of environmental and social baseline conditions, potential impacts of the Project on all relevant environmental and social attributes have been identified and suitable mitigation measures have been suggested in line with the World Bank Guidelines and Policies. The potential impacts have been identified for all stages of the project viz preconstruction, construction, operation and decommissioning stages.

A critical potential impact on account of the Project relates to the impacts on aquatic ecology of the Getalsud reservoir. The presence of infrastructure on the surface of a lake reduces the wavelengths of light which penetrate the surface of the lake which is used by submerged aquatic plants and phytoplankton. Any effect on phytoplankton could cascade to biota at other trophic levels since they are the primary producers. In some circumstances an impact on the fisheries resource may be expected. In addition, phytoplankton species composition may be affected, with knock-on effects on other biodiversity. The impacts of the Project on aquatic ecology of Getalsud reservoir has been studied and suitable mitigation measures have been suggested in the ESIA report.

Based on assessment of anticipated impacts, an Environmental and Social Management Plan has been presented in the ESIA study report. The ESIA study defines the roles and responsibilities of various functionaries in implementation of proposed ESMP and it also suggests an institutional arrangement and capacity building measures for effective implementation of the ESMP.

A budget has been proposed for ESMP implementation of the proposed FSPV Project. A tentative cost of INR 11,798,600 has been taken for the implementation of environmental and social management and monitoring plan and INR 5.89 Crores for implementation of RAP. This includes the cost of land acquisition and that of rehabilitation and resettlement.

1. INTRODUCTION

1.1. Genesis

India has an ambitious target of achieving 450 GW of renewable energy by 2030. The increase in energy demand driven by an aspiring society provides the growing need to consider economy based out of renewable energy sources. In addition, the climate change challenge poses a major threat to the depleting natural resources like coal and oil. This has led the global businesses to focus on clean, locally available, and cost-efficient energy solutions such from renewable energy sources. Figure 1 depicts the growth in renewable energy since 2013 as provided by the International Energy Agency (IEA).

It can be observed that Solar Energy has seen an increase of more than 60 GW in past six years.

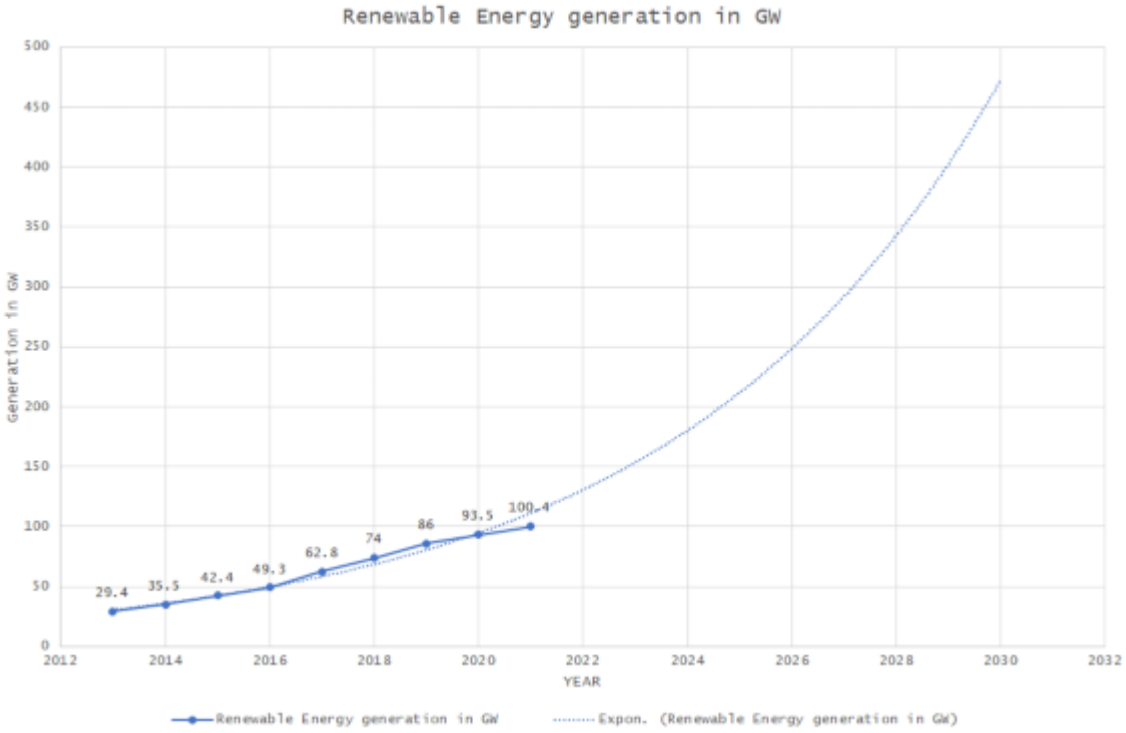

Figure 1: Growth in Renewable Energy in India (Source: IEA India 2020 Review Presentation)

Solar Energy is important as it reduces the dependency of oil imports and makes the country self-reliant. India's traditional value system revers Sun as a God and has a long relationship of utilising solar energy for drying and disinfectant needs. Solar energy is one of the best choices among all renewable energy sources. It is not as capital intensive as tidal and geothermal (and with better service and reliability); Solar Energy has a greater stability than its counterparts wind and tidal energy. There are several projects which have been implemented from mega scale such as utility-scale grid-connected solar PV plants, solar-powered airports, and railway stations to off-grid decentralised installations in temples, stadiums, and villages with no electricity access.

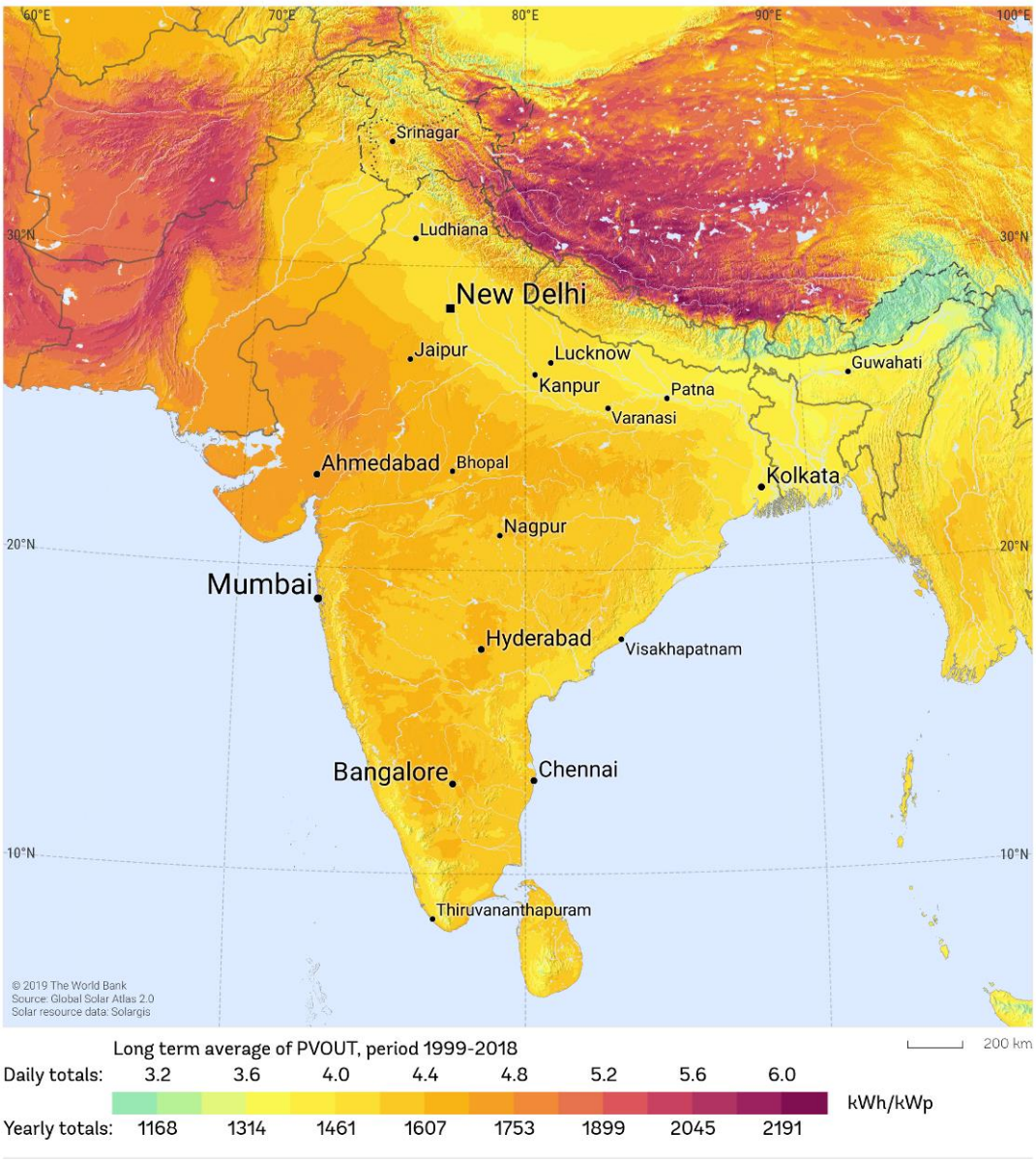

Figure 2: Solar resource map of India (Source: SolarGIS)

One of the major impediments in scaling up and implementation of large-scale solar plants in India is the availability and affordability of land and rich solar radiation throughout the Country. Figure 2 above shows the solar resource map of India. The growing population and its associated demand such as those for clean water, food and housing are constraints for utilising the full potential of the solar energy. In this regard, floating solar provides a viable alternative.

Floating solar PV plants provide options for meeting the increasing demand of solar energy generating capacity, specifically where high population density and land are the major constraints. The advantage of obtaining potentially better energy yields due to environmental and operational factors are added advantages over conventional ground-mounted PV plants in areas where use of land and constructability are the major concerns.

With a vision “To build ‘Green India’ through harnessing abundant solar radiation and to achieve energy security for the country”, Solar Energy Corporation of India Ltd. (SECI), a central public sector unit under the administrative control of MNRE has taken initiative to promote and scale up solar energy generating capacity throughout the country through floating solar power plants.

1.2. The Project proponent and consultant

"Solar Energy Corporation of India ltd" (SECI) is a central public sector undertaking (CPSU) under the administrative control of the Ministry of New and Renewable Energy (MNRE), set up on the 20th of September 2011 to facilitate implementation of Jawaharlal Nehru National Solar Mission (JNNSM) and achievement of targets set therein. In the present outlook of the RE sector, especially solar energy, SECI has a major role to play in the sector’s development. The company is responsible for implementation of several schemes of MNRE, major ones being the VGF schemes for large-scale grid-connected projects under JNNSM, solar park scheme and grid-connected solar rooftop scheme, along with a host of other specialized schemes such as defence scheme, canal-top scheme, Indo-Pak border scheme etc. In addition, SECI has ventured into solar project development on turnkey basis for several PSUs. The company also has a power trading license and is active in this domain through trading of solar power from projects set up under the schemes being implemented by it.

Tractebel has been engaged as the technical consultant (hereinafter, the “Consultant” or Tractebel) to conduct Environmental and Social Impact Assessment (ESIA) Survey along with Resettlement Action Plan (RAP) for the proposed floating solar project, which would be adopted for implementation at Getalsud reservoir in the state of Jharkhand. The Final ESIA report is founded on the initial draft report created by Tractebel in the year 2019. Subsequently, the SECI team revised and updated it to address the World Bank's safeguard requirements in the year 2023.and seek necessary funding

1.3. Indian solar energy scenario

India, being a tropical country, is blessed with good sunshine over most parts, and the number of clear sunny days over the year is also quite high.

As per the Ministry of New and Renewable Energy (MNRE), Government of India (GoI), the country receives solar energy equivalent of more than 5000 trillion kWh per year with a daily average solar energy incident varying from 4.0 to 7.0 kWh/m^2 depending upon the location.

India’s equivalent solar energy potential is about 6000 million GWh of energy per year. The hot and dry climatic regions in the country have the best solar radiations with around 300 sunny days, which makes these the appropriate locations for harnessing solar energy.

1.4. Project location and study area

The FSPV plant is proposed to be implemented at the eastern corner of Getalsud reservoir, near Getalsud village in Ormanjhi/Angara development blocks of Ranchi district, in the state of Jharkhand, India. The nearest town is Ranchi. The site is about 30km away from the district headquarter Ranchi, and 40km away of Birsa Munda Airport. The nearest railway station Tatisilwai is 20km away from the reservoir. The northern side of the reservoir near the plant substation is located at Matatu village which is 3km away from the national highway NH-320, and the southern part (Getalsud village) of the reservoir is at a distance of 8km from the nearest state highway SH-1(Ranchi-Purulia Road).

Geographical location details of the proposed site are given in Table 1 below.

Description	Value
Site location	Getalsud Reservoir
Taluka	Ormanjhi/Angara
District	Ranchi
District headquarter	Ranchi
State	Jharkhand
Country	India
Latitude	85°32'33"E
Longitude	23°27'25"N
Altitude	580m above mean sea level

Table 1: Geographical location of the proposed site

Figure 3: Location of Getalsud reservoir [source: Google Map]

The Getalsud reservoir is created out of an earthen embankment dam, which is built on Subarnarekha River in Ranchi District of Jharkhand.

The reservoir has a maximum height of 17.98 m and a length of 9.50 km. The main purpose of the reservoir is supply water to Ranchi and irrigates adjoining villages. The average water surface area of Getalsud reservoir is 1870.7 hectares while its water holding capacity is 3650 MCF.

The generated power from the proposed FSPV plant shall be evacuated at 132kV power substation.

For the purposes of this study, an area contained within a 5 km radius from the periphery of the proposed project site and 500 m corridor along the transmission line and to be extended to its projected area of influence/ impact during normal operation or in the event of catastrophic failure has been considered as the study area. The study area and all analyses shall include cumulative impact of the existing reservoir system and the proposed project. Figure 4 below shows the area under consideration for the study within 5 km radius from the periphery of the floating unit site.

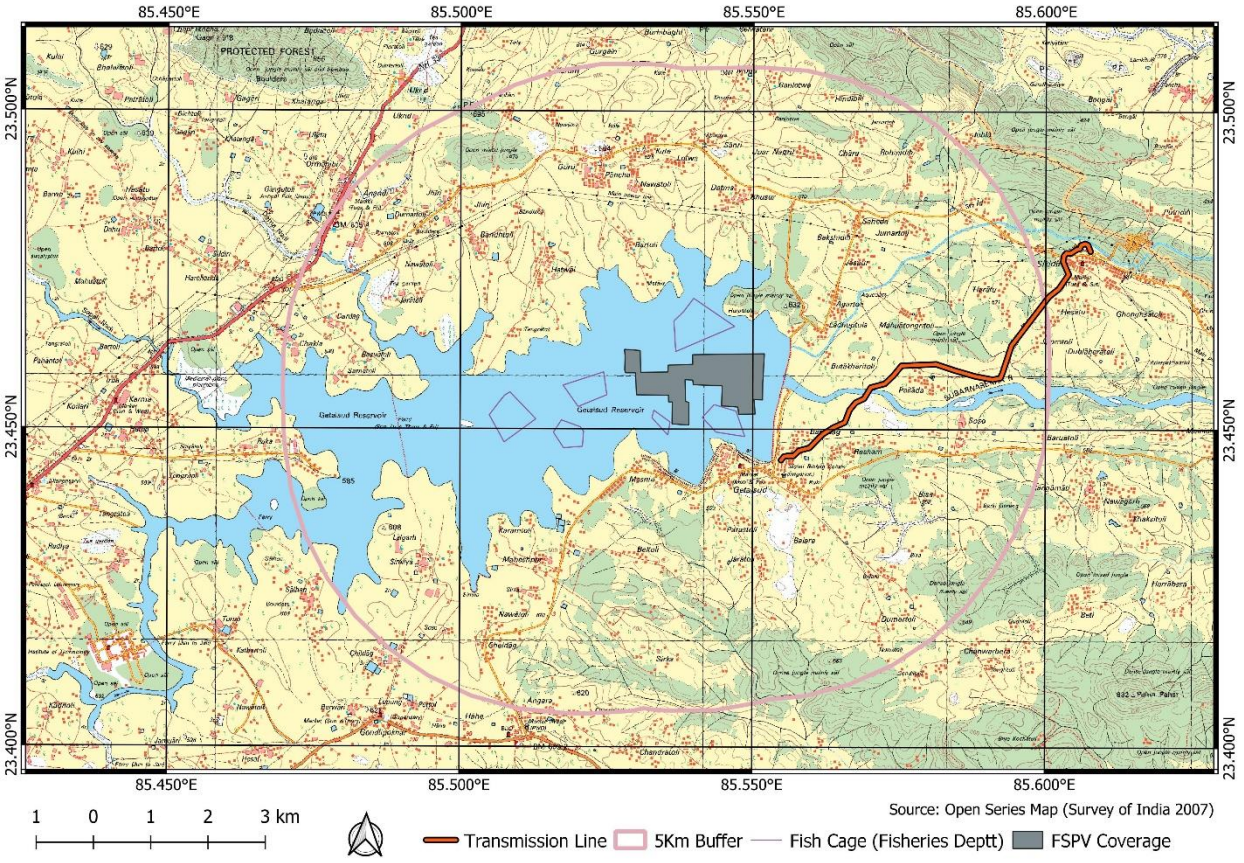

Figure 4: Study area map within 5 km radius from the project site

1.5. Transmission line alignment

The generated power from the proposed FSPV plant has been planned to be evacuated at 132kV voltage level as per details indicated below:

- **100MW will be evacuated through a 132kV double circuit transmission line with ACSR Zebra Conductor to the upcoming 132/33kV grid substation Irba at Sikidri, at an approximate distance of 10km from the plant substation.**

1.

RoW width shall be 27 m for the main corridor.

1.6. Purpose of the study

The purpose of this Environmental and Social Impact Assessment (ESIA) is to incorporate environmental concerns at project implementation level. ESIA has been carried out at project planning and design stage as part of project implementation phase to ensure that the project is environmentally sound and feasible. The general objectives of ESIA study are as follows:

- **Provide information about the baseline environmental settings of the project area**
- **Provide information on potential impacts of the project and the characteristic of the impacts, magnitude, distribution, the affected group and their duration.**
- **Provide information on potential mitigation measures to minimize the impact including mitigation costs.**
- **Assess the best alternative for the project at most benefits and least costs in terms of financial, social and environment.**
- **Provide basic information for formulating management and monitoring plan.**

1.7. Scope of ESIA Study

The scope of the ESIA includes the following:

- **Carry out Environment and Social Impact Study including Environmental and Social Impact Assessment in accordance with World Bank Operational Policies, and guidelines of the Government of India and State Government of Jharkhand.**
- **Carry out the preliminary environmental and social screening, scoping to assess the direct and induced impacts due to the project.**
- **Assess and document baseline conditions relevant to the project with the objective to establish the benchmarks.**
- **Assess the potential positive and negative significant impacts due to the project and identify the cost-effective mitigation measures to address these impacts adequately in the Environmental and Social Management Plan (ESMP).**
- **Analysis of alternatives incorporating environmental and social concerns and the associated costs in the economic analysis.**
- **Provide special attention to the environmental and social enhancement measures in the project.**

- **Undertake adequate public consultation and incorporate the recommendations arising thereon in ESIA report.**
- **Identify all mitigation measures in the ESIA and ESMP.**
- **Provide additional inputs in the areas of performance indicators and monitoring mechanisms for environmental and social components during construction and operational phase of the project.**
- **Provide the cost of mitigation measures and to ensure that environmental and social related staffing, training and institutional requirements are budgeted in project cost.**

1.8. Methodology

The methodology adopted for this study is based on the procedures and guidelines as per following:

- **World Bank Operational Policies.**
- **SECI's E&S Management Framework.**
- **Project Terms of Reference (TOR).**
- **Environmental Impact Assessment Notification dated 14th September 2006, Ministry of Environment and Forest (MoEF&CC) and amendment, Government of India.**
- **The Environmental (Protection) Act, 1986 of Government of India.**
- **Handbook of Environmental Procedures and Guidelines, 1994, Government of India; and**

Work steps followed during the ESIA process has been demonstrated in Figure 5 below. The methodology adopted includes the following work plan:

Activity 1: Submission of Inception Report with methodology

The Consultant, including the Environmental Specialist, completed field visit in September 2019, in order to get the team members appraised of the project background, present status, approach and methodology to be followed and sources of secondary data/ reports.

Activity 2: Collection and review of relevant documents

The environmental team collected and reviewed project parameters, including technical information, and design specification provided by engineering team.

Activity 3: Field investigation

The environmental team undertook a rapid reconnaissance and field visit for the entire project area including transmission line route. It was followed by field environmental survey. Various environmental features of the project corridors have been observed and studied. A standard checklist for the purpose has been provided as **Annexure F** of this report.

Activity 4: Report preparation

Based on analysis of the baseline data, detailed assessment of environmental and social impacts on project parameters was carried out. This was completed for the pre-construction, construction and operational phase.

The reference framework used for assessment of environmental and social impacts comprises World Bank Operational Policies and MoEF&CC regulatory framework and guidelines. The baseline data has been compared with applicable standards for each environmental attribute for identifying sensitive environmental attributes.

Activity 5: Public Consultation

During field environmental survey, public consultations were conducted to obtain views of the local people, project affected persons and local administrative representatives. Focussed group discussion has been adopted as tool for this public consultation along with social team.

Based on collected data and information, potential adverse environmental and social impacts have been identified and examined using standard “Checklist Method”. Thereafter possible mitigation measures have been identified and based on findings of impact appraisal comprising the key elements embodied in this ESIA, an Environmental and Social Management Plan (ESMP) has been developed. Continued discussions were undertaken with the stakeholders and technical team of the Consultant for integrating environmental and social management measures into the project.

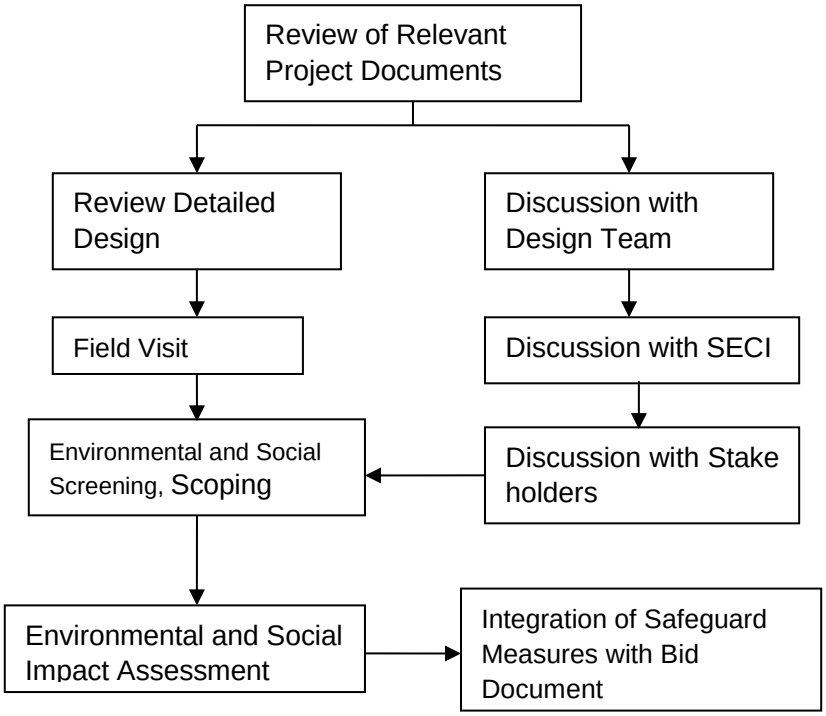

Figure 5: Work steps of ESIA

1.9. Data collection

Primary data was collected on various environmental and social attributes such as demographic profile, educational level, occupational profile, soil, meteorology, geology, hydrology, water quality, flora and fauna, habitat, demography, land use, cultural properties etc, to establish the baseline environmental and social setup. .

Secondary data on environment and social attributes for the project corridor was collected both from published and other relevant sources e.g., the State Department of Forest, Jharkhand Pollution Control Board, State Statistical Department etc. The data collection from the field was completed for 30 days beginning November 2019 with the help of field surveyors and enumerators/ investigators. Trained interviewers/ surveyors were deployed for collecting the samples and filling up the questionnaires at site. Summary of all data collection has been presented in Table 2 below:

Sl. No.	Environmental and Social Attributes	Mode of Collection	Parameters	Source of Data
(a)	Meteorological Data	Secondary	Solar Irradiance, Temperature, Humidity, Rainfall	India Meteorological Department (IMD)
(b)	Technical Project Details	Secondary	Technical specification and details of project	Detailed Project Report (DPR)
(c)	Ambient air Quality	Primary, Through a NABL accredited lab.	PM2.5, PM10, SO2, NOx, CO etc.	Field studies during winter season in November-December 2019
(d)	Noise	Primary, Through a NABL accredited lab.	Day and Night Noise	Field studies during winter season in November-December 2019
(e)	Soil	Primary, Through a NABL accredited lab.	Grab sample at 3 locations	Sample collected in December 2019
(f)	Water resource			
A	Ground Water	Secondary	Ground water level	CGWB
B	Surface water	Secondary	Reservoir characteristics	Irrigation Department
(g)	Water Quality			
A	Ground water	Primary, Through a NABL accredited laboratory	Grab sample at 3 locations	Sample collected in December 2029
B	Surface water	Primary, Through a NABL accredited laboratory	Grab sample at 2 locations	Sample collected in December 2019
(h)	Reservoir Characteristics	Primary, Through a NABL accredited laboratory	Grab sample at 8 locations on following parameters Temperature, pH, Secchi Depth, Dissolved Oxygen	Sample collected in December 2019
(i)	Terrestrial Ecology	Primary and Secondary	Floral and faunal Diversity, Aug-Oct 2020	Field studies for winter season Secondary data as available with the Forest Department and desktop studies. The following resources are referred 1. IUCN Red List 2. iBAT Tool
(j)	Aquatic Ecology	Primary and Secondary	Floral and faunal Diversity and survey in Aug-Oct 2020	Field studies for winter season Secondary data as available with the Fisheries Department and desktop studies
(k)	Socio-economic parameters	Primary and Secondary	During Nov-Dec 2019 and Jan-Feb 2020, Aug-Oct 2020	Secondary social data collected from census survey of India and other relevant publications in public domain. Primary survey to collect gender desegregated data on socio-economic attributes of the population living in the project influence area such as Demographic profile, Education level, Occupational structure.

Sl. No.	Environmental and Social Attributes	Mode of Collection	Parameters	Source of Data
				Primary survey also collected data on basic social infrastructure in the area like Health, Banking, Sanitation, Water supply, postal services etc. Interview with the Local PRIs representatives and government officials of concerned department such as Irrigation Department, Fisheries Department, Forest department and representatives of the District Administration and . Note: PRI stands for "Panchayati Raj Institution". It is a system of Local Self Government for rural areas in India wherein the Villages are the basic unit of local administration. In the revised ESIA report, we shall include a note on the PRIs in India for better clarity. "Census survey of India" refers to the collection of statistical information on different characteristics of the people of India by the Registrar General and Census Commissioner, India under the Ministry of Home Affairs, Government of India. The Census survey is carried out on decennial basis i.e. every ten years. It is the most credible source of information on demography and socio-economic attributes of a given population in India. The last survey was done in 2011. It will be elaborated in the report accordingly.
(l)	Project Affected People	Primary	Aug-Oct 2020	Questionnaire based socio economic survey for the PAPs and focus group discussion with affected communities' members.
(m)	Forest Resources	Secondary	During Nov-Dec 2019 and Jan-Feb 2020, Aug-Oct 2020	Interview with the District Forest Officials, Ranchi

Table 2: Summary of data collection

2. PROJECT DESCRIPTION

2.1. Importance of the Project

Land in Indian context is a scarce commodity. The increasing infrastructural demand puts pressure on land resources. Availability of land for meeting the requirements of renewable energy especially solar based systems are dwindling as land is seen as a multi component resource for implementing options perceived better than setting up solar power plants.

Solar power generation offers flexibility in operations through innovative design and implementation. One of the options is floating solar plant. These can be installed in water reservoirs or a static water body with adequate depth and bed conditions to support the foundations and provide anchorage.

There are several perceived advantages of floating solar plant including better efficiency, zero land requirements (excluding transmission of power), less maintenance and longer PV module life. Two major advantages of opting for floating solar PV plants are described as below.

No Loss of Valuable Land Space

One of the biggest advantages of floating solar PV plant is that the solar panel installations do not require any land space. These can be installed over unused space on water bodies, such as Irrigation canals, dam reservoirs, wastewater treatment ponds, or drinking water reservoirs. In addition, floating solar panels reduces the need for land clearances that is required for land based solar plants.

Increased Efficiency of a Solar Panel

Solar modules/ panels can perform under high temperatures. But operation under higher ambient temperatures comes with decreased power outputs. The efficiency of a solar module tends to decrease as the temperatures rises. The water bodies that host the floating solar modules helps in cooling which is likely to lead to higher efficiency of the plant, particularly in areas with hot climates.

2.2. Salient Features of the Project

Table 3 below provides the salient features of the proposed floating solar PV project at Getalsud reservoir.

General Project Information	
Purpose	Power generation
Capacity	100MW_{AC}
Location	Getalsud Reservoir in Ranchi district, Bihar, India
Coordinates	29°12 03” N, 79°29’47” E
Owner of the reservoir	Water Resources Department, Government of Jharkhand
Altitude	580m above mean sea level
Water flow/ velocity	~2m/s

General Project Information	
Height of waves in reservoir	~400mm
PV module technology envisaged	Crystalline-silicon-based technology
Inverter technology	String inverter
Platform for PV module and inverter	Fixed on floats/ pontoons secured with mooring and anchoring
Type of anchoring	Under water/ bank anchoring
Expected plant life	25 years
Arrangement of Modules	Less than 5 MWp mini power block
Tilt of the modules	Less than 5°
Azimuth	0°
Power evacuation	Power at 33kV level will be transmitted to plant substation through cable and stepped up to 132kV through power transformer for transmission to Grid Substation
Location of plant substation	On-shore
Substation	132/33kV Substation at south eastern part of the reservoir

Table 3: Salient features of the project

2.3. Components of the FSPV plant

2.3.1. Solar PV module

Solar panels may include a variety of materials like silicon, copper, silver, Cadmium, tellurium, and indium, among others. The most common type of solar panels is made of non-toxic silicon and may contain only a tiny amount of heavy metals (lead) that is used in soldering. However, these panels do not emit any toxic or hazardous material which are harmful to the environment. Also, there will not be any direct contact of these panel with the water or soil, hence no leaching for biodiversity.

Also, Solar PV panels will be mounted on floats, which will be in direct contact with Water. The material will be used for floats are HDPE (High Density Polyethylene), inert in nature and does not cause any threat to the reservoir”

Crystalline-silicon technologies are the most deployed in global solar PV installations. Considering the maturity, long-term proven track record and availability of the crystalline silicon technology, crystalline silicon technology based solar PV modules have been selected as the preferred technology for the proposed FSPV installation.

Upon decommissioning, the solar PV panels and its components will be disposed of in accordance with Hazardous and Other Waste (Management & Transboundary Movement) Rules, 2016 of the Government of India.

2.3.2. Solar inverters

Solar inverters convert the direct current (DC) electricity produced by the solar PV modules to alternating current (AC) electricity that can be used for running of appliances or export to the grid. String inverters have been selected for the proposed project considering the several advantages the technology provides.

2.3.3. Floats for FSPV Plant

In case of FSPV plants, PV modules with metal frames are typically mounted on floating platforms (floats) commonly made from plastic (e.g. HDPE). Multiple floating platforms are inter-connected with designated walkways to allow access for operation and maintenance. These connected floating platforms are anchored to the shore, or to the bed at the bottom of the reservoir, or to floating anchors.

Figure 6: An Illustration of Floating Solar Panels over a Water Body (Source: Ciel &Terre)

Most of the large scale FSPV plants deployed worldwide were carried out using pure HDPE floats where the solar PV modules are installed on pontoons above water. However, recent technological advancements have resulted in floating platforms with pontoons and metal frames which offer higher air circulation to the modules. Both these float technologies have enough manufacturing base or can be manufactured locally in India. Hence, pure HDPE floats and floats with combination of pontoons and metal frames has been selected as the best technology for the proposed FSPV plant at Getalsud reservoir. An illustrative arrangement of floaters on a water body has been shown in Figure 6 above.

2.3.4. Mooring and Anchoring

The proximity to the banks, the water depth and/ or the fluctuations in the water level will determine the type of the mooring layout. The mooring lines can be installed in a (multi-) catenary configuration or in taut configurations.

A taut system moored into the reservoir bed has been selected for the proposed FSPV system. Anchors are used to hold the mooring lines in their position. Helicoidal or plate anchors has been chosen over deadweight because they are more efficient. An illustrative arrangement of anchoring & mooring system has been shown in Figure 7 below.

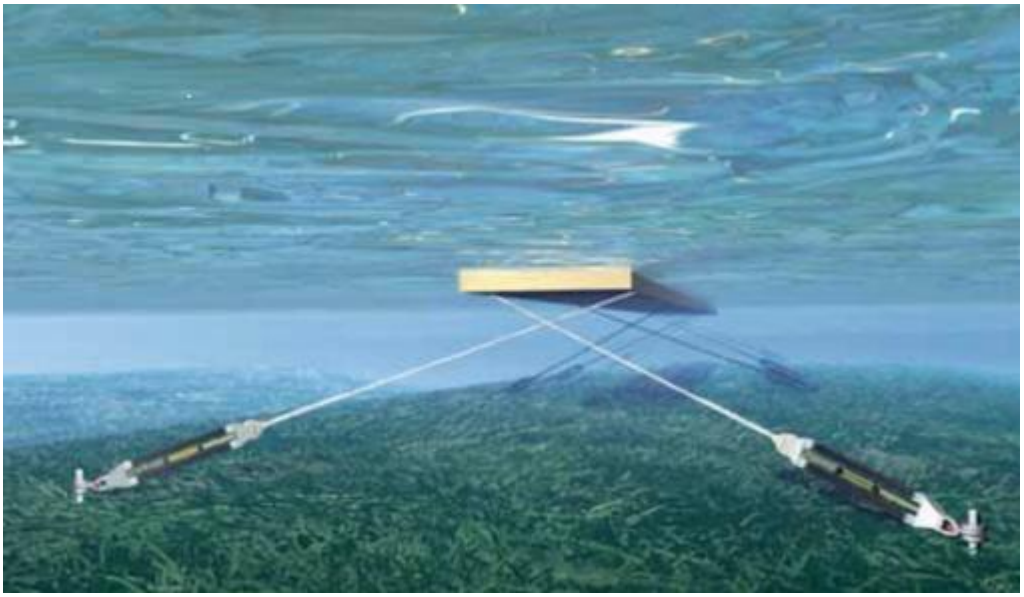

Figure 7: Anchoring for Floating Solar (Source: Sea Flex)

2.4. Power evacuation system

2.4.1. Plant substation

For evacuating the generated power from the proposed floating solar PV plant to the state grid, a 132/33kV plant substation has been proposed onshore on the south eastern part of Getalsud reservoir. The plant substation has been envisaged to accommodate one control building, two 132/33kV transformers and 132kV outdoor switchyard.

The substation is proposed to be constructed over an area of 10000 sq m. i.e. 1Ha of land.

2.4.2. Transmission line

The power generated from the proposed FSPV Project will be evacuated as per the details indicated below:

- **100 MW will be evacuated through a 132kV double circuit transmission line with ACSR Zebra Conductor to the upcoming 132/33kV grid substation Irba at Sikidri, at an approximate distance of 10 km from the plant substation.**

2.4.3. Grid substation

Jharkhand Bijli Vitran Nigam Limited has shared the power evacuation arrangement vide letter no. 860/C&R/Ranchi, dated 23.06.2022.

- **The whole of the generated power (100MW) shall be evacuated through a 132kV double-circuit transmission line to the new 132/33kV GSS at Irba, Sikidri, which is approximately 10km away.The approximate coordinates of upcoming new 132/33kV GSS at Irba , Sikidri are as follows:**
  - **New GSS @23º28’38.13’’ N, 85º36’29.96’’ E.**

3. LEGAL AND POLICY FRAMEWORK

This section presents the legal framework for the environmental, social and land acquisition process and the resettlement and rehabilitation policy which also includes the entitlements for affected eligible families. A resettlement and rehabilitation action plan has been proposed based on the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013; World Bank Operational Policies and various government orders issued by state government for issues related to R&R for the project. The action plan recognizes the need to support restoration of livelihoods of adversely affected people and for rehabilitating the affected people and broadly outlines an approach and institutional framework to achieve its objectives.

3.1. Environmental and social standards

SECI aims to promote sustainable and equitable development in all operations funded, by ensuring that these operations effectively contribute to the objective of sustainable development (combating poverty and ensuring the satisfaction of human needs, strengthening solidarity between human beings and between territories, preserving biodiversity, preserving habitats and natural resources, combating climate change). The aim of E&S risk management approach is to:

- **Assess the environmental and social risks and impacts of each project submitted to the decision-making bodies;**
- **Propose appropriate measures to avoid, minimize, and/ or offset these risks and their impacts;**
- **Monitor the implementation of these measures during implementation phase for the operation;**
- **Manage unforeseen events and;**
- **Improve the quality of projects and environmental and social performance of counterparts.**

E&S risk management

In line with World Bank Operational Policies, the E&S risks and impacts considered by SECI in its due diligence are project-related and include the following:

- Environmental risks and impacts, including (i) those identified in the World Bank Group Environmental, Health, and Safety Guidelines (EHSGs); (ii) those related to community safety (including dam safety and safe use of pesticides); (iii) those related to climate change and other transboundary or global risks and impacts; (iv) any material threat to the protection, conservation, maintenance and restoration of natural habitats and biodiversity; and (v) those related to ecosystem services and the use of living natural resources, such as fisheries and forests and

- Social risks and impacts, including: (i) threats to human security through the escalation of personal, communal or inter-state conflict, crime or violence; (ii) risks that project impacts fall disproportionately on individuals or groups who, because of their particular circumstances, may be disadvantaged or vulnerable; (iii) any prejudice or discrimination toward individuals or groups in providing access to development resources and project benefits, particularly in the case of those who may be disadvantaged or vulnerable; (iv) negative economic and social impacts relating to the involuntary taking of land or restrictions on land use; (v) risks or impacts associated with land and natural resource tenure and use, including (as relevant) potential project impacts on local land use patterns and tenurial arrangements, land access and availability, food security and land values, and any corresponding risks related to conflict or contestation over land and natural resources; (vi) impacts on the health, safety and well-being of workers and project-affected communities; and (vii) risks to cultural heritage.

3.2. World Bank Operational Policies

The implementation of the World Bank Operational Policies seeks to avoid, minimize or mitigate the adverse environmental and social impacts, including protecting the rights of those likely to be affected or marginalized by the proposed project. Based on the information collated by the consultants during the baseline study, following OP's are likely to apply to the proposed project and would require adequate measures to address the safeguard concerns.

World Bank Safe Guard Policies	Objective	Applicability	Safeguard Requirements
OP 4.01 Environmental Assessment	The objective of this policy is to ensure that Bank financed projects are environmentally sound and sustainable.	The environmental issues will be addressed adequately in advance. An integrated Environmental Screening and Environmental Assessment (EA) with Environmental Management Plan (EMP) will be developed to manage environmental risks and maximize environmental and	EIA along with EMP has been prepared to address the likely adverse impacts due to the proposed project.

World Bank Safe Guard Policies	Objective	Applicability	Safeguard Requirements
		social benefits wherever it is applicable.	
OP 4.04 Natural Habitats	The policy recognizes that the conservation of natural habitats is essential for long-term sustainable development. The Bank, therefore, supports the protection, maintenance and rehabilitation of natural habitats in its project financing, as well as policy dialogue and analytical work. The Bank supports and expects the Borrowers to apply a precautionary approach to natural resources management to ensure environmentally sustainable development	The policy is applicable as the proposed project is likely to have impacts on the reservoir water quality, flora, and fauna. These are being addressed with appropriate conservation and mitigation measures.	EIA along with EMP has been prepared to address the likely adverse impacts due to the proposed project.
OP 4.36 Forests	This policy focuses on the management, conservation, and sustainable development of forest ecosystems and resources. It applies to project that may have impacts on (a) health and quality of forests;	Due care has been taken to avoid diversion of forest area. As a result, no diversion of forest area is anticipated.	During the process of choosing the transmission line alignment, careful steps were implemented to ensure the exclusion of any designated forest areas.

World Bank Safe Guard Policies	Objective	Applicability	Safeguard Requirements
	(b) Affect the rights and welfare of people and their level of dependence upon forests and projects that aim to bring about changes in the management, protection or utilization of natural forests or plantations, whether they are publicly, privately or community owned. The Bank does not support the significant conversion or degradation of critical forest areas or related critical natural habitats.		
OP/BP 4.12 Involuntary Resettlement	The objective of this policy is to avoid or minimize involuntary resettlement where feasible, exploring all viable alternative project designs. Furthermore, it intends to assist displaced person in improving their former living standards; community participation in planning and implementing resettlement; and to provide assistance to affected people,	No private land acquisitions is envisaged under the project. The proposed land for sub station is under the ownership of GoJ and free of encroachment. Compensation will be paid for the restrictive use of land for tower footing as per the regulatory provisions. This policy applies to all components of the project that result in involuntary resettlement, regardless of the source of financing. It also applies to other activities resulting in involuntary resettlement, that in the judgment of the Bank, are	Social Impact Assessment and Resettlement Action Plan in consultation with the community and project authorities ESIA and RAP has been prepared to address the impacts due to the proposed project.

		(a) directly and significantly related to the Bank-assisted project,	

World Bank Safe Guard Policies	Objective	Applicability	Safeguard Requirements
	regardless of the legality of title of land	i. necessary to achieve its objectives as set forth in the project documents; and ii. carried out, or planned to be carried out, contemporaneously with the project.	
OP/BP 4.10 Indigenous People	This policy aims to protect the dignity, right and cultural uniqueness of indigenous people; to ensure that they do not suffer due to development; that they receive social and economic benefits	This policy may apply if there are indigenous people in the project area; when potential adverse impacts on indigenous people are anticipated; and if indigenous people are among the intended beneficiaries.	Indigenous people development Plan has been made under RAP prepared for the Project.
OP/BP 4.11 Physical Cultural Resources	This policy aims at assisting in the preservation of cultural property, historical, religious and unique natural value-this includes remains left by previous human inhabitants and unique environment features, as well as in the protection and enhancement of cultural properties encountered in Bank-financed project.	This policy may apply to sub-projects where cultural property, historical, religious and unique natural value-this includes remains left by previous human inhabitants and unique environment features may be affected due to project.	Not Applicable The Project and its associated facilities are not located close to any structures of archaeological / historical / cultural / religious importance. A chance find procedure has been included in the EMP to address any accidental encounter with objects and artefacts of historical, cultural or archaeological importance.

OP4.37 Safety of Dams	This policy aims at ensuring safe dams, where facilities supported by the Bank are dependent on such dams.	This policy applies to existing as well as new dams and dams under construction, whether or not financed by the Bank, wherever Bank supported project is	

World Bank Safe Guard Policies	Objective	Applicability	Safeguard Requirements
		dependent on the safety of such dams.	Dam safety or SECI (a) an effective dam safety program is already in operation, and (b) full- level inspections and dam safety assessments of the existing dam, which are satisfactory to the Bank, have already been conducted and documented.

Table 4: World Bank Operational Policies

3.3. Applicable National Regulatory Framework

The EIA Notification dated 14th September 2006 of the Ministry of Environment, Forests and Climate Change, Government of India, which has been issued under the provisions of Environment Protection Act, 1986, categorizes projects in India into Category A and B based on the nature and scale of their potential impacts and requires the projects that are listed under this notification to undergo the process of Environmental Clearance prior to commencement of construction. Carrying out of an ESIA study with respect to a project is mandatory for all projects covered under the EIA Notification.

All Solar PV projects in India are exempt from the provisions of this EIA notification, 2006 of MoEF&CC, Govt. of India. Therefore, the proposed FSPV project does not require environmental clearance from any of the National or Local authorities. Also, no ESIA studies for solar power projects are mandated under the Indian environmental laws.

However, all projects are subject to provisions under various other environment protection laws and rules introduced from time to time under the Environment Protection Act (EPA), 1986, which is the Principal Act to govern environmental protection in India. Two other major Acts that were notified in India prior to enactment of the EPA are Water (Prevention and Control of Pollution Act), 1974 and Air (Prevention and Control of Pollution) Act, 1986.

Further, based on pollution index scores, Indian industries have been classified under Red / Orange / Green / White categories for purposes of regulation under the Water (Prevention & Control of Pollution) Act, 1974 and the Air (prevention & Control of Pollution) Act, 1981. The most polluting industries are placed under 'Red' category while the non-polluting industries are categorized under 'White' category. The Solar PV projects are placed under the White category.

Depending upon which category of industrial classification a project falls into, the project proponents are required to obtain consent from the State Pollution Control Board (SPCB) of the State in which the project is located. The Consents are to be obtained in accordance with the provisions under Water and Air Acts. A 'Consent to Establish' is to be obtained prior to commencement of construction while a 'Consent to Operate' is to be obtained prior to commencement of operation of a project / industry.

As per the notification dated March 07, 2016 issued by the Central Pollution Control Board under the Ministry of Environment, Forest and Climate Change (MoEF&CC) of the Government of India, "there shall be no necessity of obtaining the 'Consent to Operate' for White category of industries and an intimation to the concerned SPCB shall suffice." The project company, therefore, shall not be required to obtain any consent under the Air and Water Acts as Solar PV projects are placed under the White Category.

The Contractor shall, however, need to separately obtain Consents from the SPCB, as applicable, for activities undertaken by it for construction of the project, e.g. for use of DG sets during construction phase, setting up of batching plant etc.

The Contractor shall also need to obtain licenses from the concerned Labour Department of the Government of Jharkhand under the provisions of the labour laws as applicable in the State of Jharkhand.

The applicability of national and local environmental and social regulatory framework as given in this section has been assessed with respect to the location of the project and the activities proposed under the project.

The key environmental and social regulations and legislations that will govern preparation and implementation of the project are presented below in Table 5.

National Act	Year	Objective	Authority	Applicability
Environment (Protection) Act and amendments	1986	To protect and improve the overall environment	MoEF&CC, CPCB	It is an umbrella act for all environmental legislations in the county.
Notification on Environment Impact Assessment of Development projects (and amendments) (referred to as the Notification on Environmental Clearance)	2006	To provide environmental clearance to new development activities following environmental impact assessment.	MoEF&CC, CPCB, JSPCB, and State Environmental Impact Appraisal committee	The FSPV is not covered under this notification.

National Act	Year	Objective	Authority	Applicability
E-waste (Management and Handling) Rules and E-Waste (Management) Amendment Rules, 2018	2016 /2018	To control/ mitigate potential impacts due to e-waste handling and storage on the site.	SPCB	Applicable for RE projects while using and repairing, storing of equipment. To obtain authorization from SPCB.
Forest (Conservation) Act	1980	To protect and manage forests	MoEF&CC, and State Forest Dept	Confirmation of ownership of land over which the transmission lines are to be erected is under process. Whether or not any forest land is required for the project would be confirmed after detailed survey of transmission line is complete. The applicability of this Act to the project can be confirmed only after the land ownership data is firmed up.
National Forest Policy (Revised)	1988	To maintain ecological stability through preservation and restoration of biological diversity	Forest Department, GoI	AS stated above, the extent of effect would be judged only after detailed survey of transmission line is complete.
Water (Prevention and Control of Pollution) Act (and subsequent amendments)	1974	To provide for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water.	CPCB, and JSPCB	As per the latest classification of industries in India by the Central Pollution Control Board (CPCB), Solar PV projects are exempt from the need to obtain consent from the State Pollution Control Board under the said Act. There are no specific rules in this regard with respect to floating solar power plants. Consent to Establish (CTE) and Consent to Operate (CTO) shall, however, be required to be obtained by the Contractor in case a batching plant or a Crusher unit is set up for the project
Air (Prevention and Control of Pollution) Act (and subsequent amendments)	1981	To provide for the prevention, control and abatement of air pollution, and for the establishment of Boards to carry out these purposes.	CPCB, JSPCB and Transport Department	Same as mentioned above for Water Act. Additionally, CTE or CTO shall also be required under the Air Act if a DG set is to be used for the project construction / operation.

National Act	Year	Objective	Authority	Applicability
The Hazardous Wastes (Management, Handling and Transboundary Movement) Rules,	2016	The rule provides prevention for mishandling of Hazardous Wastes and gives a process to control and transport the same.	MoEF&CC, CPCB, and JSPCB	In the operation phase, hazardous waste may be generated in the form of refuse of transformer oil and tank bottom sludge. In addition, disposal of PV modules also attracts the provisions of these rules. Authorization from the State Pollution Control Board shall be for handling hazardous wastes generated by the project.
The Bio-Medical Waste (Management and Handling) Rules, and amendments	1998	Due to its contamination and hazardous nature the Bio-Medical Wastes to be handled and treated in compliance to the rules.	MoEF&CC, CPCB, and JSPCB	If there is a PHC or First aid center, its waste to be segregated and sent for bio-medical waste management to the nearest facility. as per handling and disposal requirements of the rules.
The Noise Pollution (Regulation and Control) Rules, and amendments	2000	Workplace noise is covered under Indian factories Act, 1948 but this rule provides safety against noise in ambient condition with generation of noise by certain point and area source.	MoEF&CC, CPCB, and JSPCB	Noise abatement during construction and operation phases require compliance under these rules so as to restrict the noise levels within stipulated standards.
Electricity Act	2003	Laws relating to generation, transmission, distribution, trading and use of electricity, promotion of efficient and environmentally benign policies.	Power Grid, State transmission and distribution company	Applicable for RE and transmission line projects where national grid connectivity is being involved. Approval for commissioning required from the department.
The Chemical Accidents (Emergency Planning, Preparedness and Response) Rules,	1996	This rule ensures the preparedness for the emergencies caused by chemical hazards.	MoEF&CC, CPCB, and JSPCB	Applicable for accidental spill.
Building and Other Construction Workers (Regulation of Employment and conditions of Service) Act	1996	To regulate the employment and conditions of service of building and other construction workers and to provide for their safety, health and welfare measure and for other matter connected therewith or incidental	Ministry of Labour and Employment	Engagement of labour and facility for labour force.
The Land Acquisition Act, Rights of Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act (RFCTLARRA)	2013	Set out procedures for acquisition of land by government	Land and Land Revenue Department	No

National Act	Year	Objective	Authority	Applicability
				No Land acquisition is proposed. However, compensation for Right of Way for transmission line shall be made as per provision provided in RAP prepared for the Project.
73rd Constitution Amendment Act	1992	The Act enables participation of Panchayat level institutions in decision-making. Panchayats at the village level will be involved for preparation and implementation of the project.	Administrator (as per Act), Municipality/ Municipal Corporation/ District Collector/ Sub-Divisional Magistrate and Revenue Officer	Applicable for any project located in a Gram (Village) Panchayat area. A Gram Panchayat is a rural local self-government unit in India.
Central Motor Vehicle Act Central Motor Vehicle Rules	2019	To control vehicular air and noise pollution. To regulate development of the transport sector, check and control vehicular air and noise pollution.	Motor Vehicle Department	Applicable to the vehicles operating for the project.
Ancient Monuments and Archaeological sites and Remain Act	1958	Conservation of Cultural and historical remains found in India.	Archaeological Dept. GOI, Indian Heritage Society and Indian National Trust for Art and Culture Heritage (INTACH).	Not applicable as the project and its associated facilities are not located within the regulated or prohibited zone as defined under this Act and related rules.
Guidelines issued by the Ministry of Power for payment of compensation towards damages caused by tower and Right of Way for transmission lines.	2015	To determine compensation for the tower base area impacted due to installation of tower / pylon structure; and compensation towards diminution of land value in the width of Right of Way (RoW) corridor due to laying of transmission line and imposing certain restrictions.	Corporation/ municipality/ local body or the state government.	Applicable
Panchayat Extension to be Scheduled Areas (PESA Act, 1996)	1996	The Act provides for the extension of the provisions of Part IX of the Constitution relating to the Panchayats to the Scheduled Areas.	Gram Sabha	No Land acquisition is proposed. However, compensation for Right of Way for transmission line shall be made as per provision provided in RAP prepared for the Project.
Public Liability Insurance Act	1991	The main objective of the Public Liability Insurance Act 1991 is to provide for damages to victims of an accident which occurs as a result of handling any hazardous substance. The Act applies to all owners associated with the production or handling of any hazardous chemicals.	District Administration	Applied to all construction projects.

National Act	Year	Objective	Authority	Applicability
THE OCCUPATIONAL SAFETY, HEALTH AND WORKING CONDITIONS CODE, 2020	2020	The main objective of the Public Liability Insurance Act 1991 is to provide for damages to victims of an accident which occurs as a result of handling any hazardous substance. The Act applies to all owners associated with the production or handling of any hazardous chemicals.	District Administration	Applied to all construction projects.

Table 5: National regulatory framework

3.4. Project categorization

The project is classified as Category B as per the World Bank Classification.

Site reconnaissance survey, undertaken for screening and scoping of this project on environmental, social and Indigenous Peoples' considerations followed by field survey and investigation, have resulted in the following key findings:

- **The project does not entail encroachment of precious ecology and historical or cultural areas.**
- **The project does not involve any significant alteration of surface water hydrology, but some siltation and erosion is anticipated during construction. However, impacts on aquatic ecology during construction and operation of the project cannot be completely ruled. An assessment of the same has been covered under the present ESIA study.**
- **The installation of FSPV over the Getalsud reservoir does not involve any dislocation or involuntary resettlement of people.**
- **No temporary commercial and residential structures is located within corridor of influence of the transmission lines to be erected for the project. This has been addressed as per the principles of the resettlement framework in RAP.**
- **The transmission lines will pass along mostly through private land.**
- **No Land acquisition is proposed. However, compensation for Right of Way for transmission line shall be made as per provision provided in RAP prepared for the Project. Most of the anticipated potential adverse impacts are limited in spatial and temporal extent i.e. short-term (during construction) and mitigation.**
- **Project implementation duration is considered as Fifteen (15) months. This excludes project preparation and other pre-construction stage activities.**

The present report i.e. ESIA has been prepared as per World Bank requirement safeguard policies.

3.5. Process of land acquisition and other immovable assets

Both the RFCTLARR Act 2013 and the World Bank OP4.12 on land acquisition and involuntary resettlement aim to ensure that involuntary resettlement should be avoided or minimized, wherever feasible, exploring all viable alternative project designs, and where displacement is unavoidable, people losing assets, livelihood or other resources shall be assisted in improving or at a minimum regaining their former status of living at no cost to themselves.

There are two options available for acquisition of land required under the project. Option 1 is through direct purchase based on mutual negotiation and option 2 is through Right to Fair Compensation and Transparency in Land Acquisition and Rehabilitation and Resettlement (RFCTLARR) Act, 2013 of the Government of India.

The details are as given below:

Option 1: Direct purchase of land based on clause 46 of RFCTLARR Act, 2013

Under this option, the following steps will be followed:

- **Project to identify land parcels to be purchased and owners during social impact assessment in consultation with the local revenue officials.**
- **List of such landowners along with intent to purchase and purpose of purchase to be forwarded to the District Magistrate. A committee will be set up as per the existing government order (GO) number 271/83 dated September 2, 2013 for direct purchase.**
- **The base price of land will be as per the process mentioned in RFCTLARR Act, 2013.**
- **The rate will be finalized by the land purchase committee.**
- **The rate agreed upon will be exclusive of R&R assistances as mentioned in project specific R&R policy.**

Option 2: Acquisition of private land through Right to Fair Compensation and Transparency in Land Acquisition and Rehabilitation and Resettlement Act, 2013

As per option 2, all private immovable assets will be acquired as per new RFCTLARR Act 2013. All eligible PAPs will be entitled to R&R assistance over and above the compensation. Those PAPs who are not entitled for compensation (encroachers and squatters) will get R&R benefits as per their entitlement given in project specific R&R policy. The entitlement of compensation and assistance will be extended to only those PAPs who are identified on or prior to the cut-off date. All complaints relating to claims regarding R&R assistance shall be dealt with by the grievance redress committee.

Even though the RFCTLARR Act 2013 has no specific provisions for providing assistance to non-title holders, the same has been taken care off in the RAP prepared for this project in accordance with the requirements under The World Bank OP 4.12. The details are available in the Resettlement Action Plan prepared for the project.

3.6. Clearances and NOCs Required

Clearances and No-objection Certificates (NOCs) required at different stages of the Project and tentative time required for the same has been provided in Table 6 below:

S. No.	Activity	Statute	Requirement	Competent Authority	Responsible Agency for Obtaining Clearance	Time Required
Pre-Construction Stage (Responsibility: SECI)						
1	Diversion of Forest land into non forest purposes	Forest Conservation Act 1980 & MoEF&CC Letter Dt. 18.02.98	Not Required	MoEF&CC and Local Forest Authority	SECI	**5-6 months**
2	NOCs from concerned Gram Sabhas	Panchayat Extension to be Scheduled Areas (PESA Act, 1996)	Not required	Distrcit Administration	SECI/JBVNL	**5-6 months**
Construction Stage (Responsibility: Contractor)						
1	Establish and operate Diesel Generator Sets of more than 15 KVA	Water Act of 1974, Air Act of 1981, Noise Rules of 2000 and Environmental Protection Action of 1986 and as amended	Consent-for-establish and operate	Jharkhand State Pollution Control Board (JSPCB)	The Contractor	**2-3 months**
2	Storage of fuel oil, lubricants, diesel etc. at construction camp	Manufacture storage and Import of Hazardous Chemical Rules 1989	Permission for storage of hazardous chemical	Jharkhand State Pollution Control Board (JSPCB)	The Contractor	**2-3 months**
3	Extraction of ground water	Ground Water Rules of 2002	Permission for extraction of ground water for use in road construction activities	State Ground Water Board	The Contractor	**2-3 months**
4.	Engagement of labour	Labour Act	Labour license	Labour Commissioner	The Contractor	2-3 months

Table 6: Clearances and NOCs required

4. ENVIRONMENTAL AND SOCIAL BASELINE SETTING

4.1. Introduction

The current chapter describes the various baseline environmental and social settings including physical and biological environment in and around the proposed project site. The various physical characteristics such as seismicity, climate, temperature, rainfall, and humidity as well as soil types with their physio-chemical properties are covered in this chapter. Laboratory test results for all environmental parameters in and around the project site has been provided in **Annexure-J** of this report.

4.2. Physical environmental settting

4.2.1. Topography of the project area

The study area is the part of Chotanagpur plateau. Physiographically, the area is characterized by varied landforms like high hill ranges, eroded valleys and undulating land. Dumra pahar in the northeast and Bariburu pahar in the northwest of the study area and hills and rides in the central part towards north of proposed site and in the southern part of the study area are main hill ranges partially covered mainly dense/scrub forest. The lower area lies covers major part of the study area mainly created by river Subarnarekha and its tributaries. The maximum elevation observed for hills areas is 538 m AMSL and is at the north-western part of the study area namely Bariburu pahar. The lowest elevation is 183 m AMSL and is at the south-eastern part of the study area. The general slope of the land is towards southeast.

The position of the project location and dam along with the existing features around the project site within 5 kms radius can be seen below in Figure 98 & 9.

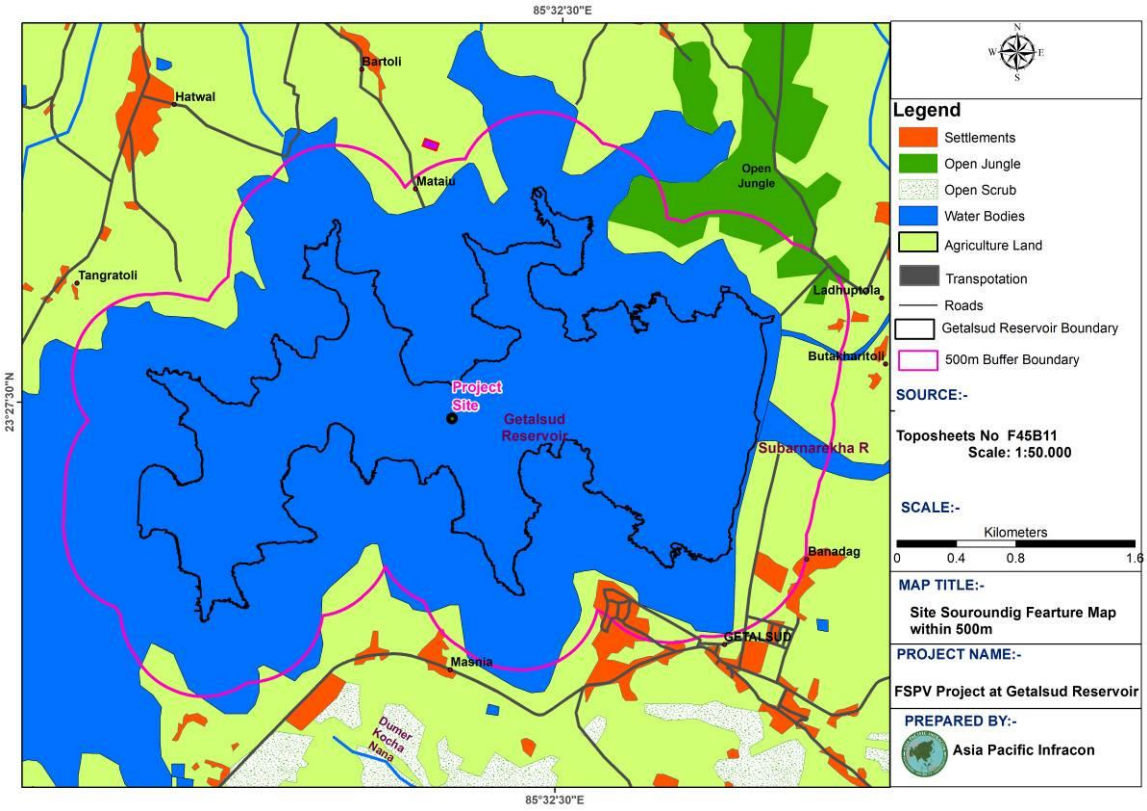

Figure 8: Getalsud Reservoir along with land use map within 5kM radius from site (Survey of India 2004-2005)

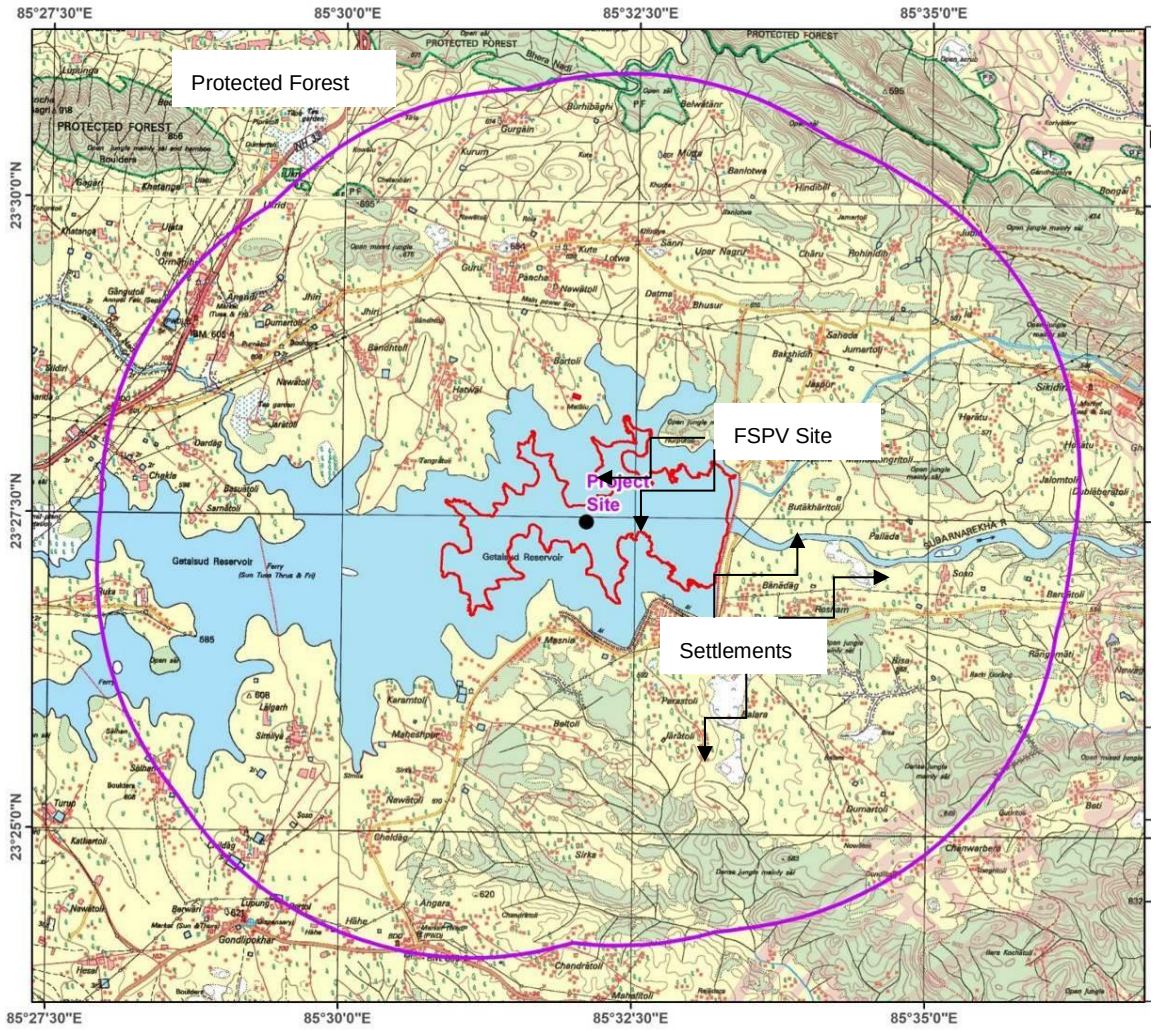

Figure 9: Getalsud Reservoir with existing features (Survey of India 2004-2005)

4.2.2. Seismicity

The project and the plant substation lie in zone II as per the seismic zone map of India. The hazard map shown below in Figure 10 indicates that the proposed site is falls under low damage risk zone.

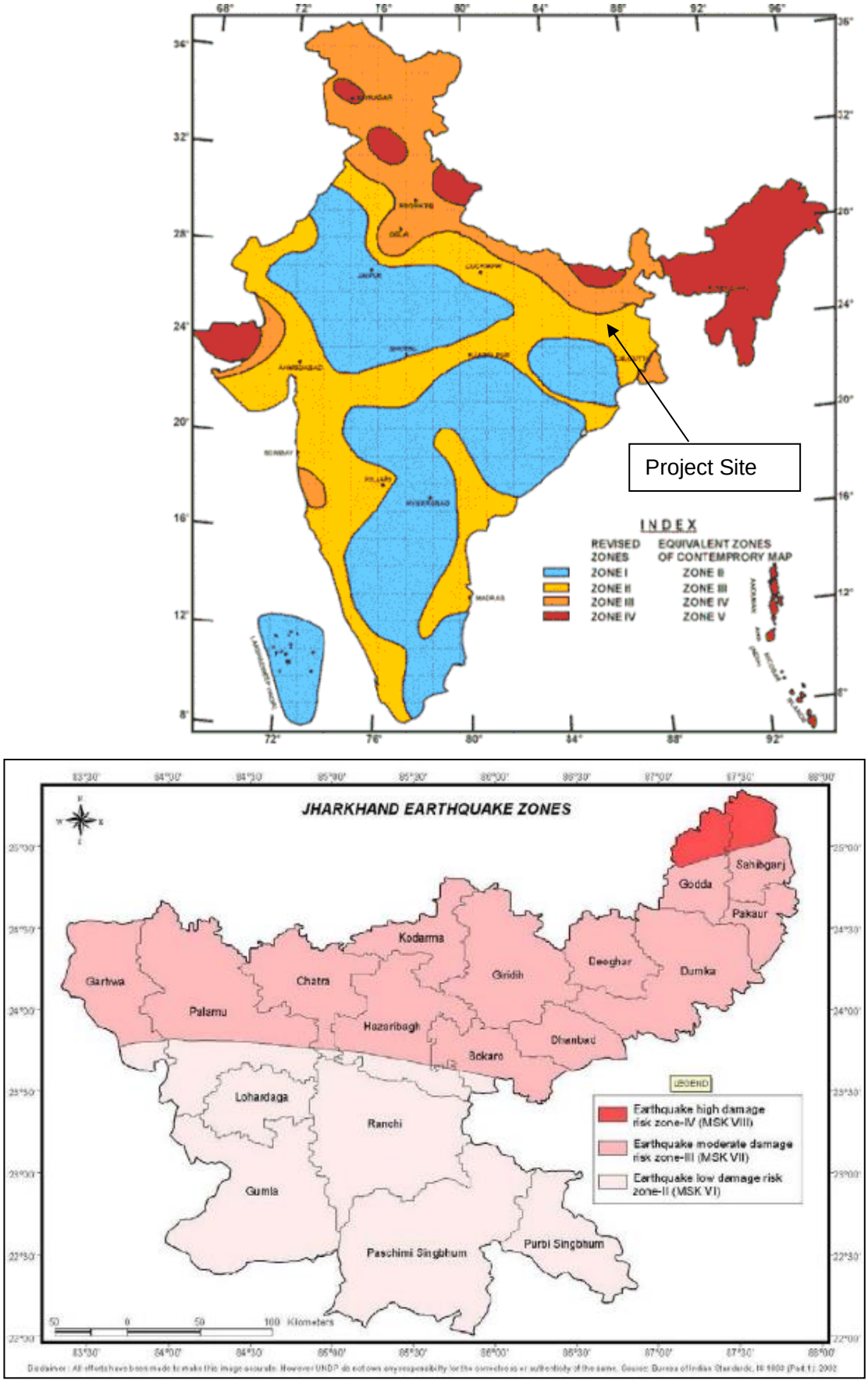

Figure 10: Seismic zones of the India and Jharkhand State (Source: Bureau of Indian Standard (BIS) seismic map)

4.2.3. Climate

The summer season for the region starts from March and lasts till end of June. Thereafter the south-west monsoon season starts which lasts till about the middle of October. Mid-October to November constitutes the post-monsoon period while the period from December to February is the winter season which is marked by dry and cold weather. The hottest months of the year are May and June while the coldest is January.

As per the map of "The Köppen-Geiger Climate Classification" (2017)[1], Getalsud reservoir region in Ranchi district falls under the sub-tropical climatic zone (i.e. Cwa, C: warm temperature, w: winter dry, a: hot summer). The climate varies from sub-tropical and sub-humid with three distinct seasons i.e. summer, monsoon (rainy season) and winter. The rainy season starts from middle of June to September followed by the winter season, which starts from October and goes up to February. The winter rains are generally experienced in late December or early January, which brings down the temperature and that is how December and January are the coldest months in the district.

4.2.3.1. WIND CONDITIONS

Winds blowing in west to north-west directions are predominant in the region during the post-monsoon, as well as the winter and in early parts of summer. In the latter parts of summer and monsoon, wind blows mainly in east and south-east directions.

The mean wind speed during winter season varies from 2.6 to 5.3km/h while during summer it varies from 5.0 to 7.6km/h. The average wind speed in the reservoir area is 16.2km/h[2].

Generally, light to moderate winds prevail throughout the year. Winds were light and moderate particularly during the morning hours, while during the afternoon hours the winds were stronger. The seasonal and annual wind rose patterns are shown in Figure 11 below.

[1] http://koeppen-geiger.vu-wien.ac.at/present.htm

[2] https://globalwindatlas.info/

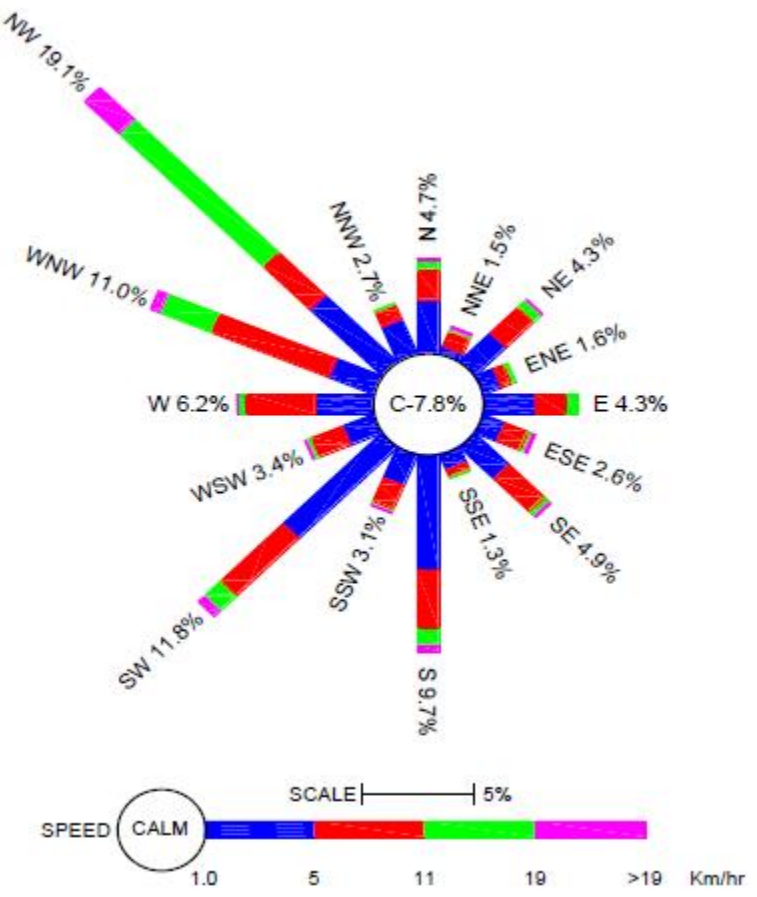

Figure 11: Wind rose map of the proposed locationt

4.2.3.2. RAINFALL

The average annual rainfall based on the 10-year IMD data, was observed to be 1424 mm. The monsoon sets in the month of June and continues till September and sometime extends up to mid-October. The maximum amount of rainfall (358.4 mm) occurs in the month of July. The maximum number of rainy days was also observed in the month of July. About 90% of rainfall in the district is received during the southwest monsoon in the period of June to September. The average annual rainfall experienced in the district is 1424mm.

4.2.3.3. TEMPERATURE

Being a sub-tropical climatic zone, the temperature of the region varies considerably from season to season. The summers are generally hot and dry with maximum temperature crossing 37°C and considerable humidity between the months of May and October, while during winters, the temperature goes below 7°C.

4.2.3.4. HUMIDITY

The air is generally humid in this region during the monsoon season. During the rainy season, the relative humidity is generally high i.e. over 84%. Thereafter, the

humidity decreases and by summer, which is the driest part of the year, the relative humidity in the afternoons become less than 40%.

4.2.4. Solar irradiation

The Ministry of New and Renewable Energy (MNRE) has initiated a major project on Solar Radiation Resource Assessment (SRRA) through National Institute of Wind Energy (NIWE) to collect solar radiation resource data covering GHI, DNI, DHI and associated meteorological parameters in a phased manner. The nearest SRRA stations to Getalsud reservoir is Ranchi, which is located at an aerial distance of around 40 km from the project site. The monthly GHI values from the station are presented in Table 7 below.

Month	NIWE SRRA (kWh/m2)3
Jan	150.2
Feb	139.9
Mar	180.9
Apr	167.0
May	181.5
Jun	146.6
Jul	114.3
Aug	107.9
Sep	135.0
Oct	135.0
Nov	131.3
Dec	125.4
Annual	1715.0

Table 7: GHI Value for the project area

4.2.5. Geomorphology and soil

4.2.5.1. GEOMORPHOLOGY

The northernmost and southernmost parts of the district are covered with hillocks and forests. Altitude of the area varies from 500m to 700m above mean sea level in general. There are many hillocks through the district having altitude 700m above mean sea level. The District forms a part of the Chotanagpur plateau.

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4.2.5.2. SOIL TYPES AND SOIL QUALITY

The soils of the district are mostly of the residual type. High temperature and high rainfall have led to the formation of lateritic type of soils from rocks of Archean

[3] 2017 Ranchi SRRA station data has been procured by the Consultant. The energy values have been calculated based on the monthly average radiation.

metamorphic complex exposed in the greater part of the district. Texturally the soils of the district have been classified into four classes-

1. Stony and gravelly soils--- These are low grade soils having a large admixture of cobbles, pebbles and gravels generally found at the base of the hills.

2. Red and yellow soils: - This soil is formed by the decomposition of crystalline metamorphic rocks like granite- gneiss etc. These rocks contain mineral particles like biotite, hornblende and iron. Higher areas have soils with light red color but the lower areas have relatively dark color. It lacks nitrogen, Phosphorus acid and humus. Potash and lime are sufficiently found.

3. Lateritic soils: - This type of soil is found in Ratu, Bero and parts of Mandar Blocks. The soil has dark red or brown colour, It has high iron content and has been formed by the process of lateritisation of the weathered material in the favourable climate and topography.

4. Alluvial soils: - River channels in the district are covered with alluvial soils consisting mainly of coarse sand and gravel mixed with silt and clay. Soil thickness depends upon the topographical control.

The Getalsud reservoir consists of soil formed in a loamy mantle with sandy or gravel sediments along with clay partings.

As part of the ESIA study, soil samples were collected from three locations as as stated in Table 8 and shown in Figure 12 below and these were tested to assess the soil quality at the proposed project site and nearby areas.

- **The collection site is demarcated into uniform portions, each of which was sampled separately.**
- **Sampling was made under normal environmental conditions.**

S. No.	Area	Soil Analysis locations	Direction	Distance (KM)
1	Getalsud	SQ1	Near project Site	0
2	Matatu	SQ2	North	2.5
3	Agartoli	SQ3	East	1.5

Table 8: Sampling locations for soil quality analysis at project (FSPV) site

2.

Figure 12: Sampling locations for soil quality at project FSPV) site

Results of soil test have been presented in Table 9 below, while photographs taken during soil sample collection have been furnished in **Annexure E** of this report.

- **It has been observed that the pH value of the soil in the study area varies from 7.52 to 7.63. The maximum pH value of 7.63 was observed at Agartoli, whereas the minimum value of 7.52 was observed at Getalsud.**
- **Electrical conductivity was observed to be in the range of 302 µmhos/cm to 347 µmhos/ cm.**
- **The nitrogen value ranged between 224 to 256 kg/Ha The nitrogen content in the study area is found to be in low category as far as the productivity of the soil is concerned.**
- **Phosphorus values range between 15 to 33 kg/ha, indicating that the phosphorus content in the study area falls under sufficient to more than sufficient category.**
- **Potassium content ranges between 66 to 68 at all the sampling sites. No traces of heavy metals like Chromium, Arsenic and Mercury were found.**

Parameters	Units	SQ1	SQ2	SQ3	Test method
Soil colour	----	Brown red	Brown red	Brown red	IS: 2720 (part 4), 1985 (Reaff:2015)
Clay	%	21.2	21.6	23.2	
Silt	%	65.2	66.2	61.2	
Sand	%	13.6	12.6	15.6	
pH	---	7.52	7.63	7.58	IS: 2720 (part-26),1987 (Reaff:2011)
Electrical conductivity	µmhos /cm	331	302	347	IS: 14767(2000) RA 2016
Moisture	%	7.39	8.12	8.44	STRL /STP/SOIL/01
Infiltration rate	cm/hr	1.22	1.33	1.37	STRL /STP/SOIL/01
Bulk density	gm/cm3	1.44	1.51	1.51	STRL /STP/SOIL/01
Porosity	%	32.9	33.8	33.4	STRL /STP/SOIL/01
Nitrogen as N	kg/ha as N	224	256	252	STRL /STP/SOIL/01
Phosphorus	kg/ha as P	15	33	18	IS: 2720 (part-26),1987 (Reaff:2011)
Potassium as K	kg/ha as K	66	68	68	IS: 14767(2000) RA 2016
Organic Carbon	%	1.26	1.22	1.22	IS: 2720 (Part-24)-1976(Reaff.2015)
Organic matter	%	1.28	1.32	1.31	STRL/STP/SOIL/01
Iron	Mg/kg	1.26	1.55	1.36	ICP-OES
Lead	Mg/kg	<1.0	<1.0	<1.0	ICP-OES
Manganese	Mg/kg	5.02	4.66	4.33	ICP-OES
Nickel	Mg/kg	<1.0	<1.0	<1.0	ICP-OES
Barium	Mg/kg	<1.0	<1.0	<1.0	ICP-OES
Zinc	Mg/kg	1.02	1.06	1.12	ICP-OES
Copper	Mg/kg	0.11	0.16	0.18	ICP-OES
Cadmium	Mg/kg	<1.0	<1.0	<1.0	ICP-OES
Chromium	Mg/kg	<1.0	<1.0	<1.0	ICP-OES
Arsenic	Mg/kg	<1.0	<1.0	<1.0	ICP-OES
Mercury	Mg/kg	<1.0	<1.0	<1.0	ICP-OES

Table 9: Result of soil sample analysis at Getalsud Reservoir

4.2.6. Physiography

The major landforms found within the study area are as follows:

Buried pediments- These are broad gently sloping erosional surface having detritus. Thickness of overburden is considerably high. Mandar, Itki and Ratu area comes in this segment.

Pediplain- These are developed over granite gneiss. Undulating erosional surface with interrupting dykes, ridges and inselbergs are prominent features. Bero locality is marked by these features.

Valley fills- These are developed over granite gneiss. It consists of boulders, cobbles, pebbles, gravels, sand, silt and clays. These features are developed in Parts of Nagri block.

Denudational hills- These features are developed in northernmost portion of the district covering parts of Burmu block. Moderate to low relief and steep slopes characterizes area.

Structural ridges— These features are developed over quartzite and having moderate relief and steep slope.

Laterite capping— These are developed over metamorphic rocks. Hard laterite cappings are formed on the highland. Its thickness is upto 50-60 metres. They are developed in Ratu and Nagri locality

4.2.7. Drainage

District Ranchi is highly dissected by rivers of varying magnitude, which has been shown in Figure 13 below. The major water divide in the district runs north to south direction through the Ratu and Lodhma Blocks. The area in the eastern part of the water divide is drained by Subarnrekha and the western part of the divide is drained by South Koel and Karo. The important river basins are the Subarnrekha, the South Koel, the Damodar and the Karkari. The Kanchi and Raru are the tributaries of river Subarnrekha. The South Koel originates from Piska near Ranchi. The Karkari river drains the southeastern part of the district.

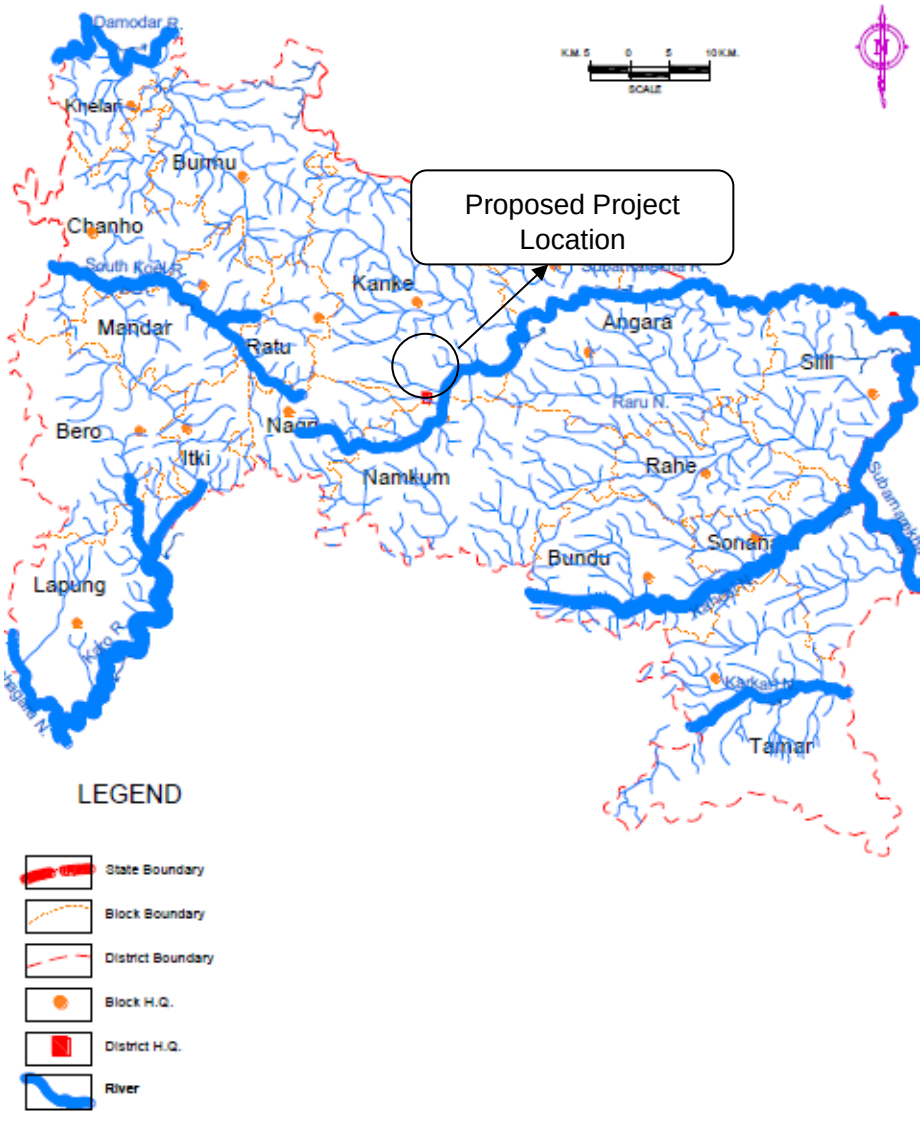


Figure 13: Drainage map of project location

4.2.8. Hydrogeology

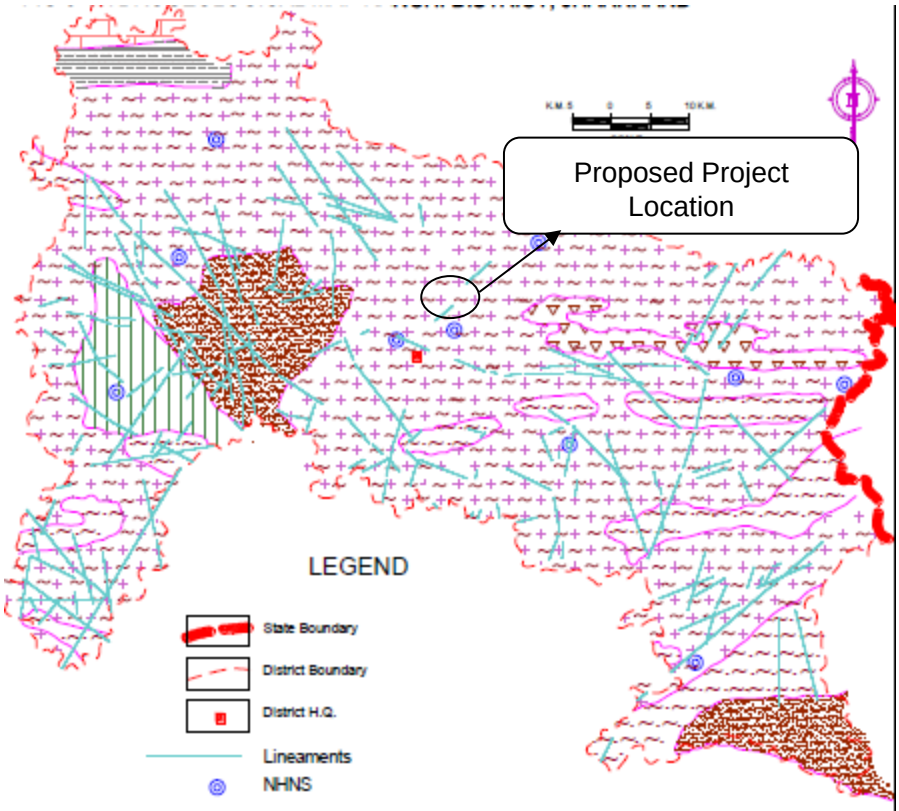
The district is having varied hydrogeological characteristics due to which ground water potential differs from one region to another. It is underlain by Chotanagpur granite gneiss of pre-Cambrian age in three-fourth of the district. In Ratu and Bero blocks thick lateritic capping is placed above granite gneiss. A big patch of older alluvium is found in Mandar block extending from Brombay and Murma areas. Khelari (northernmost portion) area consists of lmestone rocks. These are briefly described hereunder with the hydrological map of Ranchi district shown in Figure 14 below.

Aquifer systems: Two types of aquifers are found. Weathered aquifer and fractured aquifers. Thickness of weathered aquifers varies from 10-25 m in granite terrain and 30-60m in lateritic terrain. In weathered aquifer ground water occurs in unconfined condition while in fractured aquifer ground water occurs in semi confined to confined condition.

Aquifer geometry: The aquifer geometry for shallow and deeper aquifer has been established through hydro geological studies, exploration and the surface and sub-surface geophysical studies in the district.

Shallow aquifer: The shallow aquifers are being tapped through dug wells, dug - cum bore wells and hand pumps. The thickness of weathered mantle varies from 5 to 20 m.bgl. In lateritic terrain many dug wells dry up during summer months. Hand pumps generally tap first fracture zones and its depth is 30-40 m.bgl.

Deeper aquifer: In granite gneiss terrain area first fracture occurs between 50-70 m and second fracture is found between 100-120 m depth. Discharge of bore wells varies between 10 to 30 m3/hr in these areas. Drawdown varies between 13 to 20 m. In lateritic terrain of Nagri first fracture zone is found between 60 to 75 m.bgl and second fracture zone is between 90 to100 m.bgl. Third set of fracture can be found between 150-200m.bgl depth. Discharge may vary between 15 to 25 m3/hr. Drawdown may vary between 20-25 m.



Formation	Age		Symbol	Hydrogeological condition	Ground water prospects
Unconsolidated formation	Quaternary	Older alluvium (Sand,Silt,clay and gravel)		Discontinuous along river courses (unconfined)	Moderate yield prospects upto 10 m^3/hr.
	Pleistocene	Laterite		Capping over older formation (Unconfined)	Moderate yield prospects upto 2m^3/hr.
Semi consolidated formation	Upper carboniferous (Lower Gondwana)	Sandstone, Shale coal seam		Moderately thick (Unconfined to confined)	Limited yield prospects (4-10m^3/hr.)
Consolidated formation	Pre-Cambrian	Limestone and Shale		Ground water restricted to weathered residuum & secondary porosity	upto 5m^3/hr.
Consolidated formation	Pre-cambrian	Quartzite, Shale and schist		Ground water restricted to weathered residuum & secondary porosity	Limited yield prospects (1-10 m ^{3}/hr.)
Consolidated formation	Archean	Metabasic and Daima lava		———	———
Consolidated formation	Archean	Gneissic complex		Ground water restricted to weathered residuum & secondary porosity	Moderate yield prospects upto 25m^3/hr.

Figure 14: Hydrological map of Ranchi district (Source: Central Ground Water Board, Jharkhand)

4.2.9. Ground water

The district is having varied hydrogeological characteristics due to which ground water potential differs from one region to another. It is underlain by Chotanagpur granite gneiss of pre-Cambrian age in three-fourth of the district. In Ratu and Bero blocks thick lateritic capping is placed above granite gneiss. A big patch of older alluvium is found in Mandar block extending from Brombay and murma areas. Khelari (northernmost portion) area consists of Limestone rocks. Aquifer systems---Two types of aquifers are found. Weathered aquifer and fractured aquifers. Thickness of weathered aquifers varies from 10-25 m in granite terrain and 30-60m in lateritic terrain. In weathered aquifer ground water occurs in unconfined condition while in fractured aquifer ground water occurs in semi confined to confined condition.

Two samples of ground water have been collected as part of the ESIA study at the locations as shown in Table 10 below and these have been tested to assess the quality of ground water at the proposed project site and the nearby areas. Figure 15 indicates the locations on google map. The sample locations are selected based on the probability of the ground water sources getting contaminated due to the project. The IS 10500 2012 standards for drinking water are provided in **Annexure G** of this report.

Area	Locations	Direction	Distance (KM)
Agartoli	GW1	East	1.5
Chakla	GW2	West	4.5
Hatwal	GW3	South	1.5

Table 10: Monitoring and sampling for ground water – Getalsud FSPV Project, Jharkhand

Figure 15: Ground water sampling location

Results of physical, chemical and biological analysis of ground water samples from the proposed project area and surrounding villages were studied. Test results of water samples are presented in the following Table 14, while photographs taken during water sample collection have been provided in **Annexure D** of this report.

The results are within the acceptable limit. The pH value varied between 7.2 and 7.5. The total dissolved solid varied from 142 mg/l to 219 mg/l which is lower than the maximum acceptable limit of 500 mg/l for drinking water as per IS: 10500:2012, Govt. of India. The total hardness (as $CaCO_3$) varies from 46 mg/l to 77 mg/l at different locations within the study area. At all locations, the total hardness was lower than the desirable limit of 200 mg/l, as per IS: 10500:2012. The total alkalinity varied between 55 mg/l to 78 mg/l and within the acceptable limit of 200 mg/l for drinking water. The fluoride content was observed between 0.3 mg/l to 0.4 mg/l, which is lower than the acceptable limit of 1.0 mg/l. All other measured parameters including heavy metal contents were observed well within the acceptable limit for drinking water.

The biological parameters show that all parameters of the ground water in the project area are within acceptable range for drinking water.

Parameter	Unit	Limits as per IS 10500, 2012		Agartoli	Chakla	Hatwal	Test Method
		Desirable	Permissible	GW1	GW2	GW3	
Colour	Haze n	5	15	<5	<5	<5	IS: 3025(Pt-4) 1983, Reaff. 2017
Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeab le	IS: 3025(Pt-5) 1983, Reaff. 2017
Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeab le	IS: 3025(Pt-8)-1984, Reaff. 2017
Turbidity	NTU	1	5	<1.0	<1.0	<1.0	IS: 3025(Pt-10)-1984, Reaff. 2017
Temperature	^oC	-	-	22.3	22.6	22.6	IS: 3025(Pt-9)1984 Reaff 2002
Electric conductivity	umho	-	-	239	261	379	IS: 3025(Pt-14)2013
Total suspended solid	mg/l	-	-	<5.0	<5.0	<5.0	IS: 3025(Pt-17)1984 Reaff 2012
pH	-	6.5-8.5	No relaxation	7.5	7.2	7.4	IS: 3025(Pt-11)1983, Reaff. 2017
Total hardness (as CaCO3)	mg/l	200	600	53	46	77	IS: 3025(Pt-21)1983, Reaff. 2014
Iron (as Fe)	mg/l	0.3	No relaxation	0.04	0.02	<0.01	APHA 22nd Ed., 3120B (3111B (AAS),
Chlorides (as Cl)	mg/l	250	1000	22.2	16.6	22.1	IS: 3025(Pt-32)1988, Reaff. 2014
Fluoride (as F)	mg/l	1	1.5	0.3	0.4	0.04	APHA 22nd Ed., 4500F(D)
TDS	mg/l	500	2000	142	169	219	IS: 3025(Pt-16)1984, Reaff. 2017
Calcium (as Ca2+)	mg/l	75	200	12.6	12.9	17.2	IS:3025(Pt-40)1991, Reaff. 2014
Magnesium (as Mg2+)	mg/l	30	100	5.6	4.9	9.2	APHA 22nd Ed., 3500-Mg (B)
Copper (as Cu)	mg/l	0.05	1.5	<0.01	<0.01	<0.01	APHA 22nd Ed., 3120 B / 3111B (AAS)
Manganese (as Mn)	mg/l	0.1	0.3	<0.01	<0.01	0.02	APHA 22nd Ed., 3120 B)/ 3111B(AAS)
Sulphate (as SO4)	mg/l	200	400	7.7	7.3	40	IS: 3025(Pt-24)1986, Reaff. 2014
Nitrate (as NO3)	mg/l	45	No relaxation	2.8	2.6	11.4	IS: 3025(Pt-34)1988, Reaff. 2014

Parameter	Unit	Limits as per IS 10500, 2012		Agartoli	Chakla	Hatwal	Test Method
		Desirable	Permissible	GW1	GW2	GW3	
Phenolic compounds (as C6H5OH)	mg/l	0.001	0.002	<0.001	<0.001	<0.001	APHA 22nd Ed., 5530 (c)
Mercury (as Hg)	mg/l	0.001	No relaxation	<0.001	<0.001	<0.001	APHA 22nd Ed. 3120 B, 3112 (AAS-VGA)
Cadmium (as Cd)	mg/l	0.003	No relaxation	<0.001	<0.001	<0.001	APHA 22nd Ed. 3120 B /3111B (AAS)
Selenium (as Se)	mg/l	0.01	No relaxation	<0.01	<0.01	<0.01	APHA 22nd Ed., 3120 B / 3114, AAS-VGA
Arsenic (as As)	mg/l	0.01	0.05	<0.01	<0.01	<0.01	APHA 22nd Ed., 3120 B/ 3114, AAS-VGA
Cyanide (as CN)	mg/l	0.05	No relaxation	<0.01	<0.01	<0.01	APHA 22nd Ed., 4500 CN
Lead (as Pb)	mg/l	0.01	No relaxation	<0.01	<0.01	<0.01	APHA 22nd Ed., 3120 B /3111B AAS
Zinc (as Zn)	mg/l	5	15	0.02	0.02	0.02	APHA 22nd Ed., 3120 B / 3111 B (AAS)
Anionic detergent (as MBAS)	mg/l	0.2	1	<0.01	<0.01	<0.01	APHA 22nd Ed., 5540 (c)
Chromium (as Cr6+)	mg/l	0.05	No relaxation	<0.01	<0.01	<0.01	IS: 3025(Pt-52)-2003 RA 2014
Mineral oil	mg/l	0.5	No relaxation	<0.1	<0.1	<0.1	IS: 3025(Pt-39)1991, Reaff. 2014
Alkalinity (as CaCO3)	mg/l	200	600	55.6	61.2	77.9	IS: 3025(Pt-23)1986, Reaff. 2014
Aluminium (as Al)	mg/l	0.03	0.2	<0.02	<0.02	<0.02	APHA 22nd ED 3120B/3111B(AAS)/IS 3025(Pt-55)2003RA2014
Boron (B)	mg/l	0.5	1	<0.1	<0.1	<0.1	IS:3025(Pt-57):2005, APHA22nd Ed 3120 B 3111 AAS
Nitrite (NO2)	mg/l	-	-	0.30	0.24	0.22	IS: 3025(Pt-9)1984 Reaff 2002
Phosphate (PO4)	mg/l	-	-	<0.05	<0.05	<0.05	IS: 3025(Pt-31)1988 Reaff 2003
Silica	mg/l	-	-	<10	<10	<10	IS: 3025(Pt-35)1988 Reaff 2003
Sodium (as Na)	mg/l			13.2	14.8	20	IS: 3025(Pt-45)1993, Reaff. 2003
Potassium (as K)	mg/l			2.8	2.6	4.9	IS: 3025(Pt-45)1993, Reaff. 2003
Dissolved Oxygen	mg/l			2.3	2.3	3.6	APHA,4500 DC (1998)
Total Chromium	mg/l	0.05	No relaxation	<0.01	<0.01	<0.01	IS: 3025(Pt-52) 2003
Oil and grease	mg/l	0.5	No relaxation	<0.01	0.01	0.01	IS: 3025(Pt-39)1984 Reaff 2002
COD	mg/l	--	--	<10	<10	<10	IS: 3025(Pt-58)1986,
BOD	mg/l	--	--	<1.0	<1.0	<1.0	IS: 3025(Pt-44)1993,
Bicarbonate	mg/l	--	--	< 2.0	< 2.0	53.7	APHA, 2320, 22nd ED. 2012
Sodium bi carbonate	mg/l	--	--	1	1	0.13	by calculation
Biological parameter							

Parameter	Unit	Limits as per IS 10500, 2012		Agartoli	Chakla	Hatwal	Test Method
		Desirable	Permissible	GW1	GW2	GW3	
Total Coli form	Shall not be detect able			ND< 2.0	ND< 2.0	ND< 2.0	IS: 1622-1981 (Reaff.2003)

Table 11: Test result of ground water analysis

4.2.10. Surface water

The Getalsud reservoir has been constructed on the river Subarnrekha. The surface water characteristics of Getalsud reservoir, where the proposed FSPV is to be implemented, has been discussed in detail in this section.

Four samples of surface water have been collected at the locations as mentioned in Table 12 and as shown in Figure 16, which indicates the sample locations on google map. These have been tested to assess the quality of surface water at the proposed project site and the nearby areas. The surface water analysis results are presented in the Table 16.

Photographs taken during sample collection have been shown in **Annexure D** of this report. The CPCB standards relating to water quality criteria for different purposes are provided as **Annexure G** of this report.

Area	Surface water sampling locations	Direction	Distance (KM)
Getalsud reservoir	SW1, SW2, SW3	FSPV Site	0
Getalsud reservoir	SW4	Near Inlet	2.3

Table 12: Monitoring and sampling for surface water in Getalsud Reservoir

Figure 16: Surface water sampling locations

The water quality of the reservoir is represented below in Table 13. The TDS of the reservoir range from 420 to 467. The DO of the reservoir is in the range of 6-7. The BOD and COD are within the prescribed limits. The water quality of the reservoir conforms to the CPCB standards IS 2296 Class B, C, D and E for different categories of usage.

Parameter	Unit	Limit (as per IS:2296/ Class-C	Getalsud Reservoir SW1	Getalsud Reservoir SW2	Getalsud Reservoir SW3	Getalsud Reservoir SW4
Turbidity	NTU	5	6	5	6	6
pH	--	6.9-9.0	7.75	7.6	7.4	7.4
Total hardness (as $CaCO_3$)	mg/l	500	311	288	277	261
Iron (as Fe)	mg/l	1	0.3	0.4	0.4	0.4
Chlorides (as Cl)	mg/l	600	34.2	44.8	46.2	44.2
Fluoride (as F)	mg/l	1.5	0.229	0.312	0.326	0.334
TDS	mg/l	1500	467	471	455	441
Calcium (as Ca2+)	mg/l	75	22	26	27	27
Magnesium (as Mg2+)	mg/l	30	37.3	22.3	23.7	24.3
Copper (as Cu)	mg/l	1.5	0.01	0.01	0.01	0.01
Sulphate (as SO_4)	mg/l	400	16.4	22.3	22.9	23.2
Nitrate (as NO_3)	mg/l	50	4.7	4.7	5.2	4.9
Phenolic compounds (as C_6H_5OH)	mg/l	0.005	<0.001	<0.001	<0.001	<0.001
Mercury (as Hg)	mg/l	No relaxation	<0.001	< 0.001	< 0.001	< 0.001
Cadmium (as Cd)	mg/l	0.01	<0.01	<0.01	<0.01	<0.01
Selenium (as Se)	mg/l	0.05	<0.05	<0.05	<0.05	<0.05
Arsenic (as As)	mg/l	0.2	0<0.01	<0.01	<0.01	<0.01
Cyanide (as CN)	mg/l	0.05	<0.1	<0.1	<0.1	<0.1
Lead (as Pb)	mg/l	0.1	<0.1	<0.1	<0.1	<0.1
Zinc (as Zn)	mg/l	1.5	0.44	0.29	0.29	0.29
Chromium (as Cr6+)	mg/l	0.05	0.01	0.01	0.01	0.01
Alkalinity (as $CaCO_3$)	mg/l	200	44.2	41.2	34.8	36.2
Sodium	mg/l	----	21.2	18.8	21.8	22.2
Potassium	mg/l	----	10.2	8.6	11.2	11.6
Conductivity	umho/c	----	749	761	726	703
TSS	mg/l	----	<10	<10	<10	<10
Total Phosphorus (as PO4)	mg/l	----	4.42	5.64	5.68	4.96
Oil and grease	mg/l	0.1	<0.03	<0.03	<0.03	<0.03
Dissolved Oxygen	mg/l	4	5.8	6.4	6.1	6.1
Silica (as Si)	mg/l	----	4.2	3.9	4.1	4.1
COD	mg/l	----	16.3	14.8	14.2	22.8
BOD	mg/l	30	7.2	6.4	6.3	10.6
Nickel	mg/l	----	0.1	0.1	0.15	0.01
Microbiological parameter						
Total Coliform	MPN/100 ml	5000	122	103	134	218

Table 13: Surface water analysis at inlet and outlet of Getalsud reservoir

As per the water quality criteria flowed by the Central Pollution Control Board of the Government of India, Class A is for Drinking water purposes without conventional treatment but after disinfection, Class B is for Water for outdoor bathing, Class C is for Drinking water with conventional treatment followed by disinfection, Class D is for Water for fish culture and wildlife propagation and Class E is for Water for irrigation, industrial cooling and controlled waste disposal

4.3. Ambient air environment

4.3.1. Monitoring and sampling locations

Information on air environment was collected and analysed through monitoring of ambient air quality for four weeks (twice a week) as per the requirements specified by Central Pollution Control Board, MoEF&CC for suspended particulate matter ($PM_{2.5}$ and PM_{10}) comprising:

- **Oxides of Nitrogen (NOx)**
- **Sulphur Dioxide (SO2)**
- **Carbon Monoxide (CO)**
- **Ozone (O3)**
- **Ammonia (NH3)**

The sampling locations for ambient air quality monitoring were selected based on a desktop study of the project area covering wind direction, environmental hotspots and availability of habitats around the project site as well as findings of the reconnaissance survey of the locations. The selection is also based on the consideration of the MoEF&CC and CPCB norms for monitoring and sampling. The sampling duration for PM10, PM2.5, SO2, NO2, and NH3 was twenty-four hourly continuous samples per day and CO and O3 was sampled for 8 hrs continuous thrice a day. This is to allow a comparison with the present revised standards mentioned in the latest Gazette notification of the Central Pollution Control Board (CPCB) (November 16, 2009). Table 14 below shows the locations of air quality sampling, while Figure 17 indicates the locations on google map:

S. No.	Area	Air Quality Sampling Locations	Direction	Distance (KM)
1	Getalsud reservoir	AAQ1	FSPV Site	0
2	Hatwal	AAQ2	North	2.5
3	Lalgarh	AAQ3	South West	2.0
4	Chakla	AAQ4	West	4.5
5	Agartoli	AAQ5	East	1.5

Table 14: Monitoring and sampling locations for air quality

Figure 17: Locations of air quality sampling locations at project site

4.3.2. Results and conclusion

Ambient air monitoring was carried out at five locations for 24 hours (4-hourly sampling for gaseous pollutants (CO) and 8-hourly sampling for particulate matter) with a frequency of twice per week. Relevant standard for performing air quality monitoring has been indicated in Table 19 below. The monitoring was conducted for one week during the month of December 2019. Details of location-wise monitoring schedule is given in Table 18 below. Photographs related to air quality monitoring have been furnished in **Annexure B** of this report. The results of the air quality monitoring at the five sample locations are shown respectively in Tables 20, 21, 22, 23, and 24.

Air quality limit as prescribed by CPCB is given in Table 15 below. Concentration of all the parameters monitored is found within the limits prescribed by Central Pollution Control Board (CPCB), Government of India. Highest PM10 value has been recorded at the site AAQ1 near the Dam due to the activity near the reservoir for fishing activities. rest of the sites have recorded the value of particulates like PM10 and PM2.5 well within the limits. As far as the gaseous pollutants are concerned the NH3 value has been maximum near Getalsud due to the activity and discard of catches in the area.

Concentration of all the parameters monitored is found within the limits prescribed by Central Pollution Control Board (CPCB), Government of India. The Ambient air quality standards by CPCB are provided in **Annexure G** of this report.

AAQ1	AAQ2	AAQ3	AAQ4	AAQ5
02-Dec	02-Dec	03-Dec	03-Dec	02-Dec
05-Dec	05-Dec	06-Dec	06-Dec	05-Dec
09-Dec	09-Dec	10-Dec	10-Dec	09-Dec
12-Dec	12-Dec	13-Dec	13-Dec	12-Dec

AAQ1	AAQ2	AAQ3	AAQ4	AAQ5
14-Dec	14-Dec	16-Dec	16-Dec	14-Dec
17-Dec	17-Dec	18-Dec	18-Dec	17-Dec
19-Dec	19-Dec	20-Dec	20-Dec	19-Dec
21-Dec	21-Dec	23-Dec	23-Dec	21-Dec

Table 15: Air quality monitoring schedule

Parameters	Particulate Matter (PM10) µg/m3	Particulate Matter (PM2.5) µg/m3	Sulphur Dioxide (SO2) µg/m3	Nitrogen Dioxide (NO2) µg/m3	Carbon Monoxide (CO) µg/m3	Ozone (as O3) µg /m3	Ammonia (as NH3) µg /m3
Test Method	IS 5182(Part 23):2006 RA 2017	STRL/ LAB/ AIR/ STP/ 01, Gravimetric Method	IS 5182 (Part 2) :2001, RA 2017	IS 5182 (Part 6) :201	IS 5182 (Part, 10):1999 RA 2014	IS:5182 Part-IX	APHA-AIR402

Table 16: Air quality test method

Analysis Date	Particulate Matter (PM10) µg/m3	Particulate Matter (PM2.5) µg/m3	Sulphur Dioxide (SO2) µg/m3	Nitrogen Dioxide (NO2) µg/m3	Carbon Monoxide (CO) µg/m3	Ozone (as O3) µg /m3	Ammonia (as NH3) µg /m3
02-Dec 2019	65.2	32.8	12.3	16.3	0.04	10.3	14.3
05-Dec 2019	62.3	30.7	11.7	17.3	0.05	11.5	16.7
09-Dec 2019	61.2	30.7	12.2	15.2	0.04	10.7	15.2
12-Dec 2019	60.7	29.4	14.7	18.2	0.04	11.1	15.6
14-Dec 2019	61.4	32.1	12.6	16.3	0.06	12.7	19.4
17-Dec 2019	61.3	30.7	11.7	17.3	0.04	11.3	18.5
19-Dec 2019	60.9	29.1	14.4	16.7	0.03	10.7	17.2
21-Dec 2019	60.7	29.8	14.7	18.2	0.06	12.2	18.8
Maximum	65.2	32.8	14.7	18.2	0.06	12.70	14.8
Minimum	60.7	29.1	11.7	15.2	0.03	10.30	14.3
Mean	61.7	30.7	13.0	16.9	0.05	11.31	16.9
Percentile 98	64.8	32.7	14.7	18.2	0.06	12.63	19.3
Standard Deviation	1.5	1.3	1.3	1.0	0.01	0.81	1.85

Table 17: Air quality monitoring result of Getalsud reservoir (station AAQ1)

Analysis Date	Particulate Matter (PM10) µg/m^3	Particulate Matter (PM2.5) µg/m^3	Sulphur Dioxide (SO_2) µg/m^3	Nitrogen Dioxide (NO_2) µg/m^3	Carbon Monoxide (CO) µg/m3	Ozone (as O_3) µg /m^3	Ammonia (as NH_3) µg /m^3
02-Dec 2019	60.3	26.8	12.4	15.5	0.06	14.1	< 10
05-Dec 2019	58.8	27.1	11.2	15.4	0.06	12.8	< 10
09-Dec 2019	57.8	25.9	12.7	15.7	0.07	11.5	< 10
12-Dec 2019	59.6	26.4	11.6	14.2	0.06	14.2	< 10
14-Dec 2019	58.3	28.1	12.3	14.6	0.055	13.8	< 10
17-Dec 2019	56.9	27.4	11.8	14.8	0.07	12.1	< 10
19-Dec 2019	55.3	28.3	14.5	16.3	0.06	11.8	< 10
21-Dec 2019	59.2	28.1	14.8	16.1	0.06	12.7	< 10
Maximum	60.3	28.3	14.8	16.3	0.07	14.2	< 10
Minimum	55.3	25.9	11.2	14.2	0.055	11.5	< 10
Mean	58.275	27.2625	12.7	15.3	0.062	12.875	< 10
Percentile 98	60.2	28.3	14.8	16.3	0.1	14.2	< 10
Standard Deviation	1.60	0.87	1.32	0.74	0.01	1.06	0.00

Table 18: Air quality monitoring result of station AAQ2

Analysis Date	Particulate Matter (PM10) µg/m^3	Particulate Matter (PM2.5) µg/m^3	Sulphur Dioxide (SO_2) µg/m^3	Nitrogen Dioxide (NO_2) µg/m^3	Carbon Monoxide (CO) µg/m3	Ozone (as O_3) µg /m^3	Ammonia (as NH_3) µg /m^3
03-Dec 2019	60.9	26.9	11.4	17.6	0.06	16.3	< 10
06-Dec 2019	60.1	27.5	11.2	22.4	0.07	15.8	< 10
10-Dec 2019	60.8	24.8	12.2	16.6	0.06	15.8	< 10
13-Dec 2019	61.5	26.7	12.6	17.1	0.08	16.8	< 10
16-Dec 2019	61.4	27.9	11.6	18.8	0.07	17.2	< 10
18-Dec 2019	63.7	26.4	11.7	20.2	0.07	16.8	< 10
20-Dec 2019	64.9	28.6	12.8	21.9	0.075	17.8	< 10
23-Dec 2019	60.1	29.8	11.6	18.4	0.065	17.2	< 10
Maximum	64.9	29.8	12.8	22.4	0.08	17.8	< 10
Minimum	60.1	24.8	11.2	16.6	0.06	15.8	< 10
Mean	61.675	27.325	11.9	19.1	0.069	16.7125	< 10
Percentile 98	64.7	29.6	12.8	22.3	0.1	17.7	< 10

Table 19: Air quality monitoring result of station AAQ3

Analysis Date	Particulate Matter (PM10) µg/m^3	Particulate Matter (PM2.5) µg/m^3	Sulphur Dioxide (SO_2) µg/m^3	Nitrogen Dioxide (NO_2) µg/m^3	Carbon Monoxide (CO) µg/m3	Ozone (as O_3) µg /m^3	Ammonia (as NH_3) µg /m^3
03-Dec 2019	55.8	24.9	12.4	17.3	0.05	15.8	< 10
06-Dec 2019	53.2	25.6	11.2	18.9	0.05	15.7	< 10
10-Dec 2019	57.3	25.1	12.7	18.2	0.045	17.8	< 10
13-Dec 2019	55.4	25.8	11.6	18.2	0.05	14.5	< 10
16-Dec 2019	55.4	26.8	12.3	17.8	0.045	14.9	< 10
18-Dec 2019	54.8	26.3	11.8	16.9	0.05	15.1	< 10
20-Dec 2019	57.5	26.9	14.5	17.9	0.055	16.6	< 10
23-Dec 2019	54.2	25.9	14.8	17.2	0.05	16.4	< 10
Maximum	57.5	26.9	14.8	18.9	0.055	17.8	< 10
Minimum	53.2	24.9	11.2	16.9	0.045	14.5	< 10
Mean	55.45	25.9125	12.7	17.8	0.049	15.85	< 10
Percentile 98	57.5	26.9	14.8	18.8	0.1	17.6	< 10

Table 20: Air quality monitoring result of station AAQ4

Analysis Date	Particulate Matter (PM10) µg/m^3	Particulate Matter (PM2.5) µg/m^3	Sulphur Dioxide (SO_2) µg/m^3	Nitrogen Dioxide (NO_2) µg/m^3	Carbon Monoxide (CO) µg/m3	Ozone (as O_3) µg /m^3	Ammonia (as NH_3) µg /m^3
02-Dec 2019	52.4	30.5	13.8	21.2	0.06	15.3	< 10
05-Dec 2019	51.9	30.4	12.3	24.3	0.055	14.3	< 10
09-Dec 2019	58.4	29.7	10.9	22.6	0.065	13.6	< 10
12-Dec 2019	52.7	27.9	12.2	22.6	0.065	15.4	< 10
14-Dec 2019	56.5	31.1	10.6	24.8	0.065	17.3	< 10
17-Dec 2019	53.5	30.4	11.9	24.2	0.055	14.3	< 10
19-Dec 2019	52.8	29.7	12.6	21.3	0.055	13.6	< 10
21-Dec 2019	54.6	31.5	10.3	20.4	0.05	15.4	< 10
Maximum	58.4	31.5	13.8	24.8	0.065	17.3	< 10
Minimum	51.9	27.9	10.3	20.4	0.05	13.6	< 10
Mean	54.1	30.15	11.8	22.7	0.059	14.9	< 10

Analysis Date	Particulate Matter (PM10) µg/m^3	Particulate Matter (PM2.5) µg/m^3	Sulphur Dioxide (SO_2) µg/m^3	Nitrogen Dioxide (NO_2) µg/m^3	Carbon Monoxide (CO) µg/m3	Ozone (as O_3) µg /m^3	Ammonia (as NH_3) µg /m^3
Percentile 98	58.1	31.4	13.6	24.7	0.1	17.0	< 10

Table 21: Air quality monitoring result of station AAQ5

The CPCB guidelines on ambient air quality are provided below for Industrial, Residential, Rural and other Areas for 24 hourly or 8 hourly or 1 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring. However no Ecologically Sensitive Area (Notified by Central Government) which is present within 10 kms radius around the proposed site.

Analysis Date	Particulate Matter (PM10) µg/m^3	Particulate Matter (PM2.5) µg/m^3
Particulate Matter PM $_{2.5}$ (µg/m^3)	60	60
Particulate Matter PM 10 (µg/ m3)	100	100
Sulphur Dioxide (as SO2) (µg/ m3)	80	80
Oxides of Nitrogen (as NO2) (µg/m3)	80	80
Carbon Monoxide (as CO), (mg/ m3)	02	02
Ozone (as O3) (µg/ m3)	100	100
Lead (as Pb) (µg/ m3)	1.0	1.0
Ammonia (as NH3) (µg/ m3)	400	400
Benzene (as C6H6) (µg/ m3)	05	05
Benzo (O) Pyrene (as BaP) (ng/ m^3)	01	01
Arsenic (as As) (ng/ m3)	06	06
Nickel (as Ni) (ng/ m3)	20	20

Table 22: Air quality limits of CPCB

4.4. Ambient Noise Environment

Noise sampling was done for the proposed project twice a week during the study period continuously for 24 hours. The locations for noise sampling were selected based on the site sensitivities within the project area.

4.4.1. Monitoring Locations

The sampling and monitoring locations for noise sampling are based on a desktop study of the project area covering availability of habitats around the project site as well as findings of the reconnaissance survey of the locations. The selection is also based on the consideration of the MoEF&CC and CPCB norms for monitoring and sampling. Noise quality sampling locations are shown below in Table 26, while the locations are indicated in google image in Figure 18.

S. No.	Area	Noise sampling locations	Direction	Distance (KM)
1	Getalsud reservoir	ANL1	FSPV Site	0
2	Hatwal	ANL2	North	2.5
3	Lalgarh	ANL3	South West	2.0
4	Chakla	ANL4	West	4.5
5	Agartoli	ANL5	East	1.5

Table 23: Monitoring and sampling locations for Noise Quality around Getalsud Reservoir

Figure 18: Locations of Environmental attributes (noise level) at project location

4.4.2. Results and conclusion

Ambient noise level was measured at five locations for 24 hours for day and night-time noise with a frequency of twice per week. The monitoring was conducted for one month during the period of December 2019. Monitoring stations were chosen based on their proximity to settlements and other environmental hot spots. Details of location-wise monitoring schedule is given in Table 27 below while the photographs related to noise have been furnished in **Annexure C** of this report. Noise levels as prescribed by CPCB are described in Table 28 below. Monitoring

results for all sample locations are shown respectively in Table 24 till 30 below, which indicates that noise level in the study area is within the limits as prescribed by CPCB at all locations.

ANL1	ANL2	ANL 3	ANL 4	ANL 5
02-Dec	02-Dec	03-Dec	03-Dec	02-Dec
05-Dec	05-Dec	06-Dec	06-Dec	05-Dec
09-Dec	09-Dec	10-Dec	10-Dec	09-Dec
12-Dec	12-Dec	13-Dec	13-Dec	12-Dec
14-Dec	14-Dec	16-Dec	16-Dec	14-Dec
17-Dec	17-Dec	18-Dec	18-Dec	17-Dec
19-Dec	19-Dec	20-Dec	20-Dec	19-Dec
21-Dec	21-Dec	23-Dec	23-Dec	21-Dec

Table 24: Noise quality monitoring schedule

Area Code	Category of Area/ Zone	Limits in db (A)Leq*	
		Day time (6.00a.m. to 10.00p.m.)	Night-time (10.00 p.m. to 6.00 a.m.)
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45
D	Silence Zone	50	40

Table 25: Ambient air quality standards in respect of noise as prescribed by CPCB

Note: (*) db (A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is related to human hearing.

Date of monitoring	Observed value db. (A) L_{eq}	
	L_{eq} (day)	L_{eq} (night)
02-Dec 2019	51.8	36.9
05-Dec 2019	52.7	37.6
09-Dec 2019	54.1	37.8
12-Dec 2019	52.1	37.9
14-Dec 2019	51.8	38.1
17-Dec 2019	51.7	37.6
19-Dec 2019	52.1	38.8
21-Dec 2019	52.0	38.7

Table 26: Results of noise level near Getalsud reservoir (ANL1)

Date of monitoring	Observed value db (A) L_{eq}	
	L_{eq} (day)	L_{eq} (night)
02-Dec 2019	48.9	37.1
05-Dec 2019	48.7	37.4
09-Dec 2019	50.1	37.7
12-Dec 2019	49.2	38.1
14-Dec 2019	48.9	38.3
17-Dec 2019	50.1	37.8
19-Dec 2019	49.2	37.7
21-Dec 2019	49.1	38.9

Table 27: Results of noise level at Hatwal (ANL2)

Date of monitoring	Observed value db (A) L_{eq}	
	L_{eq} day	L_{eq} night
03-Dec 2019	52.5	38.1
06-Dec 2019	53.4	37.2
10-Dec 2019	50.3	37.6
13-Dec 2019	52.8	38.1
16-Dec 2019	52.5	38.3
18-Dec 2019	52.4	38.1
20-Dec 2019	51.2	37.9
23-Dec 2019	52.7	37.9

Table 28: Results of noise level at Lalgarh (ANL3)

Date of monitoring	Observed value db (A) L_{eq}	
	L_{eq} day	L_{eq} night
03-Dec 2019	48.9	36.4
06-Dec 2019	49.6	37.3
10-Dec 2019	51.2	37.1
13-Dec 2019	49.4	37.6
16-Dec 2019	48.9	37.4
18-Dec 2019	48.8	36.9
20-Dec 2019	49.2	37.7

Date of monitoring	Observed value db (A) L_{eq}	
	L_{eq} day	L_{eq} night
23-Dec 2019	49.1	38.1

Table 29: Results of noise level at Chakala (ANL4)

Date of monitoring	Observed value db (A) L_{eq1}	
	L_{eq} day	L_{eq} night
02-Dec 2019	49.5	36.8
05-Dec 2019	50.4	37.5
09-Dec 2019	51.8	37.7
12-Dec 2019	47.9	36.7
14-Dec 2019	49.5	38.4
17-Dec 2019	50.2	37.5
19-Dec 2019	49.8	38.7
21-Dec 2019	48.1	37.4

Table 30: Results of noise level at Agartoli (ANL5)

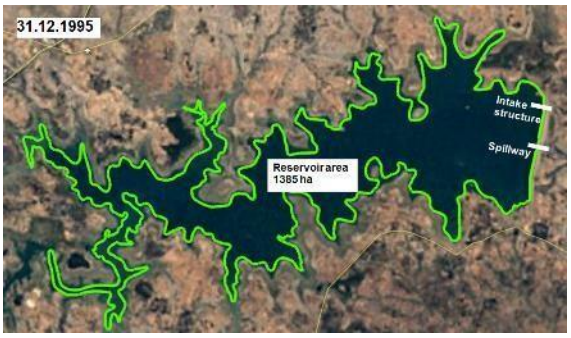
4.5. Reservoir Characteristics

4.5.1. Inflow, outflow and water level in the reservoir

Getalsud Dam is an artificial reservoir situated in Ormanjhi/Angara blocks of District Ranchi, Jharkhand. It was constructed across the Subarnarekha River and was opened in 1971. The dam provides a small-scale fishing opportunity to the local people of Rukka. The main purpose of the dam is to fulfil the drinking water requirements of the residents of Ranchi. Apart from that, it is also used for industrial purposes and generating electricity. The reservoir is used as a picnic spot for the residents of Ranchi and Ramgarh Districts.

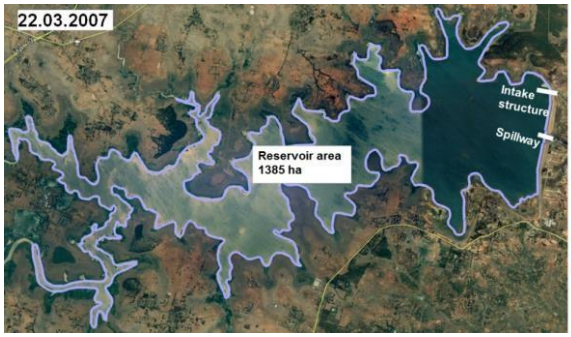
The reservoir has a maximum surface area of 3459 ha and a capacity of 288.5 million m^3 at the FRL of 595.70 m above MSL. At the lowest level, the area is only 987 ha. River Subarnarekha, the main source of inflow, originates at Nagari, in the Chhotanagpur plateau, about 50 km upstream of Getalsud dam. The multi-purpose reservoir supplies water to Ranchi town, and for the industrial needs of the Heavy Engineering Corporation and other factories. The installed PV modules are likely to reduce water evaporation, reduce solar energy absorption by the water surface, decrease water temperature and increase the dissolved oxygen concentration marginally in water during construction. The area of the reservoir at the FRL is 3475 Ha (1870.7 Ha average water surface area) and the covered area for FSPV is around 172 Ha; so, the PV modules mounted on floating platforms will cover only about 9.2% of the average reservoir area. Therefore, the impact of PV modules and floating platforms on the surface of the reservoir is considered medium.

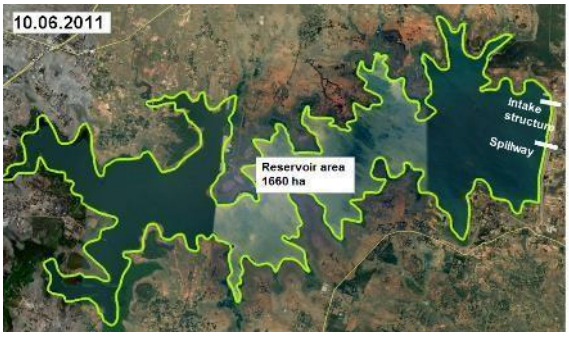

31.12.1984
Reservoir area
2378 ha
Spillway

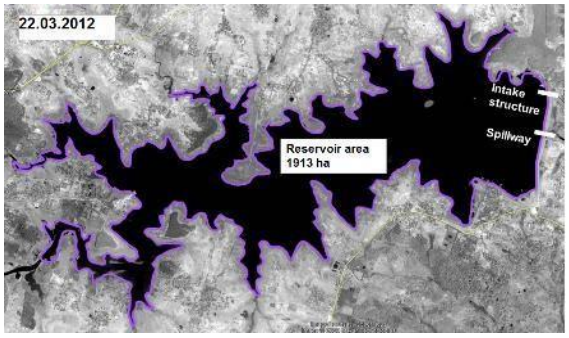

31.12.1995
Intake
structure
Reservoir area
1385 ha
Spillway


31.12.2000
Intake
structure
Reservoir area
1385 ha
Spillway


09.05.2005
Intake
structure
Reservoir area
1385 ha
Spillway


22.03.2007
Intake
structure
Reservoir area
1385 ha
Spillway


10.06.2011
Intake
structure
Reservoir area
1660 ha
Spillway


22.03.2012
Intake
structure
Reservoir area
1913 ha
Spillway


06.11.2016
Intake
structure
Reservoir area
2737 ha
Spillway


19.03.2018
Intake
structure
Reservoir area
2534 ha
Spillway


31.03.2018
Intake
structure
Reservoir area
1945 ha
Spillway

Sl. No.	Date	Area (Ha)
1	31.12.1984	2378
2	31.12.1995	1385
3	31.12.2000	1385
4	09.05.2005	1385
5	22.03.2007	1385
6	10.06.2011	1660
7	22.03.2012	1913
8	06.11.2016	2737
9	19.03.2018	2534
10	31.03.2018	1945
Average		1870.7

4.5.2. Bathymetry of the reservoir

The morphometric and edaphic indicators of productivity and the estimates on the standing crop defines status of the water body. A low shoreline development index and nutrient status in the water and sediment phases suggest oligotrophy, while the klinograde distribution of oxygen, accompanied by an increase in carbon dioxide towards the deeper layers clearly suggest high photosynthetic and nutrient releasing activities.

The river Subarnarekha receives factory effluents from the Heavy Engineering Corporation and sewage wastes emanating from the industrial township. A drop in dissolved oxygen, accompanied by decrease in plankton, has been reported below the discharge point. The water recovers its quality further downstream.

The bottom soil is acidic and poor in organic carbon (0.46 to 0.60 %). Available phosphorus and nitrogen are present in modest quantities (2.45 to 6.08 mg 100 g-1 and 24.38 to 35.06 mg 100 g-1).

An average gross primary production of 289.8 and net production of 154.4 mg C m-2 day-1 have been reported in the lentic sector of the reservoir, compared to 257.85 and 137.12 mg C m-2 day-1in the intermediate sector and 295.5 and 150.64 mg C m-2 day-1 in the lotic sector. The mean gross and net production rates are 281.07 and 147.4 mg C m-2 day-1.

4.5.3. Area and volume

The dam has a maximum height of 17.98 meters and length of 9.50 km. The reservoir has a maximum surface area of 3459 ha and a capacity of 288.5 MCM at the FRL of 595.70 m above MSL. At the lowest level, the area is only 987 ha.

4.5.4. Sampling location mapping

Eight sampling stations were identified in the reservoir, which have been indicated in the Table 31 below, while these locations are shown in Google image Figure 19 below. GR1 and GR3 were in the lotic or riverine sector of the reservoir while rest of the stations are in the lentic sector. The sampling locations has been selected to measure the vital parameters like pH, Secchi depth, DO, and temperature across the reservoir.

Site	Location	Coordinates (Latitude and Longitude)
GR1	Eastern side of the Reservoir	23°27'12.59"N, 85°32'50.64"E
GR 2	Northern Side of the reservoir	23°27'41.34"N, 85°32'29.18"E
GR 3	Southern Bank of the reservoir	23°27'7.97"N, 85°32'20.06"E
GR 4	Northern bank of the reservoir	23°27'45.74"N, 85°31'47.65"E
GR 5	Central part of the reservoir	23°27'23.56"N, 85°32'2.50"E
GR 6	Central part of the reservoir	23°27'19.94"N, 85°31'32.50"E
GR 7	Middle of the reservoir	23°27'7.42"N, 85°31'2.50"E
GR 8	Western side of the reservoir	23°26'45.00"N, 85°30'24.53"E

Table 31: Locations for physio-chemical monitoring at Getalsud Reservoir

Figure 19: Locations of environmental attributes (physico-chemical) at project location

4.5.5. Temperature

Water temperature was recorded with the help of an ordinary thermometer having range of 0- 50^{0}C, with mark up to 0.1^{0}C. The temperature has been taken between 11AM to 3 PM. The surface water temperature was recorded by dipping the mercury bulb of the thermometer directly into the water. For determining the temperature of subsurface waters, the thermometer was immediately dipped into the water as soon as it was brought in the Nansen's bottle from a given depth. Locations for temperature measurement and results are presented in Table 32 below.

Location	Temperature (^{O}C)		
	Surface	5m	10m
GR 1	16.8	16.4	16.2
GR 2	16.8	16.3	15.9
GR 3	16.8	16.3	16.1
GR 4	16.9	16.4	-
GR 5	16.8	16.5	16.1
GR 6	16.9	16.5	16.2
GR 7	17.1	16.5	16.1
GR 8	17.1	16.5	-

Table 32: Temperature measurement at Getalsud reservoir

4.5.6. Secchi Depth

Water transparency was measured by a standard Secchi disc having a diameter of 20.0 cm, with alternate quadrates of white and black colours and attached to a graduated rope. The secchi depth has been recorded between 11AM to 3 PM. The disc was lowered in water, till it disappeared visually followed by its slow lifting till it became visible again. The depths of disappearance and reappearance of Secchi disc were noted and an average of the two readings was taken as Secchi disc transparency. The results were varying from 1.7 m to 2.3 m, being higher in the lotic region compared to the lentic region. A summary of the results is shown in the following Table 33.

Location	Secchi Depth (m)
BR1	1.4
BR2	1.3
BR3	1.6
BR4	1.4

BR5	1.7
BR6	1.8
BR7	1.9
BR8	1.8

Table 33: Locations for Secchi disc measurement at Getalsud

4.5.7. Rate of evaporation

Reduction of evaporation from water surface at different wind velocities can be measured from the formula given below.

E= (0.1184+0.0025 W) (es-ea)[4]

where E is the evaporation rate in mm per hour, W is wind velocity in km per hour, es and ea are the saturation and actual vapour pressures respectively in millibars. The values of vapour pressure deficit (es-ea) for the location were calculated using the following relationship.

(es-ea) = 0.636 (Td-Tw), where Td and Tw are the dry bulb and wet bulb temperatures (^{0}C) respectively. For Getalsud reservoir, E=0.17 mm/Hr as can be seen from Table 34 below.

Parameter		Value	Unit
W	=	12	km/Hr
Td	=	34	^{o}C
Tw	=	32	^{o}C
es-ea	=	1.27	
E	=	**0.17**	**mm/Hr**

Table 34: Rate of evaporation at Getalsud reservoir

4.5.8. pH value

The pH value of the water samples was determined in the field using a digital pH meter and a summary of the results is given below in Table 35.

Location	pH Value		
	Surface	5m	10m
BR1	7.8	7.7	7.4
BR2	7.9	7.8	7.6
BR3	8.2	7.8	7.5

[4] http://cwc.gov.in/sites/default/files/evaporation-control-in-reservoirs.pdf

Location	pH Value		
	Surface	5m	10m
BR4	8.1	7.6	-
BR5	7.8	7.6	7.6
BR6	7.9	7.7	7.6
BR7	8.0	7.7	7.4
BR8	8.1	7.6	-

Table 35: pH values at Getalsud reservoir

4.5.9. Dissolved Oxygen

Dissolved oxygen in water was found in the range of 5.1 to 6.4 mg/l at all sampling locations as indicated in Table 36 below.

Location	**Dissolved Ovygen (DO)**								
	Surface mg/l	T°	Saturation Dissolution (%)	5m Depth	T°	Dissolution (%)	10m Depth	T°	Dissolution (%)
GR1	5.7	16.8	59	5.5	16.4	56	5.1	16.2	52
GR 2	6.3	16.8	65	5.7	16.3	58	5.2	15.9	53
GR 3	5.9	16.8	61	5.4	16.3	55	5.1	16.1	52
GR 4	6.4	16.9	66	5.8	16.4	59	-	-	-
GR 5	6.9	16.8	71	6.2	16.5	64	5.6	16.1	57
GR 6	6.7	16.9	69	6.1	16.5	63	5.6	16.2	57
GR 7	6.7	17.1	70	6.2	16.5	64	5.8	16.1	59
GR 8	6.5	17.1	68	6.1	16.5	63	-	-	-

Table 36: Dissolved Oxygen at Getalsud reservoir

4.5.10. Chemical characteristics

Chemical characteristics of water samples covering Chemical Oxygen Demand (COD), Bio-chemical Oxygen Demand (BOD), Nitrogen, Phosphorous and other chemical properties of Getalsud reservoir has been elaborated in Section 5.2.10.

4.6. Utilization of the Reservoir

The main river which feeds the Getalsud reservoir is Subernrekha. The reservoir has a total catchment area of 725 sq. km with water holding capacity of 10,193 million cu. ft (MCF) i.e. 288.63 million cu. meter (MCM). The main spillway of the dam, constructed with stone masonry, is located on the east of the reservoir. The spillway is anchored to the earth dam with 90m of non-overflow transition blocks on either side and has seven gates of 12.19m height and a discharge capacity of 300,175 cubic feet per second (cusec) i.e. 8500 cumec. The level of the spillway crest is 577.90m i.e.1896ft.

The installed hydro-power generation capacity is around 130MW with the plant located near village Sikidiri. It is fed through an intake structure located in the north-east of reservoir. The intake structure has a discharge capacity of 2000 cusecs. The water coming out of the hydro-turbine is discharged into the river on the downstream side.

The state fisheries department has developed pisciculture activities in the reservoir. During the walk-through survey of the reservoir area conducted by Tractebel in September 2019 site visit, around 8 fishing societies were observed to be involved in pisciculture within the reservoir.

The reservoir is surrounded by scenic sal forest and is a spot for leisure for the residents and visitors.

At present, as informed by the local Fisheries Department, around 200 families are doing commercial fishing in the reservoir. About 116 families are recorded during the socio-economic survey.

4.7. Dam Structure

Getalsud Dam is constructed on River Subarnarekha in Village Getalsud, Block: Angara, Dist: Ranchi. It consists of an Earthen Dam of length 2130 m including central spillway from RD 850 m to 1090 m. The Construction of the dam was completed in the year 1971.

Sikidri power house has been constructed about 20 Kms D/S of the Dam. Power channel has been constructed from Getalsud Dam with a discharge capacity of 56.70 Cumec through an intake structure from the reservoir with 3 RCC Barrels. Water is conveyed from the canal through penstock for generation of hydel power with installed capacity of 2 x 65 MW. Drinking water supply to Ranchi Town is being taken off from here.

The salient features of Dam and other major structures are as under:

(I) Location			
1)	Village	Getalsud	
2)	Name of River	Subernrekha	
3)	Block	Angara	
4)	Sub-Divison	Sadar Ranchi	

	5) District	Ranchi, Jharkhand	
	6) Year of completion	1971	
	(II) Dam		
a)	Type	Earth Dam and Masonry Concrete Spillway	
b)	Length	2400 m	
c)	Top Width	7.62 m	
d)	Dam top road level	593.14 m	
e)	U/s Slope	2:1, 3.5:1	
f)	D/s Slope	2:1, 3:1	
	(III) SPILLWAY		
a)	Type	Ogee type	
b)	Length	237 m including piers Overflow portion: 105.80 m Non-overflow portion 131.20 m	
c)	No. of spillway	7 nos. of radial gates	
d)	RL of crest spillway	577.90 m	
e)	Deepest bed level of river	557.76 m	
f)	Capacity discharge	8500 cumec	
	(IV) Radial Gate		
a)	Number	7 nos.	
b)	Size of each gate	12.5 m x 12.20 m	
c)	Crest Elevation	577.90 m	
d)	Radius of Gate	10.67 m	
e)	Operation operated by Electric motor operated rope drum hoist	Electric / Gen set	
	(V) SPILLWAY BRIDGE		
a)	No. of span	6 nos.	
b)	Length of span	15.50 m	
c)	Type	RCC	
d)	Height of the parapet	0.90 m	
	(VI) SLUICE GATES		
a)	No. of gates	2 nos.	
b)	Size of gates	1 m dia	
c)	Operation	Manual	
d)	Discharge Capacity	33.98 cumec	
	(VII) POWER CHANNEL		
a)	Design Discharge	56.64 cumec	
b)	Size of conduit	3 Nos. – 3.05 m x 2.52 m each	
	(VIII) DYKE		
a)	Top level of dyke	593.14 m	
b)	Length of dyke	3.50 km	
c)	Maximum height of dyke	10.00 m	
d)	Type of dyke	Earthen	
e)	U/s slope	2:1, 3.5:1	
f)	D/s slope	2:1, 3:1	
g)	Top width of dyke	7.62 m	

4.7.1. Dam Safety Review

The Government of Jharkhand, Department of Water Resources has constituted the Dam Safety Review Panel (DSRP) for reviewing the structural integrity of Dam bodies located in the State of Jharkhand. The panel comprises of members possessing expertise in construction, Concrete & Masonry Dam Design, Hydrology & Flood Management, Embankment Dam Design, Instrumentation etc.

The DSRP team visited the Getalsud dam on 27.10.2021 and submitted their dam safety report in Nov' 2021. The panel has not raised any serious concern on the

dam safety, however suggested few observations and recommendations. The major recommendations of the panel are as under:

i. The design flood of spillway of Getalsud Dam is 8500 cumec. The peak PMF has been worked out by Central Water Commission (CWC), GoI during Feb. 2020 to be the order of 7004 cumec. Therefore, there is no need of further design flood review of this dam.

ii. Sedimentation study of the project was conducted by CWC during the year 2001. There is a difference in the capacity of the reservoir at FRL is 16000 ac. Ft. therefore the reservoir condition from the sedimentation aspect is not alarming.

iii. The bushes and vegetation growth over all structures and dyke be uprooted. The water hyacinth be removed from the reservoir area with suitable treatment.

iv. The downstream slope be filled up with good quality compacted earth before benching and bring it to designed section. After that turfing be taken up.

v. Calibrated V-Notches be provided at the D/s side of Dam in the deepest portion of the toe drains as per necessity.

vi. After depletion of reservoir level, the U/s face of the non-overflow portion of the spillway be examined thoroughly. If any cracks observed, epoxy grouting treatment be carried out.

vii. Cement / polymer grouting be taken up in the top block of pier 2 on the U/s of trunnion girder of reservoir.

viii. Cementitious Geo-Synthetic Concrete Mattress/Carpet (CCGM/CCGC) as per Standards of EN 13253 & 13254 used in Reservoir & Dams as appropriate be adopted for treatment / stability of slopes including prevention of seepages.

ix. The damaged portion of 2nd stage concrete in spillway be made good with M30 concrete with adhesives & quick setting cement and proper curing be done after construction.

x. Lighting arrangement be improved.

xi. The mud deposit in the drainage gallery need to be investigated and thereafter necessary remedial / treatment measures with advance technology may be deployed, if required.

xii. The calcination be removed.

xiii. Chainage be painted over the wall in each block with block numbers.

xiv. Periodic maintenance be carried out as per guidelines issued by CWC.

xv. Sluice gates valve should be check for operation.

xvi. Uplift pressure meters be installed in the drainage gallery for measuring uplift pressure.

xvii. Tilt meters with data logger be provided in the deepest spill section in two different blocks inside the gallery.

xviii. Strong motion accelerometer be installed, one inside the gallery and another below the deck slab of the spill way above the pier.

4.8. Biodiversity Assessment

As per the State of India Forest Report, 2019 (published by the Forest Survey of India, Ministry of Environment, Forest and Climate Change, Government of India), the Forest Cover in the State is 24,303.04 sq km which is 45.44 % of the State's geographical area. In terms of forest canopy density classes, the State has 5,046.76 sq km under Very Dense Forest (VDF), 12,805.24 sq km under Moderately Dense Forest (MDF) and 6,451.04 sq km under Open Forest (OF).

As per the State of India Forest Report, 2019 (published by the Forest Survey of India, Ministry of Environment, Forest and Climate Change, Government of India), Out of the total 5097 km^2 geographical area of Ranchi, the district has 63.04 km^2 of Very dense Forest, 364.19 km^2 of moderate dense forest, 737.26 km^2 of open forest and 35.35 km^2 of open scrub land. A total of 22.85% of the geographical areas is covered by vegetation excluding scrubland (India State of the Forest Report, 2011).

For biodiversity assessment relating to the proposed project, aquatic and terrestrial surveys were conducted to determine the location of any priority biodiversity values within the proposed project area that may be affected on account of the proposed project. Table 37 below highlights the different surveys conducted to assess the biodiversity of the area.

Aspect	Study
Habitat mapping	Habitats within the project area.
Aquatic survey	Primary survey, Phytoplankton, zooplankton and macroinvertebrate
	Primary survey, Fisheries resources were recorded and identified.
	Secchi depth readings
	Temperature profile
Terrestrial survey	Vegetation, avifauna, herpetofauna and mammal surveys
Ecological survey	Primary survey, Interviews with relevant stakeholders and government officers

Table 37: Different survey for assessing biodiversity in and around the project area

4.8.1. Ecological baseline

The distribution of Ecological Habitat has been studied in order to identify risks and mitigations to biodiversity values during the impact assessment phase.

4.8.1.1. AQUATIC SURVEY OF THE RESERVOIR AREA

The aquatic samples were collected from 4 sites (GR1, GR2, GR5 and GR7) out of total 8 sites selected for physico chemical studies of the Getalsud reservoir which covers upstream, downstream and site of FSPV installation area. Locations are shown below in Figure 20.

Figure 20: Locations of ecological sampling for Getalsud Reservoir

Phytoplankton samples were collected by deploying a conical hand net with 25 µm mesh size at each site for qualitative analysis. Further samples were then collected for quantitative analysis, by filtering 10 L of surface water through the same net. All samples were stored in plastic bottles and fixed with 4% formalin solution.

Zooplankton samples were collected by deploying a conical hand net with 40 µm mesh size at each site for qualitative analysis and then filtering 10 L of water through the same net for quantitative analysis. All samples were stored in plastic bottles and fixed with 4% formalin solution.

Samples of benthic macroinvertebrates were taken a Petersen grab sampler and composited into a single sample. For littoral macroinvertebrates in the riparian lakesides, samples were collected with a 10-sweep hand net. The samples sieved for macroinvertebrates and sediment materials were collected. Samples were analysed both qualitative and quantitative samples in the laboratory using microscopes.

Fish species were confirmed with the fisheries department and discussion with the local people.

Results

Phytoplankton

19 species of phytoplankton have been found in the samples. All species recorded were freshwater phytoplankton. All the species were found at all the locations. The number of phytoplankton species was not observed to have high fluctuations among the sampling sites. The quantity was in range of 3350 (at GR7) to 7100 at (GR2) per litre at the selected locations.

Zooplankton

13 species of zooplankton were recorded at the selected locations of sampling. All species recorded were freshwater zooplankton. The zooplankton count was recorded highest at GR5 at 68 and the lowest at GR2 at 32. 4 rotifers, 3 Cladosera and 3 Copepoda are recorded. Apart from these 3 species from other phylum were also present.

Macroinvertebrates

A total of 16 species including the littoral and benthic species recorded during the study. 7 Arthropoda, 2 Annelida and 6 Mollusca are recorded. The quantity recorded at 22 (GR5) to 34 (GR2).

Fish Species

A total of 29 species of fishes are found in the reservoir. The consultation with the fisheries department and local people reveals the diversity of fishes found in the reservoir.

4.8.1.2. AQUATIC ECOSYSTEM PRODUCTIVITY

The algae are primary producers in the food chain and the algal biomass have effects to other trophic levels within the waterbody. Algal production in freshwater lakes is a function of light availability, nutrient availability, and temperature (Steele, 1962). Given that the water bodies tend to maintain a more static temperature than the surrounding atmosphere, it is expected that the water temperature of Getalsud reservoir would not vary considerably to become a limiting factor in the production of algae. The phytoplankton biomass of the lake was measured in the range of 3350 to 7100 cells per liter. Given that both temperature and nutrient availability are relatively constant, light availability would therefore be the most limiting factor in relation to ecological productivity of the lake. This assumes that the lakes oxygenation remains static and sufficient mixing is available to reduce risks of anoxic conditions. It should be noted that no reports of anoxic conditions or fish kills within the lake were reported during survey.

In order to consider changes in algal biomass, the lake was considered in terms of its entire extent, only 9.2% of the area to be covered. The location of the solar arrays on the North to South side of the lake are likely to result in a reduction of productive capacity of the waterbody at that location in small amount.

The aquatic ecology pertaining to the entire project apart from the reservoir area in presented under 4.7.3.

4.8.1.3. NESTING GROUND

The nesting grounds are located on the north eastern side of the reservoir, almost 1 km away from the proposed project site. These are scattered and are pictorially indicated in Figure 21 below.

A few bird species make their nest on the ground. The reason may be its close proximity to water body, availability of food, non-flying nature and non-accessibility of the predators. A few species like Common coot, Pond heron and few species of Erget are resident and concentrated on the northern side of the reservoir.

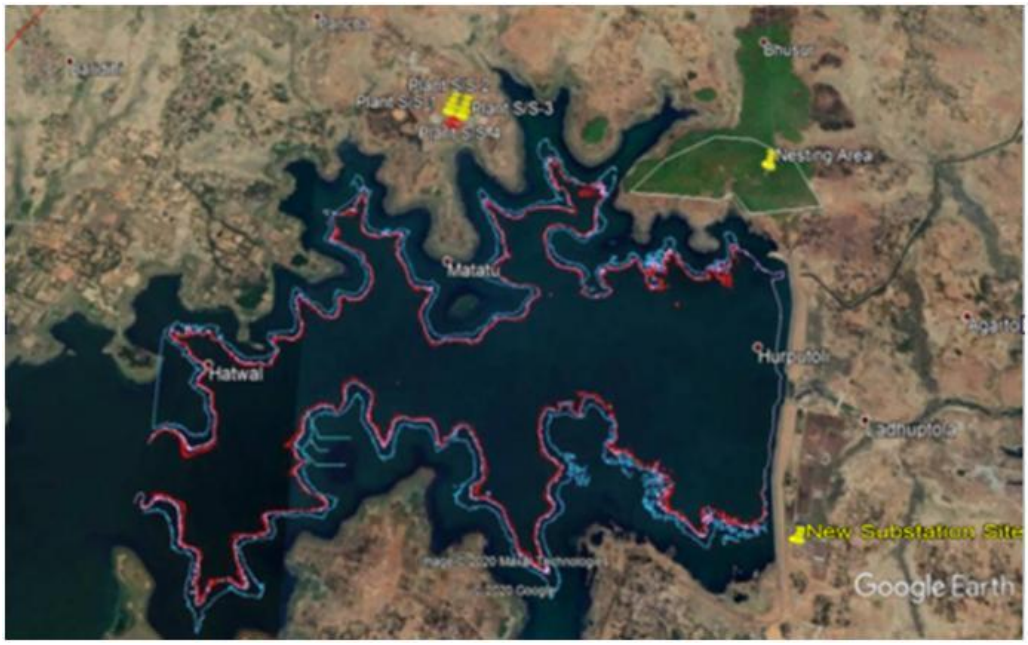


Figure 21: Locations of environmental attributes (nesting ground) at project location

4.8.1.4. TERRESTRIAL SURVEYS

The terrestrial samples were collected at 3 locations along the transmission line and substation, as shown in Figure 22 below. GESL1 has been located at plant substation, GESL2 at grid substation Chuttu and GESL3 around grid substation at Sikidri.

Figure 22: Locations of ecological sampling for Transmission Line

Proposed Transmission Line Route

The transmission line route is mainly passing through agricultural land. No tree cutting is proposed for the project

Proposed Transmission Tower locations

There has been no tree found during terrestrial surveys at proposed tower locations.

4.8.1.5. CRITICAL VULNERA

Determination of Critical Habitat is a process that usually follows the assessment as to whether the habitat in question is either Natural or Modified. Natural habitats are generally of higher biodiversity value than Modified Habitats, although both can still support species that trigger Critical Habitat. The determination of Critical Habitat is also not completely limited to Criteria 1-5 and other recognised high biodiversity values may also qualify for Critical Habitat designation which is carried out on a case by case basis.

Examples may include but not be limited to: areas of high scientific value; concentrations of Vulnerable species (under the IUCN Red List of Threatened Species) where there is uncertainty regarding their listing; and landscape and ecological processes (e.g. water catchment areas, areas which prevent flooding or fire).

4.8.2. Terrestrial Flora and Fauna

4.8.2.1. TERRESTRIAL FLORA

Foothills and Hill Slopes: The areas which are on the lower slopes with less steep elevation are covered with vegetation. This occurrence of vegetation is due to availability of top soil with some boulders and rocky outcrops. These forest areas are degraded and show signs of high anthropogenic pressure. There are no large trees occurring but mostly regenerated growth of large trees which have been cut down over the years. This forest type is mostly represented by Shorea robusta, Delonix regia, Bauhinia recemosa, Schleichera oleosa, Phyllanthus emblica, Madhuca indica, Albizia margninata, Terminalia elliptica, T. chebula and T. tomentosa.

Vegetation near Villages and Rivers: The most dominant species in this area is Butea monosperma. Uniform stands of B. monosperma can be seen on the village fringe, riverside and forest fringe near the foothills. These stands do not have large old grown trees but mostly regenerating stumps and poles as well as new regeneration in the form of seedlings and saplings. These seedlings and saplings represent the undergrowth and replace the shrubby vegetation. Villages do show typically large trees of fruit bearing species such as Tamarindus indica, Ficus bengalensis, F. religosa, Agle marmelos, Schleichera oleosa, Madhuca indica, Azadirachta indica, Sygygium cumini, Acacia sp., drumsticks and species of bamboo.

The common trees found from secondary sources and those observed in the project area are provided in Table 39 below.

S. No.	Common Name	Scientific Name	Family
1.	Religious fig/ Peepal	*Ficus religiosa*	Moraceae
2.	Palash	*Butea monosperma*	Caesalpinaceae
3.	Lantan	*Erythrina indica*	Papillionaceae
4.	Ujla Siris	*Albizia odorattissima*	Mimosaceae
5.	Banyan	*Ficus racemosa*	Moraceae

S. No.	Common Name	Scientific Name	Family
6.	Ber	*Zizyphus mauritiana*	Rhamanaceae
7.	Kanchnar	*Bauhinia variegata*	Caesalpinaceae
8.	Kamala	*Mallotus philippinus*	Euphorbiaceae
9.	Panneta	*Acacia cenescens*	Mimosaceae
10.	Indian Elm, Chilbil	*Holoptelelia integrifolia*	Ulmaceae
11.	Ram Babool	*Parkinsonia aculata*	Mimosaceae
12.	Bel	*Aegle marmelos*	Rutaceae
13.	Babul	*Acacia nilotica*	Mimosaceae
14.	Saaj	*Terminalia elliptica*	*Terminalia elliptica*
15.	Bhibitaki/ Belleric Myrobalan	*Terminalia bellerica*	Combretaceae
16.	Neem	*Azadirachta indica*	Meliaceae
17.	Shisham	*Dalbergia sissoo*	Fabaceae
18.	Haldu	*Haldina cordifolia*	Rubiaceae
19.	Drumstick	*Moringa oleifera*	Moringaceae
20.	Maharukh	*Ailanthus excelsa*	Meliaceae
21.	Amaltas/ Indian Laburnum	*Cassia fistula*	Caesalpinaceae
22.	Amla	*Phyllanthus emblica*	Euphorbhiaceae
23.	Siris	*Albizzia lebbeck*	Mimosaceae
24.	Imli/ Tamarind	*Tamarindus indicus*	Caesalpinaceae
25.	Teak/ Sagaun/Segwan	*Tectona grandis*	Verbenaceae
26.	Jack Fruit	*Artocarpus heterophyllus*	Moraceae
27.	Dhaura	*Anogeissus latifolia*	Combretaceae
28.	Nilgiri/ Eucalyptus	*Eucalyptus species*	Myrtaceae
29.	Aam	*Mangifera indica*	Anacardiaceae
30.	Khair	*Acacia catechu*	Mimosaceae
31.	Goolar fig/ Udumbara	*Ficus racemosa*	Moraceae
32.	Asna	*Terminalia tomentosa*	Combretaceae
33.	Phaldu/ Phaltu	*Mitragyna parviflora*	Rubiaceae
34.	Indian Chestnut	*Aesculus indica*	Sapindaceae
35.	Red Silk Cotton/ Semul	*Bombax ceiba*	Malvaceae
36.	Silver Oak	*Grewelia robusta*	Proteaceae
37.	Bhanj	*Quercus lannginosa*	Fagaceae

S. No.	Common Name	Scientific Name	Family
38.	Marking nut	*Semecarpus anacardium*	Anacardiaceae
39.	Sal	*Shorea robusta*	Dipterocarpaceae
40.	Domsal	*Miliusa velutina*	Annonaceae
41.	Jamun	*Syzgium cuminii*	Myrtaceae
42.	Papda	*Gardenia latifolia*	Rubiaceae
43.	Lantana	*Lantana camara*	Rubiaceae
44.	Chaste	*Vitex negundo*	Verbinaceae
Herbs and Shrubs			
45.	Pansetta	*Euphorbia geniculate*	Euphorbiaceae
46.	Burra	*Medicago polymorpha*	Papillionaceae
47.	Sandan	*Oogeinia oojensis*	Papillionaceae
48.	Naveri	*Ixora parviflora*	Rubiaceae
49.	Hatisura	*Heliotropium indicum*	Rubiaceae
50.	Bhang	*Nicotiana plubigera*	Solanaceae
51.	Banbhutka	*Solanum nigrum*	Solanaceae
52.	Solani	*Solanum xanthocarpum*	Solanaceae
53.	Datura	*Datura fastulosa*	Solanaceae
54.	Bihul	*Grewia salivifolia*	Tiliaceae
55.	Burbak	*Triumferta pilosa*	Tiliaceae
56.	Garo	*Sterculia villosa*	Tiliaceae
57.	Nishinda	*Vitex negundo*	Verbinacaee

Table 38: Different trees in and around the project area

4.8.2.2. TERRESTRIAL FAUNA

The common fauna found from secondary sources in the project area and its surroundings are provided in Table 43 below. The status of the species are in line with the IUCN and the schedules enlisting the Conservation Status as per Wildlife Protection Act, 1972 of the Government of India. Out of the five schedules, Schedule I and part II of Schedule II provide absolute protection and offences to species under these are prescribed the highest penalties. Species listed under Schedule III and IV enjoy lesser degree of protection than those listed under Schedule I and II. Schedule V enlists species that are least protected.

As far as the IUCN categorization is concerned, the Least Concern (LC) category contains species that are pervasive and abundant after careful assessment and the Vulnerable category contains species that possess a very high risk of extinction as a result of rapid population declines of 30 to more than 50 percent over the previous 10 years (or three generations).

Common Name	Scientific name	Conservation Status as per Wildlife Protection Act (1972)	Conservation Status as per IUCN Red List
Reptiles			
Oriental garden lizard	*C. versicolor*	Sch-IV	Not Evaluated
Common Rat Snake	*Ptyas mucosus*	Sch-II	Not Evaluated
Krait	*Bangarus cirulis*	Sch-IV	Not Evaluated
Indian Cobra	*Naja naja*	Sch-II	Not Evaluated
Indian chameleon	*C hamaleon zeylanicus*	Sch-IV	Not Evaluated
Common garden lizard	*Calotes versicolor*	Sch-IV	Not Evaluated
Mammals			
Rhesus Macaque	*Macaca mulatta*	Sch-II	Least Concern
Common Mangoose	*Herpestes edwardii*	Sch-II	Least Concern
Sambar deer	*Rusa unicolor*	Sch-III	Vulnerable
Rat	*Rattus rattus*	Sch-IV	Least Concern
Hanuman Langur	*Presbytis entellus*	Sch-II	Least Concern
Wild Fox	*V ulpus benghalensis*	Sch-II	Least Concern
Bat	*H ipposiderus spp.*	Sch-IV	Least Concern
Jungle cat	*Felis chaus*	Sch-II	Least Concern
Jackal	*Canis aureus*	Sch-II	Least Concern
Common Mongoose	*Herpestes edwardsi*	Sch-II	Least Concern
Indian hare	*Lepus nigricollis*	Sch-IV	Least Concern
Indian wild boar	*Sus scrofa*	Sch-III	Least Concern
Five striped palm squirrel	*Funambulus pennanti*	Sch-IV	Least Concern
Insects			
Crimson rose	*Pa chliopta hector*	Sch-IV	Not Evaluated
Lime Butterfly	*Paplio demoleus*	Sch-IV	Not Evaluated
Peacock Pancy	*Ju noria almana*	Sch-IV	Not Evaluated
Common Crow Butterfly	*Euploea core*	Sch-IV	Least Concern
Black Garden Ant	*Lasius niger*	Sch-IV	Not Evaluated
Red Emperor Dragonfly	*Anax guttatus*	Sch-IV	Not Evaluated
Wild Honeybee	*Apis dorsata*	Sch-IV	Not Evaluated
Amphibians			

Common Name	Scientific name	Conservation Status as per Wildlife Protection Act (1972)	Conservation Status as per IUCN Red List
Frog	*Rana tigrina*	Sch-IV	Least Concern
Toad	*Bufo malanosticus*	Sch-IV	Least Concern

Table 39: Terrestrial fauna in and around the project area

4.8.2.3. AVIAN FAUNA IN THE PROJECT AREA

The avian fauna found from secondary sources in the project area and its surroundings are provided in Table 41 below.

Sr. No	Name of Species	Scientific Name	Residential status Local (L)/ Migratory (M)	Conservation Status as per WPA Status	Conservation Status as per IUCN Red List
1.	Bulbul, Red-vented	*Pycnonotus cafer*	L	Sch-IV	Least Concern
2.	Buzzard, Oriental Honey -	*Pernis ptilorhynchus*	L	Sch-IV	Least Concern
3.	Crow, House	*Corvus splendens*	L	Sch-IV	Least Concern
4.	Crow, Indian Jungle	*Corvus macrorhynchos culminates*	L	Sch-IV	Least Concern
5.	Dove, Laughing	*Streptopelia senegalensis*	L	Sch-IV	Least Concern
6.	Dove, Spotted	*Streptopelia chinensis*	L	Sch-IV	Least Concern
7.	Drongo, Black	*Dicrurus macrocercus*	L	Sch-IV	Least Concern
8.	Egret, Intermediate	*Egretta intermedia*	L	Sch-IV	Least Concern
9.	Kite, Black	*Milvus migrans*	L	Sch-IV	Least Concern
10.	Kite, Black-winged (Black Shouldered Kite)	*Elanus caeruleus*	L	Sch-IV	Least Concern
11.	Koel, Asian	*Eudynamys scolopaceus*	L	Sch-IV	Least Concern
12.	Lark, Ashy-crowned Sparrow-	*Eremopterix griseus*	L	Sch-IV	Least Concern
13.	Lark, Greater Short-toed (Short-toed Lark)	*Calandrella brachydactyla*	M	Sch-IV	Least Concern
14.	Lark, Syke's	*Galerida deva*	M	Sch-IV	Least Concern
15.	Munia, Scaly-breasted	*Lonchura punctulata*	L	Sch-IV	Least Concern
16.	Munia, Silver-billed (Indian Silverbill)	*Euodice malabarica*	L	Sch-IV	Least Concern
17.	Myna, Common	*Acridotheres tristis*	L	Sch-IV	Least Concern
18.	Myna, Jungle	*Acridotheres fuscus*	L	Sch-IV	Least Concern
19.	Parakeet, Alexandrine	*Psittacula eupatria*	L	Sch-IV	Near Threatened
20.	Parakeet, Rose-ringed	*Psittacula krameri*	L	Sch-IV	Least Concern
21.	Prinia, Ashy	*Prinia socialis*	L	Sch-IV	Least Concern
22.	Prinia, Plain	*Prinia inornata*	L	Sch-IV	Least Concern
23.	Roller, Indian	*Coracias benghalensis*	L	Sch-IV	Least Concern
24.	Shrike, Long-tailed (Rufuous Backed Shrike)	*Lanius schach*	M	Sch-IV	Least Concern
25.	Silverbill, Indian (White throated Munia)	*Euodice malabarica*	L	Sch-IV	Least Concern
26.	Sparrow, House	*Passer domesticus*	L	Sch-IV	Least Concern
27.	Starling, Asian Pied (Pied Myna)	*Gracupica contra*	L	Sch-IV	Least Concern
28.	Barn Owl	*Tylo alba*	L	Sch-IV	Least Concern
29.	Crow Pheasant	*Centropus sinensis*	L	Sch-IV	Least Concern
30.	Common Kingfisher	*Alcedo Atthis*	L	Sch-IV	Least Concern
31.	Jungle Bubbler	*Turdoidess striatus*	L	Sch-IV	Least Concern
32.	Paddy field pitpit	*Anthus rufulus*	L	Sch-IV	Least Concern

33.	Weaver Bird	*Ploceus Phillipines*	L	Sch-IV	Least Concern

Table 40: Avian Fauna in and around the project area

4.8.3. Aquatic Flora and Fauna

4.8.3.1. PHYTOPLANKTON

Phytoplankton forms the basis of food chain in any aquatic water body. The diversity and abundance of phytoplankton mainly depends on the region, type of water body, either lentic or lotic, the nutrient flux in the system and the sunlight available for photosynthesis. These factors together form the dynamics of phytoplankton productivity over the seasons. The phytoplankton of a given water body determines the zooplankton populations and the fish productivity of the ecosystem. Table 42 below provides details of the phytoplankton at Getalsud reservoir as derived from secondary sources.

Phytoplankton group reported from the reservoir are Basillariophyceae, Chlorophyceae, Myxophyceae and Euglenophyceae members. About 19 species of phytoplankton were reported from all the locations. Dominance of Bacillariophyceae members followed by Myxophyceae were observed in the studied samples. The highest percentage was Cymbella sp. and Spirulina sp. and the lowest percentage was of Synedra sp. during study period.

Family	Species
Chlorophyceae	Zygnema Sp. Chlorella Vulgaris Volvox Sp. Eudorina elegans *Rivularia* sp
Cyanophyceae	Anabaena sp Oscillatoria sp Nostoc sp Spirulina Sp. *Chroococcus* sp Aphanocaspa Sp.
Bacillariophyceae	Synedra udna Synedra acus Navicula gracilis Pinnudaria Sp. Gomphonema sp Nitzschia sp. Cymbella cymbiformsis *Cymblella rombhoides*

Table 41: Phytoplanktons in Getalsud reservoir

4.8.3.2. ZOOPLANKTON

The zooplankton of the aquatic water body is the primary consumer and also in some cases, it is the secondary producer, which plays an important role for the fisheries of that system. The diversity and abundance of zooplankton also depends on whether the water body is eutrophic or oligotrophic.

Zooplankton is an important aspect of freshwater ecosystems as it serves as a consumer of phytoplankton and is a main link in the food web. Zooplankton forms a major link in the energy transfer at secondary level in aquatic food webs between autotrophs and heterotrophs. Studies of zooplankton diversity in any water body also indicate the water quality. Loss of larger cladoceran species can reduce grazing pressure on lower trophic level phytoplankton which can induce algal blooms that may eventually disrupt the function of the ecosystem. Zooplankton also has good indicator properties and can be utilized for water quality assessment.

As per the secondary data available from the local Forest Department, among the zooplankton group, Brachionous sp (Rotifera) has been reported as having the highest percentage composition and the lowest percentage composition is of Asplancha sp in the total zooplankton. Cypris sp and Cyclops sp. also occurred in the sampled water bodies. On the basis of type of species their proportional dominance and the overall diversity of both phyto- and zooplankton, it can be concluded that water bodies are oligotrophic to slightly mesotrophic in nature due to inflow and runoff from the surrounding areas. Table 43 below provides details of the zooplanktons which have been found from secondary sources at Getalsud reservoir.

Phylum	Species
Cladocera	Daphnia Sp. Chydorus sp Bosmina Sp.
Rotifera	Keratella sp Filinia Sp. Brachionus sp Notholca Sp
Copepoda	Cyclops sp Diaptomus sp Eucyclops Sp.
Others	Diaphanosoma sp Navicula gracilis Amoeba sp

Table 42: Zooplanktons in Getalsud reservoir

4.8.3.3. FISH RESOURCES

The details of the fish species in and around the Getalsud reservoir, as derived from secondary sources and as observed, during the field survey, are given in Table 44 below.

Common Name	Scientific Name	Habitat (Layer)	Conservation Status as per IUCN Red List
Tengara	M. vittatus	Epilimnion	Least Concern
Grass Carp	Ctenopharyngodon idellia	Epilimnion	Not Evaluated
Rohu	L. Rohita	Metalimnion	Least Concern
Catla	L. Catala	Epilimnion	Least Concern
Pangas	Pangasius pangasius	HypolimInion	Least Concern
Baam	Mastacembelus pancalus	HypolimInion	Least Concern
Gurda	Chanda nama	Metalimnion	Least Concern
Bata	L. Bata	Epilimnion	Least Concern
Puthia	Puntius sarana	Epilimnion	Least Concern
Bhoor	P. ticto	Epilimnion	Least Concern
Sidhari/ Bhoor	P.sophore	HypolimInion	Least Concern
Sidhari/ Bhoor	P. Chola	HypolimInion	Least Concern
Dendua	Rasbora daniconius	HypolimInion	Least Concern
Katair/ Maya	Osteobrama cotio	HypolimInion	Least Concern
Chelwa	Oxygaster bacaila	Metalimnion	Least Concern
Suhia	Gudusia chapra	Epilimnion	Least Concern
Mangur	Clarius batrachus	HypolimInion	Least Concern
Baami	Mastacembelus armatus	HypolimInion	Least Concern
Singhi	Heteropneustes/ Fossilis	HypolimInion	Least Concern
Gobi	Glossogobius giuris	Metalimnion	Least Concern
Godhi	Nandus	Metalimnion	Least Concern
Nakti	Nemacheilus botia	Metalimnion	Least Concern
Kharda	Colisa faciatus	Metalimnion	Not Assessed
Patra	Notopterus	Metalimnion	Least Concern
Tenger	Mystus tengara	Metalimnion	Least Concern
Shaul	Channa striatus	HypolimInion	Least Concern
Saur	C. marulius	Epilimnion	Least Concern
Girai	C.punctatus	Epilimnion	Least Concern
Gangatic Goonch	Bagarius bagarius	Epilimnion	Vulnerable
	Glyptothorax saisii	Epilimnion	Vulnerable

Table 43: Different fish species in Getalsud Reservoir

4.8.3.4. AQUATIC AVIAN FAUNA

The species of aquatic avian fauna found from secondary sources at Getalsud reservoir have been presented below in Table 45. Most of the species are resident and a few are winter visitors like Grey Heron, Grey Heron, Plover, Little Ringed, Red-crested Pochard, Northern Lapwing etc. and Lesser-adjutant Stork are vulnerable species as per IUCN red list. A few photographs have been shown in Figure 23 below.

Sr. No	Name of Species	Scientific Name	Residential status Local(L)/ Migratory (M)	Water Bird (WB)/ Water Dependent Bird (WDB)	Conservation Status as per WPA Status	Conservation Status as per IUCN Red List
	Babbler, Common	*Turdoides caudatus*	L	WDB	Sch-IV	Least Concern
	Babbler, Jungle	*Turdoides striata*	L	WDB	Sch-IV	Least Concern
	Barbet, Coppersmith	*Psilopogon haemacephalus*	L	WDB	Sch-IV	Least Concern
	Bee-Eater, Little Green	*Merops orientalis*	L	WDB	Sch-IV	Least Concern
	Bluethroat	*Cyanecula svecica*	M	WDB	Sch-IV	Least Concern
	Cormorant, Great	*Phalacrocorax carbo*	M	WDB	Sch-IV	Least Concern
	Cormorant, Indian (Indian shag)	*Phalacrocorax fuscicollis*	M	WDB	Sch-IV	Least Concern
	Cormorant, Little	*Microcarbo niger*	L	WDB	Sch-IV	Least Concern
	Egret, Little	*Egretta garzetta*	L	WDB	Sch-IV	Least Concern
	Flycatcher, Asian Brown	*Muscicapa dauurica*	M	WDB	Sch-IV	Least Concern
	Grebe, Little	*Tachybaptus ruficollis*	L	WB	Sch-IV	Least Concern
	Great Crested Grebe	*Podiceps cristatus*	M	WB	Sch-IV	Least Concern
	Heron, Grey	*Ardea cinerea*	M	WDB	Sch-IV	Least Concern
	Heron, Indian Pond-	*Ardeola grayii*	L	WDB	Sch-IV	Least Concern
	Heron, Purple	*Ardea purpurea*	M	WDB	Sch-IV	Least Concern
	Marsh Harrier	*Circus aeruginosus*	M	WDB	Sch-IV	Least Concern
	Ibis, Indian Black (Red-naped Ibis)	*Pseudibis papillosa*	L	WDB	Sch-IV	Least Concern
	Jacana, Pheasant-tailed	*Hydrophasianus chirurgus*	L	WB	Sch-IV	Least Concern
	Kingfisher, Pied	*Ceryle rudis*	L	WDB	Sch-IV	Least Concern

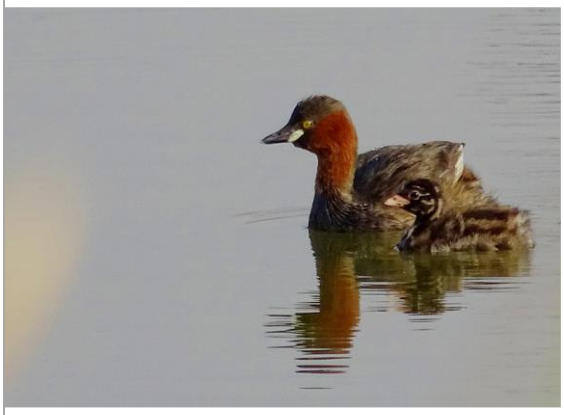
	Kingfisher, White-throated (White Breasted Kingfisher)	*Halcyon smyrnensis*	L	WDB	Sch-IV	Least Concern
	Lapwing, Red-wattled	*Vanellus indicus*	L	WDB	Sch-IV	Least Concern
	Lapwing, Yellow-wattled	*Vanellus malabaricus*	L	WDB	Sch-IV	Least Concern
	Openbill, Asian	*Anastomus oscitans*	L	WDB	Sch-IV	Least Concern
	Lesser-adjutant Stork	*Leptoptilos javanicus*	L	WDB	Sch-IV	Vulnerable
	Owlet, Spotted	*Athene brama*	L	WDB	Sch-IV	Least Concern
	Pipit, Paddyfield	*Anthus rufulus*	L	WDB	Sch-IV	Least Concern
	Plover, Little Ringed	*Charadrius dubius*	M	WDB	Sch-IV	Least Concern
	Sandpiper, Common	*Actitis hypoleucos*	L	WDB	Sch-IV	Least Concern
	Shelduck, Ruddy (Brahminy Duck)	*Tadorna ferruginea*	M	WB	Sch-IV	Least Concern
	Cotton teal	*Nettapus coromandelianus*	L	WB	Sch-IV	Least Concern
	Bar-headed geese	*Anser indicus*	M	WB	Sch-IV	Least Concern
	Red-crested Pochard	*Netta rufina*	M	WB	Sch-IV	Least Concern
	Northern-pin tail	*Anas acuta*	M	WB	Sch-IV	Least Concern
	Tufted duck	*Aythya a*	M	WB	Sch-IV	Least Concern
	Gadwall	*Anas strepera*	M	WB	Sch-IV	Least Concern
	Lesser-whistling Duck	*Dendrocygna javanica*	L	WB	Sch-IV	Least Concern
	Shikra	*Accipiter badius*	L	WDB	Sch-IV	Least Concern
	Stilt, Black-winged	*Himantopus himantopus*	M	WDB	Sch-IV	Least Concern
	Swallow, Barn	*Hirundo rustica*	M	WDB	Sch-IV	Least Concern
	Swallow, Streak-throated	*Petrochelidon fluvicola*	L	WDB	Sch-IV	Least Concern
	Swallow, Wire-tailed	*Hirundo smithii*	L	WDB	Sch-IV	Least Concern
	Wagtail, Western Yellow	*Motacilla flava*	M	WDB	Sch-IV	Least Concern

	Wagtail, White	*Motacilla alba*	M	WDB	Sch-IV	Least Concern
	Wagtail, White-browed (Large Pied Wagtail)	*Motacilla maderaspatensis*	M	WDB	Sch-IV	Least Concern
	Waterhen, White-breasted	*Amaurornis phoenicurus*	L	WB	Sch-IV	Least Concern
	Little Cormorant	*Phalacrocorax niger*	LM	WB	Sch-IV	Least Concern
	Large Egret	*Casmerodius albus*	LM	WB	Sch-IV	Least Concern
	Median Egret	*Mesophoyx intermedia*	LM	WB	Sch-IV	Least Concern
	Cattle Egret	*Bubulcus ibis*	LM	WB	Sch-IV	Least Concern
	Indian Pond Heron	*Ardeola grayii*	L	WB	Sch-IV	Least Concern
	Northern Shoveller	*Anas clypeata*	M	WB	Sch-IV	Least Concern
	Red-crested Pochard	*Rhodonessa rufina*	M	WB	Sch-IV	Least Concern
	Eurasian Wigeon	*Anas Penelope*	M	WB	Sch-IV	Least Concern
	Common Moorhen	*Gallinula chloropus*	LM	WB	Sch-IV	Least Concern
	Common Coot	*Fulica atra*	LM	WB	Sch-IV	Least Concern
	Black-headed Gull	*Larus ridibundus*	LM	WB	Sch-IV	Least Concern
	Red-rumped swallow	*Hirundo rustica*	LM	WDB	Sch-IV	Least Concern

Table 44: Aquatic avian fauna in project area

Tufted Duck

Gudwal



Bar headed goose

Little Grebe

Figure 23: Photographs of aquatic avian fauna at Getalsud reservoir

4.8.4. Proximity to Protected Areas

One National Park and eleven Wildlife Sanctuaries constitute the Protected Area network of the State covering 2.76% of its geographical area.

The Betla National Park, which is the nearest and the only national park in Jharkhand, is located at a distance of 140 kms from the Getalsud reservoir. The Hazaribagh wildlife sanctuary is at a distance of 70 kms from the reservoir. There is a zoological park at Irba which is nearly 10 kms from the site.

4.8.5. Critical and Vulnerable Species

Water bodies and nearby area are generally considered as an area of ecological importance. Considering this, and assessment has been made to identify the critical and vulnerable species present in the project area. The project area may contain species of high ecological significance, referred to as critical species in the ESIA study. These species are considered vulnerable to the local ecosystem's health. Preserving their habitats and minimizing disturbances is of utmost importance during the implementation of the FSPV project.

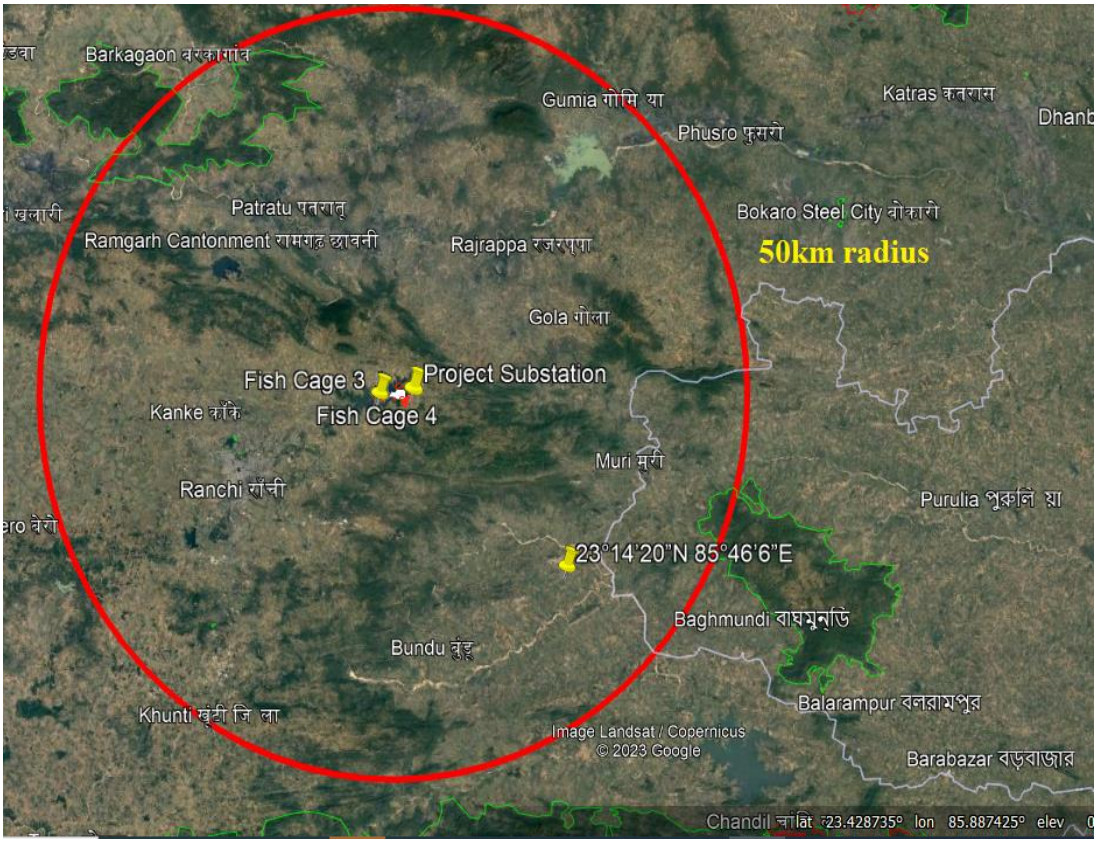
Locations of the nearby protected areas were derived through the Integrated Biodiversity Assessment Tool (IBAT) of the IUCN and the same have been shown in Figure 24 below. An assessment has also been made to identify the threatened species within 50km of the Project area using IBAT tool. As per report generated, 36 fauna species were reported.

Locations of the nearby protected areas were derived through the Integrated Biodiversity Assessment Tool (IBAT) of the IUCN and the same have been shown in Figure 24 below. An assessment has also been made to identify the threatened species within 50km of the Project area using IBAT tool. As per report generated, 36 fauna species were reported.

S. No.	Species Name	Common Name	Taxonomic Group	IUCN Category	Population Trend	Biome

1	*Indotestudo elongata*	Elongated Tortoise	REPTILIA	CR	Decreasing	Terrestrial
2	*Sypheotides indicus*	Lesser Florican	AVES	CR	Decreasing	Terrestrial
3	*Gyps bengalensis*	White-rumped Vulture	AVES	CR	Decreasing	Terrestrial
4	*Sarcogyps calvus*	Red-headed Vulture	AVES	CR	Decreasing	Terrestrial
5	*Gyps indicus*	Indian Vulture	AVES	CR	Decreasing	Terrestrial
6	*Nilssonia hurum*	Indian Peacock Softshell Turtle	REPTILIA	EN	Decreasing	Terrestrial, Freshwater
7	*Sterna acuticauda*	Black-bellied Tern	AVES	EN	Decreasing	Terrestrial, Freshwater
8	*Haliaeetus leucoryphus*	Pallas's Fish-eagle	AVES	EN	Decreasing	Terrestrial, Freshwater
9	*Neophron percnopterus*	Egyptian Vulture	AVES	EN	Decreasing	Terrestrial, Freshwater
10	*Leptoptilos dubius*	Greater Adjutant	AVES	EN	Decreasing	Terrestrial, Freshwater
11	*Cuon alpinus*	Dhole	MAMMALIA	EN	Decreasing	Terrestrial
12	*Elephas maximus*	Asian Elephant	MAMMALIA	EN	Decreasing	Terrestrial
13	*Manis crassicaudata*	Indian Pangolin	MAMMALIA	EN	Decreasing	Terrestrial
14	*Melanochelys tricarinata*	Tricarinate Hill Turtle	REPTILIA	EN	Decreasing	Terrestrial
15	*Panthera tigris*	Tiger	MAMMALIA	EN	Decreasing	Terrestrial
16	*Varanus avescens*	Yellow Monitor	REPTILIA	EN	Decreasing	Terrestrial
17	*Aquila nipalensis*	Steppe Eagle	AVES	EN	Decreasing	Terrestrial
18	*Crocodylus palustris*	Mugger	REPTILIA	VU	Stable	Terrestrial, Freshwater
19	*Lutrogale perspicillata*	Smooth-coated Otter	MAMMALIA	VU	Decreasing	Terrestrial, Marine, Freshwater
20	*Rhinoceros unicornis*	Greater One-horned Rhino	MAMMALIA	VU	Increasing	Terrestrial, Freshwater
21	*Wallago attu*		ACTINOPTERYGII	VU	Decreasing	Freshwater
22	*Glyptothorax saisii*		ACTINOPTERYGII	VU	Unknown	Freshwater
23	*Aythya ferina*	Common Pochard	AVES	VU	Decreasing	Terrestrial, Marine, Freshwater
24	*Sterna aurantia*	River Tern	AVES	VU	Decreasing	Terrestrial, Marine, Freshwater
25	*Clanga clanga*	Greater Spotted Eagle	AVES	VU	Decreasing	Terrestrial, Freshwater
26	*Aquila rapax*	Tawny Eagle	AVES	VU	Decreasing	Terrestrial, Freshwater
27	*Leptoptilos javanicus*	Lesser Adjutant	AVES	VU	Decreasing	Terrestrial, Marine, Freshwater
28	*Lissemys punctata*	Indian Flapshell Turtle	REPTILIA	VU	Decreasing	Terrestrial, Freshwater
29	*Schizothorax plagiostomus*	Snow Trout	ACTINOPTERYGII	VU	Decreasing	Freshwater
30	*Bagarius bagarius*		ACTINOPTERYGII	VU	Decreasing	Freshwater
31	*Acinonyx jubatus*	Cheetah	MAMMALIA	VU	Decreasing	Terrestrial
32	*Melursus ursinus*	Sloth Bear	MAMMALIA	VU	Decreasing	Terrestrial
33	*Panthera pardus*	Leopard	MAMMALIA	VU	Decreasing	Terrestrial
34	*Tetracerus quadricornis*	Four-horned Antelope	MAMMALIA	VU	Decreasing	Terrestrial
35	*Rusa unicolor*	Sambar	MAMMALIA	VU	Decreasing	Terrestrial
36	*Clanga hastata*	Indian Spotted Eagle	AVES	VU	Decreasing	Terrestrial

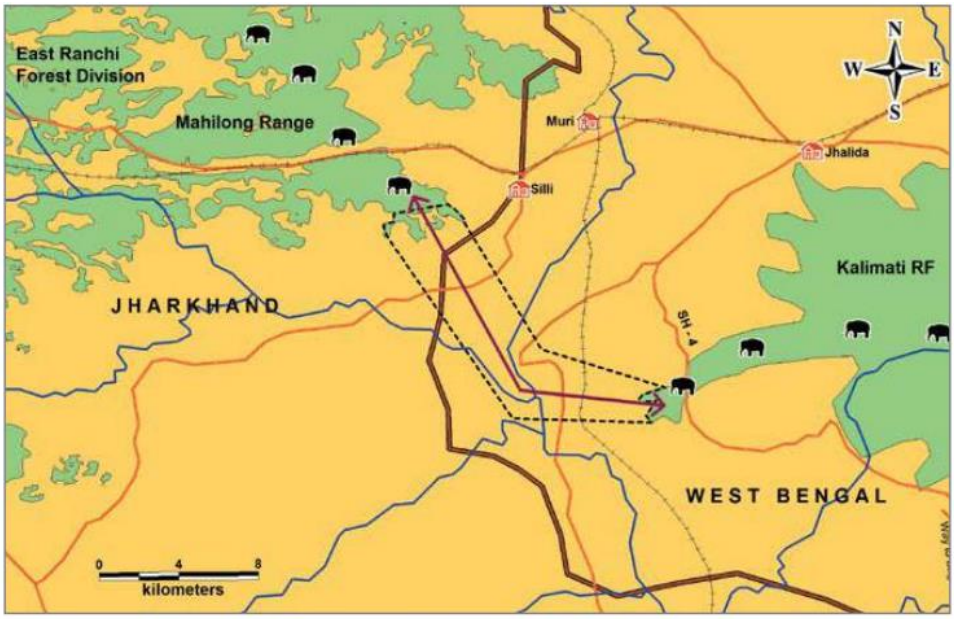
The said report was forwarded to Forest Department, Ranchi, Fisheries Department, Ranchi and Jharkhand Biodiversity Board (JBB). To access the specific impact, consultation meetings were organized with the prime stakeholders, i.e. with Forest Deptt. and Jharkhand Biodiversity Board on 26.04.2023 and with State Fisheries Deptt. on 26.04.2023 and 01.05.2023. During the discussion it was noted that most the species are not reported nearby i.e. within 10km radius of project site including transmission line. Since, 50km radius encompasses a huge area covering Forest ranges of other Districts i.e. Ramgarh, Kunti, Hazaribagh Districts of Jharkhand and Puralia District of West Bengal, wherein these species have been reported in the past. Vultures are mostly reported in the Hazaribagh distt. Tigers were spotted near Chandil reservoir which is approximately 55 – 60 km from Project site. During the discussion, JBB officials shared the Asian Waterbird Census report conducted on 12.02.2022 for Getalsud reservoir (Annexure – K). In the said report, 32 species are recorded, all except Common Pochard belongs to LC category under IUCN list. During the discussion with Fisheries Department, Ranchi, it was noted that fish species mentioned above are generally found in the Subarnarekha River but not dominant in the area. Further, these species also have no commercial value.



Mahilong - Kalimati elephant corridor is present within the 50km radius of Project site. As per report titled "*RIGHT OF PASSAGE, ELEPHANT CORRIDORS OF INDIA"* published by Wildlife Trust of India, the Mahilong -Kalimati corridor connects forest blocks in the Mahilong and Bundu Ranges under Ranchi Forest Division in Jharkhand, with the Jhalda and Bagmundi Ranges under Purulia Forest Division in West Bengal.

State	Jharkhand and West Bengal

Connectivity	Mahilong and Bundu Ranges of Ranchi Forest Division with Jhalda and Baghmundi Ranges of Purulia Forest Division
Length and Width	18 km and 0-0.5 km
Geographical coordinates	23° 14’ 20”- 23° 20’ 23” N 85° 46’ 6”- 85° 54’ 25” E
Legal status	Protected Forest and Patta Lands
Major land use	Forest, agriculture fields, human habitations
Major habitation/settlements	About 18 villages in and around the corridor
Forest type	Tropical dry deciduous forest
Frequency of usage by elephants	Regular, throughout the year



Map of the Mahilong - Kalimati Corridor

The details of the 04 species reported in the area is as under:

S. No.	Species Name	Common Name	Taxonomic Group	IUCN Category
1	*Aythya farina*	Common Pochard	AVES	VU
2	*Bagarius Bagarius*	Gangatic Goonch	ACTINOPTERYGII	VU
3	*Glyotothorax Saisii*		ACTINOPTERYGII	VU
4	*Leptoptilos javanicus*	*Lesser Adjutant stork*		VU

5. BAGARIUS BAGARIUS (GANGETIC GOONCH)

Primarily located in Bangladesh, India (Ganga River and its tributaries), and the Chao Phraya and Mekong basins in Laos, the B. bagarius is classified as a vulnerable species according to IUCN categorization.

This species breeds before the onset of the monsoon rains and is known to be an entomophagous creature (Talwar and Jhingran, 1991), displaying voracious predatory behavior. Its diet primarily consists of small fishes (Rahman, 1989 and 2005), but it also consumes frogs and crustaceans (IUCN Bangladesh, 2000). The B. bagarius prefers habitats with rapids and rocky pools (Talwar and Jhingran, 1991) and forages for food in the benthopelagic, surface, and sub-surface zones, exhibiting both diurnal and nocturnal feeding patterns.

Found in fast-flowing rivers, this species seeks refuge under stones and bog logs. It thrives in both fresh and brackish water environments, occupying the benthopelagic zone of water bodies. The migration pattern of B. bagarius is potamodromous. It can withstand tropical temperatures between 18–25 °C and prefers a pH range of 6.5–7.8.

While there is no specific conservation initiative exclusively dedicated to B. bagarius, various measures have been implemented to conserve fisheries resources, which indirectly contribute to the preservation of B. bagarius populations, having a positive impact on their conservation.

6. GLYPTOTHORAX SAISII

G. saisii, another freshwater fish species, holds a vulnerable status according to the IUCN red list. Specimens of this species can be found in the collection of the Zoological Survey of India (F 2583/1) situated in nulla, Paresnath hills, and are well-preserved. Its primary habitat is the Subarnarekha River.

Belonging to the family Sisoridae, Glyptothorax is a genus of fish commonly known as the Asian armored catfishes. These fish are prevalent in freshwater habitats across South and Southeast Asia. They earn their name "armored catfishes" due to the presence of bony plates covering their bodies, which offer a form of protection.

After conducting interactions with residents, the fishermen community, and officials of the fisheries department, the SECI team discovered that these two species are not included in the local consumption habits and have minimal domestic and commercial significance.

7. AYTHYA FERINA (COMMON POCHARD)

The common pochard is a mid-sized duck that primarily inhabits marshy and reed-fringed lakes, as well as open reservoirs. It is often seen in local flocks and frequently associates with winter flocks of Tufted Ducks. This species mainly feeds by diving.

In India, the common pochard is a non-breeding bird but is widely distributed and commonly observed as a winter visitor or migratory bird. It prefers open waters with a depth of less than six meters, where abundant submerged macrophytes and emergent vegetation can be found. Its habitats include marshes, lakes, slow-flowing rivers, reservoirs, sheltered coastal bays, lagoons, and tidal estuaries.

The common pochard feeds primarily during the evening and night, either by diving or dabbling. Its diet consists of aquatic invertebrates, aquatic plants, small fish, and molluscs. The breeding season for these birds occurs from May to July. They construct their nests on the ground near the water's edge, concealed within waterside vegetation. Alternatively, they may opt to nest on floating mats of reeds.

Conservation threats to the common pochard include disturbances from human activity, habitat destruction, eutrophication of wintering grounds, entanglement, and drowning in fishing nets, as well as nest predation. Additionally, these birds are vulnerable to avian influenza.

8. LESSER ADJUTANT STORK (LEPTOPTILOS JAVANICUS)

The Lesser adjutant species is a highly adaptable, large stork distinguished by its completely bare head and neck, which suits its scavenging habits. It is commonly found in shallow marshes, fields, and swamps. This bird frequents large rivers and lakes within well-wooded regions, as well as freshwater wetlands in agricultural areas. In India, their distribution includes the eastern states of Assam, West Bengal, Bihar, and Jharkhand.

These birds possess long legs, a large bill, and a substantial body but are unable to produce typical bird sounds. Instead, they communicate through hissing, moaning, and clattering sounds, particularly at their nests.

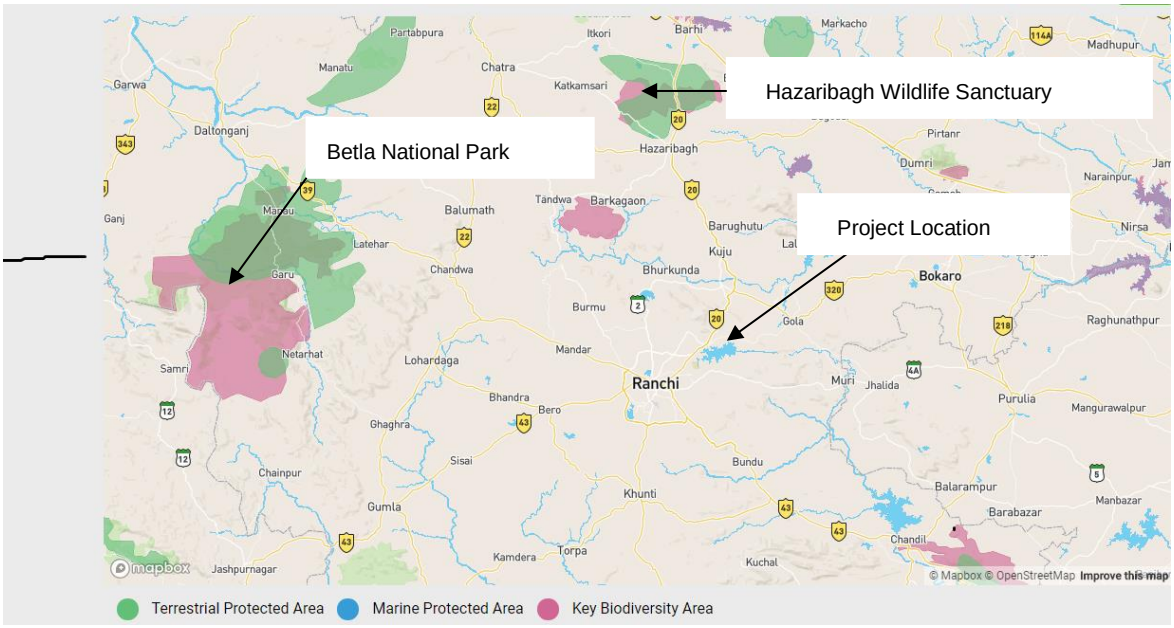
Notably, a foraging Lesser Adjutant near Getalsud dam in Ranchi was observed by Mr. S. Goswami in 2019 (pers. comm.). However, the first successful nesting breeding record of Lesser Adjutants was reported near Peterwar in Bokaro District of Jharkhand State (Dwivedi et al., 2013). Over the project period between 2012 and 2021, the population of Lesser Adjutant in Bokaro District showed an increasing and expanding trend, spreading to neighboring districts such as Hazaribag, Ranchi, Chatra, Garhwa, Giridih, Dhanbad, and the Baghmundi area of Ayodhya Hill in Purulia District of West Bengal, where breeding was observed (Jibananda Banerjee, March'2021, Pers. Comm.) (Dwivedi et al., 2013).

As the SECI team prepared the ESIA document, they noted the absence of nesting grounds within the project area of the proposed Floating Solar Photovoltaic (FSPV) system and the transmission alignment. However, they did observe scattered nesting grounds for other species on the northeastern side of the reservoir. Among the resident species observed in this area are the Common coot, Pond heron, and a few species of Egret.

Lesser Adjutants are colonial breeders, with their breeding season varying between February and May in southern India, and November to January in north-eastern India, sometimes starting as early as July. They construct their nests on tall trees, forming large platforms of sticks. These storks exhibit a strong preference for non-domestic trees, particularly favoring larger and taller varieties such as Semal, Banyan, Tamarind, and Karam, relative to the available trees in the landscape. As these birds are heavy and their chicks require extended nesting periods, bamboo sticks are essential for nest construction.

These storks typically avoid large wetlands in the plains and are restricted to marshes deep within forests. Like other large waterbirds, the south-east Asian populations of Lesser Adjutants face the risk of habitat destruction. However, the proposed Floating Solar Photovoltaic (FSPV) project and its associated transmission alignment take precautionary measures to avoid all forested areas, ensuring the complete prevention of any negative impacts on these vulnerable species.

As presented at Section 4.7.1.3, the natural bird nesting ground is located in the northern side of the reservoir, whereas project substation and associated transmission lines are primarily proposed at southern side of the reservoir, hence chance of collision with transmission line is minimal. Impact assessment and mitigation measures to minimize bird collision with transmission line is detailed out at Section 5.9.2.1.



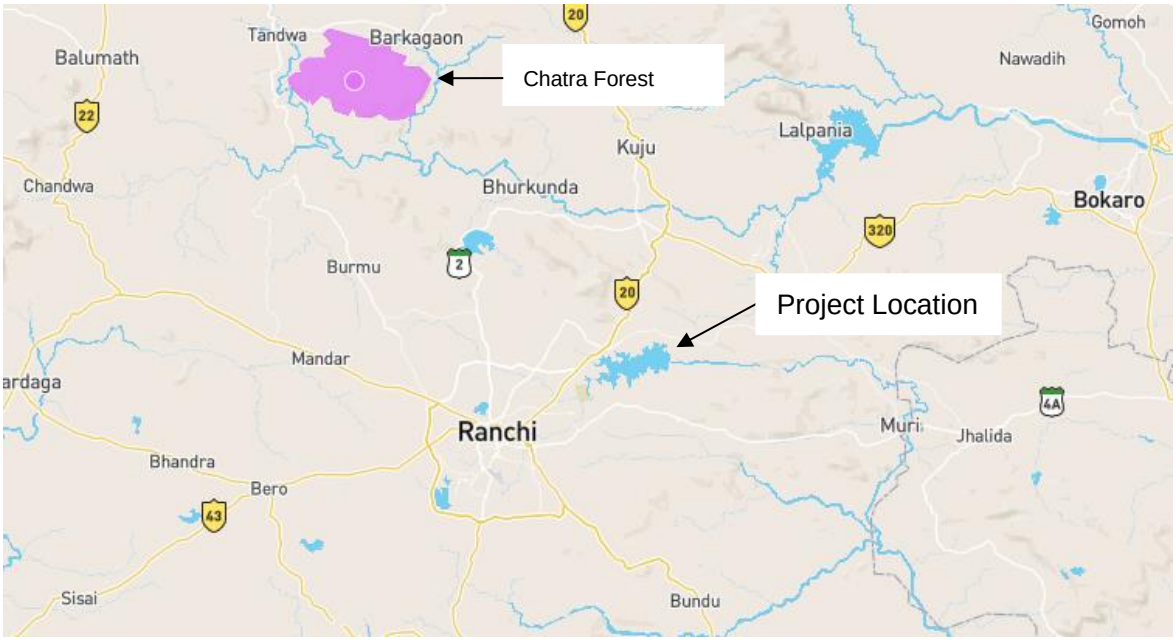


Figure 24: Protected areas around the project site as per IBAT application

8.1. Socio-econmomic environment

Ranchi district lies in the southern part of Jharkhand state. The district is bounded on the north by Ramgarh & Hazaribagh districts, on the south by Khunti & Saraikela Kharsawan, on the west by Gumla, Latehar & Lohardagga district and on the east by Saraikela Kharsawan and Purulia district of West Bengal. It is connected through NH-33 from prominent district headquarters of the state. It is also connected through Gumla and Rourkela by NH-23. The district has a total area of 5097 sq.km. and is located between 22^0 52'- 23^0 45' North latitude to 84^0 45'- 85^0 50' East longitude.

The density of population is 572 person per sq. km. The total population of the Ranchi district as per the 2011 census is 29,14,253 persons. Total urban population is 12, 57,335 and the rural population is 16, 56,918. Urban and rural populations comprise 56% and 44% respectively of the total population of the district.

8.1.1. Demographic Features of the Project area

Population:

The socio-economic profile of the project affected villages has been presented below in Table 46. As per census, the total population of the 13 villages under the core zone of influence was 27,245 of which 14,041 are males and 13,204 are females. The number of Families in these villages was 5,297.

Village Name	Nunber of HH	Total Population	Total Male Population	Total Male Population in %	Total Female Population	Total Female Population in %
Masniya	220	1051	538	51.19	513	48.81
Sirka	529	2550	1302	51.06	1248	48.94
Chaldag	696	3634	1849	50.88	1785	49.12
Haratu	212	1150	594	51.65	556	48.35
Hesatu	620	3161	1668	52.77	1493	47.23
Rukka	329	1907	1007	52.81	900	47.19
Chakla	647	3450	1820	52.75	1630	47.25
Getalsud	649	3263	1674	51.30	1589	48.70
Maheshpur	499	2467	1278	51.80	1189	48.20
Benadag	80	415	201	48.43	214	51.57
Pailada (Nagrabera-degadegi)	122	687	330	48.03	357	51.97
Baridihi	652	3325	1687	50.74	1638	49.26
Sawaiya	42	185	93	50.27	92	49.73
Total	**5297**	**27245**	**14041**	**51.54**	**13204**	**48.46**

Table 45: Demographic features of the project area (Source: Census of India, 2011)

8.1.2. Literacy Rate

As per Census 2011, 59.39% populations belong to literate category and 40.61% population comes under the illiterate category. Among these villages Benadag Village have the highest literate populations (63.61%) and Sawaiya village has the lowest literate populations (47.57%). Details of the Literacy Level village wise are mentioned below in Table 47.

Table 46: Literacy rate of the project area (Source: Census of India, 2011)

Village Name	Total Population	Total Literate	Total Literate in %	Total Literate Male	Total Literate Female	Total Illiterate	Total Illiterate in %	Total Illiterate Male	Total Illiterate Female
Masniya	1051	641	**60.99**	401	240	410	**39.01**	137	273
Sirka	2550	1372	**53.80**	839	533	1178	**46.20**	463	715
Chaldag	3634	2213	**60.90**	1314	899	1421	**39.10**	535	886
Haratu	1150	572	**49.74**	344	228	578	**50.26**	250	328
Hesatu	3161	1963	**62.10**	1171	792	1198	**37.90**	497	701
Rukka	1907	1175	**61.62**	722	453	732	**38.38**	285	447
Chakla	3450	2176	**63.07**	1313	863	1274	**36.93**	507	767
Getalsud	3263	1957	**59.98**	1155	802	1306	**40.02**	519	787
Maheshpur	2467	1469	**59.55**	861	608	998	**40.45**	417	581
Benadag	415	264	**63.61**	139	125	151	**36.39**	62	89
Pailada (Nagrabera-degadegi)	687	370	**53.86**	202	168	317	**46.14**	128	189
Baridihi	3325	**1920**	**57.74**	**1107**	**813**	**1405**	**42.26**	**580**	**825**
Sawaiya	185	88	**47.57**	53	35	97	**52.43**	40	57
Total	**27245**	**16180**	**59.39**	**9621**	**6559**	**11065**	**40.61**	**4420**	**6645**

8.1.3. Scheduled Castes and Scheduled Tribes

As per census 2011, SC (Schedule Caste) populations are present in almost all the villages. These villages have ST (Schedule Tribe) populations too as a major section. SC constitutes about 10.03% of the total population. However, SC population is highest in Haratu village (29.65%). The ST population constitutes 33.80% of the total population and varies from 12.22% to 98.98% of the total population in respective villages. This indicates that there is a mix of scheduled tribes, Scheduled castes and general population in the project affected villages. Details of ST and SC populations are mentioned below in Table 48.

Village Name	Total Population	ST Population	ST Population in %	SC Population	SC Population in %
Masniya	1051	420	39.96	232	22.07
Sirka	2550	813	31.88	81	3.18
Chaldag	3634	444	12.22	731	20.12
Haratu	1150	334	29.04	341	29.65
Hesatu	3161	1565	49.51	203	6.42

Rukka	1907	952	49.92	42	2.20
Chakla	3450	637	18.46	225	6.52
Getalsud	3263	1497	45.88	259	7.94
Maheshpur	2467	935	37.90	288	11.67
Benadag	415	279	67.23	57	13.73
Pailada (Nagrabera-degadegi)	687	680	98.98	0	0.00
Baridihi	3325	**515**	15.49	247	7.43
Sawaiya	185	138	74.59	26	14.05
Total	**27245**	**9209**	**33.80**	**2732**	**10.03**

Table 47: Scheduled Caste and Scheduled Tribes rate of the project influence area (Source: Census of India, 2011)

8.1.4. Occupational profile of the Project Area

Percentage of workers engaged in different activities indicates the nature of employment available in the area. 36.98% of the total population has been identified as workers and 63.02% of population belong to non worker category. The main worker in the concerned villages comprise 60.43% and marginal workers comprise only 39.57% of the total workers. Details of Workforce Participation are mentioned in Table 49.

Village Name	Total Population	Total Working Population	Total Working Population in %	Total Working Population (Male)	Total Working Population (Female)	Total Main Worker in %	Total Marginal Worker in %	Total Non Working Population	Total Non Working Population in %	Total Non Working Population (Male)	Total Non Working Population (Female)
Masniya	1051	328	31.21	274	54	38.11	61.89	723	40.00	264	459
Sirka	2550	1541	60.43	798	743	23.30	76.57	1009	46.25	204	505
Chaldag	3634	1463	40.26	928	535	73.68	26.32	2171	45.02	921	1250
Haratu	1150	448	38.26	310	138	94.20	5.80	702	61.04	284	418
Hesatu	3161	1286	40.68	846	440	55.21	44.79	1875	59.32	822	1053
Rukka	1907	500	26.22	424	76	75.40	24.60	1407	55.75	583	824
Chakla	3450	1221	35.39	860	361	67.90	32.10	2229	47.65	960	1269
Getalsud	3263	1188	36.41	828	360	93.43	6.57	2075	63.59	846	1229
Maheshpur	2467	1092	44.26	669	423	42.40	57.60	1375	55.74	609	766
Benadag	415	244	58.80	119	125	63.93	36.07	171	41.20	82	89
Pailada (Nagrabera-degadegi)	687	344	50.07	172	172	6.98	93.02	343	49.93	158	185
Baridihi	3325	1258	37.83	838	420	64.86	35.14	2067	62.17	849	1218
Sawaiya	185	121	65.41	64	57	32.23	67.77	64	34.59	29	35
Total	**27245**	**11034**	**40.50**	**7130**	**3904**	**58.98**	**41.00**	**16211**	**59.50**	**6611**	**9300**

Table 48: Occupational profile of the project area (Source: Census of India, 2011)

The local population from the surrounding villages depend on the Getalsud reservoir for their livelihood. According to the sources in the fisheries department and as per consultation with the dam in charge, the Getalsud reservoir is used for fish farming and commercial fishing. Around 200 families are engaged for commercial fishing from Masniya, Chaldag and other neighbouring villages. These people are fishing with their families and engage other villagers working as labourers, boat operators and assistants for the fishing activities.

The land identified for the proposed substation is a government land measuring of an area of 1 Ha.

8.1.5. Social Infrastructure in the Project Area

8.1.5.1. TRANSPORTATION INFRASTRUCTURE OF PROJECT AFFECTED VILLAGES

Getasud reservoir is located at near Matatu and Getalsud village and well-connected vis state and national highways. The nearest town is Ormanjhi, located on National highway NH 31 at a distance of 10 km and can be accessed through well-connected district and village roads. The location is around 40 km from district headquarter and state capital Ranchi.

Getalsud reservoir is located at Ormanji/Angara development blocks of the district. The capital city is at around 35km from the reservoir while the national highways NH 20 and NH 320 are at a distance of 3km from the reservoir. The road network in and around the reservoir area is well equipped to allow transportion of materials and machineries during construction. The embankment of reservoir is having a 7.6m wide paved road which is used for access to surrounding areas.

The map in Figure 25 below provides a transportation network available in the area:

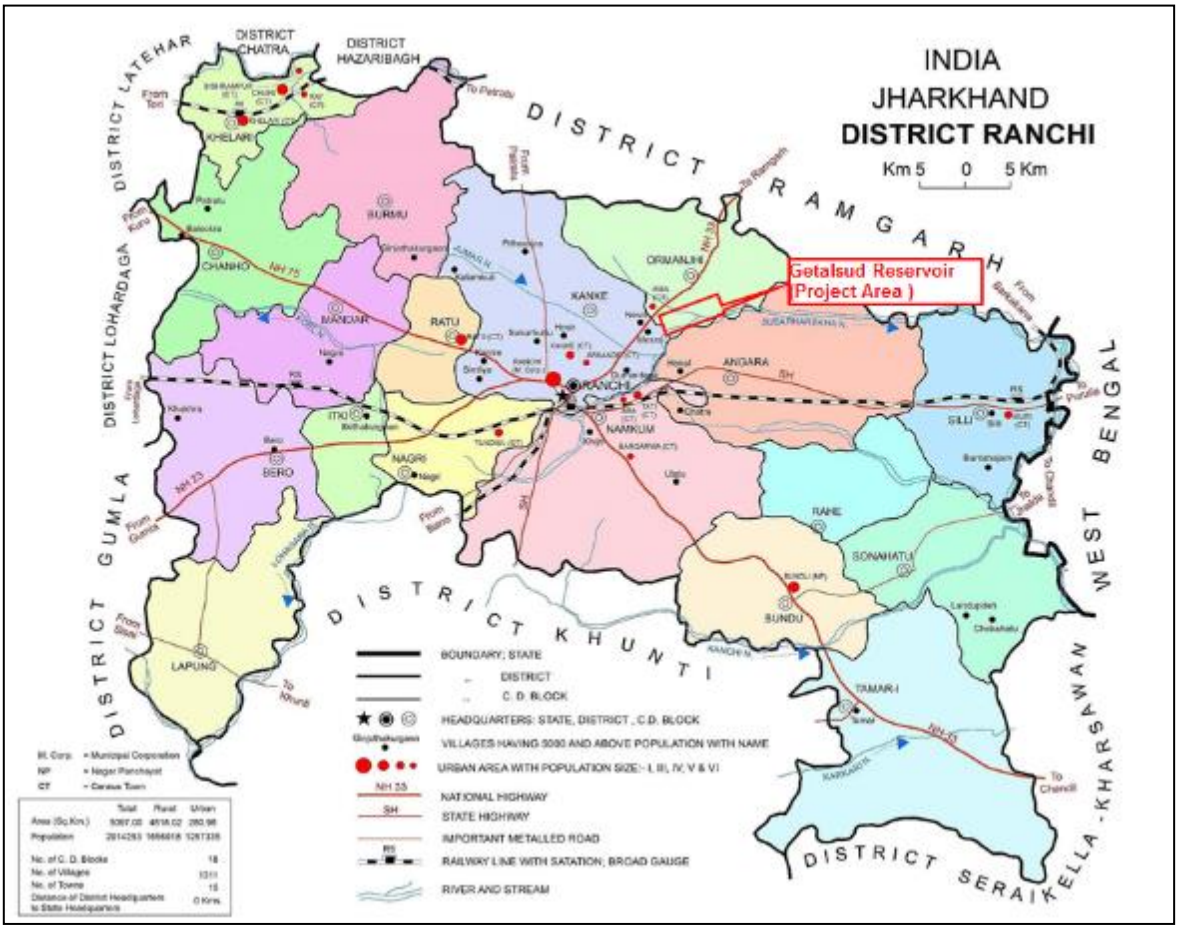


Figure 25: Connectivity of Ranchi [Source: District Administration and RCD; Ranchi)

The road infrastructure facility is available in the project affected villages. The public transport facility like Bus, Medium size public transport and Autorikshaw available in this area. For local transport most of the people use the electric rickshaw and buses. Details of transport and linkages at village level are mentioned below in Table 50.

Sl. No.	Village	Tehsil	Road	Railway Station	Public Road Transport
1	Masniya	Angara	Yes	No	Yes
2	Sirka	Angara	Yes	No	Yes
3	Chaldag	Angara	Yes	No	Yes
4	Haratu	Angara	Yes	No	No
5	Hesatu	Angara	Yes	No	No
6	Rukka	Ormanjhi	Yes	No	Yes
7	Chakla	Ormanjhi	Yes	No	No
8	Getalsud	Angara	Yes	No	No
9	Maheshpur	Angara	Yes	No	No
10	Benadag	Angara	Yes	No	Yes
11	Pailada (Nagrabera-degadegi)	Angara	Yes	No	Yes
12	Baridihi	Ormanjhi	Yes	No	Yes
13	Sawaiya	Ormanjhi	Yes	No	No

Table 49: Details of transport infrastructure (Source: Primary survey – Sep'2020)

8.1.5.2. EDUCATIONAL INFRASTRUCTURE

As per the primary information, most of the villages have the education facilities. All the villages have the primary and secondary level education infrastructures and an Aaganwadi Center. Details of educational infrastructure are mentioned below in Table 51.

S No	Village	Tehsil	Educational Institutes			
			School	College	Technical/Vocational Training Institute	Aaganwadi Center
1	**Masniya**	Angara	Yes	No	No	Yes
2	**Sirka**	Angara	No	No	No	Yes
3	**Chaldag**	Angara	Yes	No	No	Yes
4	**Haratu**	Angara	Yes	No	No	Yes
5	**Hesatu**	Angara	Yes	No	No	Yes
6	**Rukka**	Ormanjhi	Yes	No	No	Yes
7	**Chakla**	Ormanjhi	Yes	No	No	Yes
8	**Getalsud**	Angara	Yes	No	No	Yes
9	**Maheshpur**	Angara	Yes	No	No	Yes
10	**Benadag**	Angara	Yes	No	No	Yes
11	**Pailada (Nagrabera-degadegi)**	Angara	Yes	No	No	Yes
12	**Baridihi**	Ormanjhi	Yes	No	No	Yes
13	**Sawaiya**	Ormanjhi	Yes	No	No	Yes

Table 50: Details of educational infrastructure (Source: Primary survey – Sep'2020)

8.1.5.3. HEALTH INFRASTRUCTURE

As informed by the local community health workers, the main health concerns in the area are Fever, Seasonal Flu, Dengue, Malaria and Chickengunia. As per the primary survey, there is no government health infrastructure facility available in these village. The health sector is catered by Registered Medical Practitioners (RMPs) which are available in most of the villages. The nearest Hospital is Ormanjhi in the range of 0-10 kms from the affected villages. Details of heath infrastructure are mentioned below in Table 52.

S No	Village	Tehsil	Health Facilities				
			Govt. Dispensary / PHC/ CHC	RMP	Private Doctor	Hospital	Nursing Home and Child Care Centre
1	**Masniya**	Angara	No	No	No	No	No
2	**Sirka**	Angara	No	Yes	Yes	No	Yes
3	**Chaldag**	Angara	No	Yes	No	No	No
4	**Haratu**	Angara	No	No	Yes	No	No
5	**Hesatu**	Angara	No	No	No	No	No
6	**Rukka**	Ormanjhi	No	No	Yes	No	No
7	**Chakla**	Ormanjhi	No	No	Yes	No	No
8	**Getalsud**	Angara	No	Yes	Yes	No	No

Sl. No.	Village	Tehsil	Post Office	Bank
1	**Masniya**	Angara	No	No
2	**Sirka**	Angara	No	No
3	**Chaldag**	Angara	No	No
4	**Haratu**	Angara	Yes	No
5	**Hesatu**	Angara	No	No
6	**Rukka**	Ormanjhi	No	No
7	**Chakla**	Ormanjhi	No	No
8	**Getalsud**	Angara	No	No
9	**Maheshpur**	Angara	No	No
10	**Benadag**	Angara	No	No
11	**Pailada (Nagrabera-degadegi)**	Angara	No	No
12	**Baridihi**	Ormanjhi	No	No
13	**Sawaiya**	Ormanjhi	No	No

9	**Maheshpur**	Angara	No	No	No	No	No
10	**Benadag**	Angara	Yes	Yes	Yes	Yes	Yes
11	**Pailada (Nagrabera-degadegi)**	Angara	No	No	No	No	No
12	**Baridihi**	Ormanjhi	No	No	No	No	No
13	**Sawaiya**	Ormanjhi	No	No	No	No	No

Table 51: Details of health infrastructure (Source: Primary survey – Sep'2020)

8.1.5.4. WATER SUPPLY INFRASTRUCTURE OF PROJECT AFFECTED VILLAGES

Almost all villages use ground water as a source of drinking water.

8.1.5.5. ELECTRICITY INFRASTRUCTURE OF PROJECT AFFECTED VILLAGES

The electricity is supplied by Jharkhand Bijli Vitran Nigam Limited(JBVNL). All the villages are supplied with electricity infrastructure.

8.1.5.6. OTHER AMENITIES

The houses are concrete and brick masonry houses. The people are depending on utility supplied electricity, but at a few places the solar panel has also been observed. Open sanitary system has been observed and no sewerage system has been observed. Solid waste collection is being carried out by the Municipality.

As per the primary survey, only one village has the post office. All the villages are connected with Airtel, Jio and BSNL for its electronic connectivity. Details are mentioned below in Table 53.

Table 52: Details of other amenities (Source: Primary survey – Sep'2020)

9. POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

9.1. Introduction

This chapter provides a description of environmental and social impacts and their mitigation for the proposed project. This is completed after studying the existing baseline environmental scenario, analysing project activities, initial field surveys, reviewing the process and related statutory norms. The anticipated potential adverse impacts have been identified and assessed for planning, design, construction and operation and decommissioning of the proposed project. Potential positive impacts or improvements have also been reviewed. The appropriate mitigation measures have been formulated to limit the anticipated potential adverse impacts to acceptable levels for each stage of the project. The potential impacts and their suitable mitigation measures are described in the sections that follow.

9.1.1. Project Influence Area

The project influence area is generally understood as the summation of areas of individual project components which are the part of the total project. The project influence area in the case of the proposed project over the Getalsud Reservoir can be divided into three major zones

- **Reservoir Zone:** This zone forms the core of the project and houses the floating solar panels, pontoons/float, string inverters, inverter transformer, 33 KV switchgear, mooring and anchoring arrangement, etc. Area of this reservoir zone is 172 hectares (9.2% of the total reservoir area of 1870.7 hectares)
- **On-site Zone:** This zone consists of installations outside but in the immediate vicinity of the Getalsud reservoir. This zone consists of the 132 KV switchyard, the control room and other related switchgear equipment. Area of this on-site zone is 5000 square meters.
- **Transmission Zone:** This zone can be defined as the linear stretch of around 10 kms to the upcoming Grid substation at Hesatu (132/33kV IRBA GSS). This zone consists of transmission lines. The area covered under this zone is 27 hectares.

9.1.2. Project Impact Zone

The overall impact area of reservoir zone as well as the on-site zone have been anticipated to be within 500 meters from the periphery of the proposed system boundary on all sides of the respective zones. In case of the transmission zone, the impact area of this zone has been envisaged to be 500 m on each side of the towers. Figure 26 shows the Getalsud reservoir, whereas Figure 27 shows the impact area along the transmission line. The impact zones have been evaluated for all key environmental and social impact factors on human beings, terrestrial flora, terrestrial fauna, avi-fauna and aquatic ecology.

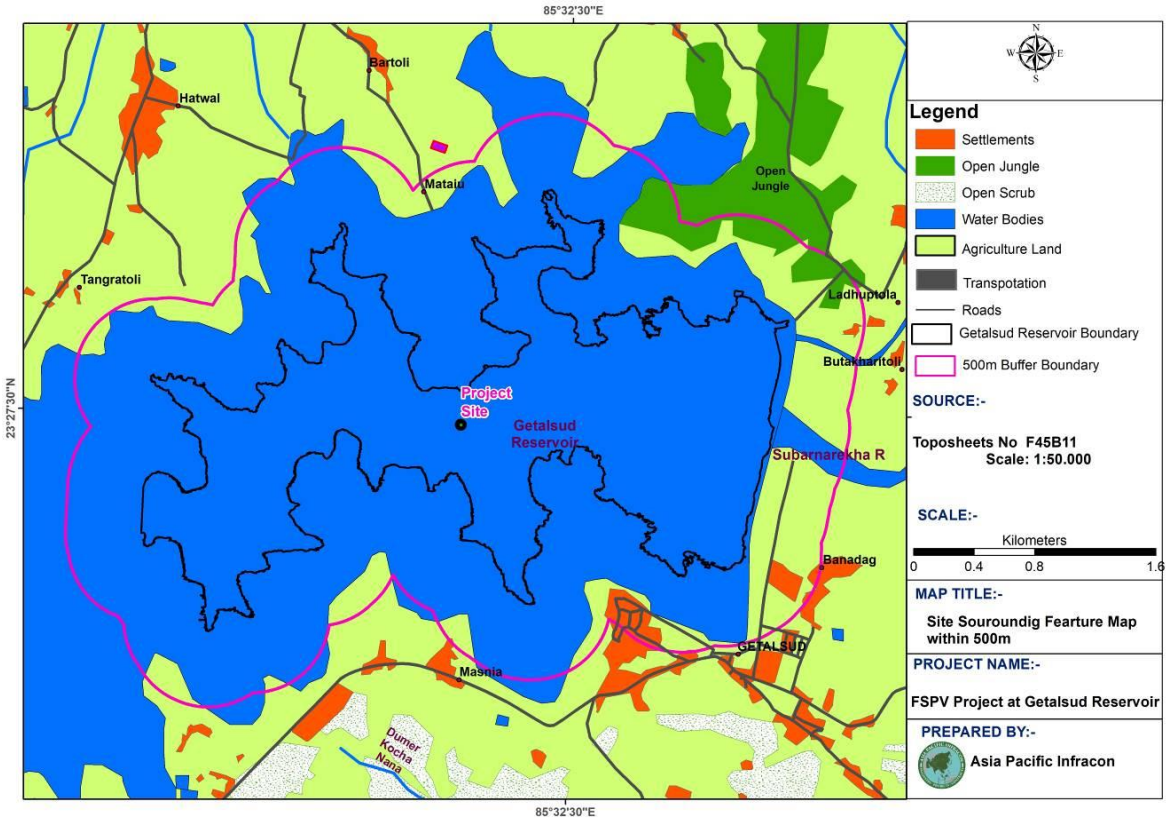


Figure 26: Corridor of Influence around Getalsud reservoir

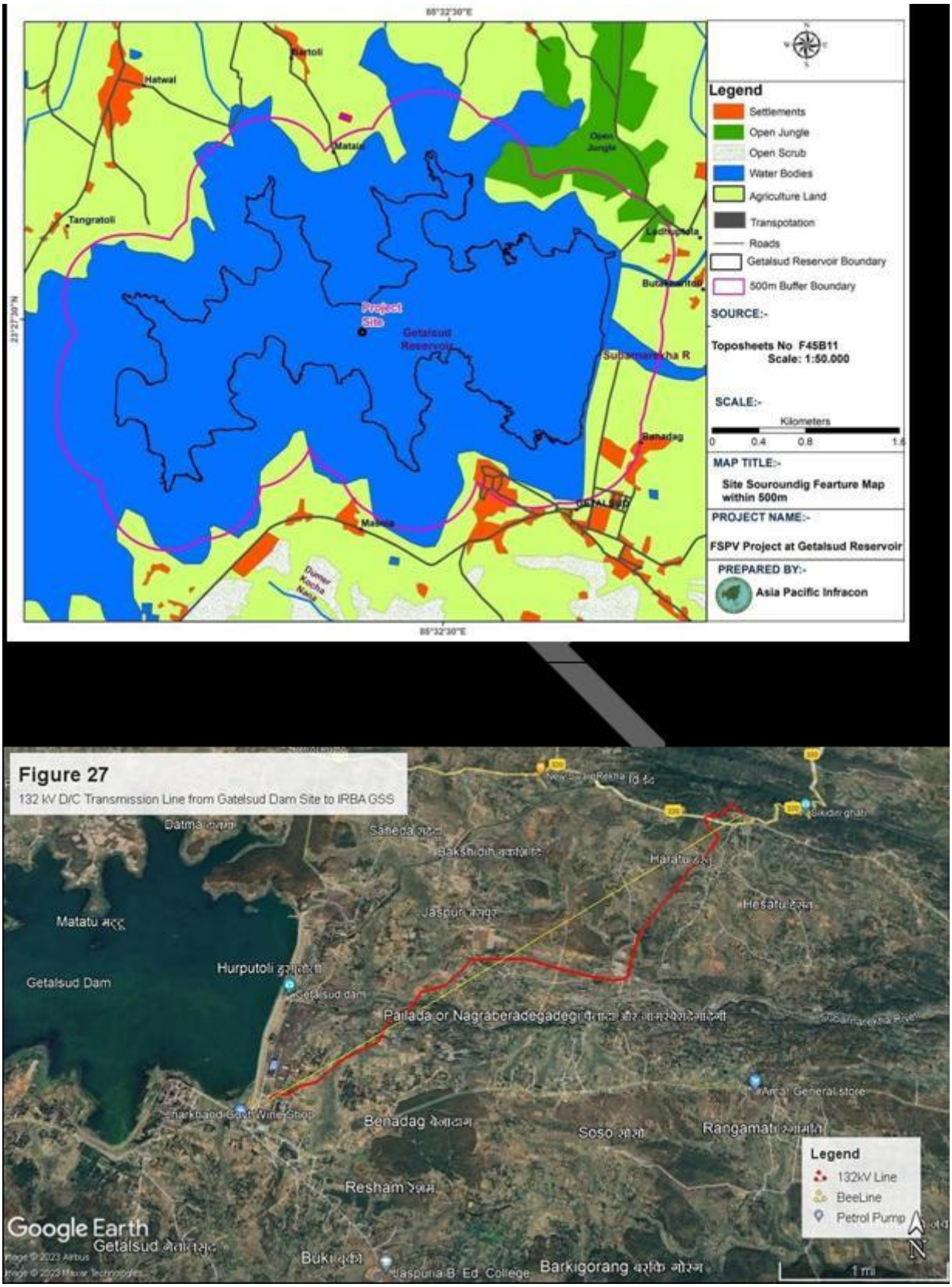


Figure 27: Corridor of Influence around Transmission lines

9.1.3. Anticipated Environmental and Social impacts

The anticipated impacts from the proposed project related to environment and socio-economic aspect could be classified based on the various stages of the project such as:

- Pre-construction phase
- Construction and commissioning phase
- Operation phase

Impacts during decommissioning phase has been dealt with separately under section 5.18 of the report.

The pre-construction phase involves mainly site preparation. This would be done on-site and off-site (inside reservoir, if applicable and deemed necessary by the project implementation team). The construction and commissioning phase would involve movement of materials, deployment of project personnel, assembling and installation along with waste management of un-used or discarded materials. The construction phase activities can be broadly divided into two categories - (i) excavation for foundation and grading of the site (including large scale material transportation and its handling using heavy vehicles and boats) and (ii) construction of structures and facilities along with FSPV project development.

The construction phase impacts are temporary in nature. However, there would be a few aspects which would result in a permanent change or a long-term impact on the surroundings. Operation phase impacts will be continuous in nature or long term.

Various environmental impacts identified for this FSPV project are based on three macro level components namely physical environment, ecological environment and socio-cultural environment with several sub-level attributes as described in following sections:

Physical environment

- Impact on ambient air quality
- Impact on water resources
- Impact on noise environment
- Impact on soil
- Impact on land use
- Impact due to waste generation
- Impact on drainage and water logging

Ecological environment

- Impact on ecologically sensitive areas
- Impact on plantation
- Impact on biodiversity
- Impact on avi-fauna
- Impact on aquatic ecology

Socio-economic environment

- Impact on Agricultural Land
- Impact on Crops
- Impact on cultural properties
- Impact on common property resources (CPRs)
- Impact on livelihood

The impact attributes were assessed based on the existing project components as applicable for an attribute. The potential impacts due to the proposed floating solar PV project with substation and transmission lines are discussed subsequently in Table 54.

Some of the impact of floating solar PV and associated systems are likely to be permanent in nature. There would be both positive and mitigable negative impacts on the water body mainly due to the physical load which would arise due to structures and auxiliaries as also due to movement of boats on the water body.

Project phase / environmental impact	Impact		No Change	Short term	Long term	
	+Ve	-Ve				Applicable Project component
Impact due to Project						
Impact on reservoir water		*		*	*	Floating Solar PV systems
Loss of infrastructure			*			Transmission line
Public utilities	*				*	The associated infrastructure could be utilized by local population too
Cultural aspects			*			Not applicable
Risk due to earthquake		*		*		Solar plant/ substation/ transmission line
Risk on aquatic ecology		*			*	Solar plant
Risk on aquatic fauna		*			*	Solar plant
Risk on avi-fauna		*		*		Solar plant
Land acquisition					*	No Land acquisition is proposed. However, compensation for Right of Way for transmission line shall be made as per provision provided in RAP prepared for the Project.
Livelihood	*	*		*	*	Solar plant/ substation/ transmission line. Livelihood of surrounding fishermen may have minimal impact.
Socio cultural change	*					Solar plant/ substation/ transmission line
Tourist Activity	*				*	Getalsud Reservoir, during consultation it was found that the FSPV may attract more tourists.
Impacts due to construction						
Change of land use		*			*	Solar plant/ substation/ transmission line
Soil erosion at construction sites		*		*		Substation/ transmission line
Pollution by construction spills		*		*		Solar plant/ substation/ transmission line
Health risks and cultural hazards		*		*		Transmission line
Air Pollution		*		*		Substation/ transmission line

Project phase / environmental impact	Impact		No Change	Short term	Long term	
	+Ve	-Ve				Applicable Project component
Noise pollution		*		*		Substation/ transmission line
Disturbance to traffic		*		*		Solar plant/ substation/ transmission line
Construction Camp		*		*		Solar plant/ substation/ transmission line, The campsite will not be used as workers residence.
Socio cultural change		*		*		Solar plant/ substation/ transmission line.
Effect on Economic Activities	*			*		Solar plant/ substation/ transmission line.
Fishing Activities		*		*		FSPV at Getalsud Reservoir
Agricultural activity		*		*		Transmission line
Impacts due to project operation						
Generation and Disposal of waste		*		*		Solar plant/ substation/ transmission line during construction
Electrical hazards		*		*		Solar plant/ substation/ transmission line
Noise pollution		*			*	Transmission lines
Traffic disturbance			*			Vehicles for construction activities
Odour problem			*			Solar plant/ substation/ transmission line
Air quality	*				*	Solar plant/ substation/ transmission line
Release of treated effluent			*			Solar plant/ substation/ transmission line
Energy	*				*	Solar energy
Health	*				*	Solar energy
Aesthetics	*				*	Solar energy
Infrastructure facilities	*				*	Solar plant/ substation/ transmission line
Effect on Economic Activities	*				*	Solar plant/ substation/ transmission line, Any new infrastructure brings a new local business opportunity, even if it is on low scale.
Agricultural activity		*			*	Transmission Towers
Fishing Activities		*			*	Getalsud Reservoir

Table 53: Checklist of impacts due to the proposed FSPV project

9.1.4. Impacts and Mitigation Measures on different Parameters

As discussed above in section 5.1.3, the project pre-construction, construction and commissioning activities and operation would have various levels of environmental and social impacts. The anticipated potential adverse environmental and social impacts and corresponding mitigation measures for each stage of the project are discussed in the following paragraphs.

The mitigation hierarchy is proposed to be formulated and developed in the following order:

- **Avoiding adverse impacts by integrating environmental and social issues into project design.**
- **Minimising adverse impacts by design modification and adopting mitigation measures.**

- **Compensating adverse impacts for those which could neither been minimized nor avoided.**

9.2. Impact on Ambient Air Quality

The proposed project does not involve any manufacturing or operation of a concrete batch plant at site. Majority of the materials would be transported from different suppliers in a pre-casted or ready to assemble state. The nature of the project is a combination of civil works, along with mechanical jobs and electrical works.

The site for the substation would require site clearance, excavation and piling for foundation works. These would generate dust for the duration of the activities.

9.2.1. Construction Phase Impacts

The major source of air pollution for the Getalsud FSPV project would be during the pre-construction and construction phases. The logistics of equipment and personnel would cause an increase in local air pollutants. This implies that motor vehicles would emerge as one of the most important source of air pollution. In addition, there could be temporary Diesel Generator Sets, which could be operated for a supply of power at the site. These would utilise oil for their operation and hence result in enhancement of air pollution. In addition, the motorised boats which could be operational during the construction inside the reservoir would lead to an increase in air pollutants. This is likely to occur for 6-8 months during the peak construction period.

A small amount of welding, cutting and similar activities would also be carried out at the site during construction phase. These activities are likely to produce toxic emissions.

Air quality along the corridor of the transmission line will be impacted during the three phases of the project i.e. pre-construction, construction and post construction (operational) phase. During construction phase, various project components such as cable laying, equipment installation, approach road construction, site levelling, grading, excavation activities, vehicle movement, DG set operation will be required, which will cause a significant amount of fugitive dust emission. This results in an increased level of particulate matter emissions, which in turn will directly impact ambient air quality. If not managed properly, there could be a risk of nuisance and health effects to construction workers onsite and to a lesser extent to nearby receptors from windblown dust (on the village access roads like on the Ormanjhi-Matatu road due to transportation of raw materials).

However, most of these project activities are expected to be restricted within a specified project work boundary and will be temporary in nature.

Further, the movement of vehicles carrying raw materials on unpaved area within the project site and on access road causes fugitive dust emission and may extend to surrounding areas of the project like the nearby settlements. Distribution of the impact can be considered to be of short duration and intensity of the impact as low. Although the impact will spread over wider area, but owing to its short duration and low intensity, the impact can be termed as of moderate significance in nature. The impact will be reversible and temporary in nature, if the mitigation measures as given in the subsequent sections are adopted.

9.2.2. Operation Phase Impacts

Compared to the construction phase, the operational stage impacts are unlikely to be as severe in terms of fugitive emission.

During the operational phase, there would be minimal vehicular movement for supervision and maintenance purposes. Since major source of emission into the ambient air will be absent during the operational phase, therefore its impact can be termed as insignificant.

In sum, it is envisaged that in this project, during construction phase there would be a moderate increase in pollution levels during site clearance for substation, construction of piles or legs or base for transmission towers and during assembly & installation of floats and plant equipment on the reservoir surface

9.2.3. Mitigation Measures

3. **The mitigation measures for restricting air pollutants and improved management of air pollution would involve the following measures:**

- **For reservoir zone, it is suggested to estimate and deploy boats to an optimum, which can be estimated after consultation with design and execution team. Feasibility of Boats which are fuel efficient or have better engine performance could be selected for operations**
- **A comprehensive construction plan which would include securing the switchyard site on all sides with appropriate screens before commencing site clearance and excavation to limit the spread of dust.**
- **Excavations should be preferably carried out during the day time**
- **Vehicles speed to be restricted to 20-30 km/hr on unpaved roads.**
- **All construction raw materials should be covered with tarpaulin sheet during transportation and in storage areas**
- **Regular water sprinkling on unpaved areas.**
- **Ensuring use of tankers and water purchased from authorised vendors only.**
- **Ensuring pollution under control certification for all the project vehicles.**
- **Ensuring regular maintenance of project vehicles during construction and operational phase**
- **Turning off the machineries when not in use**
- **Storing flammable liquids, if any in secured drums and barrels with adequate fire protection**

- **Ensure that all electrical works such as welding, if required, be carried out under supervision and without neglect and wastage of any raw materials**
- **The project team should be sensitised regarding the air pollution aspects related to project**
- **The project should take afforestation as part of a carbon mitigation project in consultation with the State Forests Department.**

9.2.4. Residual Impact

- **The project would have minimal residual impact in the construction phase only. The operation of FSPV would not have any residual impact.**

9.3. Impacts on Water Resources

9.3.1. Impact on Surface water

During monsoons, there would be an increase in water flow. The rainfall recorded by the irrigation department is 1424 mm during the monsoon season. The embankment is around 2.0 meters high from the FRL (590.09m) of the reservoir. Hence, no impact in terms of soil run-off to the reservoir is anticipated even during rainy season. However, there could be a low probability of a run-off to nearby properties, which may result in an increase in soil erosion and flooding. Soil erosion and flooding are of concern during periods of rainy season (i.e. June to September).

9.3.2. Construction Phase Impacts

Anchoring of floating systems to the bed of the reservoir is expected to affect the sediment and muddy layers in the reservoir. To reduce the impact, the construction contractor must comply with the anchoring process requirements. In particular, the position of anchors on the ground needs to be determined accurately and then the anchors should be slowly put down to the bottom by suitable equipment, such that the impact of force of collision between the anchor system and the reservoir bed is reduced. The amount of sludge dispersed can thus be kept to a minimum within a short penetration distance.

- **Impact on turbidity**

The turbidity would increase due to installation of the floating platform and construction of anchoring system during the construction phase.

- **Impact on water quality**

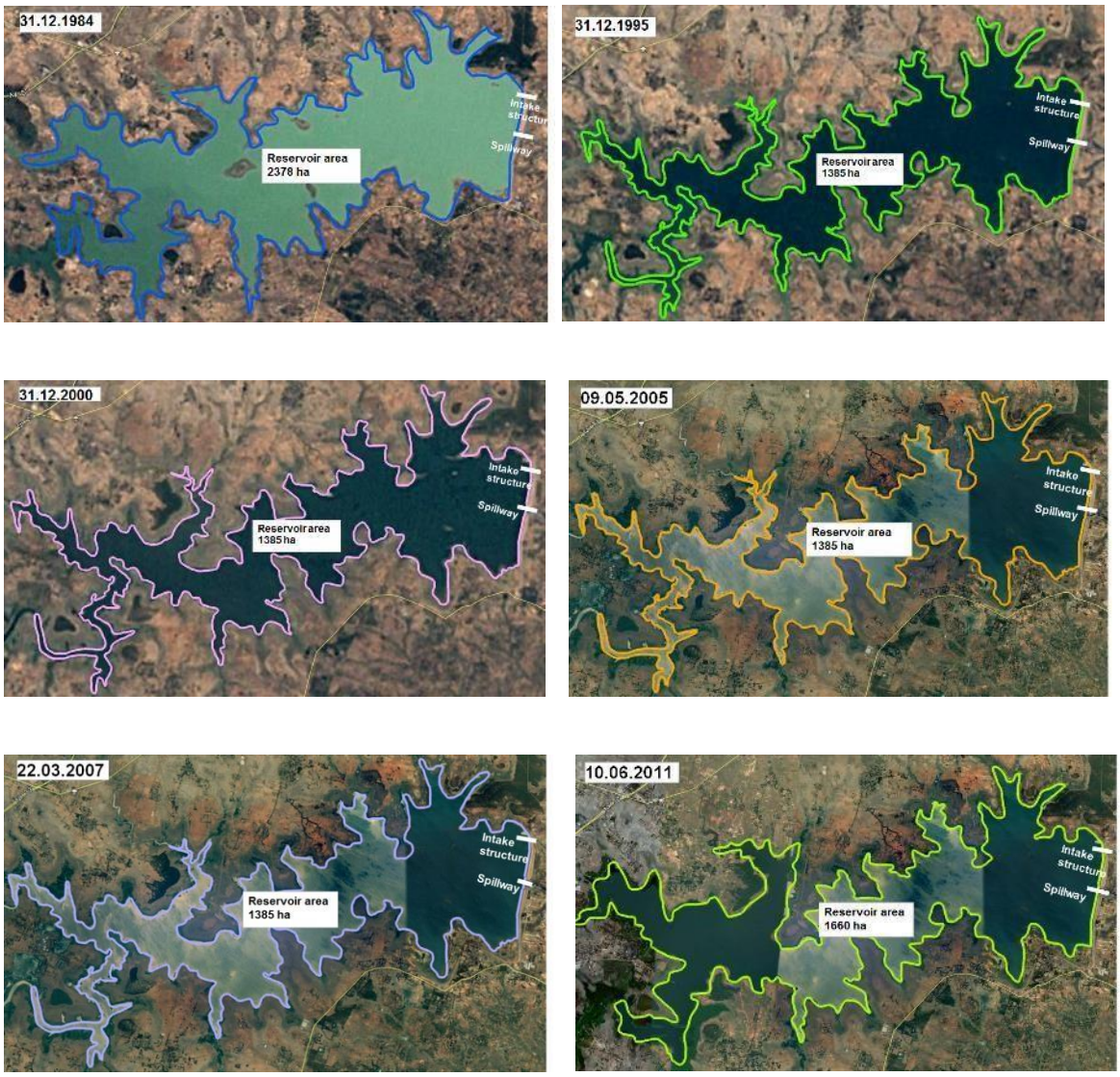
The physical, bio-chemical water quality for the part of the FSPV project would be affected during the construction period.

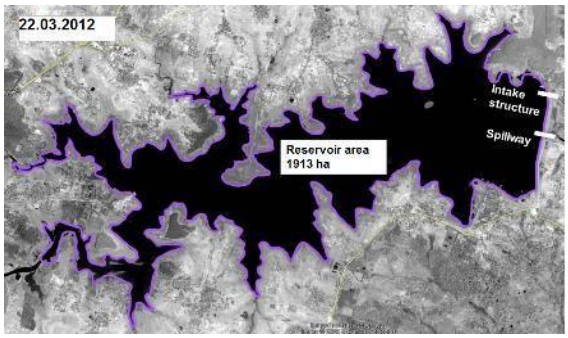
- **Impact on water quality due to oil spills**

There could be an impact on water quality due to oil spills, which could occur from operation of boats during the construction phase.

9.3.3. Operation Phase Impacts

The installed PV modules are likely to reduce water evaporation, reduce solar energy absorption by the water surface, decrease water temperature and increase the dissolved oxygen concentration marginally in water during construction. The area of the reservoir at the FRL is 3475 Ha (1870.7 Ha average water surface area) and the covered area for FSPV is around 172 Ha; so, the PV modules mounted on floating platforms will cover only about 9.2% of the reservoir area. Therefore, the impact of PV modules and floating platforms on the surface of the reservoir is considered medium.





Sl. No.	Date	Area (Ha)
1	31.12.1984	2378
2	31.12.1995	1385
3	31.12.2000	1385
4	09.05.2005	1385
5	22.03.2007	1385
6	10.06.2011	1660
7	22.03.2012	1913
8	06.11.2016	2737
9	19.03.2018	2534
10	31.03.2018	1945
Average		1870.7

1) Impact on water temperature

No significant change in water temperature of the reservoir is anticipated as the FSPV is to be installed only about 9.2% of the total reservoir area. The temperature in the affected area may be slightly lower due to restricted penetration of sunlight in the long term only.

2) Impact on dissolved Oxygen

The dissolved Oxygen is likely to be altered due to activities in reservoir water and interruption on the surface during construction and operation phases. However, this phenomenon would be restricted to the impact zone as mentioned earlier in section 6.3.1. and shown in Figure 26.

3) Impact on turbidity

The turbidity in the reservoir water may be impacted slightly if motor boats are used for O & M purposes during the operation phase.

4) Impact on water quality

The physical, bio-chemical water quality for the part of the FSPV project would be affected during the operation period.

5) Impact on water quality due to oil spills

There would be an impact on water quality due to oil spills, which could occur from operation of boats during operation phase. In addition, a worst case scenario could also result in oil spillage from the off-site transformer installed inside the reservoir.

9.3.4. Impact on Groundwater

During site preparation and construction, ground water resources may be impacted from spills and leaks of hazardous substances such as fuel and oil as a result of improper storage and handling of these substances.

The likelihood and severity of groundwater contamination are, however, low if implementation of a construction management plan is carried out in an effective manner. With respect to the substation and transmission line, there are no perceived major impacts on groundwater. It is believed that the project would not utilise groundwater for the operations and maintenance. Thus, the impacts on groundwater are anticipated to be of minor significance.

9.3.5. Mitigation Measures for Prevention of Water Pollution

The project could adopt several mitigation measures for ensuring that water pollution is minimal and controllable. These are delineated below:

A. The majority of the assembly of the FSPV plant could be completed on-site to the extent feasible. If the assembling is done off-shore (inside the reservoir), then it must be ensured that minimal alterations are done in cables and pipes and no material is left inside the reservoir.

B. The construction water should be sourced in tankers and drinking water sourced from reliable water suppliers, then stored in dedicated and secured overhead tanks.

C. The construction site should utilise temporary and modular washrooms for use by its personnel, which are cleaned daily.

D. Small underground tanks or a micro digester should be constructed through which occasional cleaning should be done through approved agencies scientifically for use by site personnel for their personal hygiene.

E. Regular water monitoring should be done for assessment of any change in water characteristics.

F. If evacuation lines are being installed underwater, then appropriate measures to avoid electrocution need to be installed.

9.3.6. Residual Impact

Although no deep boring is proposed in the construction phase, activitities may bring some disturbance. The mooring of FSPV may disturb the benthic sediments for a short time during construction. It may have low to moderate residual impact.

9.4. Impact due to Noise

Noise impacts are perceived in both construction and operation stages of the project due to several activities. The impact of noise will be moderate in construction phase while there will be minimal impact in construction phase.

9.4.1. Construction Phase Impacts

Noise generated from the construction activities would be of moderate level during initial phases of construction which would marginally fall during substation/ transmission line construction. The overall impact from noise to the nearby surrounding areas would be limited and insignificant for major parts of the project. The approach road to the project which is around 500 m from settlement area would act as a noise buffer zone as the noise from movement of construction materials and personnel would not affect the inhabitants.

In view of the impact assessment, the effect of noise pollution is perceived to be within acceptable limits during the day. For operations pertaining to night, there would be adequate standard operating practices which would be adhered to for minimising the impacts.

The project site is located in open and agricultural fields. There are no existing sources for noise pollution in the vicinity. However, the operation of construction equipment is expected to generate noise in a range of 75 – 90 dB (A). Expected noise emission by construction equipment are given below in Table 65. The propagation of noise waves was assessed (refer Equation-1) and it was estimated that noise attenuates during propagation and reduces from 90 dB(A) to 47 dB(A) at 50 m distance from the source. As the nearest settlement is about 1 km from the project site, there would not be any impact. Also, intermittent operations in large area of the project site would reduce the intensity.

Lp = Lw – 10 log10 (2xR2)-xR

Lp = sound pressure level (dB) at a distance of R from a noise source radiating at a power level,

Lw= sound pressure level (dB) at source; R = distance of receptor from source.

α =frequency dependent sound absorption coefficient.

The above equation can be used with either broadband sound power levels or a broadband estimate of the sound absorption coefficient (α = 0.005dB (A)/meter).

The construction activity will be mainly carried out during daytime. Considering the duration, distribution within site and low intensity, impact has been assessed as of minor significance.The mean noise level of different construction machineries are mentioned below in Table 55.

Type	Mean sound pressure level emission A (dB)
Hydra (Lifting Equipment)	85 dBA
Excavator	87 dBA
Heavy Loaders	87 dBA
Heavy Vehicles (Trucks)	92 dBA

Table 54: Mean noise emission level from vehicle as prescribed by CPCB

It can be inferred that the impact from noise generation from this project would be temporary in nature and would fall as the construction intensity drops with the progress of the project development.

During pre-construction, construction and commissioning phase, noise could also affect the local fauna and avi-fauna. However, such impacts are very difficult to quantify. The office of Planning, of the Federal Environmental Highway Agency, US, provides the following threshold sensitivities of various groups of wildlife

1. Mammals < 10 Hz to 150 kHz ; sensitivity to -20 dB
2. Birds (more uniform than mammals) 100 Hz to 8-10 kHz; sensitivity at 0-10 dB
3. Reptiles (poorer than birds) 50 Hz to 2 kHz; sensitivity at 40-50 dB
4. Amphibians 100 Hz to 2 kHz; sensitivity from 10-60 dB

5. Fishes: 50-2,000 Hz and is best between 200-800 Hz, 50-70 dB re 1 µPa (re= reference 1 micro Pascal; 1 Pascal = 1 N/m^2)

It could be observed that operation of heavy equipment during excavation or piling or other construction activity could result in disturbance to wildlife and fishes. However, these would be temporary and are mitigable, if proper planning and construction management processes are followed.

9.4.2. Operation Phase Impacts

The noise emitting devices for this type of project are the solar inventers, transformers on the reservoir and the switchyard on-site (on land) with transmission lines. There are very limited studies and research available on noise generation from commercial solar inverters. However, it is anticipated that the noise generation would be within acceptable limits.

The effect of noise on the biota, which is presented in Section 6.4.2, would apply during the operational phase as well. Noise from operational transmission lines would be prominent under the tower, but would dissipate with increasing distance. Corona effect (ionisation of air due to presence of highly charged electric field) would be present but would have negligible effects. Typically for a 132 KV transmission line, the noise level would be 40 dB at the edge of the ROW. Noise would be low in the night time, around 45 dB to 55 dB (anticipated values). Relay switches can also produce some noise during adjustment for grid connected unit. However, most of the electric and electronics systems would come with casing, which would reduce the external noise. Therefore, no significant impact of noise is anticipated during the operation phase.

9.4.3. Mitigation Measures

4. **The following mitigation measures are recommended for minimising the effect of noise during project implementation:**

- **The construction should be staggered as much as possible**
- **Use of screens around the construction zone to the extent feasible**
- **Use of diesel generator (DG) set with acoustic enclosure**
- **Restrict major noise generating activities from 10:00 pm to 6:00 am**
- **Provide personal protective equipment to workers wherever noise is generated due to machinery operation.**
- **Regular maintenance of project vehicles**
- **Regular health monitoring and maintenance of electrical and electronics components**
- **Proper insulation and design consideration for transmission lines and cables**
- **The personnel at the site should be sensitised regarding the various impacts of noise on biodiversity**
- **The noise monitoring would be carried out through a handheld sound level meter by technician apart from the periodic noise monitoring at sensitive locations.**

9.4.4. Residual Impact

5. **Appropriate measures have been proposed to mitigate impact due to increased noise level during the construction and operation period. The residual impact would be insignificant post implementation of suggested mitigation measures.**

9.5. Impact on Soil

Soil at the site would be impacted in a limited manner with reversible changes. Soil would be excavated for construction of plant substation and associated support infrastructure on land. Soil would also be impacted from the construction of foundation for transmission lines towers. However, these impacts can easily be mitigated through a well-planned soil conservation programme.

9.5.1. Construction Phase Impacts

During construction phase, top soil could be temporarily disturbed due to construction of plant substation, transmission lines and associated infrastructure. Soil could also be impacted from the vehicular movement during construction period.

9.5.2. Operation Phase Impacts

There would be no or minimal impact in the operation stage due to the project.

9.5.3. Mitigation measures

- **Topsoil would be kept separate from other construction debris.**
- **Topsoil would be reclaimed and utilised for project landscaping, if possible.**
- **If the soil is not able to be utilised in-situ, it could be extended to the villagers**
- **Adequate precautions should be ensured for prevention of run off to the reservoir. The project team for FSPV project would ensure that the disturbances to soil are kept at minimal using good construction practices.**
- **Soil analysis would be undertaken, preferably once in three months.**

9.5.4. Residual Impact

The stripping of soil for any construction activity is unavoidable. The soil would be stacked and relayed after construction.

9.6. Impact of Waste Generation

Waste can be classified into solid, liquid, hazardous and bio-medical wastes. Waste from any construction and commissioning activity depends on the nature of materials utilised for construction, degree of construction, size as well as personnel involved in the project for the on-site. Waste is expected to be generated from the project during construction and operation phases. These would have to be managed as per the national and local regulatory framework for waste management. The waste management regulations have been updated in 2016 in India.

9.6.1. Construction Phase Impacts

Waste would be generated mainly on-site. Waste is also likely to be generated inside the reservoir.

The entire project would utilise several packaging materials. These could also form the bulk of on-site waste generation. These can also be managed through the waste management procedures.

The project by virtue of its nature, would involve a small amount of construction waste, which can be disposed as per the existing construction and Demolition Waste Management Rules, 2016.

The project would also generate electrical wastes such as wires, insulation materials, metal portions, etc. These would have to be disposed of as per good environmental practices. The same philosophy applies for garbage.

The construction would involve the installation of PV modules and cables in the reservoir. This action calls for proper construction management with proper planning on the amount of materials mobilised for use inside aquatic environment. There should be additional precaution by the personnel carrying equipment and other materials inside the reservoir to avoid any waste being left over after the job.

9.6.2. Operation Phase Impacts

The project would utilise grease and oils, which, if not properly managed, can lead to soil and water contamination. It includes oily waste, oily cleaning mops and grease generated from machinery maintenance. This amount of hazardous solid waste generated during the construction process of the project depends on the number of construction machines and transportation, the amount of lubricant discharged from the motor vehicle, lubrication and machinery maintenance plans. However, since maintenance activities will be mainly carried out in nearby garages, impacts from hazardous solid waste are considered minor and manageable.

9.6.3. Mitigation measures

The following mitigation measures are recommended to assist the project in minimising the impact from waste generated during the project life cycle:

- During construction, waste segregation should be adopted. Compostable waste and dry waste should be kept in separate bins.

- To avoid the contamination due to spilling of the solar components of the solar panels installed ovet it. The extra protection to the solar units have been provided in the design to prevent spills.
- The municipal waste would be collected by the local municipality of Ormanjhi and disposed off at a waste management facility.
- The segregated hazardous waste would be sold to a vendor authorized by the Jharkhand State Pollution Control Board for handling and disposal in accordance with hazardous waste management rules.
- E-waste should be kept separately.
- Hazardous and bio-medical waste should be kept separately.
- Use of diesel or like substances, if any, should be made only after due approvals.
- The discarded and damaged PV modules should be sold for recycling and managed according to the prevailing rules of Government of India as per E-Waste Management Rules, 2016.

9.6.4. Residual Impact

The spills from the PV unit may damage the reservoir characteristics and after mitigation measures there would be no significant residual impact due to waste generation.

9.7. Impact on land use

During the construction period of 15 months, several construction activities will have to be performed, including land clearing, backfilling, levelling and grading. There would be a marginal change in the land use pattern due to the project for a short time of 15 months. The substation, project site and the transmission tower would cause a marginal but permanent land use change for the substation and transmission tower foundation.

9.7.1. Construction Phase Impacts

There is no major impact on the land use of the project. 4.89 Ha land is required for Transmission line and 0.5 Ha land is required for substation.

9.7.2. Operation Phase Impacts

The land use would be changed for the substation and transmission tower areas. There would be no further land use change proposed in the operation phase.

9.7.3. Mitigation Measures

The labours and other construction personnel would be accommodated in rental houses. Due care would be taken as no modifications and other disturbances allowed.

9.7.4. Residual Impact

There would be minor change in land use due to construction of Substation and Transmission towers. The land use change will have Negligible to Moderate residual impact.

9.8. Impact on Forest

The Transmission Line as well as the Substation is not situated on any land owned by the Forest Department. Hence, clearance from them is not required.

9.9. Impact on Biodiversity

The presence of infrastructure on the surface of a lake causes reduced penetration of light into the lake which is used by submerged aquatic plants and phytoplankton. Any effect on phytoplankton could cascade to biota at other trophic levels, since they are the primary producers. In some circumstances, an impact on the fish resource may be expected. In addition, composition of phytoplankton species may be affected, with knock-on effects on other biodiversity.

Reduced light penetration is also expected to have the overall effect of reducing water body temperature, primarily by reducing the heating effect of the sun, making thermal stratification less likely and slowing the rate of water body processes such as productivity and the breakdown of organic compounds, which can also affect aquatic biota. Given the relatively high and stable atmospheric reservoir temperatures in this part of Jharkhand, this is considered unlikely to be significant.

9.9.1. Construction Phase Impacts

Wind blowing over the surface of a water body results in oxygen exchange and any water circulation. Any surface installation which cover the lake surface may interfere with this process, due to the presence of a physical barrier to gaseous exchange. The lack of mixing has the potential to increase the risk of stratification and harm aquatic biota, including release of pollutants from sediments due to lack of oxygen at depth.

9.9.1.1. LOSS OF AQUATIC HABITAT

Habitat is important to support the lifecycles of aquatic fauna identified with the Project area. This includes aquatic habitat for breeding, foraging and roosting. Removal of the habitat reduces the habitat available to resident species and the ecological value of the area.

No surface macrophytes or associated biota are present on the lake surface where the array if to be installed; therefore, no loss of habitat is expected. No important benthic habitat or sessile benthic species are present; therefore, loss of any small areas of lakebed habitat as a result of anchor placement are not deemed significant.

The biodiversity values identified within the aquatic ecosystem are considered low and of a highly impacted nature. The aquatic habitat identified within the Project area is considered to be Modified Habitat.

No aquatic species were identified that are considered to be Critical Habitat candidate species. Widely distributed species and species of economic value to local people were identified within the Lake. These are assessed separately in for ecosystem services at Section below. The area of the lake surface that will be covered by floating PV is 9.2%.

The sensitivity of Modified Habitats are considered to be Low. The magnitude of effect is likely to be Small/Medium as it will affect only a small area of habitat, but without the loss of viability/function of the habitat. The overall impact is therefore likely to be Minor for Modified Habitat before Mitigation Measures.

9.9.1.2. LOSS OF TERRESTRIAL HABITAT

The transmission line for the project will pass through modified habitat. The transmission line length is 10 km with the RoW of 27m and the substation will occupy 1 Ha of land. It is expected that 30 number of towers will be used along the length of the line.

9.9.1.3. TEMPORARY AND PERMANENT BARRIER CREATION, DEGRADATION OF HABITAT, EDGE EFFECTS AND FRAGMENTATION

Construction activities relating to linear infrastructure have potential to create a temporary barrier to fauna movement (for some fauna groups). This includes construction of the access roads, the transmission line and other infrastructure. Temporary and permanent barrier creation will occur during construction. This will include the erection of fences and hoardings around construction sites, and also construction of linear infrastructure (such as the access road and transmission line). This may impact the movement of fauna within the landscape, particularly bird species.

Edge effects are an indirect impact of land clearing during construction and throughout operation and can have temporary and permanent impacts. Where vegetation clearing occurs, adjacent vegetation and habitats can be exposed to changes in noise, light (natural or artificial), dust, humidity and temperature factors as well as increased competition from predators and invasive species.

The impact of edge effects to habitat value and forest composition has been widely recognised as a contributor to habitat degradation and impacts to biodiversity.

Fragmentation of habitats can occur where currently linked habitats are disconnected through the construction of Project components. Fragmentation reduces the continuity of habitat and hence the ability for fauna to move within and between habitats patches. Fragmentation of existing habitats within the project area is not considered to be a significant impact as the infrastructure design does not lead to isolation of habitat patches and is primarily within Modified Habitat.

9.9.1.4. MORTALITY: VEHICLE STRIKE, HUNTING, FISHING AND POACHING

The sensitivity of terrestrial species to fauna mortality from vehicle strike, hunting, fishing and poaching is considered to be Low for all Least Concern, Near Threatened and Vulnerable species.

The magnitude of effect due fauna mortality from vehicle strike, hunting, fishing and poaching is likely to be Small as the effect will not cause a substantial change in the population of the species present, or other species dependent on them during construction.

9.9.2. Operations Phase Impacts

Minor residual impacts for all construction phase impacts are likely remain during operation. Additional impacts due to degradation of habitat and mortality are likely to be different during operation and hence are reassessed for operational phase impacts.

Degradation of habitat during operation will occur due to air, noise and water discharges into the environment.

Impacts due to air, noise and water emissions during operation can cause impacts to biodiversity like deposition of particulates on vegetation, leaf necrosis, disturbance of fauna from close proximity to noise sources.

Compliance with relevant standards will reduce the impacts on biodiversity values from air, noise and water pollution.

9.9.2.1. COLLISION OF AVIFAUNA WITH TRANSMISSION LINE

Impacts to fauna during operation may persist with potential impacts to infrastructure causing local mortality of individuals. This is most likely to occur with avifauna striking the transmission line during construction and operation. The magnitude of effect due fauna mortality from avifauna infrastructure strike is likely to be very less as the effect will not cause a substantial change in the population of the species present, or other species dependent on them during construction.

The overall magnitude of this impact is therefore Negligible for Least Concern, near Threatened and Vulnerable Species.

- Use of bird deflectors on the length of the power line. The deflectors will increase line visibility by thickening the appearance of the line for easier detection by avifauna.
- Insulating cables close to poles, at least 70 cm on both sides and around perching areas, and up to at least 140cm.
- Minimising the vertical spread of power lines. Having lines in a horizontal plane reduces collision risk.
- Bird Diverters/Reflectors and Bird Flappers to be used at suitable intervals for easy visibility of wires and to avoid the risk of collision and electrocution. The guidelines issued in the documents *"Technical Specifications for Bird Flight Diverter (2021), Government of India, Ministry of Power, Central Electricity Authority"*[1] and *"Wildlife Institute of India 2018 Power-Line Mitigation Measures. Second edition (2020)"*[2] shall be consulted and followed for specification and installation.

Table 56 indicates the major biodiversity impact assessment classifications applied for the project.

Magnitude	Habitat	Sensitivity of species	Magnitude of species impacted
Negligible	No existing habitat is affected	Species and sub-species of LC on the IUCN Red List, or not meeting criteria for medium or high value.	No species is affected

Magnitude	Habitat	Sensitivity of species	Magnitude of species impacted
Small	Affects only a small area of habitat, such that there is no loss of viability/function of the habitat.		Effect does not cause a substantial change in the population of the species or other species dependent on it.
Medium	Affects part of the habitat but does not threaten the long-term viability/function of the habitat.	Species on IUCN Red List as VU, NT, or DD, species protected under national legislation, nationally restricted range species, nationally important numbers of migratory, or congregator species, species not meeting criteria for high value, and species vital to the survival of a medium value species.	Effect causes a substantial change in abundance and/ or reduction in distribution of a population over one, or more generations, but does not threaten the long-term viability/ function of that population, or any population dependent on it.
Large	Affects the entire habitat, or a significant proportion of it, and the long-term viability/ function of the habitat is threatened.	Species on IUCN Red List as CR, or EN. Species having a globally restricted range (i.e. plants endemic to a site, or found globally at fewer than 10 sites, fauna having a distribution range (or globally breeding range for bird species) of less than 50,000 km2), internationally important numbers of migratory, congregator species, key evolutionary species, and species vital to the survival of a high value species.	Affects entire population, or a significant part of it causing a substantial decline in abundance and/ or change in and recovery of the population (or another dependent on it) is not possible either at all, or within several generations due to natural recruitment (reproduction, immigration from unaffected areas).

Table 55: Biodiversity impact assessment classification

Table 57 provides the different impacts of the proposed project on biodiversity during construction and operation phases.

Impact	Description	Type of impact	Construction Phase	Operation phase
Loss of aquatic habitat	Permanent/ Temporary loss of aquatic habitat or species due to permanent or temporary site activities	Moderate	As 9.2% of the total reservoir area shall be utilised for project	Same as in construction phase
Changes to aquatic habitat functionality	Changes to the physical and chemical dynamics of an aquatic environment that can result in modifications to the functionality of the habitat. The presence of floats, mooring and anchoring and related equipment would result in growth of biota in the long term.	Moderate	Pertains to surface and sub-surface construction	During operation phase, there would be minimal sub surface disturbance. However, there may be growth of plant and attachments which may grow over the anchoring lines
Loss of terrestrial habitat	Temporary or Permanent loss of terrestrial habitat or species due to permanent or temporary site activities.	Negligible	Transmission line passes through agricultural land	Transmission line passes through agricultural land

Impact	Description	Type of impact	Construction Phase	Operation phase
Disturbance to or displacement of individual species Light, noise and vibration impacts	Temporary and permanent disturbance to, or displacement/exclusion of a species from foraging habitat due to construction activities, and operational and maintenance activities.	Negligible	Transmission line passes through agricultural land. Only four towers are going to be constructed in forest areas.	The noise and vibration should not pose threat to avifauna
Barrier creation, fragmentation and edge effects	Permanent and temporary creation of barriers to the movements of animals, mammals, reptiles and amphibians and invertebrates and plants with limited powers of dispersal. Fragmentation of habitat, or permanent /temporary severance of wildlife corridors between isolated habitats of importance for biodiversity. Impacts that occur when a habitat is exposed to a different adjacent habitat type or structure. These impacts can include increased risk of parasitism or disease, increased risk of predation, adverse microclimate conditions (including drying out and subsequent fire risk), and competition from invasive species	Small	During construction phase, there may be impact on local fauna and avi-fauna	There would be a very small impact due to plant and transmission line operation
Degradation of habitat Air Pollution Water pollution Invasive species Dumping of waste	Disturbance or damage to adjacent habitat and species caused by changes in microclimate, vulnerability to predation and invasion and overall changes in conditions that can lead to a change in the community and its values for flora and fauna. This can include increased exposure to noise, light and dust. Introduction or spreading of alien species during the construction works.	Small	During construction phase, there may be impact on local fauna and avi-fauna	During operation period, area lighting could cause for avifauna disturbance
Mortality – vehicle strike, fishing and poaching	Mortality of individual fauna species as a result of vehicle or machinery strike or falling debris during clearing activities. Mortality to individual fauna species as a result of worker influx and hunting/poaching of extant fauna	Negligible	However, due to in-situ activities during construction, there may be unintentional mortality	The operation phase is unlikely to pose any threat or any action leading to mortality of fauna during operation
Impact to ecosystem services	Impacts to high and medium priority ecosystem services provided to local people, including fishing, provisioning, regulating and cultural services.	Medium	The FSPV is going to be installed in the area of the reservoir which may impact the ecosystem services	There may be an influx of visitors during operation phase, which would require to be regulated.

Table 56: Biodiversity impact assessment matrix

9.9.3. Residual Impact

In view of the implementation of mitigation measures, the residual impact is to remain as Negligible for terrestrial species considered as Least Concern, on the IUCN Red List.

In view of the implementation of mitigation measures, the residual impact remains of Minor significance.

The presence of a physical barrier at the reservoir surface can also inhibit evaporation, reducing water loss. This issue however is unlikely to be significant given that the solar array is proposed within deeper sections on the northern side of the reservoir where exposure to the atmosphere and subsequent oxygenation of water is likely to be higher (compared to oxygenation and mixing with water at depth). Given the relatively smaller proportion of the reservoir surface to be occupied by the floating solar array, and considering the degree of mixing elsewhere in the reservoir, any significant impact on biota due to reduced oxygen exchange or evaporation appears to be moderate.

- The impact on biodiversity would be negligible as the nesting sites are almost 3.0 kms away from the project site.
- The feeding ground (Reservoir) may be impacted in a moderate to major way as the FSPV would cover nearly 8% of the reservoir.
- No tree felling is proposed and 100 trees are planned to be planted so it would be positive.
- Impact on invertebrates may be there.
- Impact on fish stocks may be impacted due to construction activity enhancing turbidity and affect their reproduction.

9.10. Impacts on Physiography

The impact of the project on physiography (terrain) would be of negligible nature. The transmission line will be passing through gradual slopes with very low contour change (flat area). Therefore, there would be no visible and significant impact on physiography of the region.

9.10.1. Construction Phase Impacts

No significant adverse impacts are anticipated on the local topography due to construction of the project.

9.10.2. Operation Phase Impacts

No significant adverse impacts are anticipated on topography during the operation stage.

9.11. Alteration of Natural Drainage Pattern

There is likely to be a moderate change in the natural drainage pattern, which can be mitigated.

9.11.1. Construction phase Impacts

During construction phase, site levelling activities will be carried out for the substation area which, in turn, may result in minor change of contour level and natural drainage system. Natural drains exist adjacent to the project site at 1 km distance in the east. Therefore, change in contour level may affect the flow of surface runoff from project site.

Mitigation measures could limit the impact on natural drainage pattern. The impact on drainage is anticipated to be of moderate significance.

9.11.2. Operation Phase Impacts

In operational phase, project activities causing the alteration of natural drainage pattern will not exist, therefore no associated impacts are anticipated.

9.11.3. Mitigation Measures

- **Site levelling should be done with minimum alteration in contour level.**
- **Storm water drainage should be designed to discharge the surface runoff in the nearby natural drainage.**
- **The design of surface and sub-surface should account for local drainage patterns and slopes. The exit of runoff from the project site in the adjacent surrounding land area should be restricted.**

9.12. Impact due to Traffic

Construction materials and workers will be transported to and from the project site via the connecting roads from Ranchi (NH-20, 34.3 km) and through local access roads (including a local commune road). These roads are being used by local communities to travel to the surrounding areas. At the time of baseline survey, it was observed that the local population density was low at the roads. The main road may be busier for short periods during construction, but the potential of traffic congestion is not likely to happen.

The traffic load may increase due to transport of materials for the plants. However, due care needs to be taken during the design stage to overcome related hazards like accidents. Number of transportation trips during construction of the project is unknown; however, due to small scale of the project, transportation during the construction phase is expected to be limited.

The reservoir area is having an accessible ramp near the sluice, which needs to be strengthened for transportation of equipment/ machineries during execution. Keeping in view the approach direction of the proposed transmission line for evacuation of generated power, the location of the substation has been envisaged near the embankment area opposite to the reservoir (on the downstream side).

The traffic load may increase due to transport of materials for the plants. However, due care needs to be taken during the design stage to overcome related hazards like accidents. Number of transportation trips during construction of the project is unknown; however, due to small scale of the project, transportation during the construction phase is expected to be limited.

9.12.1. Construction Phase Impacts

The construction activities and equipment movement during the construction stage may create hindrance to the effective carriageway and restrict the traffic flow. There might be cases of inconvenience due to the construction activities. However, such incidents can be minimized with the help of an appropriate road safety and traffic management plan. All construction material shall be transported as per guidelines of Jharkhand State Pollution Control Board (JSPCB), which will be through covered / closed trucks and with zero spillage

9.12.2. Operation Phase Impacts

No significant impacts are anticipated on account of road traffic during the operation stage.

9.12.3. Mitigation Measures

The road should be kept in a motorable condition all the time. The traffic marshals would be placed to take care of traffic congestions.

9.12.4. Residual Impact

The roads are to be shared with the local residents. It may be impacted due to increased traffic during construction. However, a robust traffic management plan may decrease the chances substantially. The roads to be used for the project site are well connected with the national highways

9.13. Workers' Health and Safety

Workers may be at risk of diseases such as diarrhoea, dengue fever, malaria, etc. owing to poor living conditions and inadequate sanitation facilities during the construction phase. As informed by the local authorities in Jharkhand, the local clinics and medical staff are adequately equipped to provide health care support to workers.

During construction, there would be 100 personnel working on this project, while during operation phase, only 10 personnel would be stationed on site for operation and maintenance activities. It is planned to engage local labour to avoid stress on the essential resources like health services, water supply, sanitation, transport etc. Regular health check-up programs should be carried out for workers and the construction site should have adequate first aid facilities. In Ormanjhi, there are multiple hospital services available which are nearly 10-15 kms away from the reservoir.

All necessary safety precautions as per the relevant Indian laws such as the Construction and Other Workers Act and the Factory Act would have to be implemented and followed for relevant provisions. All workers and personnel should be insured as per the Public Liability Insurance Act, 1991.

The project would have several in-built safety measures including that for lightning. Earthing (both underwater and otherwise) shall be provided for improved safety. The control rooms would be designed as per the relevant Indian Electricity Rules and house firefighting equipment for rapid response.

9.13.1. Construction Phase Impacts

There are several factors which could affect health of personnel in the project during construction. There would be exposure of air pollutants during different phases of construction. Workers would also be exposed to stress during the project implementation. There could be other factors such as acquiring infections which are water borne or from unhygienic living conditions. Hence, it is imperative that proper risk assessment is undertaken for all possible conditions which can adversely affect health of personnel of this project. Such conditions can range from physical, chemical, biological and ergonomic factors. The construction camps should follow a good level of hygiene. There should be proper dissemination and training on safety and industrial hygiene to the workforce and management.

Due to the nature of operations inside the reservoir which involve working in depth of 10 meters or below, adequate safety precautions are important. The water environment and its quality could provide valuable indicators for personnel to work inside the reservoir.

The site should house first aid centre as well as a communication with the nearest doctor and health care centre for any emergency. There could also a possibility for a biological agent outbreak. The contingency plan should cater to such situations. Adequate protection and precautionary measures would need to be worked out as part of the on-site emergency preparedness plan to effectively address the health issues, especially during the construction stage of the project.

Additionally, other health and safety risks should be considered during the construction including drowning during the installation of the floats/ PV modules, falling when working at height for transmission line and electrocution etc. These risks could be major if the workers are not trained for health and safety and not equipped with personal protection equipment (PPE). As such, the project is required to provide health and safety briefing in induction training, appropriate PPE to relevant workers and how to use the PPE. During the construction period, supervision from both the management of contractor and the developer should continuously observe and remind the workers with safety requirements. The same set of facilities shall be provided, if the workers opted for rented accommodation.

The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 has following stipulations:

- **The fixing hours for normal working day, weekly paid rest day, wages for over time, provision of basic welfare: amenities like drinking water, latrines and urinals, crèches, first aid, canteens, etc., for the building workers;**

- **provision for temporary living accommodation to all building workers within or near the work site;**
- **making adequate provisions for safety and health measures for construction workers including appointment of safety committees and safety officers and compulsory notification of accidents;**
- **empowering the Central Government to frame model rules for safety measures headed by Director -General of Inspection at the Central Level and Inspector-General at the State Level;**
- **provision for appointment of inspecting staff including Director-General of Inspection at the Central level and Inspector-General at the State level;**
- **special provisions regarding fixing responsibility of employers to ensure compliance with safety provisions and with regard to prevention of accidents, timely payment of wages, etc;**
- **provision for penalties for contravention, obstructions, violation and offence; taking cognizance by court of offence punishable under this Bill; and protection of action taken in good faith.**

9.13.2. Operation Phase Impacts

A smaller number (tentatively ten) of personnel and technicians would be deployed and stationed in the operation stage who will be provided with the suitable gears for protection as well as medical facilities.

9.13.3. Mitigation Measures

- **During construction, workers safety should be given adequate priority.**
- **Proper personal protective equipment, scaffolding and operators safety manuals should be provided to workforce.**
- **A safety team comprising suitably qualified and trained personnel should be constituted.**
- **The project should strictly follow the national and local regulatory requirements pertaining to workers health and safety.**
- **The Contractor has to prepare implementable HSE plan based on the ESMP provided with the bid document.**

9.13.4. Residual Impact

The workers may be at risk on handling the E waste and PV units. They may also be facing the risk of drowning and other work hazards. The mitigation and management plan have been proposed to counter these issues.

9.14. Vulnerability of Floating Solar Photovoltaic Systems to Climate Change

As per the map of "The Köppen-Geiger Climate Classification" (2017)[5], Getalsud reservoir region in Ranchi district falls under the sub-tropical climatic zone (i.e. Cwa, C: warm temperature, w: winter dry, a: hot summer).

The summer season for the region starts from March and lasts till end of June. Thereafter the south-west monsoon season starts which lasts till about the middle of October. Mid-October to November constitutes the post-monsoon period while the period from December to February is the winter season which is marked by dry and cold weather. The hottest months of the year are May and June while the coldest is January.

Like all other solar plants, the proposed floating solar plant will be also be directly exposed to the weather conditions and is likely to be vulnerable to climate change manifested by hail, wind, flood, draught and extreme temperatures.

9.14.1. Effect Due to Climate Variables

9.14.1.1. SOLAR RADIATION

The sunshine hours are decreasing at a rate of about 2 hours/100 years as per Jharkhand State Action Plan for Climate Change due to increasing cloud cover. It may affect the overall performance of the project in the long-term.

According to the Jharkhand State Action Plan on Climate Change, 2014, the overall solar radiation has remained constant at 19 MJ/m^2 during the 30-year period in Jharkhand. The trend analysis of solar radiation varies spatially with an increase of 0.2–0.99 MJ/m^2 in the project area. It is noteworthy, that solar radiation has increased at places where the rainfall activity has also increased over the years during this season.

9.14.1.2. LIGHTNING

Lightning may cause damage to the PV modules and associated infrastructure or cause slower-onset problems by exposing the internal components to the environment and thus to chemical or physical degradation.

Good engineering practice is to construct appropriate lightning protection if the installation is at risk of lightning strikes. It should be done near the floating platform and other associated facilities.

[5] http://koeppen-geiger.vu-wien.ac.at/present.htm

9.14.1.3. TEMPERATURE

The maximum temperature at the nearest weather station in Ranchi, nearly 25 km away, is continuously decreasing at the rate of 1.5^0C/100 years while the minimum temperature is continuously increasing at the rate of 2.0^oC/100 years; which is the representative for the plateau of Jharkhand. The maximum temperature is observed to fluctuate with an increase of 0.55–1.5^0C in the project area.

The mean maximum temperature in the monsoon season was observed to be 34.4^0C in the month of June whereas the mean minimum temperature was observed to be 21.7^0C in the month of September. Seasonal air temperatures are also forecast to rise in all seasons. However, The winter season starts from December and continues till the end of February, the maximum temperature was 26.2^0C and the minimum temperature was 9.7^0C.

Solar PV output is usually rated at 25ºC cell temperature with output typically decreasing by about 0.25% (amorphous cells) to 0.5% (most crystalline cells) for each temperature rise of 1ºC. For large arrays, this rapid fluctuation can cause localized voltage and power quality concerns (Mills et al. 2009) because shading of one panel affects the entire array connected to a single inverter.

9.14.1.4. RAINFALL AND PROLONGED CLOUDY WEATHER

The overall cumulative rainfall during the monsoon season (June-October) for the entire state of Jharkhand was found to be almost constant over the 30 years However, the trend analysis of cumulative rainfall during the monsoon season shows that rainfall has a fluctuating trend with a decrease of 26–270 mm in the north western districts to an increase of 19–440 mm in the rest parts of the state. The spatial distribution of cumulative rainfall shows that the project area in Ranchi show a declining trend of cumulative rainfall with magnitude 26–270 mm.

The average annual rainfall based on the 10-year IMD data, was observed to be 1454.9 mm. The monsoon sets in the month of June and continues till September and sometime extends up to mid-October. The maximum amount of rainfall (358.4 mm) occurs in the month of July. The maximum number of rainy days was also observed in the month of July.

The level of water in the reservoir is dependent on the rainfall in monsoon season. However, the ESIA investigation found that that there would be not be any adverse effect of the rainfall on the infrastructure.

During cloud cover, solar module output can decrease by 40%–80% within a few seconds, increasing just as dramatically when the sky clears.

9.14.1.5. HEAT WAVES

The heat waves are not often and significant in the summer season. As the temperature of the solar module increases, its output current increases exponentially, while the voltage output is reduced linearly. In fact, the voltage reduction is so predictable, that it can be used to accurately measure temperature. As a result, heat can severely reduce the solar panel’s production of power. Hence, if heat waves are more at any time, it may affect the efficiency of plant.

According to the Jharkhand Action plan on climate change (2014) has documented the detrimental effects of increasing maximum temperature over Jharkhand. The report stated that Jharkhand experienced the highest number of heat waves during 2000 to 2010.

9.14.1.6. STORMS AND DUST

The project area experiences very few storms each year. During these storms, the visibility never drops to an alarming level. However, occurrence of storms will have an adverse impact of deposition of dust on the solar modules, which however, can be managed by periodic cleaning.

There could be deposition of dust facilitated by higher wind speeds, which could affect the solar photovoltaic cell output. However, these are remote possibilities and a detailed modelling is required for assessment. At the same time, winds can also clear the air in the vicinity of the proposed FSPV project, affecting module efficiency and output.

9.15. Impacts on Aesthetics

The Project, after completion of its development, would consist of built structures, landscaped to give a pleasing outlook. The proposed FSPV site is not located close to any habitation area. There are no flight paths above the reservoir and at present no recreation or adventure sports are organised near the proposed FSPV site. Therefore, the sight of a large area covered with floating solar PV panels, is unlikely to have any significant adverse visual impact. The transmission towers and lines are there to stay for their entire life cycle. It is anticipated that these would have limited visual impacts on the inhabitants and visitors to the area.

9.15.1. Construction Phase Impacts

The impacts envisaged during the construction stage are more or less the same as those in the pre-construction stage. Plantation would have to be cleared in order to provide the clear sight distance and meet the geometric requirements of the FSPV installation. The ESMP will need to ensure the appropriate compensatory afforestation and landscaping along the corridor to mitigate adverse visual impacts.

9.15.2. Operation Phase Impacts

There would be no significant adverse visual impact due to operation of the project.

9.15.3. Mitigation Measures

The project site would be kept clean and tidy ata all times.

9.15.4. Residual Impact

There would be positive residual impact.

9.16. Impact on Road Safety

Road safety is moderately an issue of concern in all the three stages. The activity related to construction will have the likelihood of causing accidents if movement of vehicles is not managed properly. However, this risk is likely to be much less during the operation stage

9.16.1. Construction Phase Impacts

The construction activities and equipment movement during the construction stage may create hindrance to the effective carriageway and restrict the traffic flow. There might be cases of inconvenience due to the construction activities. However, such incidents could be minimized with the help of appropriate mitigation measures.

9.16.2. Operation Phase Impacts

No such issues related to road safety is expected to be encountered in the operation stage due to the envisaged low volume of traffic.

9.16.3. Mitigation Measures

The road condition would always be kept motorable and traffic marshals would be deployed at important points.

9.16.4. Residual Impact

Safety issues for local residents may be impacted due to increased traffic during construction. However, a robust plan may decrease the chances substantially. The roads to be used for the project site are well connected with the state and national highways.

9.17. Impacts on Socio-Economic Environment

Since no land is to be acquired for installation of floating solar panels over the reservoir and the nearest settlement is about 1 km away, no significant adverse impacts on the social environment are anticipated on account of installation of solar PV panels.

The project, however, requires right of way for the transmission line works. This would require taking over of private land. Any encroachments too need to be cleared prior to commencement of construction activities. The identified land for plant substation is government land and free from any encroachment. Thus, a direct socio-economic impact is envisaged relating to the RoW of transmission lines. An Indigenous People’s Plan (IPP) has been prepared and included in the RAP report, prepared separately

The transmission line corridor would require a fencing during the ground work throughout the length of the transmission lines to ensure community safety and security.

There is no requirement of new access roads. There is sufficient road network to access the site during construction and operation phase. There is no requirement of land for campsite as the workers would be taken locally or residing in the nearby villages.

The summary of social impacts is mentioned in the Table 58 below:

Sl No	Location	Affected Items and Population	Impacts
1.	Reservoir	Fishermen	A. 116 families doing fishing in the Getalsud reservoir. B. Impact on Livelihood during construction and operation phases C. Around 5 blocks are placed in the fishing area..
2.	FSPV and Grid Substation	Land Acquisition	D. 1 Ha land required in Getalsud village for FSPV substation has been allocated Free of Cost by Water Resources Deptt., Govt. Of Jharkhand. E. The Existing infrastructure of 132/33kV IRBA GSS would be utilized for Grid substation. No additional land required for the Grid substation
3.	Transmission Towers	Land Acquisition	F. 27Ha Land is required for RoW Corridor of Transmission Towers. G. Land Compensation @85% of guideline rates shall be paid for the tower footing area.
4.	Transmission Lines	Temporary disturbance during construction	• Temporary disturbance to their agricultural activities for a season during construction. • Risk of local communities and cattle to accidents during construction • Land Compensation @15% of guideline rates shall be paid for the RoW Corridor of 27m.
5.	Throughout the Project Area	Increased traffic on road infrastructure on Local Population	• No new haul road/access road has been proposed. • Generation of Noise, vibration and dust during material transport and other construction activities affectig local population • Road Safety risks will rise from increased traffic
6.	Throughout the Project Area	Stress on local resources Local Population	• Only 100 labours are to be engaged for construction work for 15 months. • There would be very small and temporary stress on local resources would be there.

Sl No	Location	Affected Items and Population	Impacts
7.	Throughout the Project Area	Impact on Indigenous People	• Additional assistance as per the Entitlement Matrix provided in this RAP.
8.	Throughout the Project Area	Impact on Vulnerable population	• Additional assistance as per the Entitlement Matrix provided in this RAP.

Table 57: Summary of Impacts during construction phase

9.17.1. Land acquisition

Land acquition is not proposed in the Project. Project substations is being planned on the Govt. Land. However, for laying of transmission line of length 10 km approx. from Project substation to 132/33kV grid substation Irba at Sikidri right to way will be secure as per the applicable Govt. guidelines.

9.17.2. Mitigation Measures

The R&R Plan has been prepared for affected persons.

9.17.3. Community facilities

Community facilities like electricity supply, health services, educational services, water resources, public transport, etc. get impacted due to influx of labour during the construction phase due to possible sharing of resources etc. It must be ensured that additional facilities are generated for the project on temporary basis.

9.17.4. Impact on reservoir based social activities

116 number of fishermen families are impacted. There is no recreation activity reported in the reservoir including tourism. The road on top of the embankment is used by local villagers which will be impacted for a short duration during plant construction.

There is an influx of labours during construction period. Only 100 nos. of labours are required for the project during construction. The local labours would be given preference in the construction phase. There would be minimal risk of inflation, social security and stress on local resources because the number is so small. The contractor is required to prepare a labour management plan to avoid any health and safety threat to the local community.

9.17.5. Residual Impact

The livelihood dependent on the project area is limited. The fishermen would do fishing as usual without much interruption after installation of FSPV in the reservoir. The tourism activities going on the reservoir may see an improvement.

The land would be acquired permanently for the substation and transmission tower construction. The temporary disturbance for stringing will take place at the time of construction.

9.18. Impacts during Decommissioning Phase

Since the project has to be implemented on the reservoir, it is extremely important to consider that if the solar modules, floats and other equipment are not handled or disposed of properly during the decommissioning phase, the toxic materials within the modules are likely to escape into the surrounding reservoir, air, water or soil, creating environmental and public health risks.

The key issues associated with the decommissioning phase will include:

- **Improper disposal of demolition waste and obsolete machinery will lead to contamination of soil, water, and discomfort of community.**
- **Decommissioning activities of dismantling or removing the solar PV modules and removing the ancillary facilities can lead to increased noise levels.**
- **Decommissioning activity is anticipated to generate dust and exhaust emissions which can be carried downwind to habitations.**
- **Risks associated with health and safety issues such as trip and fall, electrical hazard etc.**
- **Generation of broken panels which contains hazardous material.**
- **Contamination of drainage channels due to release of hazardous waste.**
- **During the dismantling or removing of the floating solar plant, with the removal of ancillary facilities, visual intrusions will be likely for short term.**
- **Modules, floats and associated equipment should be disposed of to the authorized vendors.**
- **It is to be ensured that dismantling is carried out during the non-monsoon season and all the drainage channels shall be kept intact.**
- **The associated mitigation measures as suggested for the construction phase should be referred.**

9.18.1. Impact on Ambient Air Quality

At the time of decommissioning of the project, it is expected that the activities will generate dust and exhaust emissions. Incinerating/damaging solar modules after decommissioning, as for electronic waste in general, is harmful to the environment because of the release of toxic heavy metals, such as lead, into the atmosphere. No incineration/damage would be allowed in any condition. Some of the materials contained in solar modules are known to be persistent and accumulative when released, which means long-term effects to humans, fauna and flora.

9.18.2. Impact on Noise Level

Noise would be generated due to decommissioning activities including dismantling of various components of FSPV and its associated infrastructure. The occupational health safety guidelines should be followed strictly during this stage. Negative impact is anticipated to be short term. The noise level would be kept below national standards for ambient noise for residential areas i.e, within 50 dB at all times during decommissioning.

9.18.3. Impacts on Water Resources and Quality

Impacts on reservoir water quality and the aquatic ecology are anticipated on account of dismantling of the structures, anchorage, access paths and other infrastructure facilities within the FSPV area. The decommissioning of the project shall have medium to short-term impact on the reservoir water quality. The impacts would be similar to those during the construction stage.

9.18.4. Impact of Solid Waste Generation

Photovoltaic systems (PV systems) do not produce any waste or emissions during the production of electricity. On the other hand, PV systems must be manufactured, installed and re-dismantled at the end of their useful life, which impacts the environment. The end of the photovoltaic modules lifetime is defined by a 20 % power drop from the original. Almost all manufacturers of commonly available crystalline and thin-film modules guarantee the maximum efficiency drop by 10 % for 10 or 12 years and 20 % for 25 years.

A considerable amount of solid waste would be generated during the decommissioning phase of the project. All the dismantled infrastructures and debris shall be segregated and stored separately with cover facility to negotiate with contamination effects of such wastes. Solid wastes should be disposed of safely in compliance to the Construction and Demolition (C&D) Waste Management Rules, 2016 of the Government of India.

For PV modules and associated waste, please refer the “Section 8.4: Environmental and Social Mitigation Matrix for FSPV” on the management plan for disposal and management of PV modules.

All components of PV module are either partially or fully recyclable. However, at present recycling of such materials in India is under development. It is expected that during de-commissioning phase, definitely the process of recycling infrastructure will be completed, and these PV panels would be recycled. However, other components like floaters, structures etc. shall be recycled through authorized vendor.

Up to 97 % of the materials used during the thin film PV modules manufacturing processes can be extracted and reused by thermal recycling. Recycling of silicon PV modules is more complicated because it is necessary to disassemble the modules mechanically or manually. Such a procedure involves removing the individual components and their subsequent reuse or crushing.

9.18.5. Impact on Soil and Land Use

The PV modules/ floats can generate pollutants leading to leaching of metals/ chemicals into the reservoir. The decommissioning activities are likely to have impacts on soil erosion due to demolition activities. Proper environmental protection measures would be adopted to prevent any adverse incidences. This phase will not create negative impact to the flora and fauna present in and around the site. Impact would be positive in the long term.

There is a chance of chemical spills during decommissioning of solar PV modules. Due care would be taken to avoid any spills on ground as well as the reservoir by employing suitable oil containment measures.

9.18.6. Impact on Social Environment

The likely socio-economic impacts during the decommissioning phase are as follows:

- Loss of permanent job (10 Nos. for operation) owing to decommissioning of the plant.
- There would be a negative impact on the economic activities of the surrounding population due to the decommissioning of the project.
- There would be a positive impact on account of the resource sharing like transportation (road), health services etc.

6. The proponent/ developer shall inform the workers and local community about the duration of work and inform about decommissioning in advance.
7. There is no provision for a campsite during O & M phase. The decommissioning of transmission line has not been proposed, as it may be used further by the power transmission agency for other project.
8. The power distribution is being taken care by State power grid authority and they will ensure availability of power from other sources in the area which are affected due to decommissioning of the project.
9. All necessary personal protection equipment (PPE) shall be used by the workers during demolition work. The developer has to ensure that all health and safety measures are in place to prevent accidents and reduce the consequences of non-conformance events.
10. A summary of social impacts in decommissioning phase are mentioned in the Table 59 below.

Sl No	Location	Affected Items and Population	Impacts
1.	Reservoir	Fishermen	H. 116 fishermen impacted on Livelihood
2.	FSPV and Grid Substation	Land Acquisition	I. ·No impact
3.	Transmission Towers	Land Acquisition	J. No impact as the transmission line is going to be retained and no decommissioning is proposed
4.	Transmission Lines	Temporary disturbance during construction	• The transmission line is going to be retained and no decommissioning is proposed

Sl No	Location	Affected Items and Population	Impacts
5.	Increased traffic on road infrastructure	Local Population	• Generation of Noise, vibration and dust during material transport and other construction activities affecting local population. • Road Safety risks will rise from increased traffic • ·After decommissioning the traffic near project sites would decrease
6.	Throughout the Project Area	Stress on local resources on Local Population	• Only 10-15 labours are to be engaged for decommissioning for 2-3 month. • There would be very negligible and temporary stress on local resources would be there.
7.	Throughout the Project Area	Impact on Indigenous People	• ·Some of the ST people would be employed for the decommissioning.
8.	Throughout the Project Area	Impact on Vulnerable population	• No impact on vulnerable population due to decommissioning.

Table 58: Summary of Impacts during de-commissioning phase

9.18.7. Impact on Biodiversity

Table 60 provides the different impacts of the proposed project on biodiversity during decommissioning phase.

Impact	Description	Type of impact	Decommissioning Phase
Loss of aquatic habitat	Permanent/ Temporary loss of aquatic habitat or species due to permanent or temporary site activities	Small	May be during decommissioning phase
Impact on surface diving Birds	Disturbance during to covering of reservoir surface with FSPV units.	Small	Temporary disruption due to decommissioning of FSPV.
Changes to aquatic habitat functionality	Changes to the physical and chemical dynamics of an aquatic environment that can result in modifications to the functionality of the habitat. The presence of floats, mooring and anchoring and related equipment would result in growth of biota in the long term. Decommissioning may damage the growth.	Moderate	Pertains to surface and sub-surface decommissioning
Loss of terrestrial habitat	Temporary or Permanent loss of terrestrial habitat or species due to permanent or temporary site activities.	Negligible	Transmission line would be retained

Impact	Description	Type of impact	Decommissioning Phase
Disturbance to or displacement of individual species Light, noise and vibration impacts	Temporary and permanent disturbance to, or displacement/exclusion of a species from foraging habitat due to construction activities, and operational and maintenance activities.	Negligible	Transmission line would be retained. Negligible impact on decommissioning of plant substation.
Barrier creation, fragmentation and edge effects	Permanent and temporary creation of barriers to the movements of animals, mammals, reptiles and amphibians and invertebrates and plants with limited powers of dispersal. Fragmentation of habitat, or permanent /temporary severance of wildlife corridors between isolated habitats of importance for biodiversity. Impacts that occur when a habitat is exposed to a different adjacent habitat type or structure. These impacts can include increased risk of parasitism or disease, increased risk of predation, adverse microclimate conditions (including drying out and subsequent fire risk), and competition from invasive species	Small	Transmission line would be retained.
Degradation of habitat Air Pollution Water pollution Invasive species Dumping of waste	Disturbance or damage to adjacent habitat and species caused by changes in microclimate, vulnerability to predation and invasion and overall changes in conditions that can lead to a change in the community and its values for flora and fauna. This can include increased exposure to noise, light and dust. Introduction or spreading of alien species during the construction works.	Small	During decommissioning phase, there may be impact on local fauna and avi-fauna
Mortality – vehicle strike, fishing and poaching	Mortality of individual fauna species as a result of vehicle or machinery strike or falling debris during clearing activities. Mortality to individual fauna species as a result of worker influx and hunting/poaching of extant fauna	Negligible	The project does not involve recreational aspects. However, due to in-situ activities during construction, there may be unintentional mortality.
Impact to ecosystem services	Impacts to high and medium priority ecosystem services provided to local people, including fishing, provisioning, regulating and cultural services.	Medium	Transmission line would be retained. Negligible impact on decommissioning of plant substation.

Table 59: Biodiversity impact during decommissioning phase

10. ANALYSIS OF ALTERNATIVES

In this section, the alternatives on location and transmission line routes have been analysed for the proposed project. Alternatives that differ in environmental and social impact may be found at several levels in planning.

10.1. Preferred location for the project

The proposed plant would be located on Getalsud reservoir. Figure 28 below shows the Getalsud reservoir and the proposed location of the FSPV plant within the reservoir.

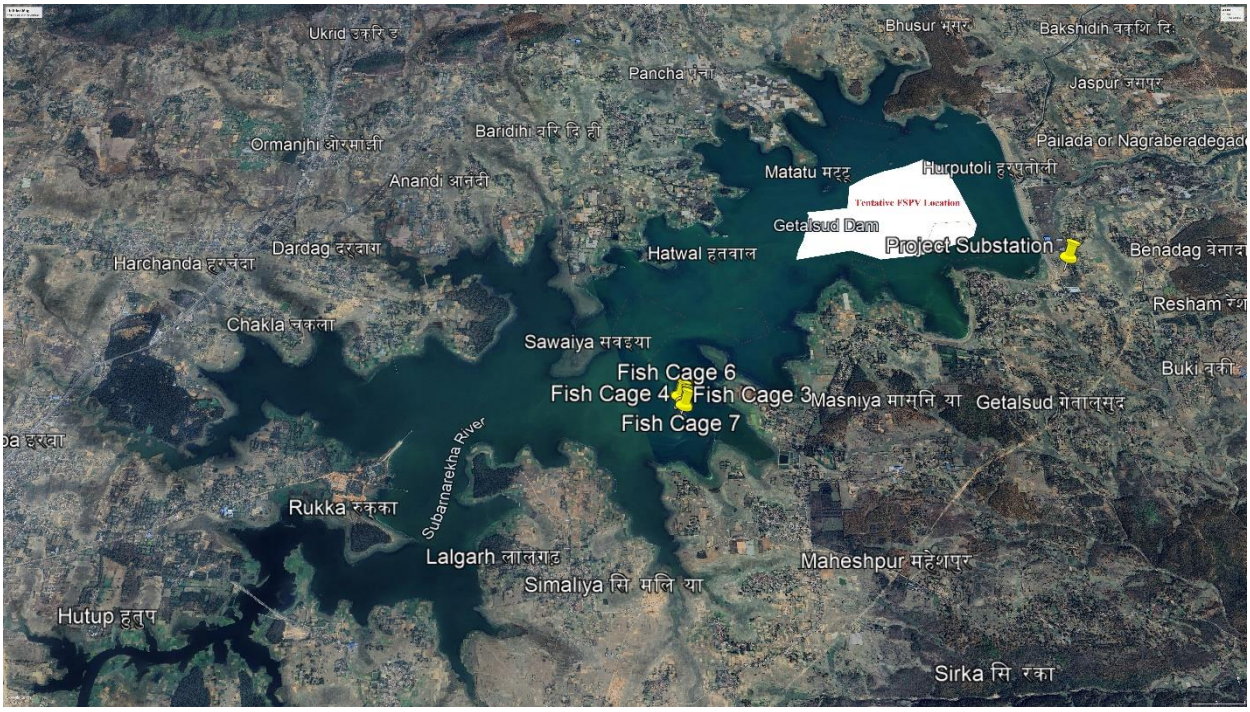


Figure 28: Proposed FSPV siting project location

10.2. Site Suitability and Justification of Project

Following analysis describes the site suitability for the solar PV power plant development, which includes:

Solar radiation at the site: Solar radiation map of India indicates that project site receives a global horizontal irradiation (GHI) is 1715 kWh/m2/year, which is favourable for most of the solar PV plants.

Topography: The project site is the water body. Hence, apart from varying height of small waves, topography of the site is flat in nature and require no such adjustment. Installation is easy due to its modular construction, which reduces cost.

Substation proximity: The proposed floating solar power plant will be connected to 132KV plant substation at Getalsud village which is government land. 100 MW power will be evacuated through 132kV double circuit transmission line to the upcoming 132/33kV grid substation Irba at Sikidri, which is only 10kM away from Plant substation.

Accessibility: The FSPV site is well connected through roadways.

Environmental Aspects: The FSPV site is not located close to any environmentally sensitive areas. The nearest wildlife protection area viz. Betla National Park is situated 250 km away from the Getalsud reservoir where the floating solar panels are to be installed. No threatened or endangered species have been reported to exist close to or within the reservoir. The nesting ground of some of the birds found in the study area is located at a safe distance from the periphery of the FSPV site over the reservoir.

The solar panels shall cover a very small surface of the reservoir (9.2%) and therefore, the impacts on reservoir water quality and on the aquatic ecology of the reservoir are likely to be very limited in nature and magnitude.

The land identified for plant substation is privately owned agricultural land. The identified land is an open land covered with shrubs and bushes (See Figure 29 below). The plant substation land is not a habitat for any flora or fauna of significance.

Figure 29: Location of Plant Substation

Socio-economic Aspects: The FSPV site is located 1-3 km away from the nearest settlement. There is no physical displacement on account of FSPV location. A variety of fish species are found in the Getalsud reservoir, the commercial fishing activity in the reservoir has been carried out by the local population. The fishing activity in the Getalsud reservoir has been carried out by at least 116 families involving nearly 467 people. The site is under use for tourism or recreational purposes on a minor scale.

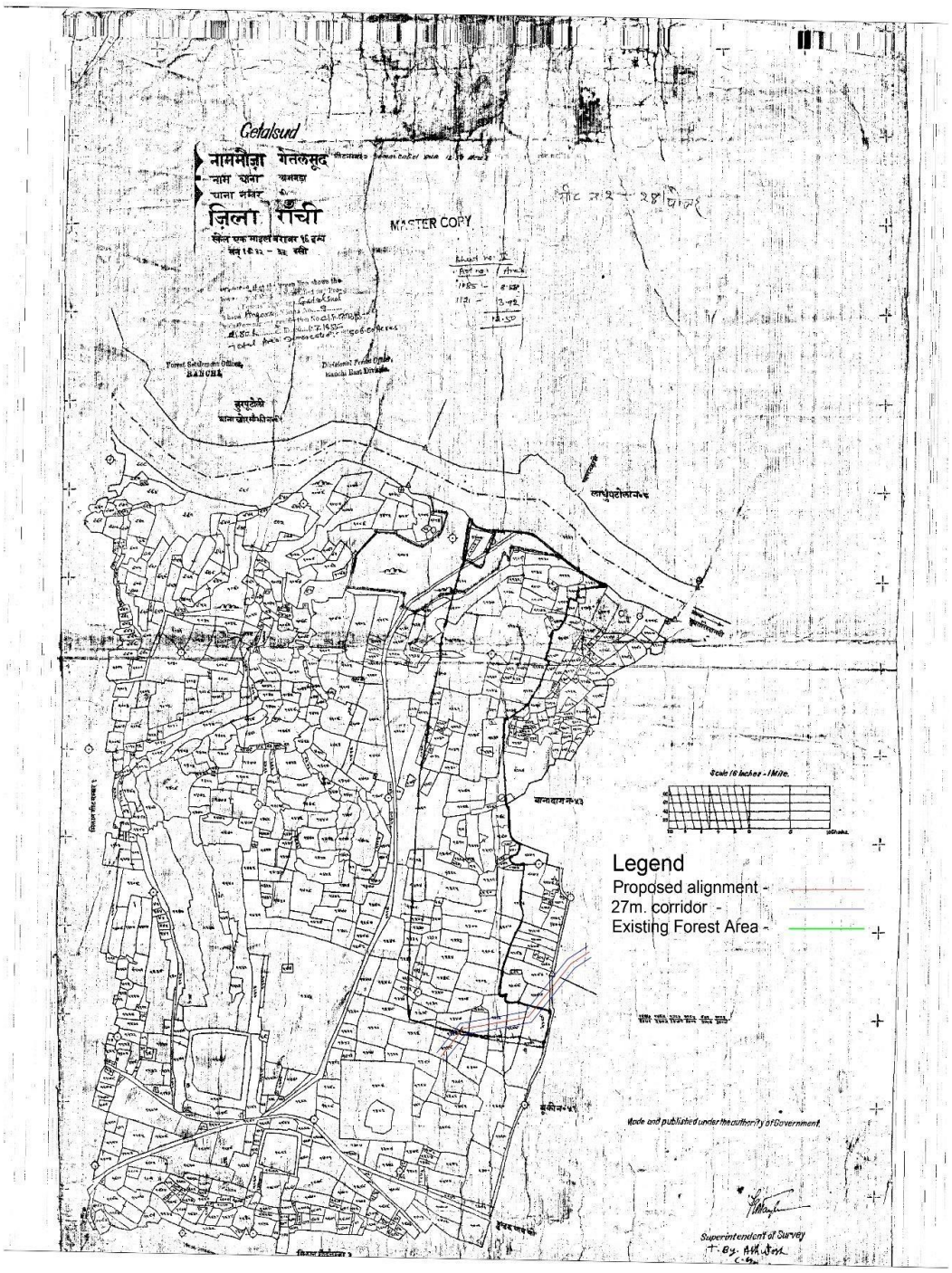
The existing layout scheme partially overlap with one of the major fishing area. Figure 30 below shows the FSPV layout and affected fishing areas marked in red blocks. It may be noted that the for setting up 100 MW of FSPV plant an area of approx. 120 Ha will be required. FSPV plant shall be setup in location where water depth of more than 2 m will be available throughout the year. Considering this, tentative FSPV location (area approx. 200 Ha) is being marked in Figures 28, 29 and 30.

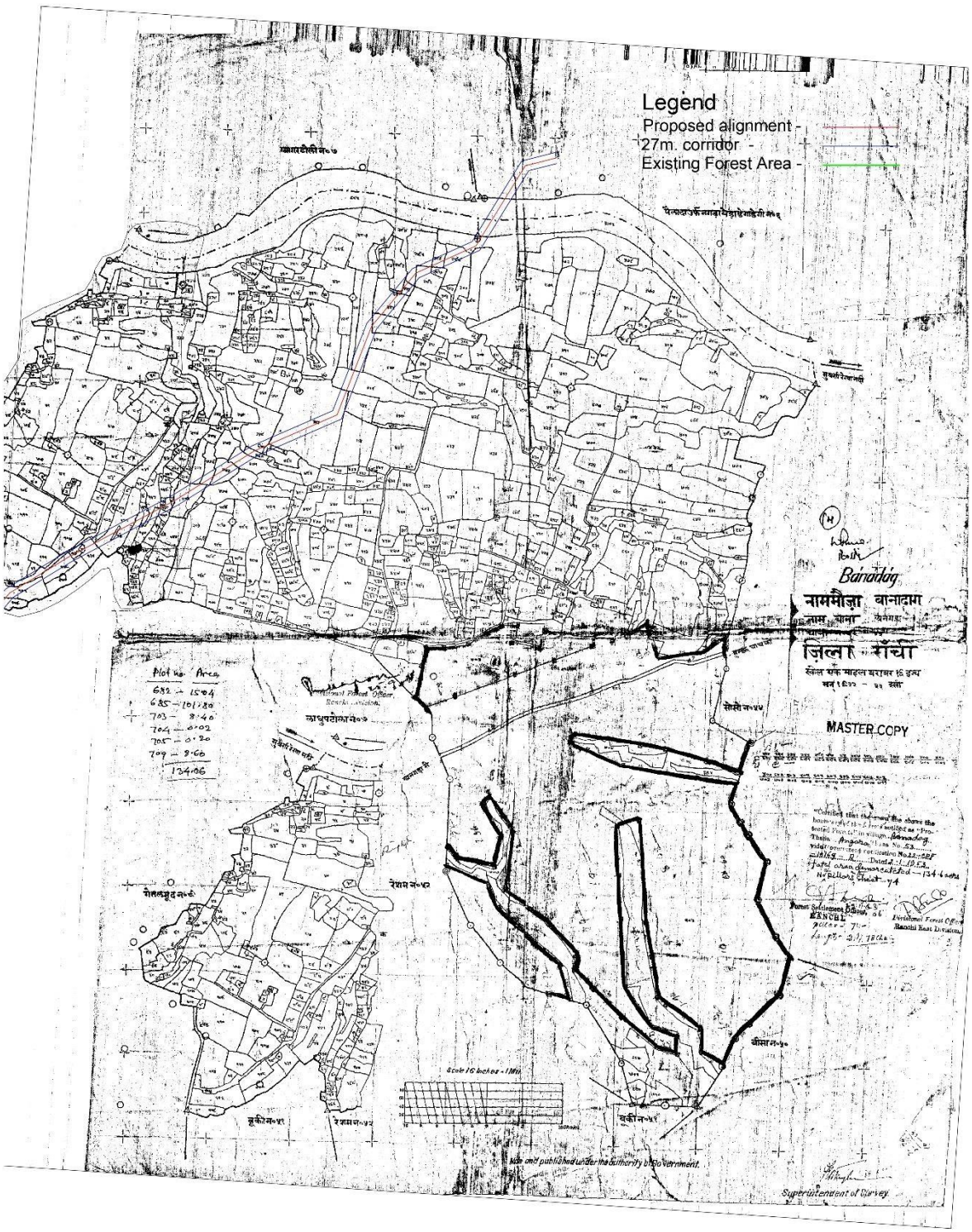
Further, during the discussion with Fishery Department it was gathered that in the getalsud reservoir, fish cages are being installed near shore at shollow depths only. Location where fish cages, provided by Fishery Department to local people, are being installed are marked in Figure 30 for reference.

Figure 30: Proposed location for Sub Station with Fishing Area

10.2.1. 132kV double circuit transmission line to the upcoming 132/33kV grid substation Irba at Sikidri

100 MW will be evacuated through this transmission line. The tentative route has been plotted upon the Forest maps of the region. The route proposed does not liein any area which is owned by the Forest Department.

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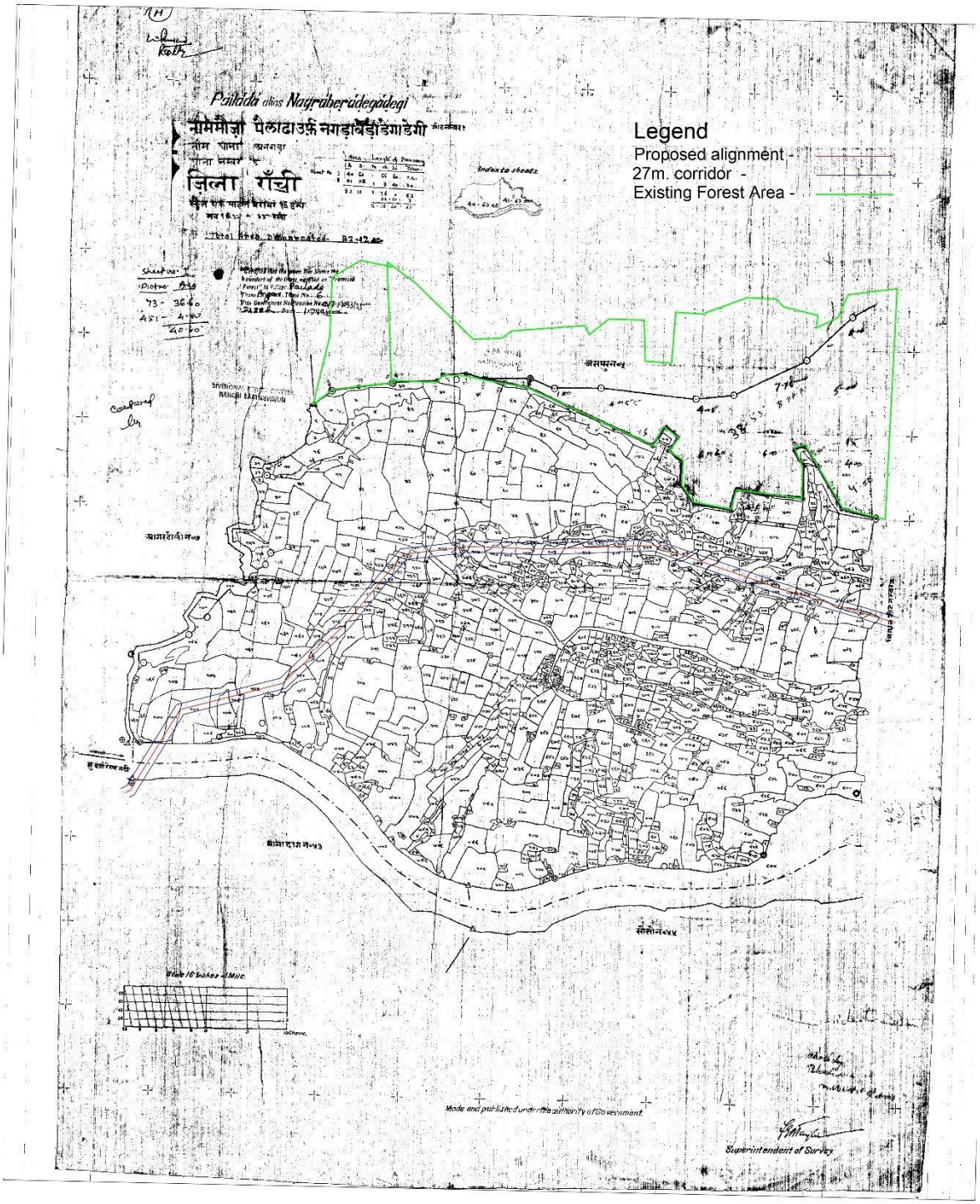
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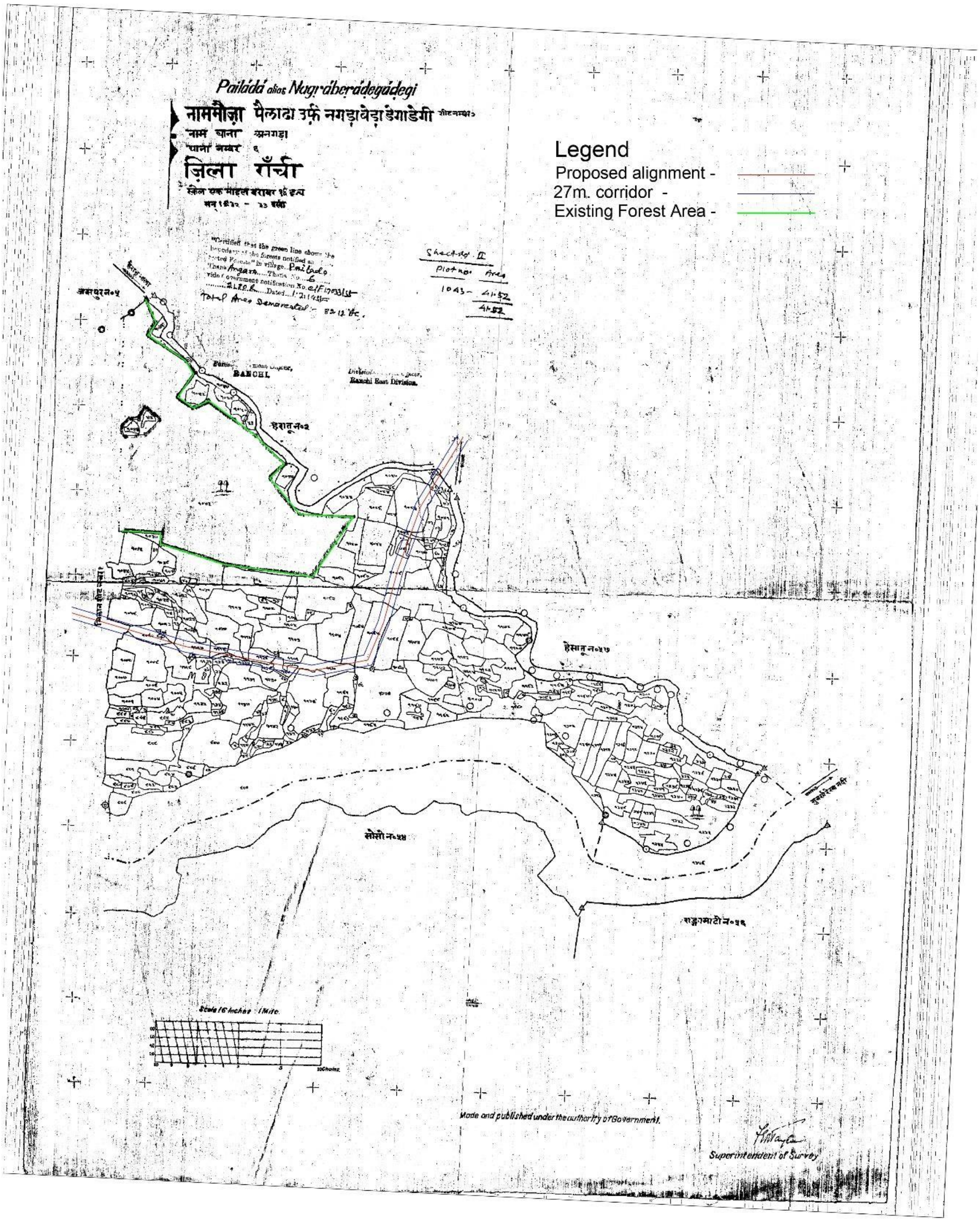

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Ranchi East Division.
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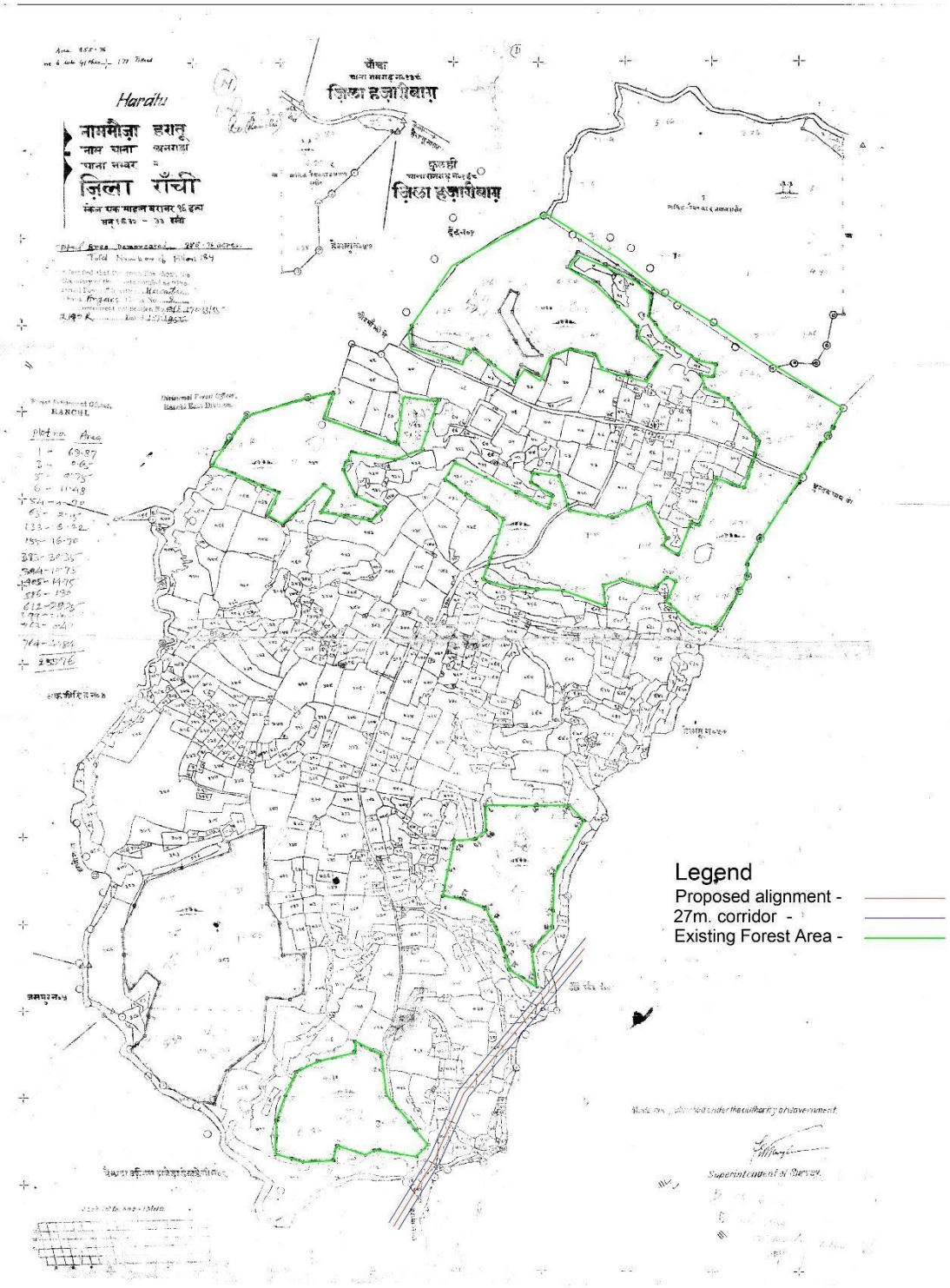
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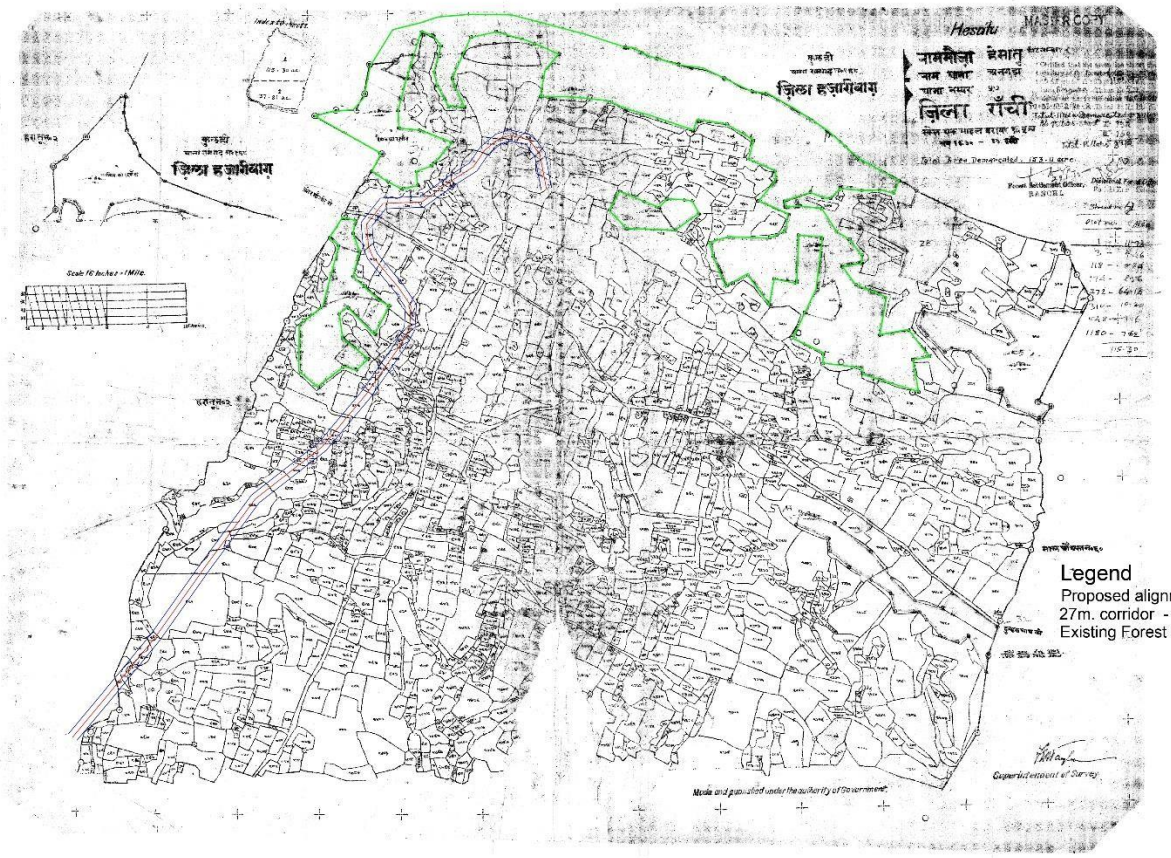
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Superintendent of Survey

11. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

11.1. Introduction

The Environmental and Social Management Plan (ESMP) consists of a set of mitigation, monitoring and institutional measures to be taken during the design, construction, operational and decommissioning stages of the project to eliminate adverse environmental impacts, to offset them, or to reduce them to acceptable levels. The plan also includes the action needed for implementation of these measures.

The major components of the Environmental and Social Management Plan are:

- **Mitigation of potentially adverse impacts.**
- **Monitoring during project implementation and operation.**
- **Institutional capacity building and training.**
- **Implementation schedule and environmental cost estimates; and**
- **Integration of ESMP with project planning, design, construction and operation.**

11.2. Objectives of the ESMP

The main aim of the Environmental and Social Management Plan is to ensure that the various adverse impacts are mitigated, and the positive impacts are enhanced. Objectives of the ESMP at various stages of the project planning and implementation are as follows:

11.2.1. Design Phase

- **To keep land acquisition and building demolition at a minimum.**
- **To develop a design that incorporates environmental and social safeguards; and**
- **To provide mitigation measures to all anticipated adverse environmental and social impacts due to the project.**

11.2.2. Construction Phase

- **To prevent and reduce the adverse environmental and social impacts of the project by implementing mitigation measures; and**
- **To ensure that the provisions of the ESMP are strictly followed and implemented by strengthening implementation arrangements.**

11.2.3. Operation Phase

- **To prevent deterioration of environment components of air, water, soil, noise at project site and the reservoir etc.**
- **To improve the safety of the local communities**

11.2.4. Decommissioning Phase

- **To prevent deterioration of environment components of air, water, soil, noise at project site and the reservoir etc.**
- **To restore the pre project condition of the site.**

11.3. Environmental and Social Mitigation Matrix

Considering the fact that certain environmental and social impacts are unique to a floating solar PV project as compared to a land based solar PV project, the environmental and social mitigation matrix as presented in this chapter has been divided into two sections – one dealing with FSPV part of the project and another devoted to the associated facilities such as the plant sub-station and the transmission lines.

Section 7.3 deals specifically with ESMM relating to the FSPV over Getalsud reservoir, while Section 7.4 deals with the ESMM for sub-station and transmission lines.

11.3.1. Environmental and Social Mitigation Matrix (ESMM) for FSPV

The Environmental and Social impact and mitigation are presented in the Table 61 below.

Environmental and Social Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
PRE-CONSTRUCTION AND CONSTRUCTION STAGE				
Land Acquisition, R&R	Land has been identified for floating solar systems. The project has to come on the reservoir belongs to Water Resource Dett. GoJ.	Water Resources Department, Government of Jharkhand	SECI	SECI
Dam safety	SECI has to ensure that the project is planned at a safe distance from the embankment to ensure safety of the Dam	Water Resources Department, Government of Jharkhand	SECI	SECI thorugh Water Resources Department, Government of Jharkhand
Relocation of Cultural Property Resources (Throughout the Project Area)	No relocation suggested in the planning stage. Although the recreation area has been identified on the Getalsud Reservoir which is nearly 1-3 kms away from the FSPV site.	District administration	SECI	SECI

Environmental and Social Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
Construction Vehicles, Equipment and Machinery	All vehicles, equipment and machinery to be procured for construction will confirm to the relevant Bureau of India Standard (BIS) norms. The discharge standards promulgated under the Environment Protection Act, 1986 will be strictly adhered to. Noise limits for construction equipment to be procured such as compactors, rollers, front loaders concrete mixers, cranes (moveable), vibrators and saws will not exceed 75 dB (A), measured at one meter from the edge of the equipment in free field, as specified in the Environment (Protection) Rules, 1986.	Regional Transport Office for vehicles and State Pollution Control Board for environmental compliance	Contractor	SECI
Identification and Selection of Material Sources				
Procurement of the Project components	The best available environment friendly technology and components are selected for the project	Dept of MNRE, Govt. of India	SECI	SECI
Construction Materials	The Contractor will not start borrowing earth from any borrow area until the formal agreement is signed between landowner and Contractor.	Jharkhand Mining Department and State Pollution Control Board.	Contractor	SECI
Stone chips	The Contractor will obtain necessary permission for procurement of materials from Jharkhand Mining Department and State Pollution Control Board. Contractor will also work out haul road network and report to Environmental Expert who will inspect and in turn report to SECI before approval.	Jharkhand Mining Department and State Pollution Control Board.	Contractor	SECI
Arrangement for Construction Water	The Contractor will source the requirement of water essentially from water supplied by Municipal bodies and cannot use the ponds, which are in use by community. The Contractor will not be allowed to pump from the surface water bodies used by community. In that case, before using any pond water Contractor will inform the owner. To avoid disruption / disturbance to other water users, the Contractor will extract water from fixed locations and consult the Environmental Expert before finalizing the locations.	Water Resources Department and State Pollution Control Board.	Contractor	SECI

Environmental and Social Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
	The Contractor will need to comply with the requirements of the State Ground Water Board and seek their approval for doing so, if inevitable.			
Labour Requirements	The Contractor will use unskilled labour drawn from local communities to avoid any additional stress on the existing facilities (medical services, power, water supply, etc.)	Department of Labour, Government of Jharkhand	Contractor	SECI
Construction Camp Locations- Selection, Design and Layout	There is no requirement of the labour camp as only 50 labours are required for construction period. In case if construction camp is required the siting of the construction camps to be as per the guidelines presented below: Construction camps will not be proposed within 1000 m from the nearest settlements to avoid conflicts and stress over the infrastructure facilities with the local community. Location for stockyards for construction materials will be identified at least 1000 m from water courses. The waste disposal and sewage system for the camp will be designed, built and operated such that no odour is generated. Unless otherwise arranged by the local sanitary authority, arrangements for disposal of night soils (human excreta) suitably approved by the local medical health or municipal authorities or as directed by Environmental Expert of SECI will need to be provided by the Contractor. If evacuation lines are being installed underwater, then appropriate measures to avoid electrocution need to be installed.	SECI	Contractor	SECI
Batching Plant Locations	Batching plants, if any, will be sited sufficiently away from settlements and agricultural operations or any commercial establishments. Such plants will be located at least 1000 m away from the nearest village settlements preferably in the downwind direction. Only 100 cum concrete is required for the project.	Jharkhand State Pollution Control Board.	Contractor	SECI
Site Access				

Environmental and Social Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
Accessibility	The Contractor will provide safe and convenient passage for vehicles, pedestrians and livestock of the Matatu, Getalsud and other nearby settlements to and from roadsides and property accesses connecting the project area.	RTO, Jharkhand	Contractor	SECI
Water				
Water Pollution from Construction Wastewater	The Contractor will take all precautionary measures to prevent the wastewater during construction from entering directly into streams, water bodies or the irrigation system.	State Pollution Control Board	Contractor	SECI
Siltation of Water Bodies and Degradation of Water Quality	Contractor will ensure that construction materials containing fine particles stored in an enclosure such that sediment-laden water does not drain into nearby watercourse.	Water Resources Department, Government of Jharkhand	Contractor	SECI
Water Pollution from Fuel and Lubricants	Contractor will ensure that all vehicle/machinery and equipment operation, maintenance and refuelling will be carried out in such a fashion that spillage of fuels and lubricants will be minimized and does not contaminate the water body. Oil interceptor will be provided for vehicle parking, wash down and refuelling areas. Contractor will arrange for collection, storing and disposal of oily wastes to the approved disposal sites. All spills and collected petroleum products will be disposed of in accordance with MoEF&CC and Jharkhand PCB guidelines.	Jharkhand State Pollution Control Board	Contractor	SECI
Maintaining minimum levels in the reservoir	Contractor will ensure that the work is undertaken only when minimum water level in the reservoir is maintained as directed and agreed by the irrigation department.	Water Resources Department, Government of Jharkhand	Contractor	SECI
Water Pollution Due to installation of Solar PV in the reservoir	Contractor will ensure that all machinery and equipment operation, maintenance and refuelling will be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the Getalsud reservoir.	Water Resources Department, Government of Jharkhand / JSPCB	Contractor	SECI
Air				

Environmental and Social Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
Emission from Construction Vehicles, Equipment and Machineries	Contractor will ensure that all vehicles, equipment and machinery used for construction are regularly maintained and confirm that pollution emission levels comply with the relevant requirements of Jharkhand State PCB. The Environmental Expert of SECI will be required to inspect regularly to ensure the compliance of ESMP.	Jharkhand State Pollution Control Board	Contractor	SECI
Noise and Vibration				
Noise and Vibration from Vehicles, Batching Plant and Equipment	The Contractor will conform to the following: All plants and equipment used in construction shall strictly conform to the MoEF&CC/CPCB noise standards. All vehicles including the floating vessels and equipment used in construction will be fitted with exhaust silencers.	Jharkhand State Pollution Control Board	Contractor	SECI
Health and Safety				
Personal Safety Measures for Labours/Staff	Contractor will provide: Protective footwear and protective goggles to all workers employed on mixing asphalt materials, cement, lime mortars, concrete etc. Welder's protective eye-shields to workers who are engaged in welding works. Protective goggles and clothing to workers engaged in stone breaking activities and workers will be seated at sufficiently safe intervals. Earplugs to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation. The Contractor will not Employ any person below the age of 18 years for any work. The Contractor will also ensure that no paint containing lead or lead products is used except in the form of paste or readymade paint. Contractor will provide facemasks for use to the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.	Department of Labour, Government of Jharkhand	Contractor	SECI

Environmental and Social Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
	All relevant provisions of the Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 will be adhered to. The Contractor will comply with all the precautions as required for the safety of the workmen as per the International Labour Organization (ILO) Convention No. 62. The Contractor will comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.			
Risk from Electrical Equipment	The Contractor will take adequate precautions to prevent danger from electrical equipment i.e. no material will be so stacked or placed as to cause danger or inconvenience to any person or the public. All necessary fencing and lighting arrangements shall be made in order to protect the public and the workers from accidents and injury. All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provision.	Building and other Construction Workers (Regulation of Employment and Conditions of Services) Act, 1996	Contractor	SECI
Risk of Boat Operation	To mitigate safety hazards relating to boat operations, following measures should be adopted during construction and operation phases: 1. The boats to be used should be in accordance with the best design available for suitability of operation in reservoirs. 2. Only adequately trained operators should be engaged for operation of boats. 3. Adequate training should be provided to all personnel engaged in construction and operation of the plant for operation till depths of 50 meter.	Water Resources Department, Government of Jharkhand	Contractor	SECI

Environmental and Social Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
	4. Adequate lifesaving kits should be made available to all personnel vulnerable to hazards relating to working in a water body. 5. A hooter and siren system should be in place. 6. Wireless communication should be provided to the team.			
Risk of Drowning	Contractor will provide all required safety gear to protect workers from drowning at all times when working in or over the reservoir.	Department of Labour, Government of Jharkhand	Contractor	SECI
First Aid	The Contractor will arrange for a readily available first aid unit including an adequate supply of sterilized dressing materials and appliances at every work site. Suitable transport/Ambulance to be provided at site to take injured or sick person(s) to the nearest hospital at Ormanjhi. In case of major injury the person is to be taken to Ranchi, the district headquater. Equipment and trained nursing staff at every workplace and construction premise.	Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996	Contractor	SECI
Emergency Preparedness and Management	The Contractor will take all reasonable precaution to prevent danger of the workers and public from fire, flood, drowning etc. The Contractor will keep emergency arrangement so that in case of any mishap all necessary steps can be taken for prompt evacuation and treatment.	Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996	Contractor	SECI
Additional Occupational Health Facilities				
Accommodation, Water and Sanitation Facilities	The Contractor will provide the facilities within the precincts of every workplace, latrines and urinals in an accessible place, and the accommodation, as per standards set by the Building and other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996.	Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996	Contractor	SECI

Environmental and Social Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
	The Contractor will construct and maintain all temporary accommodation in such a fashion that uncontaminated water is available for drinking, cooking and washing. The Contractor will also guarantee the followings: Supply of sufficient quantity of potable water (as per IS 10500) in every workplace/labour campsite at suitable and easily accessible places and regular maintenance of such facilities. If any water storage tank is provided that will be kept at a distance of not less than 15 m. from any latrine, drain or other source of pollution. If water is drawn from any existing well, which is within close proximity of any latrine, drain or other source of pollution, the well will be disinfected before water is used for drinking. All such wells will be entirely covered and provided with a trap door, which will be dust proof and waterproof. A reliable pump will be fitted to each covered well. The trap door will be kept locked and opened only for cleaning or inspection, which will be done at least once in a month. Testing of drinking water will be done every month as per parameters prescribed in IS 10500:1991.			
Sanitation and Sewage System	The Contractor will ensure that the sanitary system for the camp are designed, built and operated in such a fashion that no health hazards occurs and no pollution to the air, ground water or adjacent water courses take place. Separate latrine and urinals, screened from those from men (and marked in the vernacular) are provided for women. Adequate water supply is there to all latrines and urinals. All latrines in workplaces are with dry-earth system (receptacles) which are cleaned daily and at least twice during working hours and kept in a strict sanitary condition.	Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996	Contactor	SECI

Environmental and Social Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
	Night soil is disposed of by putting layer of it at the bottom of a permanent tank prepared for the purpose and covering it with 15 cm. layer of waste or refuse and then covering it with a layer of earth for a fortnight.			
Waste Disposal	The waste should not be dumped or spilled in the reservoir at any circumstances. All the workers and staff should be sensitized on this issue. The Contractor will provide garbage bins in the premises and regularly Emptied and disposed of in a hygienic manner as per the comprehensive Solid Waste Management plan for the labour/ Contractor's premise approved by the Environmental Expert of SECI. Contractor will follow all relevant provisions of the Factories Act, 1948 and the Building and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for construction and maintenance of labour camp. The Contractor will make arrangement for disposal of night soil by composting at the workplace unless otherwise arranged by the local sanitary authority. The composting of night soil will be done as per direction of Environmental Expert of SECI. The Contractor will also ensure that on completion of the work, all temporary structures are cleared, all rubbish are disposed according to suitable management methods, night soil or other disposal pits or trenches filled in and effectively sealed off. The site will be left clean and tidy, at the Contractor's expense, to the entire satisfaction to the Environmental Expert of SECI. The municipal waste would be collected by the local municipality and disposed of at a waste management facility. The hazardous waste thus segregated would be sold to a vendor authorized by the State Pollution Control Board for handling and disposal in accordance with hazardous waste management rules.	Solid Waste Management Rules, 2015, Municipal Solid Wastes (Management and Handling) Rules, 2000 and Construction and Demolition Waste Rules, 2016	Contractor	SECI

Environmental and Social Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
Ecology				
Terrestrial Ecology	The Contractor will take reasonable precaution to prevent his workmen or any other persons from removing and damaging any flora (plant/vegetation) and fauna (animal) including fishing in the water body and hunting of any animal. If any wild animal is found near the construction site at any point of time, the Contractor will immediately upon discovery thereof acquaint the Environmental Expert of SECI and report to the nearby forest office (forest range office or divisional forest office) and will take appropriate steps/ measures, if required in consultation with the forest officials.	State Forest Dept,, Government of Jharkhand	Contractor	SECI
Physico chemical Characteristics of Reservoir	Reduced light penetration the reservoir during this period may have overall effect of reducing water body temperature, primarily by reducing the heating effect of the sun, making thermal stratification less likely. This should be taken care during construction by minimizing the hindrances during installation. Wind blowing over the surface of a water body results in oxygen exchange and any surface installation that covers the lake surface may interfere with this process, due to the presence of a physical barrier to gaseous exchange. This could be taken care of by regular monitoring and clearing of unwanted materials from the reservoir surface. The lack of mixing has the potential to increase the risk of stratification and harm aquatic biota, including through pollutant release from sediment due to lack of oxygen at depth. Whenever this condition appears the alarm should be raised, and additional mixing might be considered during construction.	Water Resources Department, Government of Jharkhand	Contractor	SECI
Reservoir Ecology	The reservoir ecology may be impacted due to operation of the floating vessel. The contractor shall prefer the manual boat instead of power/motorboat to avoid turbulence in the reservoir.	State Forest Department / Chief Wildlife Warden	Contractor	SECI

Environmental and Social Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
	Unnecessary accumulation of the floating material should be avoided to allow the regular light penetration and in turn reducing the productivity of the reservoir. The benthic species habitat may occur as a result of anchoring the PV array. Due attention should be given while anchoring the PV array. The use of fencing and hoarding is to be kept to a minimum around construction sites to allow free movement to the dependent species of the reservoir.			
Poaching and Fishing	The contractor has to ensure that no person is involved in hunting of avifauna, fishing and poaching. Adequate measures should be taken to prevent the same.	State Fisheries Department, Government of Jharkhand	Contractor	SECI
Disturbance to birds	The birds feed on crustaceans and fishes. Therefore, all activities should be confined to designated work area and no hindrance should be created in areas lying outside of the designated work area. Also, the portion of the reservoir that is not required for the project should be kept free from all hindrances. There should be no illumination at night in order to prevent the birds from getting attracted towards the work area so that the possibility of the birds getting injured is minimized.	State Forest Department / Chief Wildlife Warden	Contractor	SECI
Environmental Monitoring				
Monitoring of Environmental Conditions	The Contractor will undertake periodic monitoring of air, water, noise, soil quality and aquatic ecology through MoEF&CC approved monitoring agency. The parameters to be monitored, frequency and duration of monitoring as well as the locations to be monitored will be as per the monitoring plan presented in the next section.	MoEF&CC and JSPCB	Contractor	SECI
Community Participation				

Environmental and Social Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
Continuous Community Participation	The consultations were carried out through Focus Group Discussions (FGDs) and meetings with the PAPs as well as the general public in the project villages. Public discussions were conducted at important points, where people could assemble in large numbers. Panchayat members were contacted to inform the people. SECI will have continuous interactions with local people around the project area to ensure that the construction activities are not causing undue inconvenience to the locals residing in the vicinity of project site under construction due to noise, dust or disposal of debris etc.	SECI	Contractor/SECI	SECI
Operation Phase				
Environmental and Social Monitoring				
Reservoir Water Quality, Aquatic Ecology and Avi-fauna	SECI shall provide for engagement of a suitable agency to monitor the reservoir water quality, the status of aquatic ecology and the impacts, if any, on the avi-fauna visiting the reservoir during different seasons of the year.	State Pollution Control Board / State Fisheries Department	O & M Contractor	SECI
Municipal Solid Waste Management	Proper disposal to the nearest MSW facility.	State Pollution Control Board	O & M Contractor	SECI
Hazardous waste management	Proper disposal through the authorized recyclers.	State Pollution Control Board	O & M Contractor	SECI
Disposal of Solar PV Modules	As per MNRE's guidelines for setting up grid-connected solar power plants, the onus of disposal of module waste rest on the developers themselves and are expected to dispose of the PV modules in accordance with the 'E-waste Rules, 2016' notified by the central government. However, there is no specific regulation for solar module waste disposal or its recycling in India. The E-waste rules make no mention of solar PV waste.	MoEF&CC	O & M Contractor	SECI
Safety of Workers	SECI shall ensure that adequate safety arrangements are put in place to prevent workers and staff from accidents and injury. This will require special attention with respect to prevention against falling and drowning into the reservoir while carrying out the O & M activities.	Department of Labour, Government of Jharkhand	O & M Contractor	SECI

Environmental and Social Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
Community Health and Safety	Access to the FSPV area shall be adequately regulated to prevent unauthorized entry that may cause accidents and injury. Appropriate signage should be put around the regulated area to prevent instances of accidental entry into the regulated area.	SECI	O & M Contractor	SECI
Orientation of Implementing Agency and Contractor's Personnel	SECI shall organize orientation sessions during all stages of the project. The orientation session shall involve all staff of Environmental Cell including the field level implementation staff and the O & M Contractor's personnel.	SECI	O & M Contractor	SECI
Pollution Monitoring	The periodic monitoring of the ambient air quality, noise level, water (both ground and surface water) quality, soil pollution/ contamination in the select location as suggested in pollution monitoring plan in ESMP will be responsibility of SECI. SECI will monitor the operational performance of the various mitigation / enhancement measures carried out as a part of this project. Status of rehabilitation of borrow areas and utility of double glazing for noise sensitive receptors. SECI/Contractor will appoint CPCB/MoEF&CC approved pollution monitoring agency for this purpose.	Jharkhand State Pollution Control Board	Contractor/ SECI	SECI

Table 60: Environmental and Social Management Matrix for proposed FSPV project at Getalsud reservoir

11.3.2. Environmental and Social Mitigation Matrix (ESMM) for Substation and Transmission line

The environmental and social mitigation matrix as part of Environmental and Social Management Plan provides mitigation measures with reference authority along with implementation and responsible authorities. The ESMM is provided in Table 62 below.

Environmental Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
PRE-CONSTRUCTION AND CONSTRUCTION STAGE				
Land acquisition, R&R (throughout the project corridor)	No Land acquisition is proposed. However, compensation for Right of Way for transmission line shall be made as per provision provided in RAP prepared for the Project.	District Magistrate/ Collector	SECI / Contractor	SECI
Clearance of Encroachment/ Squatters	Advance notice, as per RAP shall be given to the encroachers and squatters which need relocation. Entitlements shall be decided as per State Government's entitlement framework and in accordance with the World Bank / E&S Framework. All payment of compensation shall have to be completed before construction starts. The livelihood restoration would be an important aspect of the R&R implementation. the details of Livelihood restoration plan is provided in Chapter 11 of RAP.	District Magistrate/ Collector	SECI	SECI
Tree Cutting (Throughout the Project Corridor)	Although there is no tree has been identified for removal. If necessary, the trees will be cut as per guidelines of MoEF&CC and State Forest Department.	State Forest Department, Government of Jharkhand	Contractor	SECI
Dam safety	SECI has to ensure that the project is planned at a safe distance from the embankment to ensure safety of the Dam	State Irrigation Department, Government of Jharkhand	SECI	SECI
Relocation of Community utilities (Throughout the Project Area)	All such Community utilities, if required will be relocated as per Govt of Jharkhand rules.	District administration	SECI	SECI
Relocation of Cultural Property Resources (Throughout the Project Area)	No relocation suggested in the planning stage.	District administration	SECI	SECI
Crushers, and Batching Plants	Specifications of crushers, hot mix plants and batching plants will comply with the requirements of the relevant current emission control legislations.	State Pollution Control Board	Contractor	SECI
Other Construction Vehicles, Equipment and Machinery	All vehicles, equipment and machinery to be procured for construction will confirm to the relevant Bureau of India Standard (BIS) norms. The discharge standards promulgated under the Environment Protection Act, 1986 will be strictly adhered to. Noise limits for construction equipment to be procured such as compactors, rollers, front loaders concrete mixers, cranes (moveable), vibrators and saws will not exceed 75 dB (A), measured at one meter from the edge of the equipment in free field, as specified in the Environment (Protection) Rules, 1986.	Regional Transport Office for vehicles and State Pollution Control Board for environmental compliance	Contractor	SECI
Identification and Selection of Material Sources				

Environmental Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
Construction Materials	The Contractor will not start borrowing earth from any borrow area until the formal agreement is signed between landowner and Contractor.	Jharkhand Mining Department and State Pollution Control Board.	Contractor	SECI
Stone chips	The Contractor will obtain necessary permission for procurement of materials from Jharkhand Mining Department and State Pollution Control Board. Contractor will also work out haul road network and report to Environmental Expert who will inspect and in turn report to SECI before approval.	Jharkhand Mining Department and State Pollution Control Board.	Contractor	SECI
Arrangement for Construction Water	The Contractor will source the requirement of water essentially from water supplied by Municipal bodies and cannot use the ponds, which are in use by community The Contractor will not be allowed to pump from the surface water bodies used by community. In that case, before using any pond water Contractor will inform the owner. To avoid disruption / disturbance to other water users, the Contractor will extract water from fixed locations and consult the Environmental Expert before finalizing the locations. The Contractor will need to comply with the requirements of the State Ground Water Board and seek their approval for doing so, if inevitable.	Department of Water Resources, Government of Jharkhand / SGWB,	Contractor	SECI
Labour Requirements	The Contractor will use unskilled labour drawn from local communities to avoid any additional stress on the existing facilities (medical services, power, water supply, etc.)	Department of Labour, Government of Jharkhand	Contractor	SECI
Construction Camp Locations-Selection, Design and Layout	Siting of the construction camps to be as per the guidelines presented below • Construction camps will not be proposed within 1000 m from the nearest settlements to avoid conflicts and stress over the infrastructure facilities with the local community. • Location for stockyards for construction materials will be identified at least 1000 m from water courses. • The waste disposal and sewage system for the camp will be designed, built and operated such that no odour is generated. • Unless otherwise arranged by the local sanitary authority, arrangements for disposal of night soils (human excreta) suitably approved by the local medical health or municipal authorities or as directed by Environmental Expert of SECI will need to be provided by the Contractor.	SECI	Contractor	SECI
Batching Plant Locations	Batching plants, if any will be sited sufficiently away from settlements and agricultural operations or any commercial establishments. Such plants will be located at least 1000 m away from the nearest village settlements preferably in the downwind direction.	State Pollution Control Board.	Contractor	SECI

Environmental Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
Arrangements for Temporary Land Requirement	The Contractor as per prevalent rules will carry out negotiations with the landowners for obtaining their consent for temporary use of lands for construction sites/hot mix plants/traffic detours/ borrow areas etc. As per Govt. of India regulatory framework the negotiations and deal is required to be done according to RFCTLARR Act, 2013. As per discussion with SECI, all such land shall be procured based on mutual agreement between the concerned parties. The Environmental Expert of SECI will be required to ensure that the clearing up of the site prior to handing over to the owner (after construction or completion of the activity) is included in the Concession Agreement.	District administration	Contractor	SECI
Site Clearance				
Construction Wastes Disposal	The pre-identified dump locations will be a part of comprehensive solid waste management plan to be prepared by the Contractor in consultation with Environmental Expert of SECI. Location of disposal sites will be finalized prior to completion of the work on any particular section of the project area. The Environmental Expert of SECI will approve these disposal sites. Contractor will ensure that any spoils of material unsuitable will not be disposed of near any water course, agricultural land, and natural habitat like grass lands or pastures. Such spoils from excavation can be used to reclaim borrow pits and quarries, low-lying area in barren lands along the project corridors. All waste materials will be completely disposed, and the site will be fully cleaned before handing over. The Environmental Expert of SECI will certify the site after approval. The Contractor, at its own cost, shall resolve any claim, arising out of waste disposal.	District administration	Contractor	SECI
Stripping, Stocking and Preservation of Top Soil	The topsoil from all areas of cutting and all areas to be permanently covered will be stripped to a specified depth of 150 mm and stored in stockpiles. At least 10% of the temporarily acquired area will be earmarked for storing topsoil and following precautionary measures will be taken to preserve them till they are used: Stockpile will be designed such that the slope does not exceed 1:2 (vertical to horizontal), and height of the pile is restricted to 2 m. To retain soil and to allow percolation of water, the edges of the pile will be protected by silt fencing. Stockpiles will not be surcharged, or otherwise loaded and multiple handling will be kept to a minimum to ensure that no compaction will occur. The stockpiles shall be covered with gunny bags or tarpaulin sheets. It will be ensured by the Contractor that the topsoil will not be unnecessarily trafficked either before stripping or when in stockpiles.	District administration	Contractor	SECI

Environmental Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
	Such stockpiled topsoil will be utilized for covering all disturbed areas including borrow areas, top dressing of the project area embankments and fill slopes filling up of tree pits, in the median, and in the agricultural fields of farmers, acquired temporarily. The management of topsoil shall be reported regularly to the Environmental Expert of SECI.			
Accessibility	The Contractor will provide safe and convenient passage for vehicles, pedestrians and livestock to and from roadsides and property accesses connecting the project area. The Contractor will also ensure that the existing accesses will not be undertaken without providing adequate provisions to the prior satisfaction of the Environmental Expert of SECI.	Regional Transport Office, Government of Jharkhand	Contractor	SECI
Raw Materials	The Contractor shall obtain materials like Sand, Stone chips and other aggregates only from the approved sources after consent of the department of Mining.	Department of Mining, Government of Jharkhand.	Contractor	SECI
Transporting Construction Materials and Haul Road Management	Contractor will maintain all project areas (existing or built for the project), which are used for transporting construction materials, equipment and machineries. All vehicles delivering materials to the site will be covered to avoid spillage of materials. All existing highways and roads used by vehicles of the Contractor, or any of his sub-Contractor or suppliers of materials and similarly roads, which are part of the works, will be kept clean and clear of all dust/mud or other extraneous materials dropped by such vehicles. Contractor will arrange for regular water sprinkling at least thrice a day (i.e., morning, noon and evening) for dust suppression of such project areas particularly the earthen project areas. The unloading of materials at construction sites close to settlements will be restricted to daytime only.	PWD, Government of Jharkhand	Contractor	SECI
Water				
Drainage and Storm Water Management	Contractor will ensure that no construction materials like earth, stone, ash or appendage disposed of so as not to block the flow of water of any water course, and cross drainage channels. Contractor will take all necessary measures to prevent the blockage of water flow. In addition to the design requirements, the Contractor will take all required measures as directed by the Environmental Expert of SECI to prevent temporary or permanent flooding of the site or any adjacent area.	District Administration	Contractor	SECI
Water Pollution from Construction Wastewater	The Contractor will take all precautionary measures to prevent the wastewater during construction from entering directly into streams, water bodies or the irrigation system.	State Pollution Control Board	Contractor	SECI

Environmental Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
	The Contractor will strictly follow the discharge standards promulgated under the Environmental Protection Act, 1986. All waste arising from the project is to be disposed of in the manner that is acceptable to the State Pollution Control Board. Environmental Expert of SECI will certify that all liquid wastes disposed of from the sites meet the discharge standards.			
Siltation of Water Bodies and Degradation of Water Quality	The Contractor will not excavate beds of any stream/ canals/ any other water body. Contractor will construct silt fencing at the base of the embankment construction for the entire perimeter of any water body (including wells) adjacent to the RoW and around the stockpiles at the construction sites close to water bodies. The fencing will be provided prior to commencement of earthworks and continue till the project boundary for reservoir works and sub-station works only The Contractor will also put up sedimentation cum grease traps at the outer mouth of the drains located in truck lay bays and bus bays which are ultimately entering into any surface water bodies / water channels with a fall exceeding 1.5 m. Contractor will ensure that construction materials containing fine particles stored in an enclosure such that sediment-laden water does not drain into nearby watercourse.	Water Resources Department, Government of Jharkhand	Environmental Expert of SECI	SECI
Water Pollution from Fuel and Lubricants	The Contractor will ensure that all construction vehicle parking location, fuel/lubricants storage sites, vehicle, machinery and equipment maintenance and refuelling sites will be located at least 1000 m from rivers and irrigation canal/ponds or as directed by the Environmental Expert of SECI Contractor will ensure that all vehicle/machinery and equipment operation, maintenance and refuelling will be carried out in such a fashion that spillage of fuels and lubricants will be minimized and does not contaminate the ground. Oil interceptor will be provided for vehicle parking, wash down and refuelling areas. Contractor will arrange for collection, storing and disposal of oily wastes to the approved disposal sites. All spills and collected petroleum products will be disposed of in accordance with MoEF&CC and State Pollution Control Board guidelines.	State Pollution Control Board	Contractor	SECI
Maintaining minimum levels in the reservoir	Contractor will ensure that the minimum level is maintained at the reservoir.	Water Resources Department, Government of Jharkhand	Contractor	SECI
Air				
Dust Pollution from Batching Plants	All batching plants will be sited at least 1 km in the downwind direction from the nearest human settlement. Clearance for siting shall be obtained from the State Pollution Control Board. Alternatively, only approved batching plants licensed by the State Pollution Control Board shall be used.	State Pollution Control Board	Contractor	SECI

Environmental Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
	Regular water sprinkling should be provided to ensure the dust suppression. The PM10 value at a distance of 50m from a unit located in a cluster should be less than 100 μg/m3. The monitoring is to be conducted as per the monitoring plan.			
Emission from Construction Vehicles, Equipment and Machineries	Contractor will ensure that all vehicles, equipment and machinery used for construction are regularly maintained and confirm that pollution emission levels comply with the relevant requirements of State Pollution Control Board. The Environmental Expert of SECI will be required to inspect regularly to ensure the compliance of ESMP.	State Pollution Control Board	Contractor	SECI
Noise				
Noise from Vehicles, Batching Plants and Equipment	The Contractor will ensure the following: All plants and equipment used in construction shall strictly conform to the MoEF&CC/CPCB noise standards. All vehicles and equipment used in construction will be fitted with exhaust silencers. Servicing of all construction vehicles and machinery will be done regularly and during routine servicing operations, the effectiveness of exhaust silencers will be checked and if found defective will be replaced. Limits for construction equipment used in the project such as compactors, rollers, front loaders, concrete mixers, cranes (moveable), vibrators and saws shall not exceed 75 dB (A) (measured at one meter from the edge of equipment in the free field), as specified in the Environment (Protection) rules, 1986. At the construction sites within 150 m of the nearest habitation, noisy construction work such as, concrete mixing, batching will be stopped during the night time between 10.00 pm to 6.00 am. Contractor will provide appropriate noise barriers to their premises. Noise barrier may be of 2 to 3 m high wall separating the sensitive building from noise or it may a green barrier of vegetation having density of minimum 5 m between sensitive location and the highway monitoring shall be carried out near construction site as per monitoring schedule. Environmental Expert of SECI will be required to inspect regularly to ensure the compliance of ESMP.	State Pollution Control Board	Contractor	SECI
Noise and Vibration at sensitive locations	The noise monitoring would be carried out through a handheld sound level meter by technician apart from the periodic noise monitoring at sensitive locations.	State Pollution Control Board	Contractor	SECI
Health and Safety				

Environmental Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
Personal Safety Measures for Labours	Contractor will provide: Protective footwear and protective goggles to all workers Employed on mixing asphalt materials, cement, lime mortars, concrete etc. Welder's protective eye-shields to workers who are engaged in welding works Protective goggles and clothing to workers engaged in stone breaking activities and workers will be seated at sufficiently safe intervals. Earplugs to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation. The Contractor will not employ any person below the age of 18 years for any work. The Contractor will also ensure that no paint containing lead or lead products is used except in the form of paste or readymade paint. Contractor will provide facemasks for use to the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.	Department of Labour, Government of Jharkhand	Contractor	SECI
Traffic and Safety	The Contractor will take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, marking, flags, lights and flagmen as may be required by the Environmental Expert of SECI for the information and protection of traffic approaching or passing through the section of any existing cross roads. Any such activity should be reported to traffic police and a prior consent is taken.	Regional Transport Office	Contractor	SECI
Safety Measures during Construction	The Contractor will make sure that during the construction work: All relevant provisions of the Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 will be adhered to. The Contractor will comply with all the precautions as required for the safety of the workmen as per the International Labour Organization (ILO) Convention No. 62. The Contractor will comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.	Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996	Contractor	SECI
Risk from Electrical Equipment (s)	The Contractor will take adequate precautions to prevent danger from electrical equipment i.e. no material will be so stacked or placed as to cause danger or inconvenience to any person or the public. All necessary fencing and lights will be provided to protect the public. All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provision.	Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996	Contractor	SECI

Environmental Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
First Aid	The Contractor will arrange for a readily available first aid unit including an adequate supply of sterilized dressing materials and appliances at every work site. Suitable transport arrangements to be provided for to take injured or sick person(s) to the nearest hospital. Equipment and trained nursing staff at every workplace and construction premise.	Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996	Contractor	SECI
Emergency Preparedness and Management	The Contractor will take all reasonable precaution to prevent danger of the workers and public from fire, flood, etc. The Contractor will keep emergency arrangement so that in case of any mishap all necessary steps can be taken for prompt evacuation and treatment.	Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996	Contractor	SECI
Additional Occupational Health Facilities				
Accommodation, Water and Sanitation Facilities	The Contractor will provide, erect and maintain necessary (temporary) living accommodation and ancillary facilities for labour up to standards and scales approved by the SECI at the location identified for such facilities in pre-construction phase. The Contractor will provide these facilities within the precincts of every workplace, latrines and urinals in an accessible place, and the accommodation, as per standards set by the Building and other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. The Contractor will construct and maintain all temporary accommodation in such a fashion that uncontaminated water is available for drinking, cooking and washing. The Contractor will also guarantee the followings: Supply of sufficient quantity of potable water (as per IS 10500) in every workplace/labour campsite at suitable and easily accessible places and regular maintenance of such facilities. If any water storage tank is provided that will be kept at a distance of not less than 15 m. from any latrine, drain or other source of pollution. if water is drawn from any existing well, which is within close proximity of any latrine, drain or other source of pollution, the well will be disinfected before water is used for drinking. All such wells will be entirely covered and provided with a trap door, which will be dust proof and waterproof. A reliable pump will be fitted to each covered well. The trap door will be kept locked and opened only for cleaning or inspection, which will be done at least once in a month. Testing of water will be done every month as per parameters prescribed in IS 10500:1991.	Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996	Contractor	SECI

Environmental Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
Sanitation and Sewage System	The Contractor will ensure that the sewage system for the camp are designed, built and operated in such a fashion that no health hazards occurs and no pollution to the air, ground water or adjacent water courses take place. Separate latrine and urinals, screened from those from men (and marked in the vernacular) are provided for women Adequate water supply is there to all latrines and urinals All latrines in workplaces are with dry-earth system (receptacles) which are cleaned at least four times daily and at least twice during working hours and kept in a strict sanitary condition. Night soil is disposed of by putting layer of it at the bottom of a permanent tank prepared for the purpose and covering it with 15 cm. layer of waste or refuse and then covering it with a layer of earth for a fortnight.	Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996	Contactor	SECI
Waste Disposal	The Contractor will provide garbage bins in the premises which shall be regularly emptied and the waste shall be disposed of in a hygienic manner as per the Solid Waste Management plan for the labour/ Contractor's premise approved by the Environmental Expert of SECI. Contractor will follow all relevant provisions of the Factories Act, 1948 and the Building and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for construction and maintenance of labour camp. The Contractor will make arrangement for disposal of night soil by composting at the workplace unless otherwise arranged by the local sanitary authority. The composting of night soil will be done as per direction of Environmental Expert of SECI. The Contractor will also ensure that on completion of the work, all temporary structures are cleared, all rubbish are burnt, night soil or other disposal pits or trenches filled in and effectively sealed off. The site will be left clean and tidy, at the Contractor's expense, to the satisfaction of the Environmental Expert of SECI.	Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996	Contractor	SECI
Ecology				
Flora/ Fauna	The Contractor will take reasonable precaution to prevent his workmen or any other persons from removing and damaging any flora (plant/vegetation) and fauna (animal) including fishing in any water body and hunting of any animal. Contractor shall have to prepare a mitigation / management plan for vulnerable species.	State Forest Department, Government of Jharkhand	Contractor	SECI

Environmental Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
	If any wild animal is found near the construction site at any point of time, the Contractor will immediately upon discovery thereof inform the Environmental Expert of SECI and report to the nearby forest office (forest range office or divisional forest office) and will take appropriate steps/ measures, if required in consultation with the forest officials. Clearing of vegetation outside of designated areas shall be prohibited for project staff, workers, all contractors and personnel engaged in or associated with the Project. The contractor shall take care and provide training to staff and workers on all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation. The land rehabilitation shall be undertaken using native and indigenous species. The area of landscaping within the project area shall comply with the local habitat values.			
Hunting and Poaching	No Poaching, hunting shall be allowed in any condition and the training and sensitization should be done for the staff and labourers.	State Forest Department / Chief Wildlife Warden	Contractor	SECI
Plantation	Avenue plantation (wherever space is available) will be implemented by Contractor. The plantation will be done as per the plantation scheme prepared for this project. The plantation will be carried by Contractor.	State Forest Department, Government of Jharkhand	Contractor	SECI
Cleaning of Construction Premises and Restoration	The Contractor will clear all temporary structures, remove all rubbish, and night soils. All disposal pits or trenches will be filled in and effectively sealed off. Residual topsoil, if any will be distributed on adjoining/ proximate barren land or areas identified by Environmental Expert of SECI in a layer of thickness of 75 mm-150 mm.	Department of labour, Government of Jharkhand	Contractor	SECI
Cultural Heritage				
Archaeological Property	All fossils, coins, articles of value of antiquity, structures and other remains or things of geological or archaeological interest discovered on the site shall be the property of the Government and shall be dealt with as per provisions of the relevant legislation The Ancient Monuments and Archaeological Sites and Remains Act, 1958.	Archaeological survey of India, GoI	Contractor	SECI
Environmental Monitoring				
Monitoring of Environmental Conditions	The Contractor will undertake seasonal monitoring of air, water, noise, and soil quality through MoEF&CC approved monitoring agency. The parameters to be monitored, frequency and duration of monitoring as well as the locations to be monitored will be as per the monitoring plan presented in the next section.	MoEF&CC, GoI	Contractor	SECI
Community Participation				

Environmental Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
Continuous Community Participation	The Environmental Expert of SECI will have continuous interactions with local people around the project area to ensure that the construction activities are not causing undue inconvenience to the locals residing in the vicinity of project site under construction due to noise, dust or disposal of debris etc.	SECI	Environmental / Social Expert of SECI	SECI
Operational Phase				
Environmental and Social Monitoring				
Atmospheric Pollution	Ambient Air concentrations of various pollutants shall be monitored as envisaged in the pollution-monitoring plan.	State Pollution Control Board	O & M Contractor	SECI
Ground and Surface Water Analysis	Ground and Surface water has to be analysed as per IS 10500.	State Pollution Control Board	O & M Contractor	SECI
Noise Pollution	Noise pollution will be monitored as per monitoring plan at sensitive locations. Noise control programs to be enforced strictly. Monitoring of the effectiveness of the pollution attenuation barriers, if there is any will be taken up thrice in the operation period.	State Pollution Control Board	O & M Contractor	SECI
Wastewater management	Provision of soak pit	State Pollution Control Board	O & M Contractor	SECI
Municipal Solid Waste management	Disposal as per Solid Waste Management Rules of the MoEF & CC, GoI	State Pollution Control Board	O & M Contractor	SECI
Hazardous Waste management	Disposal as per Hazardous Waste Management Rules of the MoEF & CC, GoI	State Pollution Control Board	O & M Contractor	SECI
Changes in Land Use	SECI shall take initiative and act as facilitator to prepare an action plan for balanced regional development in consultation with Local Development Authority and State Government to control the ribbon development along the project area.. A separate governing body may be formed with the representation of SECI, Revenue Department and Local Civic Body (Municipal Corporation/ Gram Panchayat) with the power of taking necessary action, if required to remove un-authorized development along the project area. This special body will meet periodically and monitor the development along the project area.	District Administration	SECI and Local Authorities (Revenue Department and Local Civic Bodies)	SECI
Hunting and Poaching	No Poaching, hunting shall be allowed in any condition and the training and sensitization should be done for the operating staff.	State Forest Department / Chief Wildlife Warden	Operator	SECI
Avifauna	The bird deflectors should be placed on the length of the transmission line. The deflectors will increase line visibility by thickening the appearance of the line for easier detection by avifauna.	State Forest Department / Chief Wildlife Warden	Operator	SECI

Environmental Issue	Mitigation Measures	Reference Authority	Implementation	Responsible Agency
	Contractor shall have to prepare a mitigation / management plan for vulnerable species. Having lines in a horizontal plane reduces collision risk. The vertical spread of power lines shall be minimized to the extent possible.			
Orientation of Implementing Agency and Contractor's Personnel	SECI shall organize orientation sessions during all stages of the project. The orientation session shall involve all staff of Environmental Cell including its field level implementation staff of SECI and Contractor's personnel.	SECI	O & M Contractor	SECI
Monitoring of Social Aspects	This section includes R&R, Compensation, income restoration etc. The social risk and corresponding mitigation measures are provided in the RAP prepared for the project.	District Administration/SECI	SECI	SECI
Pollution Monitoring	The periodic monitoring of the ambient air quality, noise level, water (both ground and surface water) quality, soil pollution/ contamination in the select location as suggested in pollution monitoring plan in ESMP will be responsibility of SECI. SECI will monitor the operational performance of the various mitigation / enhancement measures carried out as a part of this project. SECI will appoint CPCB/MoEF&CC approved pollution monitoring agency for this purpose.	State Pollution Control Board	O & M Contractor	SECI

Table 61: Environmental and Social Management Plan for Plant Substation and Transmission Line

11.4. Additional Environmental Mitigation Measures aimed at safeguarding vulnerable species

To ensure the protection of critical species and their habitats, the bid document must incorporate the following additional EMP measures specific to the identified vulnerable species.

DURING CONSTRUCTION PHASE

1. Construction activity to be restricted to the immediate footprint of the infrastructure, and to the proposed project road network.
2. Locate appropriate sites for the placement of floating solar panels, ensuring that the nesting, congregation and foraging areas remain undisturbed and provides clear open water surface for landing.
3. Maintain adequate distances between the solar panels and sensitive areas to reduce potential disturbances.
4. Preserve existing vegetation: Avoid clearing natural habitats, such as wetlands or grasslands, during the construction of floating solar PV plants. Retaining natural vegetation helps maintain essential habitats for birds.
5. The banks are quite rich as they have the highest biodiversity acting as ecotones (transition areas between two ecosystem types). Therefore, it is important to estimate the average distance and submerged slope from the boundary of water body, where the submerged and floating vegetation is visible. This can be done using stratified random sampling either over the drawdown depth (as recorded) or across two seasons to

capture the seasonal variation of water depth. The FSPV shall be installed beyond 20 m of these average distances.

6. Anti-perching measures: Implement deterrents to prevent birds from perching on sensitive structures, like power lines and transmission equipment, near the solar PV plant. To minimize bird mortality resulting from collisions and electrocution incidents, it is essential to include passive bird diverters and bird spikes for power lines and poles. These measures will help in deterring birds from these hazardous areas. Bird Diverters/Reflectors and Bird Flappers to be used at suitable intervals for easy visibility of wires and to avoid the risk of collision and electrocution. The guidelines issued in the documents "Technical Specifications for Bird Flight Diverter (2021), Government of India, Ministry of Power, Central Electricity Authority" and "Wildlife Institute of India 2018 Power-Line Mitigation Measures. Second edition (2020)" shall be consulted and followed for specification and installation.
7. Bird Spikes on poles shall be installed at the construction phase itself to prevent birds from perching or building nest. Bird Spikes are designed to deter birds from roosting in the desirable areas. These aren't designed to hurt birds. In facts, the spiles are blunt, which prevent injury to birds and workers installing them.
8. Congregation and foraging areas of the birds should be identified and any installations related to FSPV should not disturb such areas. The existing platforms or islands within or around the floating solar array where birds can safely perch, and land should not be disturbed due to the floating solar installations. The minimum footprint areas of infrastructure should be used wherever possible.
9. Contractor to demarcate congregation and foraging areas of identified avian species and avoid installation of FSPV and related appurtenances in and around such areas. Both the Adjutant stork and common pochard require clear open water surface for landing, as they come flying in. So a minimum landing distance should be maintained from the FSPV, especially in areas where they are generally seen foraging.
10. Nesting and roosting sites such as large trees and bushes should be avoided. Appropriate buffers should be created around such sensitive areas. Construction should be scheduled during times of least disruption e.g., daytime thus avoiding early morning and late evening. The trees, bushes and other vegetation that have nests or are roosting sites shall not be cut, trimmed, or disturbed that can result in destruction of bird's nest, eggs, or the habitat.
11. Appropriate mitigation to be deployed to address potential collisions and electrocutions. As with all mitigation, the facilities should be monitored to ensure mitigation measures are effective and durable.
12. All project activities shall be undertaken with appropriate noise mitigation measures to avoid disturbance to faunal population in the region.
13. General awareness regarding wildlife shall be enhanced through trainings, posters, etc. among the staff and laborers.
14. No food waste shall be disposed/littered in and around project site so that that it does not attract wild animals.
15. Use erosion and sediment control measures during construction to prevent sedimentation in the reservoir, which can impact the water quality and affect the bird's food sources.
16. Only the essential unavoidable trees should be felled with proper approvals from the concerned government agency/department.
17. Strict prohibition shall be implemented on trapping, hunting or injuring wildlife within sub-contractors and shall bring a penalty clause under contractual agreements.
18. Implement a comprehensive monitoring program to assess the impacts during the construction stage of the project.
19. Use surveillance cameras to monitor the storks' activities (in immediate vicinity of FSPV) and detect any potential disturbances caused by the solar panel's installation and operation. Continuously monitor bird activity and behavior around the floating solar panels to identify potential issues and assess the effectiveness of implemented measures.

20. Schedule construction and installation activities during the bird's non-breeding season to minimize disturbances during nesting periods.
21. Raise awareness among local communities, workers, and visitors about the presence and importance of these vulnerable species.
22. Stay open to adaptive management strategies and make necessary adjustments to the EMP based on new data and monitoring results during the implementation phase.
23. The contractor shall prepare its C-ESMP before installation to identify potential risks to the aquatic species including Common Pochard's, Lesser Adjutant stork, and other wildlife species. This review should consider factors such as water quality changes, shading effects, and any potential barriers to aquatic species and bird movement.
24. If required, the contractor / Implementing agency during the project implementation phase should consult with environmental biologists, and conservation organizations to ensure that the mitigation measures are effective and appropriate for protecting the aquatic species including common Pochard and its habitat. By implementing these environmental mitigation measures, it is possible to strike a balance between renewable energy production and wildlife conservation, ensuring the long-term survival of the wildlife species including Common Pochard, and Lesser Adjutant stork and maintaining the ecological integrity of the reservoir ecosystem.

DURING OPERATIONS PHASE

1. Use surveillance cameras to monitor activities of birds (in immediate vicinity of FSPV) and detect any potential disturbances caused by the solar panel’s installation and operation. Continuously monitor bird activity and behavior around the floating solar panels to identify potential issues and assess the effectiveness of implemented measures.
2. Training of local staff and security guards for spotting of bird carcass and reporting the same. This will help to ensure the strategic actions when the species are spotted in the region.
3. Covered conductors, daytime visual markers, visibility enhancement objects such as marker balls, bird deterrents, or diverters shall be installed on any guy wires and power lines to enhance visibility of poles/distribution lines for bird to avoid avian collision and electrocution.
4. Any dead animals/carcass shall be removed in time from the site within 2 days so that it does not attract movement of raptors.
5. Continue monitoring the species biodiversity, in particular the vulnerable species and their foraging areas after construction is completed to ensure that the floating solar plant does not cause any unforeseen negative effects.
6. Stay open to adaptive management strategies and make necessary adjustments to the EMP based on new data and monitoring results during operation phase.

6.1. Labour Management Plan

The proposed 100 MW floating solar power project requires around 100 workers for construction activities. It is envisaged that many of the labours will be employed from outside the region and will, therefore, be migrant labourers. Hence, accommodation and other facilities would be provided. These migrant labours will be accommodated in the nearby villages on rental houses and the proposed substation land. The construction of FSPV would lead to an influx of labour. However, there would be an effort to exploring and engages as many local workers as possible. This would result in reduced stress on local resources, disruption in community relations and enhanced employment potential for local population.

The labour engaged for the transmission line works will be accommodated in temporary campsite within the project boundary which can have significant interface with the nearby community. However, this influx of migrant workers would lead to a transient increase of population in the immediate vicinity of the project area for a limited time.

If migrant workers are accompanied by their families, provisions should be made accordingly including baby care centres/crèches and educational facilities for children and adolescents. Guidance on Workers Accommodation provided in BOCWA, 1996 has been referred for the inclusion of requirements for labour camp to be established by the developer during the construction phase of the project. Employee Provident Funds and Public Liability Insurance shall ensure social security for the workers.

Since the labour required for the project is intended to be sourced from the local community it is important that a clear communication on this is made during the public consultation meeting organized by the project proponent during the course of execution. Details of public consultation process proposed for the project are provided in Chapter 8 of the RAP report prepared separately for the project.

The workers should be provided with the basic facilities like safe accommodation, electricity, clean drinking water, sanitary facilities and proper safety arrangements. They should be provided with uniforms and identification cards for smooth movement in the project area.

11. **The increased temporary and contract employment means that traditional relationships between workers and employers are shifting. The demobilization process should be handled with care and following steps can be helpful in this regard. Demobilization is both a physical and a mental process.**

- **Preparing them for demobilization**
- **Training should be an integral part of employment policies and should facilitate the reintegration or re-employment of demobilized workers.**
- **Extend support to find them a new project**

A Worker's safety plan has been developed in conformity with the requirements of the Building and Other Construction Workers Act (BOCWA), 1996 of Government of India, International industry practices. Construction labour management plan can be changed based on project needs.

6.2. Worker's Safety Plan

Construction and operation of a floating solar power project involves many on job hazards which need to be identified and eliminated or minimized in order to achieve a safe and healthy work environment. Safe working practices should be established for works including but not limited to the following areas:

- **Working in the reservoir**
- **Working at heights**
- **Working on solar Field / Lockout / Tagout (LOTO)**
- **Woking near electrical equipment**

- **Working in hot /cold environment**

The workers and other staff would be supported by the HSE team comprising of EHS officer and guided by the ESO (Environment and Social Officer). The worker would be given adequate training on the above-mentioned issues relevant to the project activities.

6.2.1. Working on Floating Structures and Boats

The risk associated with the working for installation and securing of the floating solar panel systems along with utility systems inside the reservoir include:

- **Risk of drowning. Workers, who install and/or maintain solar panels often work on floats and owing to their proximity to a water body are exposed to hazards of falling and drowning.**
- **Exposed to the water borne disease**
- **Extreme humid condition**

All required safety measures should be put in place to prevent workers from hazards of falling and drowning in the reservoir.

6.2.2. Working at Heights

Workers, who install and/or maintain transmission line or associated components often work at height, operate cranes, are in proximity to ledges, and are exposed to fall hazards. Construction workers involved in the installation of transmission line are exposed to fall distances of 6 feet or more.

Following protection measures should be put in place as a prevention against fall hazards:

- Guardrail systems
- Safety net systems
- Personal fall arrest systems

Workers should never be allowed to climb ladders while carrying any equipment. Lifting equipment, such as ladder hoists, swing hoists, or truck-mounted cranes/conveyors, should be used wherever possible.

Maintenance workers working on transmission line when exposed to fall hazards of 4 feet or more must be protected by safety belt and PPE.

6.2.3. Working on Solar field / Lockout / Tagout (LOTO)

LOTO refers to specific practices and procedures to safeguard employees from the start-up of machinery and equipment, or the release of hazardous energy during service or maintenance activities.

Solar energy equipment can generate electrical energy and may be connected to electrical circuits. Workers may be exposed to electrical hazards from solar panels and from electrical circuits. While installing or servicing solar panels, employers should ensure that workers cover the solar panels, in addition to protecting workers from electrical circuits. Workers performing servicing or maintenance of solar panels may be exposed to injuries from the unexpected energization or release of stored energy in the equipment.

The following are some of the significant requirements of a Lockout / Tagout procedure required under a Lockout / Tagout program.

- **Only authorized employees may lockout or tagout machines or equipment in order to perform servicing or maintenance.**
- **Lockout devices (locks) and tagout devices (tags) shall not be used for any other purposes and must be used only for controlling energy.**
- **Lockout and Tagout devices (locks and tags) must identify the name of the worker applying the device.**
- **All energy sources to equipment must be identified and isolated.**
- **After the energy is isolated from the machine or equipment, the isolating device(s) must be locked out or tagged out in safe or off position only by the authorized employees.**
- **Following the application of the lockout or tagout devices to the energy isolating devices, the stored or residual energy must be safely discharged or relieved.**
- **Prior to starting work on the equipment, the authorized employee shall verify that the equipment is isolated from the energy source, for example, by operating the on/off switch on the machine or equipment.**
- **Lock and tag should not be removed from the machine until the work is completed.**
- **Only the authorized employee who placed the lock and tag must remove his/her lock or tag.**

6.2.4. Working with Electrical Components

Floating Solar energy workers are exposed to potential electrical hazards present in their work environment, which makes them more vulnerable to the danger of electrocution and arc flash hazards. Workers may be exposed to electric shocks and burns when hooking up the solar panels to an electric circuit.

6.2.5. Working in Hot/Cold Environment

Solar energy workers often work in very hot weather, where hazards include dehydration, heat exhaustion and heat stroke, which at times may also lead to death of an individual. Employers should monitor employees and workers and they should be trained to identify and report early symptoms of any heat-related illness. Workers may also be exposed to extremely cold weather conditions and should be protected from such conditions.

Heat Stroke occurs when the body's temperature regulation fails, and body temperature becomes abnormally high. Some of the signs and symptoms of heat stroke are:

- **Confusion.**
- **Loss of consciousness.**
- **Convulsions.**
- **Lack of sweating (usually) hot, dry skin; and**
- **Very high body temperature**

If a worker shows signs of possible heat stroke, immediate medical treatment should be provided to him. While waiting for medical help, the worker should be:

- **Placed in a shady area and the outer clothing should be removed.**
- **Air movement around the worker should be increased and**
- **Fluids should be administered as soon as possible.**

6.2.6. Personal Protective Equipment (PPE)

Using personal protective equipment is often essential, but it is generally the last line of defence after engineering controls, work practices, and administrative controls. Solar plant employers must assess their workplace to determine if hazards are present that require the use of protective equipment. Solar plant workers can be exposed to many hazards that may require the use of safety glasses, hard hats, gloves, respirators, or other personal protective equipment used to protect against injuries and illnesses. Workers exposed to potential electrical hazards must be provided with appropriate electrical protective equipment, and workers must use them. Electrical protective equipment must be maintained in a safe and reliable condition. They must be periodically inspected or tested for their workability.

6.3. Emergency Preparedness and Response Plan

6.3.1. Purpose

SECI will develop a site-specific Emergency Preparedness and Response Plan (EPRP) for implementation at the proposed site in the event of an emergency situation, so that the loss of life and damage to the properties and natural resources are minimized as per the recommendation provided in this report. This plan outlines a series of emergency actions that will be executed by SECI and its Contractors to ensure preparedness and response to emergency situations throughout the life cycle of the project. The construction related EPRP would be taken care by the contractor and the operation related EPRP would be taken care by the operator.

6.3.2. Probable Emergencies

The emergency situations that are probable to occur at the project site and the probable causes are listed below:

- **On Reservoir front: these would include incidents like boat capsize, sinking of floating vessel, drowning, oil spills (minor and major), breakage of mooring and anchoring, damage to off-shore equipment, trips, slips, falls off the working platform, etc. The consequence of these could also result in injuries to personnel and equipment.**
- **Fire at site during temporary construction phase which cannot be doused by fire extinguishers; Also fire due to short circuit at the plant and equipment during both construction and operation phase.**
- **Collapse of any structure**
- **Outbreak of endemic disease among a large section of construction workers due to contaminated drinking water, unhygienic conditions that have developed at workplace.**
- **Protests by the local community or other stakeholders at any point of the project lifecycle due to grievances.**
- **Serious injury or death of employee or sub-contracted worker at work, due to non-work-related illness or work-related accident.**
- **Onset of any natural disaster like earthquake.**

6.3.3. Emergency Management

The following steps shall be taken to ensure proper management of emergency or crisis situations:

- **The emergency divers are identified around the area before starting the work in the reservoir.**
- **The nearest civil hospitals, private health care centers or practitioner clinic shall be identified, and an agreement shall be made with the aforesaid medical centers/practitioners to provide prompt health care services (including ambulance services) in the event of an emergency situation at site.**
- **A list of important telephone numbers such as fire brigade, health care facility/practitioner, police station, EHS and Social Coordinator, project office, head offices shall be displayed at all the prime locations at site and the worker's camp (during construction phase).**
- **Regular liaising with the police, Gram Panchayat, district administration shall be carried out to ensure that prompt assistance is readily available in the event of an emergency.**
- **An Emergency Management team comprising of 4-6 professionals both from the developer and contractors' side, during construction phase and 2-3 professionals during operation of the proposed project; shall be formed to combat any emergency situation and ensure safety of the life and property at site. For this purpose, 2-3 personnel employed in the plant during operation phase shall be trained on management measures to be taken, including their roles and responsibilities, in case of an emergency situation.**
- **The workers (staff and contractual workers from amongst both SECI and contractor's personnel) shall be trained on their duties and emergency preparedness during an emergency. All site personnel shall be trained to follow the communication protocol given below in case of an emergency:**

a) Personnel at site affected by the emergency situations shall immediately inform the project office and the external agencies (such as police, fire brigade, ambulance services); In case, project office cannot be reached, the coordinator will be informed directly.

b) The HSE officer on being informed about the emergency by project offices or by the employee directly, reaches site if necessary, and also follows-up with the aforesaid external agencies for aid.

c) The HSE coordinator takes charge of the emergency response and directs further action and coordination, including escalating the matter to the CEO or other top-level managers as required.

6.3.4. Responsibilities

The HSE officer of the contractor will be responsible for implementing this procedure, which includes

- **Ensuring that the emergency preparedness measures are in place.**
- **Providing training to the personnel at site regarding reporting of the emergencies, and to site office personnel regarding response to emergency calls from the site personnel,**
- **Direct action and co-ordination at the time of an emergency**

6.4. Chance Find Procedure

6.4.1. Purpose of the chance find procedure

The chance find procedure outlines actions required if previously unknown heritage resources, particularly archaeological resources, are encountered during project construction or operation. A Chance Find Procedure, as described in Archaeological Survey of India guidelines, prevents chance finds from being disturbed until an assessment by Archaeological Survey of India (ASI) is made and actions consistent with the requirements are implemented.

6.4.2. Scope of the chance find procedure

This procedure is applicable to all activities conducted by the people engaged for the project mainly contractors. They may uncover a heritage item/site during construction period. The procedure details the actions to be taken when a previously unidentified and potential heritage item/site is found during construction activities. The procedure also outlines the roles and responsibilities and the response required from both project staff, and Archaeological Survey of India.

6.4.3. Induction/Training

All personnel, especially those working on earth movements and excavations, are to be inducted on the identification of potential heritage items/sites and the relevant actions for them with regards to this procedure during the Project induction and regular toolbox talks.

6.4.4. Chance find procedure

If any person discovers a physical cultural resource, such as (but not limited to) archaeological sites, historical sites, remains and objects, or a cemetery and/or individual graves during excavation or construction, the following steps shall be taken:

- **All works shall be stopped in the vicinity of the find, until a solution is found for the preservation of these artifacts, or advice from the relevant authorities is taken.**
- **Immediately notify the supervisor and EHS officer. The EHS officer will then notify the Project Manager. The project manager of contractor notifies the PMC about the same and in turn notified to SECI.**
- **The details shall be recorded in the Incident Report and photos are taken of the find.**
- **The discovered site or area are isolated/delineated. The site shall be secured to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be arranged until the responsible local authorities take over.**
- **The evaluation of the findings by archaeologists would be done by ASI. Based on this assessment the appropriate strategy can be implemented. The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage such as aesthetic, historic, scientific or research, social and economic values of the find.**
- **Construction works could resume only after permission is granted from the ASI.**
- **All finds must be registered. Photolog, copies of communication with decision making authorities, conclusions and recommendations/guidance, implementation reports – kept.**

Management options for archaeological site

- **If the boundaries of the site have been delineated attempt must be made to redesign the proposed development to avoid the site. (The fastest and most cost-effective management option)**
- **It may be possible to protect the site through the installation of barriers during the time of the development and/or possibly for a longer term. This could include the erection of high visibility fencing around the site or covering the site area with a geo textile and then capping it with fill. The exact prescription would be site- specific. Management of replicable and non-replicable heritage Different approaches for the finds apply to replicable and non-replicable heritage.**
- **The project is redesigned to completely avoid the found remains. An assessment should be made as to whether the remains may be affected by residual or accumulative impacts associated with the development, and properly addressed by a comprehensive management plan.**

6.5. Community Health and Safety Management Plan

A few aspects of community health and safety shall be addressed during the project implementation.

6.5.1. Objective

- Mitigate potential impacts of Project related activities that may affect the health, safety and security of communities within the Project area and along the transportation route;
- Maintain a healthy workforce and labour pool in the community; and
- Contribute to the improved health and wellbeing of the local community in the Project area.

6.5.2. Management Strategy

The management strategy includes

Spread of Communicable diseases.

- **The influx of new workers to the area could bring with it an increase of communicable diseases.**
- **Awareness campaigns on hygiene and sanitation and how these diseases spread.**
- **Emissions from equipment and vehicles**
- **Information will be obtained on all hazardous materials and means of their control on site and in the vehicles, which will transport them.**
- **All efforts will be taken to avoid possible community exposure, and if it does occur, staff will be trained to control and mitigate the situation.**

Illness and harm of employees/community

- **Training of staff on matters pertaining to materials that could be encountered on site and measures to be taken in case of a spill or road accident during material transportation.**
- **Controlling the transport and disposal of all material and waste of and off site.**
- **Ensuring that only registered disposal sites are used and records are maintained of all waste leaving site.**

Emissions from equipment and vehicles

- **Haul trucking limited to daylight hours;**
- **Maintenance checks of all vehicles and equipment;**
- **Use of modern well designed vehicles and equipment; and**
- **Regular monitoring.**

6.6. Community Management Plan

The Community Management Plan is a critical element of the overall Social Management Plans. Regular and transparent communication between the project representatives and the communities is crucial in building positive relationship between the two parties. This relationship is crucial for managing unexpected situations which might arise during the course of the project implementation.

6.6.1. Objectives

The Performance Standards mandate continuous communication between project and the different stakeholders e.g. workers and local community. The onus of initiating the process of communication rests on the project proponent. The project proponent should ensure that disclosure of relevant project information that would help the affected communities understand the risks, impacts and opportunities of the project. The Community Management Plan is developed to ensure a clear communication channel between the project and the local community.

6.6.2. Communication with the Community

As has been stated earlier in this report a total of 635 families for the project and 116 fishermen families doing fishing in the reservoir spread across 24 villages are likely to be affected due to the project. 63 of these would be losing a part of their land holding due to erection of transmission towers while another 116 may be impacted partially who are doing fishing in the reservoir. With the respect to the remaining 572 families, their agricultural land would be coming under the RoW. Detailed analysis of socio-economic impacts and corresponding rehabilitation measures have been presented in the RAP prepared for the project.

As mandated in the Performance Standards of World Bank's E&S framework, SECI has disclosed the project details to make the community aware of the important features of the project. A project information booklet would be prepared and distributed in the project affected villages prior to start of construction. This booklet should preferably be prepared in local language. For the people who cant read or write, it may be orally presented in the local language. The booklet in addition to containing the salient features of the project should have a map depicting the boundaries of the plant and its ancillary facilities. The important landmarks e.g. the settlement, schools and the roads, etc. should also be demarcated so that it becomes easy for the people in the villages to relate to the ground conditions. In addition to the project information, the booklet should also highlight the impacts on the community as presented in the ESIA document and the safeguard commitments including the entitlement matrix. To ensure wide circulation of the Project Information Booklet, the booklet should be made available at all the schools, Anganwadi centres, and other public facilities in the project affected villages. To ensure continuity of the flow of information to the community it is suggested that a quarterly community Information Booklet should be published. During the construction phase, the booklet would contain information about the progress of the project and also other such information which are pertinent to community e.g. disruption of the transportation links, outcome of consultation process on community development etc. It is proposed that the "Project Information Booklet" be continued even during the operations stage where this also acts as a transfer of information from the project to the community. In addition, it can also be used to

share information between the communities e.g. achievement of a particular member of the community or any worker can be published in this booklet.

6.7. Waste Management Plan

The Waste Management Plan (WMP) will be applicable to the wastes arising during construction, operation and decommissioning of the proposed solar power plant. Major waste streams from the project include non-hazardous solid waste, wash water generated from panel washing and sewage. WMP is intended to serve as a guideline for SECI and the contractor(s) to manage wastes effectively during the project life cycle.

The WMP describes how wastes will be managed during the project life cycle and how the project will:

- **Minimize the potential to cause harm to human health and the environment.**
- **Comply with Indian Environmental Regulation and Standards.**
- **Reduce operational costs and reduce any potential liabilities which may arise from waste handling operations.**
- **This plan also ensures that every waste stream and solid waste materials from the main plant site and bracketed facilities will be managed effectively. The EPC contractor will manage the waste generated during construction phase like construction debris, packing material, paint containers and filters. The management measures of the aforementioned solid wastes and the hazardous wastes are discussed in detail below:**
- **The recyclable and non-recyclable non-hazardous solid waste generated onsite should be collected and stored in a temporary waste storage facility from where all wastes will be sent for recycling and disposal to appropriate facilities.**

6.8. Storm Water Management Plan

Storm Water Management would be applicable to the on-site facilities such as the control room, switchyard, at the substation and transmission lines etc. The purpose of Storm Water Management Plan (SWMP) is to ensure prevention and control of any adverse impact caused by un-regulated storm water runoff from the main plant to the nearby natural drainage channels, surface water bodies, public and private properties.

Following measures will be taken as part of the Storm Water Management Plan:

- **The peripheral drains will be provided outside the plant boundary during construction phase, which will prevent the silt contaminated surface run-off from site to enter into the adjoining lands.**
- **Rainwater collected from the project site will be used to recharge the ground water through onsite rainwater harvesting tank/pits.**

6.8.1. Community Property Resources

During the project construction phase there might be some sharing of resources by the villagers and the workers working on the project. This should be avoided to prevent potential conflict between the project and the community. The movement of heavy vehicles and machineries might lead to conditions like disruption of electric wires and telephone wires in the project area and along transportation routes. Any damage utilities should be repaired/replaced to normal conditions at the earliest. An account of the damage to the community resource should be documented and the root cause analysis should be carried out. The findings of the root cause analysis should also be documented and discussed with the agency/agencies found responsible for the incident. No water should be extracted from surface water bodies which are used by the community for drinking or domestic purpose. Any vacant or barren land, not assigned for project, should not be used for storage of fill/construction material, wastes, etc.

SECI and its contractors should ensure that the sharing of community resources is minimized by organizing necessary support infrastructure/facilities within the project premises. However, in case where sharing would be essential SECI (including contractors) should have an agreement with the Gram Sabha for the sharing of the resources. In case of damage to community property, SECI including its contractors should ensure that it is repaired or replaced to the satisfaction of the community at the earliest. SECI should maintain documentation of all incidents of damages to the community property. All cost for repair/replacement should be borne by SECI /contractor. A system should also be developed for recording such incidents and tracking the incident till it is closed to the satisfaction of the community.

As per census and socio economic survey, it has been found that there is no adverse impact on Community Property Resources due to the project.

6.9. Road Safety and Traffic Management Plan

The plan encompasses measures to address workers' and community safety related impacts that may arise from increased vehicular traffic, particularly during construction phase. The plan will be regularly updated by the contractor as the project progresses and as vehicle movement requirements are identified in detail. Designated traffic coordinator will be responsible for overall coordination of traffic management.

6.9.1. Construction Phase

The following mitigation measures will be implemented during this phase:

- **Project vehicular movement will be restricted to defined access routes.**
- **Proper signage will be displayed at important traffic junctions along the vehicular access routes to be used by construction phase traffic. The signage will serve to prevent any diversion from designated routes and ensure proper speed limits are maintained near residential areas.**

- **Any road diversions and closures will be informed in advance to the project vehicles accessing the above route. Usage of horns by project vehicles will be restricted near sensitive receptors viz. schools, settlements etc.**
- **Traffic flows will be timed wherever practicable during period of increased commuter movement in the day.**
- **Temporary parking facilities shall be provided within the work areas and the construction sites to avoid road congestion.**
- **Vehicular movement to be controlled near sensitive locations viz. schools, colleges, hospitals identified along designated vehicular transportation routes.**
- **Routine maintenance of project vehicles will be ensured to prevent any abnormal emissions and high noise generation.**
- **Adequate training on traffic and safety operations will be imparted to the drivers of project vehicles including the operators of the floating vessels over the reservoir. Safety awareness programs will be organized in coordination with local authorities to sensitize target groups viz. school children and other local community members on traffic safety rules and signage.**
- **The contractor(s) shall frame and implement a "No Drug No Alcohol" Policy to prevent accidents and injuries. The violating personnel would be fined for each such incident.**

6.9.2. Operation Phase

Since limited vehicular movement is anticipated during operational phase considering only the daily movement of project personnel, any impacts arising from the same can be effectively addressed through implementation of mitigation measures as discussed during the construction phase. In addition, the following measures will also be implemented:

- **Use of horns near the villages along the access road to villages, main plant and internal roads shall be restricted.**
- **The vehicular movements along the access roads and highways shall be restricted during the night-time.**
- **All the vehicles entering the access roads and plant shall have Pollution under Control (PUC) certificates.**
- **The speed limit in the internal roads shall be restricted to 25 km/hr. Proper warning signs and road safety awareness posters shall be displayed to create road safety awareness among the personnel accessing the site.**
- **Periodic road safety and Traffic management campaigns and awareness sessions shall be carried out among the villagers and the plant workers/personnel to develop road safety awareness among the people likely to be impacted by the project.**
- **An emergency road safety plan shall be framed by the Proponent to combat any emergency conditions/accidents along the highways, access roads and within plant area.**
- **The Proponent shall frame and implement a "No Drug No Alcohol" Policy to prevent road accidents/incidents.**

- **The drivers shall be given an induction on road safety and traffic management policy.**
- **A permanent parking lot shall be provided within the main plant site (in individual work areas) and the associated facilities.**
- **Use of seat belts for both drivers and passengers shall be made compulsory to minimize fatal injuries in the event of an accident.**

6.10. Boat Safety Management

12. **Boat operations and operation of other floating vessels are an integral requirement in construction and operation of a floating solar power project. Safety risks relating to boat operations arise primarily on account of the following factors:**
    - **Distraction faced by an operator**
    - **Reckless operation of the boat**
    - **Inexperienced operator and**
    - **Equipment failure**
13. **To mitigate safety hazards relating to boat operations, following measures should be adopted during construction and operation phases:**
    - **The boats to be used should be in accordance with the best design available for suitability of operation in reservoirs.**
    - **Only adequately trained operators should be engaged for operation of boats.**
    - **Adequate training should be provided to all personnel engaged in construction and operation of the plant for operation till depths of 50 meter.**
    - **Adequate lifesaving kits should be made available to all personnel vulnerable to hazards relating to working in a water body.**
    - **A hooter and siren system should be in place.**
    - **Wireless communication should be provided to the team.**

6.11. Disaster Management Plan

6.11.1. Philosophy

The Disaster Management Plan (DMP) for floating solar power plant proposed to be installed and operated at the Getalsud reservoir is based out of the following philosophy.

The proposed plant of capacity 153.6 MW consists of two major on-site components, namely the floating solar plant with all accessories on reservoir and an on-shore sub-station for withdrawal of power generated from the solar panels and transferring it to the transmission lines for further transmission to state grid. The transmission line is about 27.2 kms in length.

The power collection would be achieved through AC power from string inverters collected through 800V volt switchgear and stepped up to 33kV through inverter transformer. The sub-station is located approximately 500 m from the solar panel systems and 100 m from the embankment.

The DMP consists of elements from the construction and operational phases of the project. It covers risks from physical, climatic and technical aspects of the proposed project. A detailed DMP can be formulated post a risk assessment study.

This chapters provides a framework for management of disasters for the proposed FSPV project at Getalsud reservoir and an incident management system for a robust and effective response system during the entire cycle of disaster management including preparedness, response and recovery phases.

The panel installation would take place at least 500 meters inside from the dam. The existing bund walls are 6 meters in width and are tapered. Vehicular traffic movement takes places in the current scenario.

6.11.1.1. PREAMBLE

The DMP of the proposed floating solar power project follows the guidelines for emergency preparedness as specified in the Disaster Management Act, 2005 along with guidelines published by the National Disaster Management Authority (NDMA) as well as those prescribed by Central Electrical Authority (CEA) for power plants. These are referenced in accordance with the needs and features of the proposed project.

6.11.1.2. SITUATION ANALYSIS

There could be several situations which would require the activation of this DMP. These could be in terms of local climatic conditions or arise from physical and technological aspects of the proposed floating solar project. These are highlighted in the next section.

6.11.1.3. WEATHER CONDITIONS

The project may face extreme weather conditions during its commissioning and operation. These generally include high winds, thunderstorms, hail, lighting, squalls, etc. A comprehensive study on the local weather pattern could provide indicators of safeguard for management during such conditions. Weather conditions would also include the risk from forests fires. Dust arising from different activities can also hamper operations and maintenance.

6.11.1.4. NATURAL HAZARDS

There may be a risk from earthquake or tremors for the proposed project. Seismic analysis could assist in identifying the risk from such tremors during the construction, commissioning and operation of the proposed FSPV project. There would be 483840 numbers PV modules for the PV plant with 960 number of string inverters.

6.11.1.5. PHYSICAL CONDITIONS

A floating solar power plant, as in the case of the present project, would expose the workers to situations which could be ergonomically stressful. In addition, there would be hazards relating to slips and falls, trips, shocks and installation dangers such as drowning, or exposure to excess water inside the reservoir.

6.11.1.6. TECHNICAL CONDITIONS

These might arises due to human error, technical faults as well as non-compliance of standard operating procedures during commissioning, operation and maintenance. Technical conditions also include electrical based faults or component failures. These also include risks to plant personnel during installation, commissioning, operation and maintenance.

6.11.1.7. HUMAN INDUCED

These include human induced disasters such as arsenal, sabotage or terror attacks.

6.11.1.8. ENVIRONMENTAL RISKS

These would include risk to the surrounding environment from the glare of solar panels, risk to the aquatic environment and so forth.

6.11.1.9. DISASTER MANAGEMENT MATRIX

A summary of disaster class along with probable scenario with applicable management measures is provided in this section.

Table 63 below provides different scenario for the proposed project which could affect different phases of the project. The applicable phases are classified as installation and commissioning (construction phase) denoted by character “C” and operational phase by the character “O”.

Disaster class	Scenario	Applicable Phase	Philosophy	Management
Climate	High winds	C and O	The design should consider all wind simulations in engineering. Wind speed, direction, prevalent time should be considered.	The technical equipment and personnel should take adequate precautions during work especially inside the reservoir and secure themselves and the equipment to resist any damage due to winds.
	Heat Waves	C and O	The local temperature pattern should be analysed.	Precautions taken during a heat wave is adequate shelter and rehydration. These should be taken into account. All sensitive equipment and components could be insulated, and critical components could be designed as per NFPA requirements for such systems.
	High Water levels	C and O	These should be analysed through wave pattern and built in the design.	Rough tides can cause the system to behave abruptly with swings depending on the wave behaviour. These should be managed physically through adequate provision in tethering and mooring components. Walkways should be designed so as to sustain maintenance in these conditions

Disaster class	Scenario	Applicable Phase	Philosophy	Management
	Low water levels or drought	C and O	These should be extensively discussed with irrigation department	Very low levels during construction could lead to a held up in construction and other challenges. The operational issues should be investigated through design solutions.
	Forest Fires	C and O	These should be analysed as there is a presence of forests on the way of transmission line.	The operational team during commissioning and installation should be made aware and work should be planned accordingly. All sensitive equipment and components could be insulated, and critical components could be designed as per NFPA requirements for such systems.
Physical	Earthquake/Tremors	C and O	These should be taken into consideration during design.	Operational aspects of management include stable anchoring and mooring so that the system is minimally affected during any occurrence.
Technical	Solar Panel glare	Majorly O	The solar panel design and alignment should minimise this effect.	
	Boat operations	C and O	The boats used should be in accordance with the best design available for suitability of operation in reservoirs. Boat operation incidents OPERATORS DISTRACTION Any distraction faced by the person operating a boat or a personal watercraft while driving the boat may cause accidents. RECKLESS OPERATION OF THE BOAT Many a times, boats accidents occur due to over speeding of boats or watercrafts. In addition, negligence in boat operations also cause accidents. INEXPERIENCED OPERATOR Just as car accidents are more common among new drivers, anyone who is new to operating a boat or a personal watercraft is at higher risk of causing or being involved in a boating accident. EQUIPMENT FAILURE Boat accident may also be caused due to the failure of equipment on board of boats or personal watercrafts.	Adequate training of personnel should be provided and training appropriate for operation till depths of 50 meter should be ensured for any personnel engaged in commissioning of the plant. Adequate lifesaving kits should be made available. A hooter and siren system should be in place. Wireless communication should be provided to the team.
	Anchoring and mooring	C and O	This should be provisioned for during the design.	A monitoring system should be in place, if feasible, for monitoring the health of the anchoring and mooring system. Standard operating procedures as provided by the technical team should be strictly adhered to.
	Electrical hazards	C and O	These are mainly due to malfunction or any incident arising in inverter systems, substation and other electrical AC and DC components.	The personnel involved in commissioning and installation should be trained in handling components in wet and dry conditions.

Disaster class	Scenario	Applicable Phase	Philosophy	Management
Human induced	Manmade disasters	C and O	These should be included as part of HR policies through screening of team in accordance with high risk, high pressure situations.	There should be regular monitoring of health indicators for any indicator of stress in the operation team and corrective measures should be in place. The property should be adequately secured. Security should be provided round the clock.
Other Process Hazards		O	These are process and technical hazards which would be identified through a risk assessment including malfunction of any components or accessories.	Adequate levels of safety such as redundancy, engineering controls would be essential for prevention and controlling of process hazards. Secondary systems such as alarms, PPEs and fire protection equipment would be essential for these types of hazards.
Physical hazards		C	These would be at the maximum during the construction phase and less in operational phase. The physical hazards should be identified at each and every step of the plant commissioning through appropriate Risk Assessment	There should be a strong standard operating procedure for installation of floating solar PV panels and accessories for personnel involved in such action. Due to location and actual site conditions, adequate PPE would be important. Personnel should be properly secured that they are not over exposed to any dangers through the water in the reservoir. Biological testing of the water would be essential for ensuring that there is no contamination of the water in the reservoir. Slips, trips, falls, shocks should be managed with proper first aid and then if required a more comprehensive medical treatment.
Traffic		C and O	A traffic management should be in place for the same.	
Waste		C	A strong waste management plan should be in place for the same.	Hazards during waste handling include cuts, burns, etc. Adequate PPE should be worn.
Civil and Mechanical		C	Civil and Mechanical incidents include failures of construction equipment, cranes, lifts and securing equipment utilised for the project. In addition, moving equipment, retracting or rolling equipment could also pose hazard.	The construction should follow proper scaffolding and securing of all equipment and personnel when working in heights and depths in the reservoir area. In addition, the provisions of the building and construction workers act, and other safety provisions should be followed.

Table 62: Disaster Management Matrix

6.12. COVID-19 Outbreak Preparedness and Management

To reduce the impact of COVID-19 outbreak conditions on construction and civil projects, it is important that Contractors develop a plan for COVID-19 pandemic and any infectious disease epidemics that may arise in the future. For Contractors who have already planned for disease pandemic outbreaks in their emergency preparedness plan, planning for COVID-19 may involve updating plans to address the specific exposure risks, sources of exposure, routes of transmission, and other unique characteristics of SARS-CoV-2. Contractors who have not prepared for pandemic events should prepare themselves and their workers as far in advance as possible of potentially worsening outbreak conditions. Lack of continuity planning can result in a cascade of failures as Contractors attempt to address challenges of COVID-19 with insufficient resources and workers who might not be adequately trained for jobs they may have to perform under pandemic conditions.

Contractors are required to comply with the Project Health and Safety Manual. A key component of the Health and Safety Manual is the Emergency Preparedness Plan, which addresses emergency events during the life of the project. COVID-19 is an emergency event due to the novel corona virus pandemic that falls under the EPP. The Contractors are obligated to implement the EPP during this emergency event to protect the health and safety of the workers.

The objectives are as follows:

- **Preparedness - undertake readiness activities to reduce the impacts on the project operations and local community during COVID-19 pandemic;**
- **Prevention - prevent or minimize COVID-19 outbreaks within the construction sites and potential spread to local communities;**
- **Maintain essential project operations in the case of an outbreak at construction sites; and**
- **Communications- develop standardized messages, procedures and tools for stakeholders under the management of the Contractors (e.g. subcontractors, suppliers, community workers).**

Role of Contractors: Contractors are responsible to comply with the Project OHS Management Plan, including the Emergency Preparedness Plan in which COVID-19 pandemic is classified as an emergency. The responsibilities of the Contractors are to:

- **Implement the COVID-19 OHS Protocols to protect the health and safety of project workers during this emergency crisis.**
- **Prepare site readiness in response to COVID-19 when restarting the project and returning to work.**
- **In consultation with PMU, assess the resources and capacity of site medical facilities and engage with external healthcare network to ensure adequate care for the project workers if there is an outbreak. Agree with the local or private health care service provider on the scope of services to be provided, the procedure for in-take of patients and (where relevant) any costs or payments that may be involved.**
- **Ensure workers, sub-contractors and suppliers are in compliant with COVID-19 OHS Protocols.**

Role of Project Workers: Project workers include contractors, subcontractors and their contracted workers; suppliers and community workers who work in the project in any capacity. The responsibilities of Project Workers are to:

- **Follow all the requirements of the COVID-19 OHS Protocols and actively participate in the activities related to pandemic preventive measures.**
- **Immediately notify their Supervisor, Project Manager or Project Medical Provider if feeling ill, sick or unwell.**

Risk Assessment: The Contractors, with support from PIU should conduct a COVID-19 risk assessment starting with the workforce. Assessing these different aspects of the workforce will help in identifying appropriate mitigation measures.

Transmission Risk between Project Workers and Community Members: The risk of COVID-19 transmission between project workers and community members is significantly high during the pandemic and management decisions will need to be made on preventive measures as they may affect the project timelines, costs and delays.

Return to Work Plan: Based on the risk assessment, the Contractors should be able to identify essential workers that are required on the construction sites and the non-essential workers who are able to work remotely or from home.

Communications & Training: Workers need to be provided with regular opportunities to understand their situation, and how they can best protect themselves, their families and the community. They should be made aware of the COVID-19 OHS Protocols that have been put in place in the workplace, and their own responsibilities in implementing them.

6.12.1. Preventive Measures

Physical Distancing: It is an important prevention measure to minimize the spread of COVID-19, at least 1 meter physically apart will be challenging at some construction sites.

Work Schedules/ Rotations: The Contractors should review current work processes and timings to determine if changes are needed to reduce or minimize contact between workers, recognizing that this may impact the project schedule. Contractors and PMU should work together to an agreement if this impacts the project schedule

Shift Change: Where shift change requires the workers to clock-in, queuing in line or gathering to take place the Contractors should implement shift change procedures to ensure physical distancing.

Travel to Work/ Travel between Sites: When travelling to work or between site locations, workers should travel alone if possible. If workers have no option but to share a vehicle, contractor bus or public transportation then they should:

- **Journeys should be shared with the same individuals and with the minimum number of people at any one time.**
- **All workers should wear a face mask/ covering when travelling in a shared vehicle, contractor bus and public transportation.**
- **Wherever possible maintain a distance of 1 meter and avoid/ remove middle seat**

- **Good ventilation (i.e. keeping the windows open) and facing away from each other may help to reduce the risk of transmission.**
- **The vehicle should be cleaned regularly using proper PPE and standard cleaning/ disinfecting products, with particular emphasis on handles and other areas where passengers may touch surfaces.**

6.12.2. Personal Hygiene

Hand washing: is a simple yet one of the most effective ways to prevent the spread of COVID-19

Coughing and Sneezing: Coughing and sneezing releases droplets that contaminate air and surfaces and help to spread COVID-19. When an infected person uses their hands to block a cough or sneeze, those hands become contaminated. Need adequate measure to prevent contaminated.

Face Masks: A “face mask” is any well-secured fabric, cloth, fabric or paper mask that covers one’s nose and mouth.

Cleaning and Disinfection of Surfaces: Current evidence suggests that COVID-19 virus can remain viable for hours to days on surfaces made from a variety of materials. Cleaning of surfaces followed by disinfection is a best practice measure for prevention of COVID-19 in the workplace, camps and community settings.

Personal Protective Equipment (PPE): While engineering and administrative controls are considered more effective in minimizing exposure to COVID-19, PPE may also be needed to prevent certain exposures. While correctly using PPE can help prevent some exposures, it should not take the place of other prevention strategies (e.g. face masks/coverings, physical distancing, hand washing, coughing & sneezing etiquette).

Biohazard & Medical Waste Management: Biohazard and medical wastes are contaminated with blood or other infectious materials. The infectious materials pose a risk of spreading disease in humans, animals and the environment. It should be noted that the SAR-CoV-2 virus that causes COVID-19 infection has been found in body fluids such as blood, respiratory (saliva, sputum, droplets, etc.), semen and faeces.

Contractors should be aware that any waste produced during the care of COVID-19 suspect or confirmed infected workers in the medical clinic should be treated as biohazard waste, and collected in designated biohazard containers or bags, treated and disposed by following relevant requirements (e.g., local authority, WHO). Treatment of biohazard waste is typically by autoclaving or incineration. Where autoclaving and/or incineration equipment not available within the project, the Contractors should engage with external service provider, local hospital, or health clinic to ensure biohazard waste is properly disposed.

6.12.3. Management of COVID-19 Outbreak

Medical Service Obligations: Given the limited scope of the project medical facilities and service capabilities, the Contractors should ensure that external healthcare network (public and private medical facilities) is available to test and to treat suspected/ infected workers if there is an outbreak or when illness escalates.

Testing for COVID-19, Daily Health Screening, Incident Management and Reporting, COVID-19 Outbreak EPP Drills, COVID-19 information and daily Toolbox talk will adopt by the Contractors.

6.13. Site Restoration Plan

1. **At the completion of construction, all construction camp facilities shall be dismantled and removed from the site.**
2. **The site shall be restored to a condition in no way inferior to the condition prior to commencement of the works.**
3. **Various activities to be carried out for site restoration are like (1) cleaning / removal of oil and fuel contaminated soil and its disposal in approved waste disposal areas. (2) construction campsite shall be grassed and planted with trees as per the restoration design; (3) Sealing / filling up of soak pits and septic tanks; (4) disconnection of electricity supply; (5) disposal of all garbage in the disposal site only (site approved by local authority**

6.14. Monitoring

This ESMP should be monitored on a regular basis viz. monthly, quarterly or half-yearly and all outcomes should be audited in accordance with existing EHS commitments. The monitoring process should cover all stakeholders including contractors, labourers, suppliers and the local community impacted by the project activities and associated facilities thereby increasing the effectiveness of suggested mitigations measures. SECI should ensure that all the contractors comply with the requirements of conditions for all applicable permits, suggested action plans and scheduled monitoring. The inspections and audits should be carried out by an internal trained team and external agencies/experts. The entire process of inspections and audits shall be documented, and key findings should be implemented by the project proponent and contractors in their respective areas. There is a proposal of EHS officer from the contractor's side to implement the ESMP on the project.

6.15. Documentation and Record Keeping

Documentation and record keeping system must be established to ensure updating and recording of requirements specified in ESMP. Responsibilities have to be assigned to relevant personnel for ensuring that the ESMP documentation system is maintained and that document control is ensured. The following records should be maintained at site:

- Documented Environment and Social Management System.
- Legal Register.
- Operation control procedures.
- Work instructions.

- Incident reports.
- Emergency preparedness and response procedures.
- Training records.
- Monitoring reports.
- Auditing reports; and
- Complaints register and issues attended/ closed

6.16. Training of Personnel and Contractors

Developer should ensure that the job specific training and Environment Health and Safety (EHS) Induction training needs are identified based on the specific requirements of ESMS and existing capacity of site and project personnel (including the contractors and sub-contractors). Special emphasis shall be placed on road and reservoir traffic management, stakeholders' engagement and grievance redress mechanisms. General environmental and occupational health awareness shall be increased among the project team (including Contractor's personnel) to encourage the implementation of environmentally sound practices and compliance requirements of the project activities. This will help in minimizing adverse environmental impacts and in ensuring compliance with the applicable regulations and standards. An environment and social management training program shall be conducted to ensure effective implementation of the management and control measures during construction and operation of the project. The training program shall ensure that all concerned members of the team understand the following aspects

- **Purpose of action plan for the project activities.**
- **Requirements of the specific Action Plans**
- **Understanding of the sensitive environmental and social features within and surrounding the project areas; and awareness of the potential risks from the project activities.**
- **A basic occupational training program and specialty courses shall be provided, as needed, to ensure that workers are oriented to the specific hazards of individual work assignments.**
- **Training shall be provided to management, supervisors, workers, and occasional visitors to areas of risks and hazards.**
- **Workers with rescue and first-aid duties must receive dedicated training so as not to inadvertently aggravate exposures and health hazards to themselves or their co-workers.**
- **Through appropriate contract specifications and monitoring, the employer shall ensure that service providers, as well as contracted and subcontracted labour, are trained adequately before assignments begin.**

7. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

7.1. Public Consultation

7.1.1. Purpose

Public consultation has been carried out in the surrounding affected area near proposed FSPV project location at Getalsud reservoir with the objectives to minimize the probable adverse impacts of the project through alternate design solutions and to achieve speedy implementation of the project by bringing in awareness in the community on the benefits of the project. Purpose of the public consultation includes the following:

- **To ascertain the public views on various environmental and social issues relating to the proposed project.**
- **To encourage people's participation in project design and development stage.**
- **To use it as a tool for collecting information about natural and the human environment, much of which may not be accessible through more traditional approaches of data collection.**
- **Adopting possible mitigation measures based on local knowledge of the communities and;**
- **To ensure reduction of public resistance to the project by sharing information in a timely and transparent manner and by providing them a role in the decision-making process.**

Detail of public consultation carried out nearby villages has been presented in the Table 64 below. The photographs taken during public consultation has been presented in **Annexure A** of this report.

Name of Village	Issues Discussed	Concerns Raised	Response Shared
Getalsud	Air Pollution	The residents are concerned about the dust pollution during construction	The dust suppression mechanism will be in place and water sprinkling will be regularly done.
	Livelihood Concern	Fear of losing fishing ground	The people are informed about the FSPV layout.
	Livelihood and Income Restoration	The respondents were keen to know about the assistance provided for their income restoration	The category wise entitlement was shared with the group.
	Hiring of Local labour	The concern raised that the migrant labour would be used for construction	The local unskilled labour shall be hired as much as possible. There is an availability of the local labours in the project area.

Name of Village	Issues Discussed	Concerns Raised	Response Shared
	Safety	Risk of accidents and injury due to increased movement of project vehicles	Various safety signage will be provided. Project has developed a road safety plan. The traffic marshals would be placed at important points of risk. Physical barriers could also be provided where ever necessary.
	Employment	Temporary employment with contractor was sought.	As per the policy, contractor to give preference to local population in matters of employment.
	Compensation options	The compensation; in what form and when?	The group was informed that no construction would be started before compensating all the affected PAFs. The issue is discussed and the opinion is discussed in section 7.5 of the RAP report.
	Implementation of GRM	Where and when the entire information can be had and if any complain to record, what is the platform.	The group was informed about their rights and demonstrated the functioning of the GRC.
	Any other issues	1. If they don't accept the proposal from the project proponent. 2. Will the entire reservoir be covered by the solar panels. 3. What would happen to the current tourism activities 4. Will it adversely impact the availability of water for the downstream users? 5. Compensation for Crop damage	1. You can refuse the proposal and go for fresh negotiations. All compensation/ rehabilitation measures would be in compliance with the provisions of GoI and GoJ regulatory framework. 2. No, only 8% of the reservoir would be covered by the solar panels. 3. No adverse effect on tourism; it may attract more tourist to the spot. 4. No, it will not affect any water discharge/availability. 5. The crop compensation would be given as per Government guidelines. However, the construction would be planned in such a way that the crop is not affected.
Saheda	Employment	Would prefer permanent employment on the project. Temporary employment with contractor was also sought.	As per the policy, contractor to give preference to local population in matters of employment.
	Compensation	Cash compensation at replacement value	As per the policy, compensation will be provided at replacement value.
	Compensation options	The compensation; in what form and when?	The group was informed that no construction would be started before compensating the last impacted family/person. The issue is discussed, and the opinion is discussed in section 7.5 of the RAP report. It was informed that the vulnerable group is entitled for more compensation in comparison to general compensation.

Name of Village	Issues Discussed	Concerns Raised	Response Shared
	Civic Amenities	Impact on sanitation, drinking water resources of the community	Adequate separate arrangements for drinking water and sanitation shall be made for project staff and workers.
	Environmental Pollution	The residents are concerned about the dust pollution during construction	The dust suppression mechanism will be in place and water sprinkling will be regularly done.
	Livelihood and Income Restoration	The respondents were keen to know about the assistance provided for their income restoration	The category wise entitlement was shared with the group.
	Implementation and GRM	Where and when the entire information can be had and if any complain to record, what is the platform.	The group was informed about their rights and demonstrated the functioning of the GRC.
	Safety	Children fence should be given at all the points of danger	Various safety signage will be provided. Necessary safety arrangements shall be made to avoid accidents and injury to the general public. The traffic marshals would be placed at important points of risk. Physical barriers could also be provided wherever necessary.
	Any other issues	1. If they don't accept the proposal from the project proponent. 2. Will the entire reservoir be covered by the solar panels? 3. What would happen to the current tourism activities? 4. Will it adversely impact the availability of water for the downstream users?	1. You can refuse the proposal and go for fresh negotiations. All compensation/ rehabilitation measures would be in compliance with the provisions of GoI and GoUK regulatory framework. 2. No, only 5% of the reservoir would be covered by the solar panels. 3. No adverse effect on tourism; it may attract more tourist to the spot. 4. No, it will not affect any water discharge/availability.
Maheshpur	Encroachment	A few PAPs agreed that they are encroachers / squatters, but they also said that they have no space for reconstruction / relocation	Assistance to vulnerable encroachers, squatters and kiosk owners as per the project R&R policy.
	Employment	Would prefer permanent employment on the project. Temporary employment with contractor was also sought.	As per the policy, contractor to give preference to local population in matters of employment.
	Livelihood and Income Restoration	The respondents were keen to know about the assistance provided for their income restoration	The category wise entitlement was shared with the group.

Name of Village	Issues Discussed	Concerns Raised	Response Shared
	Compensation options	The compensation; in what form and when?	The group was informed that no construction would be started before compensating the last impacted family/person. The issue is discussed, and the opinion is discussed in section 7.5 of the RAP report.
	Implementation and GRM	Where and when the entire information can be had and if any complain to record, what is the platform.	The group was informed about their rights and demonstrated the functioning of the GRC.
	Land Acquisition issue	If they don't except the proposal from the project proponent.	You can refuse the proposal and go for fresh negotiations. All the acquisition would be complying the provisions of GoI and GoJ legislation.
	Environmental Pollution	The residents are concerned about the dust pollution during construction	The dust suppression mechanism will be in place and water sprinkling will be regularly done.
Matatu	Encroachment	A few PAPs agreed that they are encroachers / squatters, but they also said that they have no space for reconstruction / relocation	Assistance to vulnerable encroachers, squatters and kiosk owners as per the project R&R policy.
	Employment	Would prefer permanent employment on the project. Temporary employment with contractor was also sought.	As per the policy, contractor to give preference to local population in matters of employment.
	Livelihood Concern	Fear of losing fishing ground	The people are informed about the FSPV layout.
	Livelihood and Income Restoration	The respondents were keen to know about the assistance provided for their income restoration	The category wise entitlement was shared with the group.
	Compensation options	The compensation; in what form and when?	The group was informed that no construction would be started before compensating the last impacted family/person. The issue is discussed and the opinion is discussed in section 7.5 of the RAP report.
	Implementation and GRM	Where and when the entire information can be had and if any complain to record, what is the platform.	The group was informed about their rights and demonstrated the functioning of the GRC.
	Land Acquisition issue	1. If they don't except the proposal from the project proponent. 2. Crop Compensation	You can refuse the proposal and go for fresh negotiations. All the acquisition would be complying the provisions of GoI and GoJ legislation. The crop compensation would be given as per Government guidelines. However, the construction would be planned in such a way that the crop is not affected.

Name of Village	Issues Discussed	Concerns Raised	Response Shared
Chuttu	Compensation for land	The compensation; in what form and when?	The group was informed that no construction would be started before compensating the last impacted family/person. The issue is discussed and the opinion is discussed in section 7.5 of the RAP report.
	Compensation for Crop	The compensation; in what form and when?	The compensation would be as per Jharkhand state policy and currently it is 15% of circle rate.
	Safety Issues	Safety due to transmission tower and line	The group was informed that all necessary safety measures would be taken during construction and operation
	Employment	Would prefer permanent employment on the project. Temporary employment with contractor was also sought.	As per the policy, contractor to give preference to local population in matters of employment.
	Environmental Pollution	The residents are concerned about the dust pollution during construction	The dust suppression mechanism will be in place and water sprinkling will be regularly done.
Haldama	Compensation for land	The compensation; in what form and when?	The group was informed that no construction would be started before compensating the last impacted family/person. The issue is discussed and the opinion is discussed in section 7.5 of the RAP report.
	Compensation for Crop	The compensation; in what form and when?	The compensation would be as per Jharkhand state policy and currently it is 15% of circle rate.
	Safety Issues	Safety due to transmission tower and line	The group was informed that all necessary safety measures would be taken during construction and operation
	Employment	Would prefer permanent employment on the project. Temporary employment with contractor was also sought.	As per the policy, contractor to give preference to local population in matters of employment.
	Environmental Pollution	The residents are concerned about the dust pollution during construction	The dust suppression mechanism will be in place and water sprinkling will be regularly done.
Ramdaga	Compensation for land	The compensation; in what form and when?	The group was informed that no construction would be started before compensating the last impacted family/person. The issue is discussed and the opinion is discussed in section 7.5 of the RAP report.
	Compensation for Crop	The compensation; in what form and when?	The compensation would be as per Jharkhand state policy and currently it is 15% of circle rate.
	Livelihood Concern	Fear of losing fishing ground	The people are informed about the FSPV layout.
	Livelihood and Income Restoration	The respondents were keen to know about the assistance provided for their income restoration	The category wise entitlement was shared with the group.

Name of Village	Issues Discussed	Concerns Raised	Response Shared
	Safety Issues	Safety due to transmission tower and line	The group was informed that all necessary safety measures would be taken during construction and operation
	Employment	Would prefer permanent employment on the project. Temporary employment with contractor was also sought.	As per the policy, contractor to give preference to local population in matters of employment.
	Environmental Pollution	The residents are concerned about the dust pollution during construction	The dust suppression mechanism will be in place and water sprinkling will be regularly done.

Table 63: Public consultation – Getalsud Reservoir FSPV project, Jharkhand

7.1.2. Process Adopted

Public consultation with key stakeholders is an integral part of ESIA process. The process of public consultation for this project began during the early stages of environmental and social assessment process while carrying out the survey and investigation works, that is, while environmental screening and prioritization was undertaken. Outcomes of the public consultation on social issues shall be provided in greater detail in the RAP to be prepared for the project after finalization of transmission route on revenue map. Minutes of Meeting and Attendance Sheet recoded during consultation has been given in **Annexure I** of this report.

Local communities, who are primary stakeholders on environmental and social aspects, were chosen for consultation. Focused group discussion with the local community is adopted as a tool for the consultation.

Other key stakeholders such as officials of various Departments of the Government of Jharkhand and the representatives of the concerned Panchayati Raj Institutions (Rural Local Self Government), which are of relevance to the project, were consulted during the reconnaissance survey. Consultations have been carried out with key stakeholders to understand environmental and social concerns, identify potential impacts, necessity of specific safeguard measures and statutory compliance requirements and procedures for each of the project activities.

The public consultation in the project area were held at various levels i.e. Village level, Block level and District level. The local communities were briefed on project interventions including its benefits as well as potential adverse impacts and the propose mitigation measures.

7.1.3. Stakeholder Mapping

Based on the stakeholder mapping exercise carried out for the project, a list of identified stakeholders, their status as primary or secondary stakeholders, their respective roles in the project process and the degree of their potential influence on the project are discussed in the Table 65 below.

Stakeholder	Category	Role	Influence
SECI	Primary	• Project proponent	High

Stakeholder	Category	Role	Influence
		• Responsible for all the project risks and impact liabilities • Responsible for establishment and operation of this project	
Consultant	Primary	• Carry out the detailed engineering design of the project • Conduct environmental and social impact assessment study for the project	High
Contractor	Primary	• Procurement of all equipment and material required for the project • To carry out the works in accordance with the agreed scope of works and in accordance with the contract	High
Project financer	Primary	• Providing for the finance to support the project	High
Irrigation Department.	Primary	• Responsible for allocating the required space within the reservoir area and allowing the project to come up on the reservoir	High
Jharkhand Bijli Vitran Nigam Limited (JBVNL)	Primary	• Responsible for the construction of the transmission line • Engagement during construction period for setting up transmission corridor	High
District and Block administration	Primary	• Responsible for moderation in the land procurement for the project.	Low
Local community around the project area	Primary	• Providing the required public support for smooth execution of the project	Medium
Project affected people; landowners and farmers	Primary	• They are the owners of the land located within the RoW of the transmission line for the project.	High
Project affected people on account of livelihood on the reservoir	Primary	• Local people depend upon the reservoir for fishing as an economic activity. • There may be limited impact during construction	Medium
Vulnerable population	Primary	• There are a few vulnerable household / population affected by the project.	Medium
Women	Primary	• Being a part of the traditional patriarchal set up, women have little	High

Stakeholder	Category	Role	Influence
		control over economic resources of the family • They have little role to play in decision making process relating to major aspects of their family or village life. • Women centred FGD could not be conducted on account of the restriction due to the current situation of COVID-19. However women were invariably consulted during the course of household survey.	
Panchayat administration	Primary	• Support in the land purchase process. • Responsibility to carry out group activity and facilitate local development work • Support in developing the public opinion about the project.	Medium
Department Of Fisheries	Primary	• Fisheries department use these reservoirs as their breeding area.	Low
Local NGOs	Secondary	• The community based social welfare groups and charitable organizations which can influence people at the ground level. • A few NGOs like Pratigya, Aadhar, Aao Hath Milayen etc. are a few working in the area for developmental work. A list of NGO has been provided as Annexure H	Low

Table 64: Stakeholder mapping

7.1.4. Outcome of Public Consultation and Action Taken

Local communities are well aware of the proposed project. All the participants have welcomed the project and requested for early completion. People are optimistic about the possibility of more opportunities emerging due to this project, especially through their direct engagement during construction phase. Specific environmental and social concerns and suggestions put forth by the local community are provided in the Table 73 above.

The environmental and social issues discussed by the participants are summarized below:

- **Impact on air quality due to increased dust level and emission level.**
- **Impact on nearby human habitats due to increased noise levels.**
- **Restoration of water supply sources and common property resources before demolition, if affected.**

- **Provision of public toilets in habitations.**
- **Plantation of trees along project roads to compensate trees cutting; and**
- **Provision of recreation area for children.**

Specific environmental and social safeguard measures proposed against potential impacts and the statutory compliance requirements and procedures for each of the project activities were explained to the community members by the representatives of the project and the officials of the Government Departments participating in the consultation process.

More details on public consultation and its outcomes has been provided in the RAP report prepared for the project.

7.1.5. Information Disclosure

Summary of environmental and social assessment reports prepared for a project are to be made accessible to all interested parties including the general public. As per the requirements for Category B Projects, the full ESIA report is also to be made available to the interested parties upon request to SECI.

8. ENVIRONMENTAL AND SOCIAL MONITORING

The environmental and social monitoring is important in terms of evaluating the performance of pollution control measures adopted for the project. The sampling and analysis of the environmental attributes will be as per the guidelines of Central Pollution Control Board. The frequency of sampling and location of sampling will be as per the directives of CPCB / SPCB.

Environmental and social monitoring will be conducted on a regular basis to assess the pollution levels in the surrounding area. The impact assessment study carried out for the proposed project is based on a single season data collected over a short period of time and consequently, the data cannot bring out all variations induced by the natural or human activities within the study area. Therefore, regular monitoring programme of the environmental parameters is essential to consider the changes in the environment on account of the project. Table 76 below shows the environmental and social monitoring plan to be maintained throughout the life of the project.

The objectives of environmental monitoring are:

- **To verify the result of the impact assessment study.**
- **To follow the trend of parameters which have been identified as critical.**
- **To check or assess the efficiency of the control measures that have been adopted.**
- **To ensure that new parameters, other than those identified in the impact assessment study, do not become critical through the commissioning of new installations or through the modification in the operation of existing facilities.**
- **To check assumptions made with regard to the development and to detect deviations in order to initiate necessary measures; and**
- **To establish a database for future impact assessment studies for new projects.**

The environmental and social attributes, which require regular monitoring, are specified below:

- **Air quality.**
- **Water and wastewater quality.**
- **Noise levels.**
- **Soil quality.**
- **Ecological preservation and afforestation, if required; and**
- **Socio economic aspects and community development. Monitoring will be undertaken internally by the project staff at different levels. The Field Officer of SECI on monthly basis will carry out the project's internal monitoring. The Field Office will submit monthly report to the Social Development Officer of SECI.**
- **Land Acquisition**
- **Public Consultation**
- **Implementation of R&R issues**
- **Livelihood Issues**

- **Community Health and Safety**
- **Grievance Management**
- **Gender Issues**

This aspect has been covered in detail in the Chapter 12: Monitoring and Evaluation Indicators of RAP report prepared separately for this project.

The environmental and social monitoring plan has been elaaborated in Table 66.

Sl. No.	Environmental Attributes	Parameters/ Indicators	Location	Method of Monitoring	Frequency	Agency/ Responsibility
Planning						
1.	Land acquisition	➢ Land in Ha ➢ Payment of compensation ➢ Grievance redressal ➢ Disbursement for Land and Crop ➢ Income and Livelihood Restoration	No Land acquisition is proposed. However, compensation for Right of Way for transmission line shall be made as per provisions provided in RAP prepared for the Project.	RFCTLARR Act, 2013 and the State Government Rules	Throughout the Project Construction phase and implementation of the RAP.	SECI
2.	Loss of Livelihood	No. of affected persons	FSPV site, Plant Sub-station and Transmission lines	Entitlement matrix and As per / WB Policies and Guidelines	Throughout the Project Construction phase and implementation of the RAP.	SECI
3.	Public Consultation and dissemination of information on project issues	Number, issues, agenda and outcomes of Consultation	FSPV site, Plant Sub-station and Transmission lines	As per / WB Policies and Guidelines	Once for each of the affected Villages	SECI
4.	Follow up action on agreement reached during consultations/ meetings	Complaints and its disposal	FSPV site, Plant Sub-station and Transmission lines	As per / WB Policies and Guidelines	Throughout the implementation of the RAP.	SECI
5.	Displacement of Non titleholders	No. of affected persons	FSPV site, Plant Sub-station and Transmission lines	Entitlement matrix and As per / WB Policies and Guidelines	Throughout the implementation of the RAP.	SECI
Construction						
6.	Chance find of artefacts of historical / cultural / archaeological significance	Chance find properties/artefacts shall be notified to the Archaeological survey of India and District Administration soon after noticing.	FSPV site, Plant Sub-station site and Transmission lines	As per GoI Regulations	Regular	Contractor / Supervising authority / SECI

Sl. No.	Environmental Attributes	Parameters/ Indicators	Location	Method of Monitoring	Frequency	Agency/ Responsibility
7.	Air	PM10, PM2.5, CO, NOx, SO2	Locations of construction activity and places as per baseline data generation	Monitoring to be carried out by NABL accredited laboratory in accordance with CPCB guidelines	Quarterly	Contractor
8.	Noise	Day and Night Noise (Daytime: 6 AM to 10 PM) and Night time: 10 PM to 6 AM) Average and Peak value during construction	Locations of construction activity and places as per baseline data generation	Monitoring as per CPCB guidelines by NABL accredited laboratory	Quarterly	Contractor
9.	Emissions (DG Sets)	PM, CO, HC and Noise	Location of its operation	Monitoring as per CPCB guidelines by NABL accredited laboratory	Quarterly	Contractor
10.	Water Supply	Quantity of water required for various purposes during construction phase such as Construction activities, and for drinking and washing needs of labour and staff.	FSPV site, Plant Sub-station site and Transmission lines	Water register for water received for construction	Monthly	Contractor
11.	Water quality	As per IS 10500 for drinking water parameters.	Locations of construction activity and places as per baseline data generation	Sampling and Analysis by as per CPCB guidelines by NABL accredited laboratory	Quarterly	Contractor
12.	Wastewater	As per CPCB guidelines on Wastewater discharge The parameters like pH, O&G, BOD, COD, Hardness should not exceed the prescribed limits as per CPCB standards.	Construction camp	Sampling and Analysis by as per CPCB guidelines by NABL accredited laboratory	Quarterly	Contractor
13.	Solid waste	Waste Collection and disposal records	Construction camp	Waste register	Monthly	Contractor
14.	Erosion	Subsistence	FSPV site, Plant Sub-station and Transmission lines	Observation	Regular	Contractor
15.	Occupational health and safety (accidents and injuries)	Health and safety incidents	FSPV site, Plant Sub-station site and Transmission lines	On site register for EHS, Site inspection and observation of health and safety practices	Monthly	SECI / Contractor

Sl. No.	Environmental Attributes	Parameters/ Indicators	Location	Method of Monitoring	Frequency	Agency/ Responsibility
16.	Community health and safety (accidents and injuries)	Health and safety incidents, Community health programmes and HIV programmes conducted Safety Signages	Settlement near the FSPV site, Plant Sub-station site and Transmission lines	Project Management	Weekly	SECI / Contractor
17.	Water quality of Getalsud Reservoir	pH, turbidity, Secchi depth, DO and BOD.	Area of the reservoir that is impacted by the installation of floating solar panels	Sampling and monitoring	Monthly	SECI
18.	Nesting Ground of birds	Birds population	Place of nesting ground, North of Getalsud reservoir	Census of birds by the State Forest Department	Seasonal	SECI
19.	Vulnerable Species	Avifauna	Project and nearby area including around the Transmission line corridor	Record of State Forest Department, Data collected from cameras etc.	Seasonal	SECI / Contractor
20.	Rented Properties	Agreement and its compliances	Project sites	Inspection of Records of payments	Monthly	SECI / Contractor
21.	Rented Resources like vehicles, machines etc.	Agreement and its compliances	Project activities	Inspection of Records of payments	Monthly	SECI / Contractor
22.	Labour Engagement	Percentage of local labour engaged out of total labour engaged for the project.	Project sites	As per BOCWA, 1996 and Department of Labour, GoUK	Regular	SECI / Contractor
23.	Gender issues	1. Equality in Wage Payment 2. Special Facilities for women workers 3. Grievance Redress Mehanism 4. Training and Gender Sensitivity	Project sites	Recording relating to the specified indicators	Regular	SECI / Contractor
24.	Livelihood issues	Implementation of livelihood restoration plan	Project sites	As per RAP	Monthly	SECI / Contractor
25.	Information Dissemination	No. of public meetings	Project sites	Records of public meeting	Monthly	SECI / Contractor

Sl. No.	Environmental Attributes	Parameters/ Indicators	Location	Method of Monitoring	Frequency	Agency/ Responsibility
		Display and distribution of IEC material		Visual evidence of publicity material Random Feedback from the local population		
Operation						
26.	Water Supply	Quantity of water required for various purposes during construction phase such as Construction activities, and for drinking and washing needs of labour and staff.	FSPV site, Plant Sub-station site and Transmission lines	Water register for water received for construction	Monthly	Contractor
27.	Community health and safety (accidents and injuries)	Health and safety incidents, Community health programmes and HIV programmes conducted	Settlement near the FSPV site, Plant Sub-station site and Transmission lines	Project Management	Continuous	SECI / Operator
28.	Water quality of Getalsud Reservoir	pH, turbidity, Secchi depth, DO and BOD.	Area of the reservoir that is impacted by the installation of floating solar panels	pH, turbidity, Secchi depth, DO and BOD.	Weekly	SECI / Operator
29.	Nesting Ground of birds	Birds population	Place of nesting ground, North of Getalsud reservoir	Census of birds by the State Forest Department	Seasonal	SECI / Operator
30.	Vulnerable Species	Avifauna	Project and nearby area including around the Transmission line corridor	Record of State Forest Department, Data collected from cameras etc.	Seasonal	SECI / Contractor
Decommissioning Phase						
31.	Dismantling of FSPV	Quantity of waste generated	Project Site	Disposal as per Govt. of India Norms	At th time of Decommissioning	SECI / Operator
32.	Air	PM10, PM2.5, CO, NOx, SO2	Locations of construction activity and places as per baseline data generation	Monitoring to be carried out by NABL accredited laboratory in accordance with CPCB guidelines	Quarterly	Contractor

Sl. No.	Environmental Attributes	Parameters/ Indicators	Location	Method of Monitoring	Frequency	Agency/ Responsibility
33.	Noise	Day and Night Noise (Daytime: 6 AM to 10 PM) and Night time: 10 PM to 6 AM)	Locations of construction activity and places as per baseline data generation	Monitoring as per CPCB guidelines by NABL accredited laboratory	Quarterly	Contractor
34.	Emissions (DG Sets)	PM, CO, HC and Noise	Location of its operation	Monitoring as per CPCB guidelines by NABL accredited laboratory	Quarterly	Contractor
35.	Water Supply	Quantity of water required for various purposes during construction phase such as Construction activities, and for drinking and washing needs of labour and staff.	FSPV site, Plant Sub-station site	Water register for water received for construction	Monthly	Contractor
36.	Water quality	As per IS 10500 for drinking water parameters.	Locations of construction activity and places as per baseline data generation	Sampling and Analysis by as per CPCB guidelines by NABL accredited laboratory	Quarterly	Contractor
37.	Wastewater	As per CPCB guidelines on Wastewater discharge The parameters like pH, O&G, BOD, COD, Hardness should not exceed the prescribed limits as per CPCB standards.	Construction camp	Sampling and Analysis by as per CPCB guidelines by NABL accredited laboratory	Quarterly	Contractor
38.	Solid waste	Waste Collection and disposal records	Construction camp	Waste register	Monthly	Contractor
39.	Erosion	Subsistence	FSPV site, Plant Sub-station	Observation	Regular	Contractor
40.	Occupational health and safety (accidents and injuries)	Health and safety incidents	FSPV site, Plant Sub-station site	On site register for EHS, Site inspection and observation of health and safety practices	Monthly	SECI / Contractor
41.	Community health and safety (accidents and injuries)	Health and safety incidents, Community health programmes and HIV programmes conducted	Settlement near the FSPV site, Plant Sub-station site	Project Management	Continuous	SECI / Contractor

Sl. No.	Environmental Attributes	Parameters/ Indicators	Location	Method of Monitoring	Frequency	Agency/ Responsibility
42.	Water quality of Getalsud Reservoir	pH, turbidity, Secchi depth, DO and BOD.	Area of the reservoir that is impacted by the installation of floating solar panels	Sampling and monitoring	Monthly	SECI
43.	Nesting Ground of birds	Birds population	Place of nesting ground, North of Getalsud reservoir	Census of birds by the State Forest Department	Seasonal	SECI
44.	Rented Properties	Agreement and its compliances	Project sites	Inspection of Records of payments	Monthly	SECI / Contractor
45.	Rented Resources like vehicles, machines etc.	Agreement and its compliances	Project activities	Inspection of Records of payments	Monthly	SECI / Contractor
46.	Labour Engagement	Percentage of local labour engaged out of total labour engaged for the project.	Project sites	As per BOCWA, 1996 and Department of Labour, GoUK	Regular	SECI / Contractor
47.	Gender issues	5. Equality in Wage Payment 6. Special Facilities for women workers 7. Grievance Redress Mehanism 8. Training and Gender Sensitivity	Project sites	Recording relating to the specified indicators	Regular	SECI / Contractor
48.	Livelihood issues	Loss of livelihood by the local population engaged on the project	Project sites	Settlement Records	Monthly	SECI / Contractor
49.	Information Dissemination	No. of public meetings Display and distribution of IEC material	Project sites	Records of public meeting Visual evidence of publicity material Random Feedback from the local population	Monthly	SECI / Contractor

Table 65: Environmental and Social Monitoring Plan

8.1. Monitoring of Environmental Parameters during Construction Phase

The monitoring of environmental parameters has to be carried out through an NABL accredited agency in construction phases by the Contractor. Environmental monitoring program during construction phase has been shown in the Table 67 below. The Environmental standards proposed by CPCB are provided in **Annexure G** of this report.

Sl. No.	Item	Parameters	Frequency	Location
•	Effluent from wastewater	pH, BOD, COD, TSS, TDS, O&G	Once every month	Before and after treatment from each wastewater discharge point
•	Noise	Equivalent noise level (Leq)	Once in three months	At major construction sites and sensitive receptors in the surrounding area.
•	Air quality	PM2.5, PM10, SO2 and NO2, CO, H2S, NH3 etc.	Once in three months	At major construction sites and sensitive receptors in the surrounding area.
•	Soil Quality	Parameters for FAO agriculture use	Once in three months	At major construction sites
•	Drinking Water	IS 10500 drinking water parameters	Monthly	Source of drinking water supplied to workers and staff.
•	Getalsud reservoir water characteristics	Parameters like Temperature, pH, Turbidity, TSS, TDS, DO, O&G, BOD and COD	Monthly	4 locations at Getalsud Reservoir
•	Getalsud reservoir Ecological Characteristics	Parameters like Phytoplankton, Zooplankton, macro invertebrates, fishes and other aquatic species	Three times during construction	4 locations at Getalsud reservoir

Table 66: Summary of Environmental monitoring program during construction phase

8.2. Monitoring of Environmental Parameters during Operation Phase

The monitoring of environmental parameters has to be carried out through an NABL accredited agency in operation phase by the plant operator. Environmental monitoring program during operation phase has been shown in below Table 68. The Environmental standards by CPCB are provided in **Annexure G** of this report.

Sl. No.	Item	Parameters	Frequency	Location
1.	Effluent from wastewater	➢ pH, BOD, COD, TSS, TDS, O&G	Once every month	Before and after treatment from each wastewater discharge point
2.	Noise	Equivalent noise level (Leq)	Once in three months	At substation site, FSPV site and sensitive receptors of the surrounding areas.

Sl. No.	Item	Parameters	Frequency	Location
3.	Air quality	PM2.5, PM10, SO2 and NO2, CO, H2S, NH3 etc.	Once in three months	At substation site, FSPV site and sensitive receptors of the surrounding areas.
4.	Soil Quality	Parameters for FAO agriculture use	Once in three months	At substation site and FSPV area.
5.	Drinking Water	IS 10500 drinking water parameters	Monthly	Source of drinking water supplied to workers and staff.
6.	Getalsud reservoir water characteristics	Parameters like Temperature, pH, Turbidity, TSS, TDS, DO, O&G, BOD and COD	Once in Three Months	4 locations at Getalsud Reservoir
7.	Getalsud reservoir Ecological characteristics	Parameters like Phytoplankton, Zooplankton, macro invertebrates, fishes and other aquatic species	Once in a Year	4 locations at Getalsud reservoir

Table 67: Summary of Environmental monitoring program during operation phase

9. INSTITUTIONAL REQUIREMENT

9.1. Executing Agency

SECI would be the main executing agency for the project, supported by the contractor. The responsibility is provided in the Table 69 below.

Project executing agencies	Role	Responsibility on ESMP Implementation
SECI	• Project proponents • Responsible for all the project risks and impact liabilities • Responsible for establishment and operation of this project	Overall responsible for ESMP implementation
Contractor	• Procurement of all equipment and materials required for the project • To carry out the works in accordance with the agreed scope of works and in accordance with the contract	Adhere to the contract conditions and legal compliance requirements

Table 68: Responsibility Matrix for ESMP implementation

Environmental and social officer of the contractor will support SECI in implementing the environmental and social management plan and monitoring during implementation of proposed safeguard measures at the project level. SECI will be responsible for overall performance of the ESMP implementation.

The designated Environmental and Social Officer (ESO) of contractor will be responsible for ensuring compliance of safeguard measures in the field and submit monthly reports to SECI, certifying that relevant environmental and social safeguard measures have been complied with during project implementation. The E & SO will also be responsible for coordinating and supervising implementation of safeguard measures at the field level.

The environmental monitoring would be carried out by contractor through an NABL accredited agency during the construction phase as part of the ESMP compliance and by operator during the operation phase. SECI may interact with the monitoring agencies and facilitate them in carrying out such activities.

The environment and social unit of SECI will liase to ensure that the Contractor complies with the requirements of various environmental and social safeguard measures through supervision, monitoring and reporting on the same. SECI will ensure that environmental mitigation and good construction practices are actually an integral part of each construction activity. It should be considered as day-to-day activity.

Preparing procedures for implementing the ESMP.

- **Review Contractor's ESMP, traffic management plan and health & safety plan and recommend for its approval / improvements, to the Team Leader;**
- **Provide training to SECI technical staff and Contractors' staff on implementing environmental and social safeguard measures.**

- **Advise on obtaining various statutory environmental clearances and social clearances on time.**
- **Conduct periodic field visits to examine environmental compliances and suggest corrective action; and**
- **Any other issues as will be required to ensure environmental and social compliance.**

The ESO would be responsible for record keeping, providing instructions through the Engineer for corrective actions, ensuring compliance of various statutory and legislative requirements and assist the Engineer for submitting reports. He will maintain a close coordination with the Contractor for successful implementation of the environmental and social safeguard measures.

One full time Environmental, Health and Safety (EHS) Officer will be engaged by the Contractor for effective implementation of ESMP during construction activities. The eligibility criteria for Contractor's EHS Officer are as stipulated below.

The qualification of EHS Officer will be as given below:

- **A Bachelor's Degree in Environmental Science / Environmental Engineering with additional training in Industrial Health and Safety Management.**
- **5 to 10 years of total professional experience in environment, health and safety management on projects / or in industrial establishments; and**
- **About 3 to 5 years of experience in similar projects i.e. management of environmental, health and safety issues in design and construction of energy infrastructure projects/renewable energy projects.**

The responsibilities of EHS Officer of the Contractor will include the following:

- **Directly reporting to the Project Manager of the Contractor.**
- **Discussing various environmental, health and safety issues and related mitigation, enhancement and monitoring actions with all Contractor's and its Sub-contractor's personnel.**
- **Preparing Contractor's ESMP, traffic management plan and on-site emergency plan/ health and safety plan as part of their Work Program.**
- **Ensuring contractor's compliance with the ESMP stipulations and conditions of statutory bodies;**
- **Assisting the project manager to ensure environmentally sound and safe construction practices;**
- **Assisting the project manager to ensure the timely procurement of materials that are included in the Bill of Quantities relating to environmental mitigation and enhancement measures;**
- **Conducting periodic environmental and health & safety training for contractor's engineers, supervisors and workers;**
- **Preparing a register for material sources, labour, pollution monitoring results, public complaint and a record of any other EHS aspect as may be directed by the Engineer;**
- **Assisting SECI on various environmental monitoring and control activities including pollution monitoring; and**

- **Preparing and submitting monthly reports to SECI on status of implementation of safeguard measures.**

10. ENVIRONMENTAL AND SOCIAL BUDGET

A tentative budget has been proposed for ESMP implementation of the project. The Table 70 below covers the items of ESMP and the corresponding cost estimates. No land acquisition is required for installation of floating solar panels over the reservoir and for construction of the plant substation at the identified site. The component wise detailed cost related to the social aspects have been included in the RAP report prepared separately for this project.

Item	Details	No. / unit	Rate (INR)	Total (INR)
Planning and Construction Phase				
RAP	Implementation of RAP	Has been Covered in RAP Budget		
Land Requirement	Land for transmission lines	Has been Covered in RAP Budget		
Dust suppression during Construction	Dust Management with sprinkling of water, covers for vehicles transporting construction material	15 months	50.000	750.000
Horticulture	Planting and guard for ornamental plants for environmental enhancement	100 Nos.	2.000	200.000
Solid Waste Disposal Measures	Disposal of sewage and other wastes in the construction yard and labour camps as per directions of the Environmental and Social Officer of SECI.	Lumpsum		200.000
Oil interceptors	Providing Oil Interceptors as per design and drawing at vehicle parking areas and as per directions of the Engineer.	8 Nos.	50,000	400.000
Traffic Signages	Traffic signages at important places	Lumpsum		500.000
Traffic Marshals		15 months	80,000	1,200.000
Environmental Enhancement	Environmental Enhancement around the working area and Reservoir	Lumpsum		1,000.000
Environmental Monitoring	The environmental monitoring includes the Air, Noise, Drinking Water, Effluents, Soil, Reservoir characteristics. The monitoring has to be carried out once in three months. Other Details are provided in section 9 of this Report			
	Air Monitoring	6 locations for 6 times (Project duration is 15 month)	15000	540,000
	Noise Monitoring	6 locations for 6 times (Project duration is 15 month)	10000	360,000
	Soil Sampling and Analysis	3 locations for 6 times (Project duration is 15 month)	10000	180,000

Item	Details	No. / unit	Rate (INR)	Total (INR)
	Drinking Water Sampling and Analysis	Monthly for 15 months	10000	150,000
	Effluent Sampling and Analysis	Monthly for 15 months	8000	120,000
	Sampling and Analysis of Getalsud water Characteristics; Parameters like Temperature, pH, Turbidity, TSS, TDS, DO, O&G, BOD and COD at four points of the reservoir	Monthly for 15 months	100000	1,500,000
	Sampling and Analysis of Ecological Characteristics of Getalsud Reservoir	3 times; Baseline, Midterm and End term	250000	750,000
Environmental Audit	Midterm and End term	Thrice during construction period	200,000	600,000
Training on EHS aspects	Training on E&S safeguards and EHS issues during construction phase for Boat operations, Emergency Preparedness, Environmental protection etc.	Three times	150,000	450,000
Training on Social aspects	It has been covered under RAP implementation budget.			
	Sub-Total (A)			8,900,000
Operation and Maintenance Phase (Yearly)				
Environmental Monitoring	Environmental Monitoring			
	Air Monitoring	4 locations for 3 times	15000	180,000
	Noise Monitoring	4 locations for 3 times	10000	120,000
	Soil Sampling and Analysis	2 locations for 3 times	10000	60,000
	Drinking Water Sampling and Analysis	Monthly for 12 months	10000	120,000
	Effluent Sampling and Analysis	Monthly for 12 months	8000	96,000
	Sampling and Analysis of Getalsud water Characteristics; Parameters like Temperature, pH, Turbidity, TSS, TDS, DO, O&G, BOD and COD at four points of the reservoir at 4 points	Once in Three Months	100000	400,000
	Sampling and Analysis of Ecological Characteristics of Getalsud Reservoir at 4 points	Once in a year	250000	250,000
	EHS Audit	Once in a year	300,000	300,000

Item	Details	No. / unit	Rate (INR)	Total (INR)
Decommissioning Phase				
	Same as the Constrction Phase			The
	Sub-Total (B)			1,526,000
Training on EHS aspects		Lumpsum		300.000
	Sub-Total (C)			300,000
Contingency		@10%		1,072,600
	Sub-Total (D)			1,072,600
	Grand Total (A+B+C+D)			11,798,000

Table 69: Environmental and Social Budget

ANNEXURE - A: PHOTOGRAPHS OF PUBLIC CONSULTATION

Consultation at BDO Office at Angara

Public Consultation at Getalsud

Public Consultation at Maheshpur

Public Consultation at Matatu

Public Consultation at Ramdaga Village

Public Consultation at Haldama Village

ANNEXURE - B: PHOTOGRAPHS OF AIR QUALITY MONITORING

Air quality monitoring at Getalsud reservoir

Air quality monitoring at Matatu

Air quality monitoring at Lalgarh

Air quality monitoring at Chakala

Air quality monitoring at Agartoli

ANNEXURE - C: PHOTOGRAPHS OF NOISE QUALITY MONITORING

Noise quality monitoring at Getalsud

Noise quality monitoring at Matatu

Noise quality monitoring at Lalgarh

Noise quality monitoring at Chakala

Noise quality monitoring at Agartoli

ANNEXURE - D: PHOTOGRAPHS TAKEN DURING WATER SAMPLE COLLECTION

Ground water collection at Agartoli

Ground water collection at Chakla

Getalsud-Temperature and DO

Surface water collection at Getalsud

Secchi disc for water transparency measurement

ANNEXURE - E: PHOTOGRAPHS TAKEN DURING SOIL SAMPLE COLLECTION

Soil sample collection at Getalsud

Soil sample collection at Matatu

Soil sample collection at Agertoli

ANNEXURE - F: CHECKLIST FOR ENVIRONMENT AND SOCIAL SCREENING

1. Project activities affecting the natural physical environment

S. No.	Information/Checklist confirmation	Status	Detailed Information
•	State /National Boundaries	No	150 kms
•	Anticipated change in Topography (Cut and Fill activity)	No	No such major activity proposed as the land is plain for the substation.
•	Clearance of land, vegetation, any other physiographic feature (number and type specify)? Specify area under each feature (in Hectare)	Yes	A few trees may be affected for the transmission line erection.
•	Addition of new features to topography due to project	No	
•	Anticipated underground works	Yes	Foundation piling may be required for the project
•	Anticipated changes in existing drainage pattern	No	No effect on the regional and natural drainage pattern
•	Land Reclamation works	No	No land reclamation is proposed under the project.
•	Water source identified for activities	No	Not yet identified
•	Identification of erosion prone areas	Yes	The surrounding unlined areas of Getalsud Reservoir are erosion prone.
•	Change in land cover due to project	Minor	On account of plant sub-station and transmission lines.
•	Site prone to any natural hazard	No	As per the 2002 Bureau of Indian Standards (BIS) Seismic Hazard map, this area falls in Zone II, which indicates low vulnerability to earth quakes. There is no occurence of flood in last 10 years.
•	Activities changing hydrology or water courses or aquifers	No	No change in hydrology, water source courses and aquifers as per DPR study.
•	Abstraction / transfers of water from ground or surface waters	Not yet known	Construction water source is yet to be identified.
•	Water body identified for floating solar is reservoir / backwater/ any other (specify)	Yes	Getalsud reservoir has been identified for FSPV installation.
•	Is the identified water body used for water supply?	Yes	Part of the water is utilized for water supply for domestic use to the neighbouring settlement.
•	Is water body used for fishing activities?	Yes	As per estimates provided by the local fisheries department around 200 families carry out fishing activity in the reservoir. As per census survey carried out for preparation of RAP 116 families have been identified that carry out fishing activities in the reservoir area coming under the proposed FSPV site.

S. No.	Information/Checklist confirmation	Status	Detailed Information
•	Is water body used for any other human activity?	Yes	The reservoir is occaasionally used for recreation purposes through boating on a minor scale which is not a regular activity.
•	Will project activity restrict access to the water body	Yes	Access will be impacted in a limited way of controlled access only to the FSPV site. The project activity would cover only 9.2% of the total reservoir surface area and the balance area will be available for regular access and functioning.
•	Any order/policy specific to the site Project activities affecting the biological environment	No	No such regulation available on biological point of view.

2. Project activities affecting the biological environment

S. No.	Information/Checklist confirmation	Status	Aerial distance (within 10 km) of proposed-project location boundary
1.	Vicinity to National Park, Wildlife Sanctuary, Reserved forests, woodland, protected forests	No	
2.	Vicinity to Migratory bird routes	No	
3.	Site in vicinity to congregatory areas (nesting, roosting, breeding, foraging)	Yes	The nearest nesting ground is at a distance of 1.5 km from the FSPV site.
4.	Vicinity to sensitive flora, fauna	No	
5.	Areas already subjected to pollution or environmental damage	No	
6.	Vicinity to eco-sensitive areas (wetlands, CRZ, water course, mountains etc)	No	
7.	Presence of endangered species / habitat areas	Yes	One endangered species as per IUCN "Elephant" is found in the area. However the species covered under Schedule IV of the Wildlife protection Act, 1972, of the Govt of India, which means the species is commonly available and not considered as endangered or thretened species.
8.	Vicinity to island, coastal marine or underground water	No	
9.	Loss of any native species or genetic diversity	No	
10.	Any season specific issues with site regarding ecological functions	No	

3. Project activities affecting the visual environment

S. No.	Information/Checklist confirmation	Status	Aerial distance (within 10 km) of proposed-project location boundary

1.	Area with Outstanding Natural Beauty (ANOBs) or Natural Heritage sites	No	
2.	Area with Archaeological importance	No	
3.	Area with high scenic value	No	
4.	Existing viewpoints/ pause points	No	

4. Project activities affecting the settlement / infrastructure

S. No.	Information/Checklist confirmation	Status	Details thereof (quantification wherever possible) with source of information data
1.	Settlement area/Built up environment in vicinity / distance	Yes	Around 11 villages are surrounding the reservoir within 1-2 kms and 28 villages within 5 kms.
2.	Agricultural land/land under livelihood (area in Hectare)	Yes	Proposed plant substation is privately owned agricultural land. 4.59 Ha of land is required for transmission line (Installation of Towers) and 0.5 Ha land required for subtation. 73.31 Ha of land will be come under
3.	Type of crops grown / number of crops	Yes	Rabi and Kharif (Paddy, Maize and Wheat) are grown in the vicinity.
4.	Source of Irrigation	Yes	Getalsud reservoir also serve the purpose of Irrigation as well.
5.	Drinking water sources	Yes	The reservoir is used for drinking water supply in Ranchi city.
6.	Area of sensitive receptors	Yes	The nearest settlement is 1.5-2 kms from the reservoir.
7.	Religious –Physical Resources	No	
8.	Community-Physical Resources	No	
9.	Underground utility lines like electricity lines, pipelines for gas, etc	No	
10.	Defence Installations / Airport Routes	No	
11.	Likely damage to existing infrastructure, public utilities, amenities etc.	No	
12.	Presence of Indigenous / vulnerable communities	Yes,	A few Schedule castes and Scheduled tribes are present in the project vicinity.
13.	Major Movement Corridors /Traffic	NH30	NH30 between two state capitals Patna and Ranchi of Bihar and Jharkhand states respectively is passing at around 10 kms from the FSPV site.
14.	Anticipated waste generation & Waste Disposal Facility	Yes	Waste would be generated in Construction, operation and decommissioning phases.

S. No.	Information/Checklist confirmation	Status	Details thereof (quantification wherever possible) with source of information data
			A considerable amount of solid waste would be generated during the decommissioning phase of the project. All the dismantled infrastructures and debris shall be segregated and stored separately with cover facility to negotiate with contamination effects of such wastes. Solid wastes should be disposed of safely in compliance to the Construction and Demolition (C&D) Waste Management Rules, 2016 of the Government of India. For PV modules and associated waste, please refer the "Section 7.4: Environmental and Social Mitigation Matrix for FSPV" on the management plan for disposal and management of PV modules.
15.	Potential Water sources for project activities	Yes	Source of water for project activities is yet to be ascertained.
16.	Source of energy including electricity and fuel for various purposes for the project (amount of fuel in MT & electricity in MW)	Yes	11KV power supply distribution line operated by the state utility with prior approval. Portable diesel generating set is one of the options, but it must be compliant to the norms as stipulated by Central Pollution Control Board.
17.	Facilities for transportation of construction materials	Yes	NH30 between two state capitals Patna and Ranchi is passing at around 4 kms from the site and a village road connecting the site from the NH30.
18.	Facilities for storage of construction goods & materials	Yes, Temporary	To be provided in the Construction Camp.
19.	Facilities for storage of any hazardous material	Yes, Temporary	To be provided in the Construction Camp.
20.	Facilities for long term housing for operation workers	Yes	To be provided in neighbouring village(s).
21.	List of construction works (Permanent &Temporary)	Yes, Permanent	Construction Requirement-Permanent a. Floating solar PV on reservoir a) Plant substation b) Transmission line towers Construction Requirement-Permanent b. Construction Camp
22.	Facilities for construction workers (temporary labour camp, drinking water, waste disposal, etc.)	Yes, Temporary	To be provided in construction camp. The construction worker would be accommodated and provided the facilities as per provisions of Building and Other Construction Workers (Regulation of Employment and conditions of Service) Act,, 1996.
23.	Facilities for disposal of waste (dry or wet)		The facility would be provided as per Waste Management Rules, 2016 of GoI.
24.	Facilities for disposal of liquid waste/effluents	Yes	Water (Prevention and Control of Pollution) Act , 1974
25.	New Road, rail etc. during construction or operational phase	No	The connecting roads is not required for the project.

S. No.	Information/Checklist confirmation	Status	Details thereof (quantification wherever possible) with source of information data
26.	Any closure or diversion to the current movement pattern due to the project during construction or operational phase	No	There is no requirement for such temporary or permanent closure or diversion.
27.	New or diverted transmission lines due to the project	Yes	Two new transmission lines are required to connect the plant substation to the grid substation.
28.	Is there a risk of long term build-up of pollutants in the environment from storage of hazardous material, disposal of effluents and waste disposal?	Yes	However, the E waste is generated due to the project shall have to be disposed in an effective manner in accordance with E-waste (Management and Handling) Rules, 2016 of GoI.
29.	Cumulative effects due to proximity to other existing or planned projects with similar impacts	No	There are no existining or planned project with similar impacts near the proposed FSPV project and its associated facilities.

ANNEXURE - G: ENVIRONMENTAL STANDARDS

ANNEXURE - H: LIST OF NGO WORKING IN THE AREA

LIST OF NGO WORKING IN THE LOCALITY

Sl No	Name of Organization	Area of Working	Address
1	Pratigya	Children	Cd-611, sec 2, hec, po- dhurwa, Ranchi- 834004
2	Aadhaar	Animal Husbandry	Aadhaar, church raod,vikrant chowk, Ranchi , pin:834001,Jharkhand, (m)09334706167
3	Aadivasis Reformation And Welfare Society Wars	Aged/Elderly	A/po-gua, dist- west singhbhum, Jharkhand, pin-833213
4	Aao Hath Milaye	Education & Literacy	Hussain nagar purani Ranchi near alpha gas godown gausulwara masjid lane Ranchi Jharkhand - 834001
5	Aastharanchi	Agriculture	Kamla kant road, hill side, , ratu road, Ranchi
6	Aawaz	Animal Husbandry	At + p.o. - jamudag, sonahatu, Ranchi-Jharkhand, pin - 835215
7	Bhagirathi SewaSamiti	Education & Literacy	Dahu, Ormanjhi
8	Action For Women And Rural Development Award	Animal Husbandry	Action for women and rural development, sahijana maore, garhwa, Jharkhand-822114
9	Active Social Development Foundation	Animal Husbandry	Hawai nagar road no - 3 po hatia dist- Ranchi pin - 834003 Jharkhand
10	Adivasi Ewam Banvasi Vikas Samiti	Human Rights	Adivasi ewam banvasi vikas samiti, h.no.- 181, new garden, siramtoli, old h.b. Road, Ranchi pin 834001
11	Adivasi Jan Kalyan Samiti	Children	Gosai toli, chutia, p.s.+p.o.-chutia, dist.-Ranchi-834001 (Jharkhand)
12	Centre for Entrepreneurship Development	Animal Husbandry	Centre for entrepreneurship development, ramnagar, harmu- argora bye pass road, Ranchi - 834002, Jharkhand, india.
13	Centre For Socal Welfare	Animal Husbandry	House number 07 sant peters school campus birsachowk post doranda district Ranchi state Jharkhand pin code 834002
14	Chetna	HIV/Aids	Vilage p.o.& p.s.-Bijupara, Tangar ,p.s+block - chanho, district-Ranchi (Jharkhand)pin-835214
15	Chotanagpur Youth Social Society	Animal Husbandry	R-15/2, harmu housing colony, harmu, Ranchi, pin 834002 Jharkhand
16	Vision Spring	Drinking Water	133/c-3, vidyalaya marg, ashok nagar, Ranchi-834002
17	Parvatiya Gram Nirman Mandal	Animal Husbandry	Qrno a-182-sector-4,dhurwa Ranchi , pin-834004
18	Pathari Janjati Sewa Samittee	Animal Husbandry	The secretary, pathrai janjati sewa samittee, vill tau, po - bundu, district Ranchi

Sl No	Name of Organization	Area of Working	Address
19	Yourth Action For Rural Development	Education & Literacy	Sri krishama puri chutia district-ramchi, pin-834001
20	Holding Hand Organization	Human Rights	11 churi tola kanke

ANNEXURE - I: MOM AND ATTENDANCE SHEET RECORDED DURING CONSULTATION

ANNEXURE - J: LABORATORY TEST RESULTS

Annexure - K: Asian Water Bird Census conducted at Getalsud Dam, Ranchi

ANNEXURE-K

Table : Asian Waterbird Census (AWC)_Getalshusd Dam_Jharkhand_2022

Date: 12.02.2022

Site: Getalshud Dam

Sl. No.	Common Name	Scientific Name	Habitat	RS	WPA, 1972	IUCN Status	Count
	Podicipedidae (Grebes)						
1	Little Grebe	*Tachybaptus ruficollis*	WB	R	IV	LC	30
2	Great Crested Grebe	*Podiceps cristatus*	WB	M	IV	LC	50
	Phalacrocoracidae (Cormonant/Shags)						
3	Little Cormorant	*Phalacrocorax niger*	WB	RM	IV	LC	100
4	Great Cormorant	*Phalacocorax carbo*	WB	M	IV	LC	6
5	Indian Cormorant	*Phalacrocorax fuscicollis*	WB	R	IV	LC	3
	Ardeidae (Heron,Egrets & Bitterns)						
6	Little Egret	*Egretta garzetta*	WB	RM	IV	LC	12
7	Large Egret	*Casmerodius albus*	WB	RM	IV	LC	3
8	Median Egret	*Mesophoyx intermedia*	WB	RM	IV	LC	10
9	Cattle Egret	*Bubulcus ibis*	WB	RM	IV	LC	50
10	Indian Pond Heron	*Ardeola grayii*	WB	R	IV	LC	7
	Ciconiidae (Storks)						
11	Asian Openbill-Stork	*Anastomus oscitans*	WB	R	IV	LC	100
	Threskiornithidae (Ibis)						
12	Red-naped Ibis	*Pseudibis papillosa*	WB	R	IV	LC	3
	Anatidae (Swan,Geese & Ducks)						
13	Lesser Whistling-Duck	*Dendrocygna javanica*	WB	R	IV	LC	800
14	Gadwall	*Anas strepera*	WB	M	IV	LC	300
15	Northern Shoveller	*Anas clypeata*	WB	M	IV	LC	80
16	Red-crested Pochard	*Rhodonessa rufina*	WB	M	IV	LC	150
17	Common Pochard	*Aythya ferina*	WB	M	IV	Vu	50
18	Tufted Pochard	*Aythya fuligula*	WB	M	IV	LC	150
19	Brahminy Shelduck	*Tadorna ferruginea*	WB	M	IV	LC	2
20	Eurasian Wigeon	*Anas penelope*	WB	M	IV	LC	300
	Rallidae (Rails,Crakes,Moorhens, Coots)						
21	Common Moorhen	*Gallinula chloropus*	WB	RM	IV	LC	2
22	Common Coot	*Fulica atra*	WB	RM	IV	LC	300
	Charadriidae (Plover,Lapwings)						

Scanned with CamScanner

Sl. No.	Common Name	Scientific Name	Habitat	RS	WPA, 1972	IUCN Status	Count
23	Red-wattled lapwing	*Vanellus indicus*	WB	R	IV	LC	1
24	Little Ringed Plover	*Charadrius dubius*	WB	RM	IV	LC	3
	Scolopacidae (Sandpiper,Stints,Snipe & Curlews)						
25	Common Sandpiper	*Actitis hypoleucos*	WB	RM	IV	LC	4
	Laridae (Gull,Tern)						
26	Black-headed Gull	*Larus ridibundus*	WB	M	IV	LC	40
	Alcedinidae (Kingfisher)						
27	Small Blue Kingfisher	*Alcedo atthis*	WDB	RM	IV	LC	1
28	White-breasted Kingfisher	*Halcyon smyrnensis*	WDB	R	IV	LC	3
	Hirundinidae (Swallow)						
29	Common Swallow	*Hirundo rustica*	WDB	RM		LC	30
30	Red-rumped Swallow	*Hirundo daurica*	WDB	RM		LC	40
	Motacillidae (Wagtails & Piptes)						
31	White Wagtail	*Motacilla alba*	WDB	RM	IV	LC	7
32	Large Pied Wagtail	*Motacilla maderaspatensis*	WDB	R	IV	LC	6
					Total count		**2643**

Abbreviation :-

EN- Endangered ; **Vu –** Vulnerable; **NT -** Near Threatened; **LC-** Least Concern; **R-**Resident; **M-**Migrant ; **RM-** Resident-Migrant; **WB-**Water Bird; **WDB-**Wetland Dependent Bird; **RS-**Residential Status ; **WPA,1972-** Wild Life (Protection) Act,1972

Summary:

1. Total number of species: 32
2. Total estimated number of Birds: 2643
3. Migratory Birds: 10
4. Resident: 9
5. Resident-Migrant: 13
6. Number of Threatened Birds: 7

As per IUCN Red List:

i. Common Pochard

Dr. Satya Prakash
AWC/IBCN State Coordinator-Jharkhand

Scanned with CamScanner