FINAL

AECOM

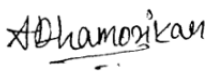
Environment and Social Impact Assessment

400 Tons Bio-CNG Project, Bhopal, Madhya Pradesh, India

EverEnviro Resource Management Private Limited

8 Feb 2023

Quality information

Prepared by	Checked by	Verified by	Approved by
			
Akash Tiwari EHS Expert	Shubhangi Jadhav EHS Expert		Chetan Zaveri Vice President – Environment
			
Amruta Dhamorikar Ecology Expert	Deepti Bapat Biodiversity Expert		
			
Pranalee Balsaraf			
			
Aditi Deopujari			

Revision History

Revision	Revision date	Details	Authorized	Name	Position
00	11 Nov 2022	Draft ESIA	Yes	Chetan Zaveri	Vice President – Environment
01	22 Dec 2022	Final ESIA	Yes	Chetan Zaveri	Vice President – Environment
02	8 Feb 2023	Final ESIA	Yes	Chetan Zaveri	Vice President – Environment

Distribution List

# Hard Copies	PDF Required	Association / Company Name
No	Yes	Ever Enviro Resource Management Pvt. Ltd.

Prepared for:

EverEnviro Resource Management Pvt. Ltd.
One World Centre, 16th Floor, Tower 2A,
Senapati Bapat Marg, Elphinstone Road,
Mumbai - 400013
Maharashtra, India

Prepared by:

AECOM India Private Limited
19th Floor
Building No.5
Tower C
Cyber City
Gurgaon 122002
Haryana
India

CIN: U74210KA2005PTC037770

T: +91 124 4682700/800
aecom.com

Table of Contents

Figures

Tables

List of Abbreviations

SNo.	Abbreviation	Extension
1.	AECOM	AECOM India Private Limited
2.	AC	Alternate Current
3.	AAQ	Ambient Air Quality
4.	AoI	Area of Influence
5.	CGWA	Central Ground Water Authority
6.	CPCB	Central Pollution Control Board
7.	CPR	Common Property Resource
8.	CTE	Consent to Establish
9.	CTO	Consent to Operate
10.	CSR	Corporate Social Responsibility
11.	CR	Critically Endangered
12.	DPR	Detailed Project Report
13.	DG	Diesel Generator
14.	DC	Direct Current
15.	ERT	Emergency Response Team
16.	EN	Endangered
17.	EPC	Engineering, Procurement and Construction
18.	EPA	Environment (Protection) Act, 1986
19.	EAP	Environment Action Plan
20.	ERMPL	Ever Enviro Resource Management Private Limited
21.	ESIA	Environment and Social Impact Assessment
22.	ESMP	Environment and Social Management Plan
23.	ESMS	Environment and Social Management System
24.	EMS	Environment Management System
25.	EHS	Environment, Health and Safety
26.	FGD	Focus Group Discussions
27.	GGEF	Green Growth Equity Fund
28.	GMP	Government of Madhya Pradesh
29.	GP	Gram Panchayat
30.	GHG	Green House Gases
31.	GRM	Grievance Redress Mechanism
32.	MPPCB	Madhya Pradesh Pollution Control Board
33.	MPPGCL	Madhya Pradesh Power Generating Company Limited
34.	MSL	Mean sea level
35.	HSE	Health, Safety and Environment
36.	ISA	Implementation and Support Agreement
37.	IMD	Indian Meteorological Department
38.	IP	Indigenous People
39.	IFC	International Finance Corporation
40.	IUCN	International Union for Nature and Natural Resources
41.	MW	Mega Watt
42.	MoEF&CC	Ministry of Environment, Forest and Climate Change
43.	MNRE	Ministry of New and Renewable Energy
44.	MPPMCL	Madhya Pradesh Power Management Company Limited
45.	NOC	No Objection Certificate
46.	O&M	Operations and Maintenance
47.	PRI	Panchayati Raj Institution
48.	PPE	Personal Protective Equipment
49.	PUC	Pollution Under Control
50.	PSS	Pooling Sub-station

SNo.	Abbreviation	Extension
51.	PPA	Power Purchase Agreement
52.	PIC	Prior Informed Consent
53.	SC	Scheduled Caste
54.	ST	Scheduled Tribe
55.	SPV	Special Purpose Vehicle
56.	ULB	Urban local body
57.	VU	Vulnerable
58.	WMP	Waste Management Plan
59.	WPA	Wildlife Protection Act

1. Introduction

EverEnviro Resource Management Private Limited (hereinafter referred to as 'ERMPL') is a 100% subsidiary of Green Growth Equity Fund (GGEF). The company is engaged in the business of handling solid waste management encompassing municipal waste, agricultural waste, agricultural industry waste, construction & demolition waste.

AECOM India Private Limited (hereinafter referred to as 'AECOM') has been appointed by ERMPL to undertake the Environment and Social Impact Assessment (ESIA) study for 400 Tons Bio-CNG Project, Bhopal, Madhya Pradesh, India.

1.1 Project Background

ERMPL was engaged by Bhopal Municipal Corporation to develop and operate 400 TPD of segregated organic fraction of municipal solid waste, by setting up a biogas and bottling plant, at Adampur (Adampur Chawni dumping ground), Bhopal (hereinafter referred to as the Project). The project's operations and maintenance would be handled for a period of 20 years. Currently the waste lying above and below the grounds are being cleared from the site. After it gets cleared, construction will take 12-15 months. Construction will start from the mid of January 2023.

Adampur Chawni dumping ground (Bhopal Municipal Corporation Waste Processing Plant) located in Bhopal is managed by Bhopal Municipal Corporation. It was set-up in 2017 after Bhanpur landfill was closed following NGT orders as the new landfill and municipal solid waste (MSW) dumping and disposal site. ERMPL was engaged by Bhopal Municipal Corporation to develop and operate Bio-CNG Project on only 9 acre of land parcel out of which approximately 6 acres will be part of 45 acres of land of Bhopal Municipal Corporation Waste Processing Plant and approximately 3 acres will be adjoining vacant land of Bhopal Municipal Corporation. The remaining land of Bhopal Municipal Corporation Waste Processing Plant will continue to handle non-biodegradable and other waste components of municipal waste. This will not be under purview of ERMPL.

1.2 Purpose and Scope of Work

The main purpose of the ESIA study is to identify, evaluate and manage environmental and social impacts that may arise during the development and operation of the project. The objectives of the ESIA study have been detailed below:

- Reconnaissance survey and primary site assessment to collect and review baseline environmental and social conditions;
- Collection of secondary environmental, social and demographic information;
- Identification and review of the applicable environment and social standards and identification of key issues;
- Assessment of potential environment and social impacts of the project and its components;
- Identifying key stakeholders and undertaking stakeholder consultations to assess the influence and impact of the proposed project on them;
- Preparing an ESIA Report encompassing all components of the baseline study, impacts assessed, documented consultations undertaken and management plans to mitigate the impacts assessed; and
- Developing an Environmental and Social Management Plan (ESMP) based on the impacts identified including monitoring aspects of the mitigation measures suggested.

1.3 Applicable Reference Framework

The following reference framework is referred to while developing the ESIA Report for the project,

- Applicable National, State and local environmental & social regulations (including relevant approvals, permits and consents obtained);

- IFC Performance Standards Framework 2012;
- IFC's Environmental, Health, and Safety Guidelines for Waste Management Facilities, 2007
- World Bank Group (WBG) Environment, Health and Safety (EHS) General Guidelines, 2007

1.4 Approach and Methodology

The approach and methodology applied for the execution of the impact assessment study is as provided:

- The relevant project documents and detailed project report were reviewed to understand the project requirements;
- Regulatory review was undertaken to understand the applicable, local and national legislation and regulatory frameworks;
- A detailed social and environmental assessment of the site and surrounding areas was undertaken through the following:
  - Reconnaissance surveys to understand site specific issues;
  - Discussions with the local community;
  - Collation of secondary information on social aspects of the site, supplemented by consultations with the local communities to understand community perception with regard to the project and its activities;
  - Stakeholder identification;
  - Focused group consultations;
- Assessment of impacts based on understanding of the project activities and existing baseline status;
- Preparation of an Environment and Social Management Plan (ESMP).

1.4.1 Delineation of the Study Area/Area of Influence

For the purpose of the ESIA study, an area of 5 km (aerial distance) radius has been considered as the Area of Influence (AoI) for identification and assessment of potential environmental and social impacts around the proposed project. AoI is further classified as:

- **Direct Impact Zone (Core Components):** The area covering the Project Site is designated as the area under the direct influence of the project for environmental, ecological and social impacts.
- **Indirect Impact Zone (Shared Facilities):** Area outside the direct impact zone of the project, up to a radius of 5 km from project site's centre, is considered as the indirect influence zone for the project for environmental, ecological and social impacts.

All the baseline environmental profiling, including environmental monitoring, socio-economic studies and public consultations, have been carried out within the AoI of 5 km. For ecological studies, area up to 10 km radius from project site's centre, was considered for secondary data search.

1.4.2 Desktop Review

AECOM carried out a desk-based review of the information shared by the client prior to mobilizing for the site visit for undertaking the Impact assessment. As part of the review, the proposed project area was screened using Google Earth. Based on the review of Google Earth imagery, the environmental and social settings to be covered as part of the site visit were assessed and subsequently scoped in. The desk-based review was primarily focussed on but was not limited to the following documents:

- Project report BMC 400 TPD;
- Site layout plan;
- Eversource capital's Environmental Social Governance Management System, 2020
- Land related documents;
- Organizational chart; and

- Other Project related documents.

The screening and scoping assessment was undertaken based on the understanding of the objective and scope of work. The AECOM team, comprising of one (1) EHS expert, one (1) Social expert and one (1) bio-diversity expert undertook a site visit to the project location between 16th May to 20th May 2022. As part of the site visit, the following key activities were undertaken:

- Meeting with the on-site project team;
- Site walk through for the project;
- Consultations with members of local communities in Padariya, Kolua Khurd, Jhiriya Kheda and Haripura village;
- Preliminary biodiversity observations on habitats types.

1.4.3 Site Survey

AECOM team conducted a site survey between 16th May to 20th May 2022 and 12th & 13th Oct 2022. The following activities were undertaken during this visit:

- Undertake environmental assessments to gain an understanding of the following and consultations with site representatives:
  - Site setting assessment of 5 km study area for the centre of project site;
  - Study of key environmental receptors such as large water bodies, forest area, man-made sensitivities such as schools, colleges, hospitals etc.
- Undertake environmental monitoring and collection of baseline environmental data;
- Undertake social assessments and consultations in the form of individual interviews and focussed group discussions (FGDs) with the following key stakeholder groups:
  - Local stakeholders; and
  - Institutional stakeholders/government departments.
- Collection of biodiversity baseline data and key stakeholder consultations (Forest department, local community, etc.).

1.4.4 Socio-Environment Baseline Data collection

Environmental baseline data was collected through primary monitoring and reconnaissance surveys of the study area (5 km distance around the project site). Secondary information through literature surveys was also collected for the study area. The baseline study included the following:

- Primary environmental baseline data collection within the study area. The primary environmental and social baseline data was collected with respect to ground water, ambient air quality (AAQ), ambient noise level, soil quality, and socio-economics profile. The ecology and biodiversity data were also collected as part of the primary data collection;
- The GIS mapping of the study area was done to present details on land use pattern, forest/ vegetation cover, settlements, water bodies, drainage pattern; and
- Information on geology, meteorological conditions, water and ecological resources, socio-economic status etc. was collected from secondary sources.

1.4.5 Stakeholder Consultation

During the site visit for ESIA, following groups of stakeholders were consulted with the objective of collecting baseline data/information:

- **ERMPL site representative**: ERMPL site level team.
- **Local community**: Locals from villages within the defined study area, rag pickers working at the waste management facility, Women from the local community, Shopkeepers, Users of roads used by the project, Users of water from the Ghodapachad dam, etc.

- **Institutional stakeholders:** Panchayat Members of Villages, Official of Bhopal Municipal Corporation, Official from Water Resources Department Bhopal, Official from Forest Department Madhya Pradesh, Chief of an Educational Institute within the defined study area.

1.4.6 Impact Assessment

Impact identification and prediction were undertaken on the basis of environmental and social baseline data collected. The major processes involved are:

- Identification – to define the impacts associated with different phases of the project and the activities undertaken;
- Prediction – to forecast the nature, magnitude, type, duration, extent, scale, frequency likelihood and sensitivity of the major impacts identified; and
- Evaluation – to determine the significance of residual impacts i.e. taking into account how mitigation will reduce a predicted impact.

Professional judgement, experience and knowledge of similar projects were used for impact analysis. The extent and potential consequences of the impacts have been compared against applicable reference framework. Mitigation measures have been suggested for the identified adverse impacts.

1.4.7 Environment and Social Management Plan

This section delineates the roles and responsibility and timeline for implementing mitigation measures to prevent the significant impacts arising from activities during different phases of the project.

1.5 Layout of Report

The current ESIA Report has been arranged under the following chapters:

1. **Chapter One: Introduction** (This chapter provides a background of the project and the current Report, the objectives with which the study has been undertaken, the scope of work, etc.)
2. **Chapter Two: Project description** (This chapter provides details of the project location, key project components and utilities, land requirements, power purchase agreement, current project status, etc.)
3. **Chapter Three: Environment and Social Regulatory framework** (This chapter encompasses the national administrative requirements, applicable permits, licences, approvals and consents and project categorisation as per Reference Framework)
4. **Chapter Four: Environmental and socio-economic baseline** (This chapter illustrates the environmental baseline, socio-economic baseline and Ecology baseline)
5. **Chapter Five: Stakeholder Engagement and Consultation** (This section presents the key stakeholders consulted during this study)
6. **Chapter Six: Analysis of Alternatives** (This section presents the analysis of alternatives for the proposed project)
7. **Chapter Seven: Impact Assessment** (This chapter highlights the impact assessment criteria, key environmental risks and key social risks)
8. **Chapter Eight: Environment and Social Management Plan** (This chapter highlights the organization structure, training, Inspection monitoring and audit and Documents and record keeping)
9. **Chapter Nine Conclusion**

1.6 Limitations / Disclaimer

This report presents the observations made by AECOM's professionals based on the scope of work and agreed approach and methodology with client. The present report has been developed to identify the potential E&S issues and conditions associated with the activities of the project for which the assessment has been carried out. During the course of this assessment, AECOM has attempted to independently assess the potential presence of

E&S issues or conditions within the limits of the established scope of work as described in the contract between client and AECOM. Any risk / observations related to soil and water contamination was not part of this assessment. It was reported that client is also planning on installing 1.1 MW solar power plant in for their captive usage. This is under planning phase and the design are yet to finalized which will be starting after the bio-CNG plant is operational. This report does not cover impacts related to solar project or its associated facilities.

The study/ audit / assessments is/ are based on the information and documents received by AECOM, and the site conditions as witnessed by the AECOM team during the time of the inspection. As with any assessment exercise, there is a certain degree of dependence upon verbal information provided by the point of contact for assessment, limited number of documents available for review and information available in the public domain, which is not readily verifiable through visual observations or supported by any available written documentation. During the course of the site assessment, AECOM has attempted to independently assess the potential presence of such conditions within the limits of the established scope of work as described in the proposal. However, verification of potentially important facts is not always possible. AECOM shall not be held responsible for conditions or consequences arising from relevant facts that were concealed, withheld, or not fully disclosed by site representative at the time this assessment was performed. The assessment is based on sample site visits carried out by AECOM. This report is to be used to understand the overall E&S requirements of the project covered under this study rather than performance of overall entity.

This report has been prepared by AECOM for the benefit of its client. AECOM's client may release the information to third parties, who may use and rely upon the information at their discretion. However, any use of or reliance upon the information by any party shall be solely at the risk of such party and without legal recourse against AECOM, its parent, its subsidiaries and affiliates; or their respective employees, officers, or directors; regardless of whether the action in which recovery of damages is sought is based upon contract, tort (including the sole, concurrent, or other negligence and strict liability of AECOM), statute, or otherwise. This information shall not be used or relied upon by a party that does not agree to be bound by the above statement.

Client must not in any way (directly or indirectly) provide, allow or enable the AECOM's documents to be included or referred to in any written material or relied upon by any third party. No party other than the Client shall have the right to rely on the AECOM's documents rendered in connection with the works. Client shall indemnify and hold harmless AECOM in respect of any claim or loss claimed whether in contract, tort or by statute, by any third party in respect of use or reliance on any of the Consultant's documents or opinions.

The environmental and social assessment for client is based on the documents made available for review, discussions with site personnel and observations from the site walkthrough of the sample project sites as well as the potential project sites (where investment is probable) undertaken by AECOM professionals at the site during the assessment process. Wherever documentation, policies and procedures for evaluation were not available for review, it has been presented in the report at relevant sections. In addition, wherever AECOM has not been able to make a judgment or assess any process, it has been presented as an information gap and a way forward has been suggested.

The assignment was carried out during pandemic conditions related to the Coronavirus disease (COVID-19). This health emergency has been impacting multiple facets of the life including, without limitation, labour, personnel, manufacturing, equipment, materials, transportation and related supply chains, and tasks such as travel for site visits and obtaining environmental database reports and other data from government agencies, all of which have the potential to adversely impact the critical path of the project. AECOM had taken all reasonable care to mitigate the potential impact of the Coronavirus to the extent within AECOM's reasonable control.

2. Project Description

2.1 Project Location

The Project site is located within Bhopal Municipal Corporation Waste Processing Plant (BMCWPP) in an area known as Adampur Chawni located on Raisen Road at Bhopal in Madhya Pradesh ("Project site" or "Site"). The BMCWPP is established on approximately 45 acres of land and the Project will be developed on only 9 acre of land parcel out of which approximately 6 acres will be part of 45 acres of land of BMCWPP and remaining approximately 3 acres will be adjoining vacant land of Bhopal Municipal Corporation. Bhopal Municipal Corporation will clear the Project site of municipal waste before handing over the site to the Client for setting-up the proposed Bio-CNG plant.

Table 2-1: Salient Features Of The Plant Side

Area	Adampur, Bhopal
District	Bhopal
Nearest railway station	Bhopal Junction
Nearest airport	Raja Bhoj Airport, Bhopal
Nearest access road	NH-146
Nearest highway	NH-146
Source of water	Bhopal Municipal Corporation/ Treated Wastewater from STP/ Bore Well
Total land area of existing plot	9 acres
Latitude	23.2599° N
Longitude	77.4126° E
Site elevation	Around 460 m above MSL[1]

2.2 Access

The project site is located towards west of Bhopal city. The project site can be accessed through NH 146 from Bhopal. From NH 146, site can be accessed through village road. There are 3 gates provided at BMCWPP facility. Gate no. 1 is currently used for official purposes and as informed will be discontinued post the development of the project as it will come inside the project boundary. For all the existing activities being performed fusing Gate no 1 will be shifted to the new gate which is provisioned to be provided at the North-east corner of the project. Gate no. 3 is used by the loaded waste carrying vehicles and will be continued for the same. A concrete road connecting project site (near gate no. 3) to NH 146 near Kolua Khurd village was specifically constructed for waste carrying vehicles. Gate no. 2, which is situated at the north of the BMCWPP boundary opens at adjacent land which is used by BMC for the purpose of plantation.

The indicative proposed project site location has been depicted in the figure below.

[1] Google earth imagery

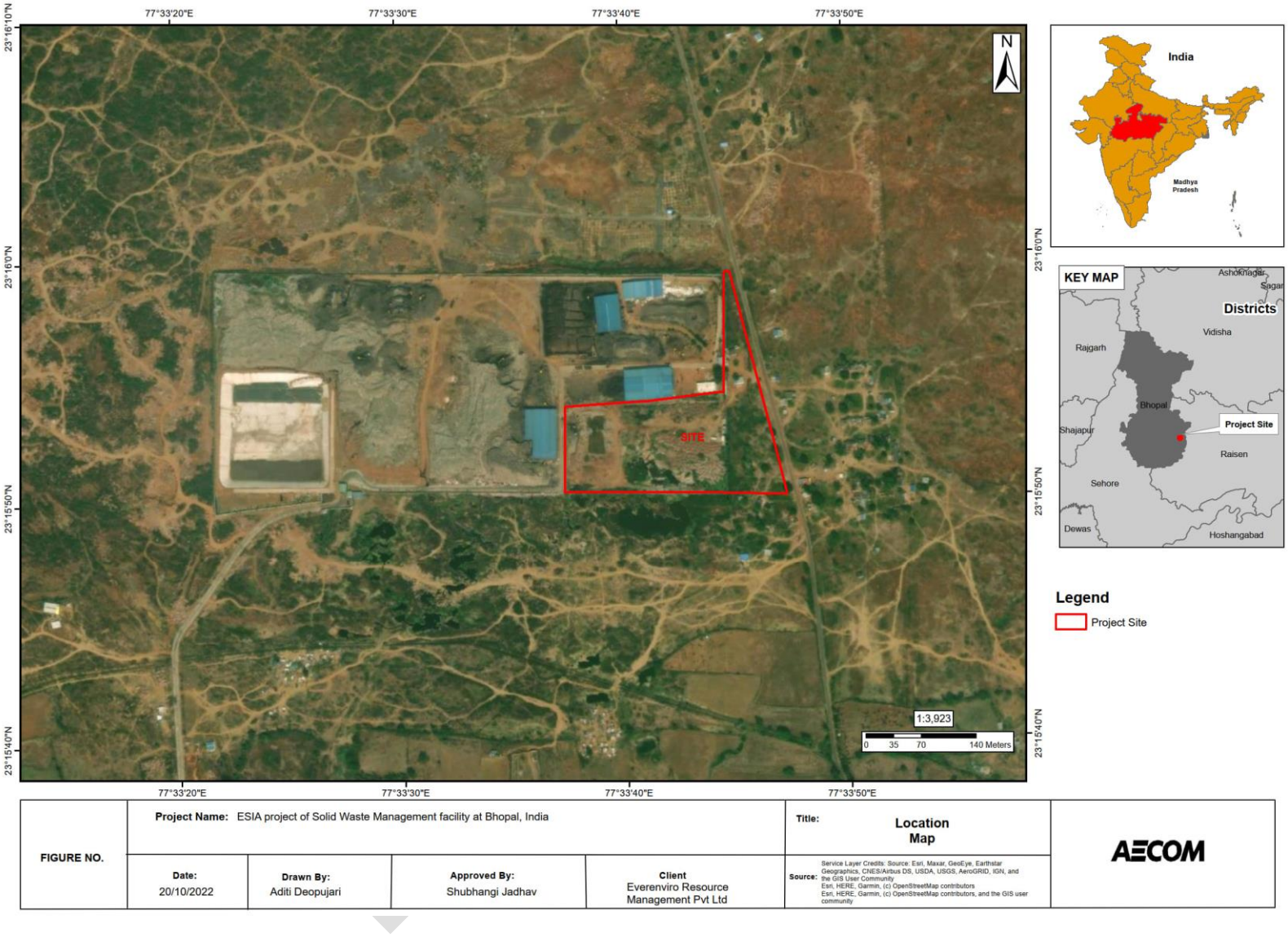


Figure 2-1: Project Location

2.3 Site Clearance

Out of 9 acre of land parcel required for project, approximately 6 acres will be part of 45 acres of land of BMCWPP and remaining approximately 3 acres will be adjoining vacant land of BMC. Land portion on BMCWPP as waste previous waste dumped on it. BMC will clear the Project site of all waste before handing over the site to ERMPL.

There are 33 kV and 11 kV power lines in the plant area, mostly along eastern boundary. These will be shifted by concerned electricity department. The site has few trees on the same which will required to be removed/cut. This will be done with prior permission by relevant forest / urban department. Since the land will be provided by BMC for project, it was known from the client that the clearance of for transmission line (TL) comes under BMC's scope.[2].

2.4 Project Overview

2.4.1 Project Components

The proposed project is 400 tons per day (TPD) capacity Bio-CNGproject. The purpose of the project is to convert waste with organic content to biological compressed natural gas which can be further made into use as an alternative of conventional fuel usage. Project site will be receiving segregated biodegradable waste from Bhopal Municipal Corporation. During the operation phase, approximately 186 KLD liquid fertilizer (out of which 182 KLD will come from liquid digestate, 2 KLD from domestic usage and 4 KLD from biogas processing section) will be produced which will be stored at site and then sold off. Salient features of the project plant are as follows:

- The plant will be executed in single phase of capacity 400 TPD capacity
- The plant will be completely automated except for the input of segregation of waste which will be partially automated.
- The waste coming into the plant will be directly dumped into the feeder. Project will not have any separate waste collection or storage area so the chances of waste getting dispersed is very few.
- Segregated organic waste will be received at site. The remaining impurities will be removed from the waste by routing the waste through a conveyor belt and trommel and will be processed in the composting section. The operators will be provided with sufficient PPE to ensure safe handling of waste.
- The input system will consist of a shredding system and a feeding tank (for mixing of slurry) to ensure homogenized food waste slurry is added to the digester.
- The system will be consisting of anaerobic digesters in which the temperature will be maintained in the range of 38-41 degree Celsius which is the most optimum temperature range for mesophilic process.
- Each digester will be provided with agitators to ensure homogenized slurry in the digester. Each digester will be fitted with a double membrane balloon on top. This will help in storing biogas as well as insulate the digester from weather and thus preventing heat loss.
- Biogas generated will be purified to remove H_2S and carbon dioxide, thus generating Bio-CNG. Bio-CNG will be compressed and stored in cylinders at 200-250 bar pressure.
- The output slurry will be properly managed by dewatering it and processing it by converting the solids to compost.

As informed by client, BMC has planned a separate project for slaughter house waste management project (livestock waste incinerator). This plant has a design capacity of 500 kg per hour. This plant is at a distance of 300 m from the project site boundary. Thus project will not receive any slaughter waste.

[2] Based on the information shared by client. BMC agreement copy was not available for review for AECOM.

Details on Bio-CNG plant technology and its subsystem specifications are discussed in the below:

Table 2-2: Technology overview of Bio-CNG plant

Feedstock Type	Food waste (inclusive of pre-cooking waste, food leftovers, bones, etc.)
Solid's content	15-20%
Density	0.9-1 kg/m3
Gas productivity	80-90 cubic metre of raw biogas/tonne

Source: Detailed Project Report (DPR)

The various project components' details have been provided in subsequent sections.

Table 2-3: Subsystem of Bio-CNG plant

Sr. No.	Sub	Work/product/machinery
1	**Raw material feeding tank equipment's machinery**	
	1	EOT crane for wet waste feeding
	2	Reading belt conveyor with hopper system
	3	Screw conveyor for feeding material to grinder
	4	Raw material grinding system capacity
	5	Water inlet systems for grinders
	6	Grinder to feeding tank material flow arrangement system
	7	Slurry pump at feeding tank with necessary fixing arrangement with flexible pipe
	8	Air blower at feeding tank
	9	MS grill on top of the feeding tank
	10	Feeding pump
	11	Overhead tank with pure water dispensing arrangement at feeding platform
	12	Balloon platform and necessary civil work for blower and pump
	13	Weigh bridge
2	**Digester tank equipment's and machinery**	
	1	Floating double membrane balloon on top/FRP drone
	2	Agitator systems for digesters
	3	Temperature control systems for digester with monitoring arrangements
	4	Moisture trap system with gas distribution lines and tank
	5	Sensors
	6	Biogas auto flaring unit
3	**Slurry tank equipment and compost machinery**	
	1	Slurry tank mixing
	2	Slurry pump at slurry tank
	3	Sieving machine
	4	Shredder machine
	5	Earth mover/JCB
4	**Bio-gas purification and bottling**	
	1	VPSA/MPSA based two stage purification unit (methane slip <1%)
	2	Recovery system
	3	High pressure compressor
	4	Buffer tank
	5	Double membrane balloon with flow transmitter and blower
5	**Electrical and electronics requirements**	
	1	Electrical control panel
	2	Electrical wing, Bus, bar, joints, protectors
	3	Earthing
	4	11kV connection with transformer
	5	Control room with computers
6	**Solid Liquid separator**	
	1	Solid liquid separator
	2	Slurry agitator with necessary fixing systems

Sr. No.	Sub	Work/product/machinery
	3	Slurry pump
7	**General requirement**	
	1	Firefighting equipment's
	2	Fire hydrant system – 1 set
	3	Initial feeding requirements
	4	Lighting system purpose
	5	Generator system for emergency
	6	IT equipment's like desktop, laptop, printer, modem, speaker etc
	7	Office furniture and internal storage systems
8	**Additional items as per site condition**	
	1	CNG Storage cascade for gas distribution- loose cylinders
	2	CNG storage cascade for gas distribution -cascades, static storage structure
	3	Internal roads
	4	Fencing/compound wall with gate
	5	Approach road
	6	CNG station
	7	Landscaping and other aesthetics

Source: Detailed Project Report (DPR)

The representative process flow plan for the biogas plant is provided below:

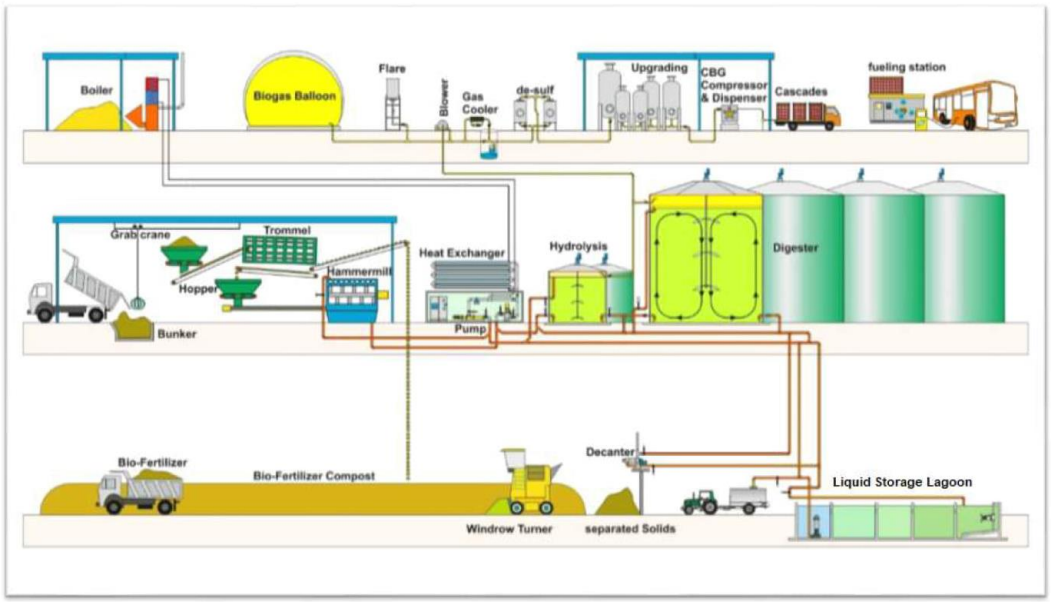


Figure 2-2: General Process Flow Diagram

Raw Material Feeding Tank Equipment (Input System)

The waste will be brought in at the site in trucks and measured at the weigh bridge. Incoming source segregated organic waste after pre-treatment will be used in bio methanation. Waste like coconut shells will be shred and converted into bio-fuel which can be utilised in plant's hot water generator or sold. Pre-treatment rejects and solids separated from digestor effluent will be processed in aerobic composting section of the plant. The waste will be fed to the hopper with conveyor, using the Electric overhead traveling cranes (EOT) Crane. The conveyor will route the waste to the grinder. In the grinder water addition will be done. From the grinder, the waste slurry will be routed to the feeding tank. From the feeding tank, the slurry will pumped to the hydrolyzer tank system which has 5-6 day retention time.

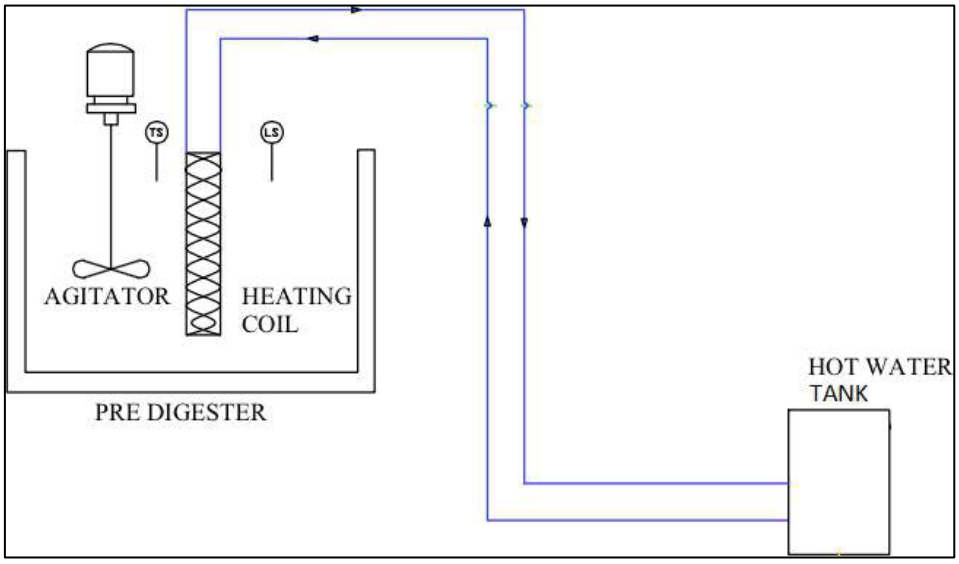
Feeding Belt Conveyor with Hopper

It will help in feeding the entire waste during the day and also enable segregation of waste, if needed.

Pre-digester/Hydrolyser

The pre-digester will be used for separating the hydrolysis phase of the digestion process. The pre-digester has a retention time of 5-6 days. Accordingly, keeping in mind a daily feeding capacity of 400 tons, the total volume of the pre-digester system would be 1000 m^3. The feedstock inside the pre-digesters will be heated using hot water in a circulation coil. The pre-digesters operates in mesophilic range which is between 25-40 degree Celsius.

The heater operates to increase the water to a temperature of 60 degree Celsius. It is triggered by a temperature controller circuit which starts the heating circuit whenever the water temperature drops to 30 degrees Celsius. The centrifugal pump circulates the hot water via the coil in the pre-digesters. The pump is triggered whenever the temperature in the pre- digester is below the expected 25 degree Celsius. The pre-digester unit block diagram and a representative image of a pre-digester is shown below.



Pre-digester Flow diagram

The specifications of the hydrolyzer are as follows:

- Total Volume of pre-digester system: ~ 1000 cu.m.
- Material: Glass Fused Steel/ RCC/ MS Steel Tank

Digester Tank Equipment and Machinery

From the input system, waste slurry will be pumped into the digester system. Each digester will have agitators and an automated heating system. The heating system will ensure that the temperature of the digesters is maintained in the range of 38-41 degrees Celsius. The digesters have double membrane balloon on top, for gas storage. Any excess gas that is unutilized in the gas management system, will be routed to the flaring unit, to ensure no methane is released directly into the atmosphere. The gas piping has water traps to ensure the piping is free of any water accumulation. All these arrangements will be checked and ensured during the engineering phase.

The specifications of the digester system are as follows:

- Total Volume of digesters: ~ 15000 cu.m. (For the 400 TPD capacity)
- Material: Glass Fused Steel/ RCC/ MS Steel Tank

Biogas Purification and Bottling System

Biogas from the digesters will be routed to the double membrane balloon that forms a part of the purification system. From the balloon the biogas will be routed to the Minor Pressure Swing Adsorption (MPSA) based purification system. Once the biogas is purified to give Bio-CNG, it will be routed to the bottling system, compressed and stored at 200-250 bar in cylinders.

From the process flow diagram presented in Annexure-G, it was seen that the cascade-based storage system will be followed, the cascade storage system typically consists of three reservoirs with low, medium and high pressure, respectively; accordingly, CNG is filled to on-board cylinders via three steps from low pressure to high pressure. Compared to the buffer storage system, the cascade system consumes about 50% less energy, but charges 20% less biogas and requires three times longer filling time. Therefore, cascade system is preferred for fleet time filling, which usually takes hours. [3]

Raw biogas parameters are as below:

- Biogas Flow : 32000-34000 m^3/ day (for the total 400 TPD capacity)
- CH_4 : 58% (approx.)
- H_2S : 0.1% Max
- CO_2 : 32%
- Pressure : 0.01 Kg/cm²g

Purification System

The biogas collected in the balloon will be fed to a Roots compressor where pressure of gas is raised to 0.5 kg/cm^2g. This gas is then fed to a chemical - based purification unit which has a twin tower arrangement filled with special grade of chemical adsorb H2S and CO2 from the inlet gas, where H_2S in the biogas would be scrubbed in a caustic scrubber. The outgoing gas will be free from H2S and will have approximately 4% CO_2. While one tower is purifying the gas, the other tower is taken for regeneration which is achieved by:

a. Depressurization of the tower
b. Creating partial vacuum in the tower

The changeover from one tower to another is fully automatic and accordingly continuous supply of purified gas is available at the outlet of the system. The output biogas parameters after the above process would be:

- Flow : 18,000-20,000 Nm3/hr (for the total 400 TPD capacity)
- CH_4 : 96% and better
- H_2S : 5 ppm
- Max CO_2 : 4% (max.)
- Pressure : 0.2 kg/cm²g

Dryer Unit

From CO_2 removal system biogas will be passed through drying system. Dryer is generally two vessel molecular sieve type and heatless. Here the moisture is removed to ppm level. It is equipped with timer logic for regeneration. Purge gas is taken to the clean gas holder.

Buffer Tank

From the drying unit biogas will be sent to the buffer vessel at pressure 6 to 7 kg/cm_2. It will be equipped with pressure control system and PRV connected in close loop to recycle gas header. Gas from this buffer vessel is taken to the high-pressure compressor. All above units are operated through PLC.

Gas Compressing System

Two compressors will be installed for compressing the purified biogas from 7 bar to 200 bar pressure and bottled into a cascade of cylinders. The bio-CNG will be stored in cylinders at 200-250 bar pressure.

Biogas flare system

[3] Converting Biogas to Transportation Fuels | Ohioline (osu.edu)

If the biogas in the storage exceeds the set pressure limit or during maintenance activity, the biogas flows to flare which gets ignited automatically. Flaring will occur only rarely as the biogas is main revenue earning product.

Biogas Storage Cascades

The compressed biogas (CBG) stored in cylinders (cascades) can be used for vehicle fuel or transported to the client place and used instead of diesel, LPG and furnace oil. Excess Biogas released during plant breakdown or in any other case of emergency will be burned by flare unit[4].

Slurry Tank Equipment

The output slurry from the digester will be collected in the output slurry tanks. The slurry will be then dewatered, and the liquid is disposed of as a liquid fertilizer. The solids will be routed to the composting.

[4] Details of flaring system will be worked out later at project design stage.

2.4.2 Operation and Maintenance

The Bio-CNG plant requires least maintenance among all the other forms of energy generation from waste facilities due to the absence of fuel, intense heat, rotating machinery, waste disposal, etc. However, keeping the temperature in the digester in a stable condition, monitoring and correcting faults are still required in order to get maximum energy from the plant. Operations and maintenance activities will be performed by subcon engaged as informed by the site team.

The maintenance functions of a typical Bio-CNG plant can be categorized as below.

- Scheduled or preventative maintenance – Planned in advance and aimed at preventing faults from occurring, as well as keeping the plant operating at its optimum level.
- Breakdown maintenance – carried out in response to failures.

The remote management and monitoring system (RMS) is the key to the biogas solution. It keeps track of the system health all the time and informs the operations and maintenance team of the health of the system and alarms, if any. It will have the following features:

- RMS system as part of the installation consists of the sensors to measure the various parameters of the health of the system. It is also fitted with a mobile based solution to keep the communication with the server.
- The server constantly communicates with all the RMS installed across India and constantly analyses the data to evaluate the health.
- In case of alarms of any kind, the server generates the alerts and informs all the personnel involved.

2.5 Resource Requirement

2.5.1 Land Requirement and Procurement Process

The following project components were identified for which land was required during the construction and/ or operation phase;

- the main plant,
- associated facilities,
- laydown areas,
- fuel storage yard,
- cascade storage yard,
- storage for by-products such as compost and liquid fertilizer, etc.

The project's land requirement is 9 acres for the combined 400 TPD capacity.

The entire land required for the project has been leased to the proponent by BMC for 20 years starting COD, after which it will expire unless renewed. The land is owned and has been under BMC's possession. It was used as a waste dumping yard since 2014. As reported, there are no pending litigations or disputes on the land, and it is free of all encumbrances.

2.5.1.1 Key Features of Land Procurement

As indicated earlier, land required for the proposed project development will be leased by BMC and thus does not envisage any physical or economic displacement. The position of the project/ land procurement vis-à-vis key socio-economic issues are as follows:

- **Schedule V Area and Tribal Land:** The Project area does not fall under Schedule V areas as defined in the Indian Constitution under Article 342. The land identified for the project does not comprise of any tribal land/ land parcels owned by members belonging to the Indigenous Peoples (IP). It is to be noted that though there are presence of Scheduled Tribe population in the study area, no land belonging to those tribes is involved in the project.

- **Forest land:** The project will be developed on government land being used as a waste dumping ground. As reported, no forest land will be used for the project.
- **Common Property Resources (CPR):** There are 2 approach roads to the project. One connects to the site to NH 146 near Kolua Khurd village and another from Padariya village. The access road passing near Kolua Khurd is dedicated for heavy load vehicles' transportation to/from the site and it is not shared with any villagers. The road passing from Padariya village is the main village road with residential and commercial structures on either side of the road. No vehicle carrying waste is permitted to go through this road based on mutual understanding of the villagers and BMC. However, smaller vehicles for office use, often travel from this road. The villagers did not have any objections on this minimal use of the road.
- **No Objection Certificate (NOC) from Panchayat:** Gram Panchayat NOC from Padariya village was reportedly obtained at the time of setting up a waste dumping ground[5].
- **Landlessness:** The project has not resulted in new land procurement, therefore, has not affected any landowner.
- **Encumbrance on Land:** No encumbrance or encroachment on the project land could be observed at site or reported during stakeholder consultations.
- **Cultural Heritage sites:** Within or adjacent to the proposed site (with 500 m radius from project centre) there are no sites of cultural or religious importance.

2.5.2 Workforce

The project shall have one project head, one site engineer, and a team of maintenance officers, operators, drivers, and helpers at site during the construction stage of the project. The exact numbers are yet to be decided. In terms of third-party workforce, the project would require ~70-80 persons per day during the construction stage. For the construction of boundary wall, the project has already engaged a local contractor to provide workers and currently 5-6 workers are engaged at the site. So approximately 100 persons will be engaged during construction stage, comprising of workers and technical team members. Labours and workers will be staying on a rent basis in nearby villages / Bhopal and labour camps will be setup for project near the site area.

During its operations phase, the project will require 48-52 person team out of which 15-16 members shall comprised of the company employees including project head, engineers; whereas the remaining 30-32 persons will comprise of mechanical fitters, electricians, drivers, operators, helpers, and security. So approximately 50 persons will be engaged during operation stage.

2.5.3 Water

The drinking water requirement will be met through packaged water supplied by local vendors. So, considering approximately 100 persons during construction stage, 4.5 KLD of water will be required for domestic usage[6]. Water demand for civil activities is yet to be estimated but the same will managed by use of curing agents, super plasticizers and other best construction practices. The water required for construction purposes will be sourced through local tanker water vendors and borewell water will be used for the washroom needs. In case ground water is used, ERMPL will ensure that permission for ground water extraction is available for the same. As per the information provided by the Client, currently water is needed for office purpose mainly and they use cans of 20 ltrs. capacity which is procured from the local provider.

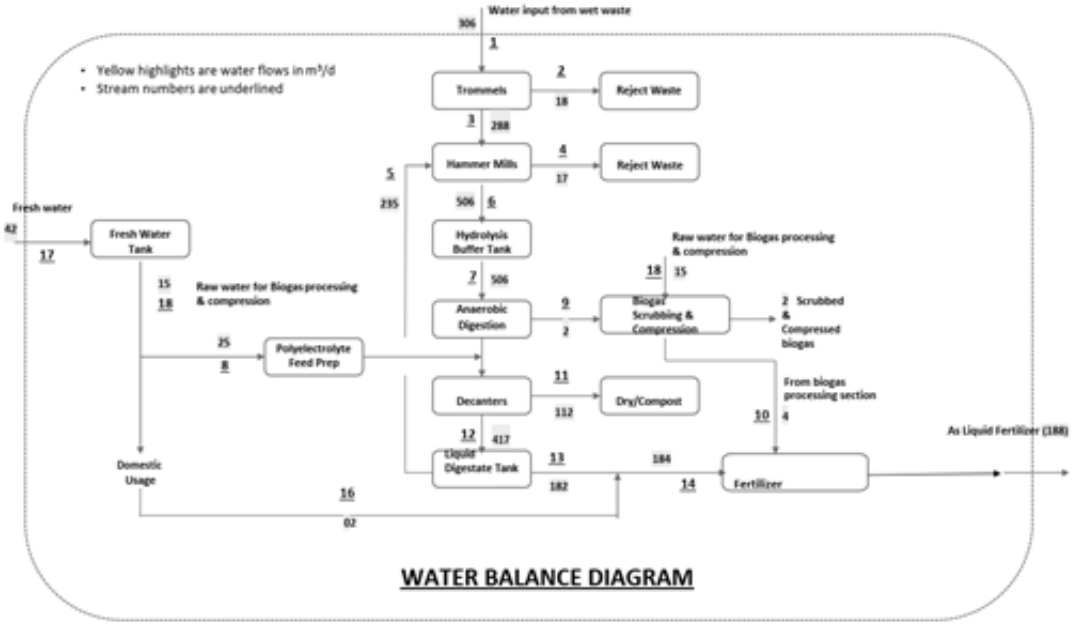
The main water supply for operation phase will be provided by the Bhopal Municipal Corporation which will be supplied after piping the water from nearby Ghoda Pachad Dam. Ghoda Pachad dam capacity is 11.57 MCM (million cubic metre). Currently the water from Ghoda Pachad dam is given mainly for irrigation purpose, 0.11 MCM to ISRO and 0.073 MCM to police facility. It was noted that 1.85 MCM is allotted for central Pey Jal Yojna for village drinking water. 0.55 MCM of water is allocated for integrated solid waste management facility for Bhopal Municipal Corporation. Out of 0.55 MCM, the Project will need only 42 KLD of water which will be provided by BMC[7], During the operations phase, water will be required for fire hydrant systems, bio processes,

[5] Panchayat NOC copy was not available for AECOM's review.

[6] 45 litre / worker / day

[7] As per the information shared by clients, however BMC agreement copy was not available for review.

green belt, offices and washrooms. Some of the water requirement can be fulfilled through Effluent Treatment Plant of capacity 200 KLD (approx.). The amount of water needed/received from wet waste was calculated and presented in the form of a water balance. The output slurry coming out of the digestor will be dewatered. Digestor effluent will be stored and sold / disposed off as Liquid Fermented Organic Manure (LFOM) conforming to Fertilizer Control Order (FCO) specifications of Ministry of Fertilizers.



In case ground water is used during the construction or operational phase, client will ensure that necessary statutory permissions (NOC from CGWB) will be obtained / available.

2.5.4 Power

ERMPL will have an agreement with the Madhya Pradesh Madhya Kshetra Vidyut Vitran Corporation Limited (MPMKVVCL) for 100 kVA mainly for the construction phase which will be extended to 1 MW during operation phase.

During operation phase, one DG set of approximately 200 kVA capacity is proposed to be installed at the site, for emergency services during power failure.

It was reported that client is also planning on installing 1.1 MW solar power plant in for their captive usage. This is under planning phase and the design are yet to finalized which will be starting after the bio-CNG plant is operational.[8]

2.5.5 Sewage

During construction phase, adequate number of portable toilets will be provided by the EPC contractor at site and a septic tank with soak pit will be provided for disposal of domestic wastewater generated.

During the operation phase, domestic wastewater will be limited to domestic wastewater discharged from the site office. Wastewater generated at the site office will be disposed of either in septic tank + soak pit or sewage treatment plant.

2.5.6 Solid Waste

The project's land requirement is 9 acres out of which approximately 6 acres will be part of 45 acres of land of BMCWPP and remaining approximately 3 acres will be adjoining vacant land of BMC. The 6 acre land parcel

[8] It was reported that client is also planning on installing 1.1 MW solar power plant in for their captive usage. This is under planning phase and the design are yet to finalized which will be starting after the bio-CNG plant is operational. This report does not cover impacts related to solar project or its associated facilities.

(land parcel part of BMCWPP) has waste previous waste dumped on it. BMC will clear the Project site of all waste before handing over the site to ERMPL. As per the consultation it was informedthat it will be shifted to the adjacent land by BMC.[9]

Solid waste generation during the construction phase will consist primarily of scrapped building materials, excess concrete and cement, rejected components and materials, packing and shipping materials (pallets, crates, styrofoam, plastics etc.). The waste will be disposed by the EPC contractor through local waste disposal agencies.

During project operation, the output slurry from the digester will be collected in the output slurry tanks. The slurry will be then dewatered, and the liquid will be sold off as liquid fertilizer. The solids will be routed to the composting which will be around 80 TPD. The generated compost/manure will be sold off. Any waste rejects, from incoming bio-degradable waste, will be handed back to BMC.

During operation phase, the in-house waste generated will be limited to municipal waste from workers which will consists of paper, plastic waste and food waste from the site office. The waste shall be collected in designated bins at site and disposed at a regular interval by the O&M contractor through local waste disposal agencies.

2.5.7 Hazardous Waste

During construction phase, hazardous waste such as used oil from diesel generator (DG) sets, oil-soaked cotton, oil lined containers, paints, etc. will be generated at the site. The hazardous waste will be disposed through a State Pollution Control Board (SPCB) authorized hazardous waste recycler.

During operation phase, one DG set of approximately 200 kVA capacity is proposed to be installed at the site and thus the hazardous waste generation will be limited to used diesel used, oil and grease and oily cotton waste from the maintenance of machineries. The hazardous waste disposed through SPCB approved hazardous waste recycler / vendor.

2.6 Implementation Schedule & Status

As per the information shared by the Client, contract of the project was awarded on 12th December 2021, and land parcel was handed to client on 10th November 2022. Project development which includes activities like construction approvals, boundary wall construction, survey and design, procurement of all the units, modules, etc., will all go hand in hand and will take around 12 to 15 months for completing all these activities. The expected date of construction to start is mid of January, 2023.

During the site visit in Oct 2022, waste was being cleared by BMC (both above the ground and below). ERMPL have engaged GPS Renewables Pvt. Ltd. on turnkey basis for undertaking the construction and O&M works. The construction works will comprise of carrying out soil investigation, foundation work, installation of various units, etc., which as per the schedule will take around 12-15 months post 2.5 to 3 months of clearing of waste.

The site development activities for the proposed project will entail the following:

- site clearing;
- site levelling;
- fencing of site;
- laying of foundations; and,
- Installing of plant units, tankers and digesters.

All construction activities shall occur within the site boundary limits, which will be performed by the ERMPL. ERMPL shall only be responsible for site clearing and grading of the site as required for construction, operation, and maintenance of the plant.

[9] As per the information shared by clients

3. Environment and Social Regulatory Framework

This section highlights the environmental and social regulations applicable to the proposed project. The section broadly focuses on the institutional framework, national administrative/ regulatory requirements, applicable environment, health and safety and social legislative requirements and IFC Performance Standards, relevant to the proposed project.

3.1 National and Regional Enforcement Authorities

In India, the environmental regulation aspects are governed by Ministry of Environment, Forests and Climate Change (MoEF&CC), Central Pollution Control Board (CPCB), Central Electricity Authority (CEA) and Central Electricity Regulatory Commission (CERC). The social governance aspects at the micro level are addressed by institutions like *panchayats* and municipal bodies.

All the permissions and the approvals have to be taken from the concerned ministries, line departments and the local civic bodies for any upcoming project in India. The environmental and social governance approach in the country consists of:

1. Regulatory and implementing entities;
2. Legal framework including policies, acts and laws; and
3. Permitting system.

A brief description of the relevant enforcement agencies with respect to the institutional framework is described below:

Table 3-1 Enforcement Agencies Relevant to The Project

S. N.	Name of the Agency	Description
1.	MoEF&CC	MoEF&CC is the apex body in India which has been formulated to plan, promote, co-ordinate and oversee the implementation of India's environmental and forestry policies and programmes. Various acts like The Environment (Protection) Act 1986, as amended in April 2003, The Air (Prevention and Control of Pollution) Act, 1981, amended in 1987 and The Water (Prevention and Control of Pollution) Act, 1974, amended in 1988 have been developed. It is the responsibility of the apex body to ensure the compliance under the acts to maintain stipulated standards and environmental management through various supporting rules promulgated under the Acts.
2.	Central Pollution Control Board (CPCB)	The CPCB was established in September 1974, for the purpose of implementing provisions of the Water (Prevention and Control of Pollution) Act, 1974. The executive responsibilities for the industrial pollution prevention and control are primarily executed by the CPCB at the Central level, which is a statutory body, attached to the MoEF&CC. CPCB works towards control of water, air and noise pollution, land degradation and hazardous substances and waste management. CPCB will direct MPPCB in case any violation is undertaken in complying with the conditions of Hazardous Waste Authorization.
3.	Madhya Pradesh Pollution Control Board (MPPCB)	MPPCB has been vested with considerable authority and responsibility under various environment legislation to prevent the pollution. MPPCB presently looks after the implementation of rules/acts:- a) Water (prevention control of pollution) Act, 1974, b) Air (prevention and control of pollution) Act, 1981 c) Environment protection act, 1986 (certain sections) d) Public liability insurance act, 1991 The main objective of is to maintain water, air and soil in healthy and usable condition for various purposes. There are 6 Zonal offices (Bhopal, Indore, Jabalpur, Gwalior, Ujjain, Rewa), 16 regional offices, 1 sub-regional, equipped with trained personnel and sophisticated instruments, are constantly keeping watch on environmental activities in the state to attain the objectives.
4.	Petroleum and Explosives Safety Organisation (PESO)	The PESO is under the Department of Industrial Policy & Promotion, Ministry of Commerce and Industry, Government of India. Key regulations related to project: The Gas Cylinders Rules, 2016, The Static and Mobile pressure vessels (Unfired) Rules, 2016, The Explosive Act, 1884 and Rules, 2008, The Petroleum Act, 1934 and the Rules 2002, Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 and their amendments.

S. N.	Name of the Agency	Description
5.	Director Industrial Safety and Health (DISH)	The main objective of the DISH is to ensure safety, health, welfare and working conditions of workers working in factories and in construction works by effectively enforcing the provisions of the *Factories Act, 1948* the *Building & Other Construction Workers Act 1996,* and other labour legislations. It is also to ensure the protection of rights of workers and to redress their grievances. Factory license is required as 'factory' means 'any premises having ten or more workers involved in a manufacturing process'. Factory License from the State Government or Chief Inspectorate of Factories, Madhya Pradesh is required to be obtained for the project. Project proponent/ Construction contractor shall comply with all requirements of *Madhya Pradesh Factories Rules 1962* and participate in periodic inspection. It is also to be ensured that no child labour is engaged during construction or operation phases of the project.
6.	Ministry of New and Renewable Energy (MNRE)	The MNRE is the nodal ministry of Government of India for all matters related to new and renewable energy. The broad aim is to develop and deploy new and renewable energy for supplementing the energy requirements of the country as stated on its website. The role of MNRE has been assuming importance in recent times with growing concerns of energy security.
7.	Madhya Pradesh Urja Vikas Nigam (MPUVN)	The MPUVN established by the Government of Madhya Pradesh in 1982 as the nodal agency for implementing various programs and policies of the Government of India as well as the State Government for the renewable energy sector. Its scope of activities extends from implementing various schemes for meeting the energy needs of rural areas to the promotion and setting up of industrial and commercial projects for the use of non-conventional power. Besides implementing all Government sponsored programs and projects in this sector MPUVN, creates awareness about the benefits of energy conservation and renewable energy among users of various forms of energy.
8.	Central Electricity Authority	CEA is a Statutory Body constituted under the erstwhile Electricity (Supply) Act, 1948, thereafter replaced by the Electricity Act, 2003, where similar provisions exist, the office of the CEA is an "Attached Office" of the Ministry of Power. The CEA is responsible for the technical coordination and supervision of programmes and is also entrusted with a number of statutory functions.
9.	Central Electricity Regulatory Commission	The Commission intends to promote competition, efficiency and economy in bulk power markets, improve the quality of supply, promote investments and advise government on the removal of institutional barriers to bridge the demand supply gap and thus foster the interests of consumers.
10.	Central Ground Water Authority (CGWA)	CGWA was constituted under Sub-section (3) of Section 3 of the Environment (Protection) Act, 1986 for the purposes of regulation and control of ground water development and management. As per CGWA's guidelines effective from 01 June 2019, NOC is required for ground water withdrawal for all infrastructure projects drawing/proposing to draw ground water through an energised means. (with effect from 16.11.2015).
11.	Gram Panchayat	Gram Sabha or the Panchayats are the local bodies which have been defined by the 73rd Constitutional Amendment Act, 1992. Panchayats have to be consulted before acquiring land in the Scheduled Areas for development projects and before re-settling or rehabilitating persons affected by such projects in the Scheduled Areas. The responsibilities that have been entrusted upon Panchayats comprises of the preparation of plans for economic development and social justice and the implementation of such schemes for economic development and social justice, as may be assigned to them. NOC from Padariya village was reportedly obtained at the time of setting up the waste dumping site[10].

3.2 Applicable Environment and Social Laws and Regulations

Table below summarizes the key regulations that are relevant to the project across its lifecycle. This table is indicative and can be used to update/develop a comprehensive legal register for the Project.

[10] Copy of panchayat NOC was not available for AECOM's review.

Table 3-2: Applicable Environment and Social Laws and Regulations

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
EHS Laws, Acts, Rules and Regulations					
1.	Environmental Protection	• Construction activities will generate air, water and noise emissions; and • Scattering of debris and construction material can contaminate the soil, water and surroundings.	• The Environment (Protection) Act 1986, as amended in April 2003; and • EPA Rules 1986, as amended in 2002.	MPPCB	As per Section 7 of Environment Protection Act, 1986 and Rule 3 of the Environment Protection Rule, 1986, no person carrying on any industry, operation and process shall discharge or emit any environmental pollutant in excess of prescribed standards. Compliance under the rules to maintain stipulated standards and environmental management through various supporting rules promulgated under the Act. Bio-CNG plants are not covered in the EIA notification 2006, hence environmental clearance will not be required *ERMPL and the EPC contractor are required to ensure that Project implementation adheres to the various clauses laid down in the Act*
2.	Prevention and Control of Water Pollution	Wastewater generation during construction and operation of the Plant	The Water (Prevention and Control of Pollution) Act, 1974, amended in 1988	MPPCB	As per the section 24 of the Water (Prevention and Control of Pollution) Act, 1974, amended in 1988 no person shall knowingly cause or permit any poisonous, noxious or polluting matter into any stream or well or sewer or on land. Consent to establish and consent to operate will be applicable for the project.
3.	Prevention and Control of Air Pollution	Movement of vehicles, operation of diesel generators for power at project site or other construction activities.	The Air (Prevention and Control of Pollution) Act, 1981, amended in 1987.	MPPCB	As per section 22 of The Air (Prevention and Control of Pollution) Act, 1981, amended in 1987, no person operating any industrial plant, in any air pollution control area shall discharge or cause or permit to be discharged the emission of any air pollutant in excess of the standards laid down by the MPPCB. MPPCB issued notification regarding harmonization of classification of industrial sectors under Red/Orange/Green/White categories which states that 'Compressed/Refined Biogas, Bio-Diesel etc. Production from Bio-degradable Wastes etc.' is classified as orange category industry. We understand that ready mix cement concrete will be sourced from vendors and Ready-mix cement concrete plant or batching plant will not be set up at site.
4.	License under Factories Act, 1948	Factory license is required as the project is generating, transforming or transmitting power.	Chapter I of The Factories Act, 1948	Directorate, Industrial Safety and Health, Government of Madhya Pradesh	As per the section 6 of The Factories Act, 194, client would have to obtain registration from the State Government or Chief Inspectorate of Factories if 10 or more workers are engaged, triggering the applicability of the Factories Act.
5.	Noise Emissions	Noise generated from operation of construction machinery	• The Noise (Regulation & Control) Rules, 2000 as	MPPCB	As per the Rules 3 and 4 of the Noise (Regulation & Control) Rules, 2000 as amended in October 2002, noise emissions in the

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
			amended in October 2002; and • As per the Environment (Protection) Act (EPA) 1986 the ambient noise levels are to be maintained as stipulated by CPCB for different categories of areas like, commercial, residential and silence zones etc.		project area which comes under the residential zone, should not exceed standards specified in the Schedule.
6.	Hazardous Wastes Management	• Oil and grease and oily cotton waste from the maintenance of machineries. • Solvents and chemicals used or cleaning, etc.	Hazardous and Other Wastes (Management and Trans boundary Movement) Rules, 2016 as amended in 2019	MPPCB	As per the Hazardous Waste and Other Wastes (Management and Trans boundary Movement) Rules 2016 and its amendment, an occupier shall be required to obtain an authorisation under this rule from the State Pollution Control Board.
7.	Construction and Demolition Waste	Collection, segregation, storage and disposal of construction and demolition (C&D) waste at construction phase of the project.	Construction and Demolition Waste Management Rules, 2016	Gram Panchayat	As per the Construction and Demolition Waste Management Rules, 2016, if waste more than 20 tons or more in one day or 300 tons per project in a month is generated then ERMPL shall submit waste management plan and get appropriate approvals from the local authority before starting construction or demolition work. ERMPL should also ensure responsible collection, store and disposal of the C&D waste.
8.	BioCNG manufacturing, storage, filling and transport	• Generation, storage and transportation of Bio-CNG • Storage of Diesel.	• The Petroleum Act, 1934 and the Rules 2002 & amendments • The Gas Cylinders Rules, 2016 & amendments • The Static and Mobile pressure vessels (Unfired) Rules, 2016 & amendments • The Explosive Act, 1884 and Rules, 2008 & amendments • Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 & amendments	PESO (Chief Controller of Explosives)	Approvals & licences related to manufacturing, store, filling and transport of Bio-CNG, as applicable Approvals & licences related to manufacturing, store, filling and transport of Diesel, as applicable
9.	Surface Transportation	Movement of construction vehicles and other vehicles for transportation of workers	• The Motor Vehicles Act 1988, and amendments • The Central Motor Vehicles Rules 1989, and amendments	State Transport Authority	ERMPL to ensure compliance of the Section 39, Motor Vehicle Act, 1988 as amended in 2017 and Rule 47, Motor Vehicle Rule, 1989.
Biodiversity related laws					
10.	Forest Protection	Presence of legally protected Forest Land in proximity to the project site	The Indian Forest Act, 1927	Forest Department	Not Applicable

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
					Approval of the Forest Department is required only if project-related infrastructure or activities are anticipated within legally protected Forest Land.
11.	Wildlife Conservation	Presence of wildlife habitats, including those of species listed in Schedule I of the Wildlife (Protection) Act, in and around the project site	The Wildlife (Protection) Act, 1972	National Board for Wildlife	Not Applicable Approval of the National Board for Wildlife is required only if project-related infrastructure, activities or personnel occur within any notified Protected Area, Eco-sensitive Zone or recognized wildlife corridors.
12.	Forest Conservation	Presence of legally protected Forest Land in proximity to the project site	The Forest (Conservation) Act, 1980	Forest Department	Not Applicable Approval of the Forest Department is required only if Forest Land needs to be diverted for Project-purposes.
13.	Tree Felling	Presence of tree on site	The Forest (Conservation) Act, 1980 MP Land Revenue regulations	Forest Department	Applicable Approval will be required for removal/cutting of trees on site from relevant regulatory department
Social and labour-related Laws, Regulations and Acts					
14.	Labour	Engagement of workers for construction and operation of the plant	The Factories Act, 1948 and Madhya Pradesh Factories Rules, 1962	Labour Department, Government of Madhya Pradesh	Contractor shall comply with all requirements of Factories Rules and participate in periodic inspection.
15.	Contract Workers	Engagement of contract workers	The Contract Labour (Regulation and Abolition) Act, 1970 as amended in 2017	Labour Department, Government of Madhya Pradesh	As per Section 12 of the Contract Labour (Regulation and Abolition) Act, 1970 a contractor executing any contract work by engaging 20 or more contract labourers has to obtain a licence under the Act.
16.	Contractor Labour License	Contractors or third parties to be involved in the construction works for the proposed project, if required, will also be engaged only subject to availability of valid registration.	Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 and Contract Labour (Regulation and Abolition) Act, 1970.	Labour Department, Government of Madhya Pradesh	Section 7 of the Act mandates the registration of establishments. Client should ensure that contractor/ sub-contractors have a valid registration under the Building and Other Construction Works Act and Contract Labour (Regulation and Abolition) Act, 1970.
17.	Contract Labour	Principal Employer registration for engaging contract labour through third party is required.	The Contract Labour (Regulation and Abolition) Act, 1970	Labour Department, Government of Madhya Pradesh	Section 7 of the Act mandates the Principal Employer registration for engaging contract labour through third party.
18.	Migrant Workmen	Principal Employer registration for engaging migrant labour is required for direct/indirect labour.	The Inter-State Migrant Workmen (Regulation of Employment and conditions of service) Act, 1979	Labour Department, Government of Madhya Pradesh	Section 4 of the Act mandates that the Principal Employer registration should be obtained for engaging migrant labour through third party.

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
19.	Child Labour	Engagement of Child Labour at site	The Child Labour (Prohibition and Regulation) Act, 1986	Labour Department, Government of Madhya Pradesh	Section 3 under the Child Labour (Prohibition and Regulation) Act, 1986 (CLA, 1986) including amendment in 2016. No child below the age of 14 years shall be employed in any establishment mentioned in Schedule Part A and Part B of the CLA, 1986.
20.	Bonded Labour	Engagement of Bonded Labour at site	Bonded Labour (Abolition) Act 1976	Labour Department, Government of Madhya Pradesh	Rule 4 of the Bonded Labour System (Abolition) Act, 1976 specifies "After the commencement of this Act, no person shall- make any advance under, or in pursuance of, the bonded labour system, or compel any person to render any bonded labour or other form of forced labour."
21.	Payment of Wages	Provision of wages to labour engaged at the site	Minimum Wages Act, 1948	Labour Department, Government of Madhya Pradesh	Section 12 of the Minimum Wages Act, 1948: The employer shall pay to every employee engaged in a scheduled employment under him wages at a rate not less than the minimum rate of wages fixed by the appropriate Government Authority for that class of employees in that employment without any deductions except as may be authorized within such time and subject to such conditions as may be prescribed. Every employer shall be responsible for the payment to persons employed by him of all wages required to be paid under this Act.
22.	Payment of Wages.	Equal wages to male and female workers at site	Equal Remuneration Act 1976	Labour Department, Government of Madhya Pradesh	It is the duty of an employer to pay equal remuneration to men and women workers for same work or work of a similar nature.
23.	Payment of Wages	Engagement of Labour at site	Workmen's Compensation Act, 1923	Labour Department, Government of Madhya Pradesh	Requires if personal injury is caused to a workman by accident arising out of and in the course of his employment, his employer shall be liable to pay compensation in accordance with the provisions of this Act.
24.	Women at Workplace	Engagement of Female Labour at site	Maternity Benefit Act, 1961	Labour Department, Government of Madhya Pradesh	Section 4 of the Maternity Benefit Act, 1961 including amendment as in Maternity Benefit (Amendment) Act, 2017: - • "No employer shall knowingly employ a woman in any establishment during the six weeks immediately following the day of her delivery or her miscarriage; • No woman shall work in any establishment during the six weeks immediately following the day of her delivery or her miscarriage; and • Without prejudice to the provisions of section 6, no pregnant woman shall, on a request being made by her in this behalf, be required by her employer to do during the period specified in sub- section (4) any work which is of an arduous nature or which involves long hours of standing, or which in any way is likely to interfere with her pregnancy or the normal

S. No.	Aspect	Relevance	Applicable Legislation	Agency Responsible	Applicable Permits and Requirements
					development of the foetus, or is likely to cause her miscarriage or otherwise to adversely affect her health." Section 5 of the Maternity Benefit Act, 1961 including as amended in 2017. "As per the amendment in 2017, • Subject to the provisions of this Act, every woman shall be entitled to, and her employer shall be liable for, the payment of maternity benefit at the rate of the average daily wage for the period of her actual absence, that is to say, the period immediately preceding the day of her delivery, the actual day of her delivery and any period immediately following that day; • No woman shall be entitled to maternity benefit unless she has actually worked in an establishment of the employer from whom she claims maternity benefit, for a period of not less than eighty days in the twelve months immediately preceding the date of her expected delivery; • The maximum period for which any woman shall be entitled to maternity benefit shall be twenty-six weeks of which not more than eight weeks shall precede the date of her expected delivery; • A woman who legally adopts a child below the age of three months or a commissioning mother shall be entitled to maternity benefit for a period of twelve weeks from the date the child is handed over to the adopting mother or the commissioning mother, as the case maybe; and In case where the nature of work assigned to a woman is of such nature that she may work from home, the employer may allow her to do so after availing of the maternity benefit for such periods and on such conditions as the employer and the woman may mutually agree."
25.	Working Conditions	Working conditions of contracted Labour working at the site	Contract Labour (Regulations and Abolition) Act, 1970	Labour Department, Government of Madhya Pradesh	Section 16,17,18,19,20 and 21 of the said Act mandates the provision of the principal employer to ensure that all the contracted workers are provided with condition of services, rate of wages, holidays, hours of work as stipulated in the act and rules.

3.3 Policy Framework in India

Policies with respect to the biofuel in India and Madhya Pradesh, focusing on the biofuel, as released by the Government of India and Madhya Pradesh state from time to time and applicable to the project are discussed briefly in ***Table 3-4:***

Table 3-3: National and State Level Policies Applicable to the Project

S. N.	Name of the Policy	Description
1.	National Policy on Biofuels-2018 Amendment, 2022, Ministry Of Petroleum And Natural Gas	The Goal of the Policy is to enable availability of biofuels in the market thereby increasing its blending percentage. Government has prepared a road map to reduce the import dependency in Oil & Gas sector by adopting a five pronged strategy which includes, Increasing Domestic Production, Adopting biofuels & Renewables, Energy Efficiency Norms, Improvement in Refinery Processes and Demand Substitution. This envisages a strategic role for biofuels in the Indian Energy basket.
2.	Scheme for Promotion of Ethanol and Bio-fuel Production, 2021, Government of Madhya Pradesh	Government of Madhya Pradesh is introducing an "Special Financial Assistance Policy for Ethanol and Bio-fuel". The scope of the Policy package encompasses following categories of fuels as "Ethanol and Bio-Fuel" which can be used as transportation fuel or in stationery applications. The policy aims to promote, facilitate and financially incentivize investment in fuel-grade standalone green field Ethanol manufacturing units as well as existing distilleries planning to expand in the area of ethanol production in Madhya Pradesh

3.4 Applicable International Standards and Guidelines

3.4.1 IFC Performance Standards

The performance standards stipulate that any proposed project shall meet the following requirements throughout the life of an investment by IFC or other relevant financial institution: -

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;
- Performance Standard 2: Labour and Working Conditions;
- Performance Standard 3: Resource Efficiency and Pollution Prevention;
- Performance Standard 4: Community Health, Safety, and Security;
- Performance Standard 5: Land Acquisition and Involuntary Resettlement;
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;
- Performance Standard 7: Indigenous Peoples; and
- Performance Standard 8: Cultural Heritage

These Performance Standards and guidelines provide ways and means to identify impacts and affected stakeholders and lay down processes for management and mitigation of adverse impacts. The applicability of the Performance Standards is discussed in table below.

Table 3-4: Applicability of IFC Performance Standards

S. No.	Performance Standard	Description and Applicability
1.	PS1 – Assessment and Management of Environmental and Social Risks and Impacts	***APPLICABLE*** PS 1 establishes the importance of: • Integrated assessment to identify the environmental and social impacts, risks, and opportunities of projects; • Effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and • The project proponent's management of environmental and social performance throughout the life of the project.

S. No.	Performance Standard	Description and Applicability
		The PS 1 is applicable to projects with environment and/or social risks and/or impacts. The proposed project is a waste management project and will have environmental and social impacts such as stress on existing water resources, construction activities, direct or indirect impact on communities, etc.
2.	PS2 – Labour and Working Conditions	***APPLICABLE*** PS-2 recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers.
3.	PS3 - Resource Efficiency and Pollution Prevention	***APPLICABLE*** PS3 recognizes that increased economic activity and urbanization often generate increased levels of pollution to air, water, and land, and consume finite resources in a manner that may threaten people and the environment at the local, regional, and global levels. The objectives of PS 3 are: • To avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities. • To promote more sustainable use of resources, including energy and water. • To reduce project related GHG emissions. The proposed project is an energy from waste project. The construction works for the development of project will entail generation of wastes like air emissions, wastewater, and construction debris. The operation phase will result in generation of minor quantities of waste such as used domestic sewage, municipal waste, etc..
4.	PS4 – Community Health, Safety and Security	***APPLICABLE*** PS 4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. Its main stress is to ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities. Objectives of PS 4 thus are: • To anticipate and avoid any adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances. • To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities. The proposed project will involve transportation of construction material and movement of construction machinery during construction phase. Movement of trucks carrying waste during operation phase may pose safety risks to the nearby communities.
5.	PS5 – Land Acquisition and Involuntary Resettlement	***NOT APPLICABLE*** PS 5 recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Its main aim is to anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by providing compensation for loss of assets at replacement cost and ensuring that resettlement activities are implemented with appropriate disclosure of Information, consultation, and the informed participation of those affected. The PS is not applicable for the project as land for the project in question as neither been acquired by the government nor does it involve any privately-owned land. The land belongs to government and will be allotted for the project. Stakeholder consultations at site also confirmed that there were no economic/ livelihood activities on the concerned land prior to its allotment to players for setting up plant.
6.	PS6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources	***APPLICABLE*** The requirements of this Performance Standard apply to projects (i) that are situated in modified, natural, and critical habitats; (ii) that potentially impact on or are dependent on ecosystem services over which the client has direct management control or significant influence; or (iii) that include the production of living natural resources e.g., agriculture, animal husbandry, fisheries, and forestry. PS-6 considers relevant threats to biodiversity and ecosystem services, owing to project-related direct and indirect impacts, with a focus on habitat loss, degradation and fragmentation, introduction or spread of invasive alien species and loss or degradation of priority ecosystem services, while recognizing the differing values attached to biodiversity and ecosystem services by Affected Communities and any other stakeholders, especially Indigenous Peoples. PS6 recognizes that protecting and conserving biodiversity,

S. No.	Performance Standard	Description and Applicability
		maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. The Project Site, as well as the estimated area of influence of the project, contain natural and modified habitats. The Project infrastructure & activities can potentially impact biodiversity & ecosystem services. Therefore, PS6 is applicable to the Project.
7.	PS7 – Indigenous People	***NOT APPLICABLE*** Performance Standard 7 recognizes that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development. The PS 7 is not applicable to the project as; • The project is not located in a schedule V area; • No livelihood dependence on the land has been reported of tribal or non-tribal community; and • The land belongs to government and will be allotted for the project.
8.	PS8 – Cultural Heritage	***NOT APPLICABLE*** For the purposes of this Performance Standard, cultural heritage refers to tangible forms of cultural heritage, such as tangible moveable or immovable objects, property, sites, structures, or groups of structures, having archaeological (prehistoric), paleontological, historical, cultural, artistic, and religious values. The PS is not applicable to the project as; • The land on which the project is being setup does not contain any structures bearing cultural, historical, religious or spiritual significance; and • No sites bearing cultural, historical, religious or spiritual significance has been impacted by the project

3.4.2 IFC EHS Guidelines

IFC has released the following environmental, health and safety guidelines on 30th April 2007:

- Environmental, Health, and Safety General Guidelines
- Environmental, Health, and Safety Guidelines for waste management facilities issued on 10th December 2007.

The key requirements stated in the EHS guidelines have been discussed in below.

ENVIRONMENTAL ATTRIBUTES

- Air Emissions and Ambient Air Quality,
- Energy Conservation,
- Wastewater and Water Quality,
- Water Conservation,
- Hazardous Materials Management,
- Waste Management,
- Noise and
- Contaminated Land

OCCUPATIONAL HEALTH AND SAFETY

- General Facility Design and Operation,
- Communication and Training,
- Physical/Chemical/Biological Hazards,
- Personal Protective Equipment (PPE) and

- Monitoring.

COMMUNITY HEALTH AND SAFETY

- Water Quality and Availability,
- Structural Safety of Project Infrastructure,
- Life and Fire Safety (L&FS),
- Traffic Safety,
- Transport of Hazardous Materials,
- Disease Prevention and
- Emergency Preparedness and Response.

CONSTRUCTION AND DECOMMISSIONING

- Environment Baseline environmental,
- Occupational Health and Safety and
- Community Health and Safety.

3.4.3 Classification as per IFC Performance Standards

As part of its review of a project's expected social and environmental impacts, IFC uses a system of social and environmental categorization. This categorization is used to reflect the size of impacts understood as a result of the client's social and environmental assessment and to specify IFC's institutional requirements. The categories used by the IFC are:

1. ***Category A Projects***: Projects with potential significant adverse social or environmental risks or/and impacts that are diverse, irreversible or unprecedented;
2. ***Category B Projects***: Projects with potential limited adverse social or environmental risks or/and impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures;
3. ***Category C Projects***: Projects with minimal or no adverse social or environmental risks or/and impacts, including certain financial intermediary (FI) projects with minimal or no adverse risks; and
4. ***Category FI Projects***: All FI projects excluding those that are Category C projects.

IFC therefore categorizes the project primarily according to the significance and nature of its impacts. IFC defines the project's area of influence as the primary project site(s) and related facilities that the client (including its contractors) develops or controls; shared facilities that are not funded as part of the project (funding may be provided separately by a client or a third party including the government), and whose viability and existence depend exclusively on the project and whose goods or services are essential for the successful operation of the project; areas potentially impacted by cumulative impacts from further planned development of the project; and areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location. The area of influence does not include potential impacts that would occur without the project or independently of the project.

Applying the criteria stipulated by the IFC Policy on Environmental and Social Sustainability for environmental and social categorization of projects, ERMPL's proposed Bio-CNG project may be assigned as '***Category B***' with respect to environmental and social impacts. This is so basis the primary data available to date which indicates that the environmental and social risks and impacts of the proposed project activities are expected to be few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures, which supports the *'**Category B**'* classification.

Additional rationale for the above categorization is as below:

- Bio-CNG is a clean technology project using waste and converting it to form energy;

- There is no land acquisition for the project;
- The Project Site does not coincide or overlap with any Designated Area; and
- Available data suggests that the construction, operation and decommissioning of the proposed project are likely to have limited environmental and social impacts which can be readily addressed with mitigation measures.

3.5 Applicable Environmental Standards

3.5.1 Ambient Air Quality

As per the IFC EHS guidelines (April 2007), "the ambient air quality standards are ambient air quality levels established and published through national legislative and regulatory processes and ambient quality guidelines refer to ambient quality levels primarily developed through clinical, toxicological, and epidemiological evidence (such as those published by the World Health Organization)". National Ambient Air Quality Standards (NAAQS), as notified under Environment (Protection) Rules 1986 and revised through Environment (Protection) Seventh Amendment Rules, 2009 are given table below.

Table 3-8: National Ambient Air Quality Standards

Pollutant	Time Weighted Average	Concentration in Ambient Air	
		Industrial, Residential, Rural and other Areas	Ecologically Sensitive Area (notified by Central Government)
Sulphur Dioxide (SO_2), µg/m^3	Annual*	50	20
	24 Hours**	80	80
Nitrogen Dioxide (NO_2), µg/m^3	Annual*	40	30
	24 Hours**	80	80
Particulate Matter (size less than 10 µm) or PM_{10}, µg/m^3	Annual*	60	60
	24 Hours**	100	100
Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$, µg/m^3	Annual*	40	40
	24 Hours**	60	60
Ozone (O_3), µg/m^3	8 Hours**	100	100
	1 Hour**	180	180
Lead (Pb), µg/m^3	Annual*	0.5	0.5
	24 Hours**	1	1
Carbon Monoxide (CO), mg/m^3	8 Hours**	2	2
	1 Hour**	4	4
Ammonia (NH_3), µg/m^3	Annual*	100	100
	24 Hours**	400	400
Benzene (C_6H_6), µg/m^3	Annual*	5	5
Benzo (O) Pyrene (BaP), particulate phase only, ng/m^3	Annual*	1	1
Arsenic (As), ng/m^3	Annual*	6	6
Nickel (Ni), ng/m^3	Annual*	20	20

**Annual arithmetic mean of minimum 104 measurements in a year taken twice a week, 24 hourly at uniform interval*

***24 hourly or 8 hourly or 1 hourly value as applicable shall be complied with 98% of the time in a year. 2% of the time they may exceed, but not on 2 consecutive days. Note: Whenever and wherever monitoring results on two consecutive days of monitoring exceed the limits specified above for the respective category, it shall be considered adequate reason to institute regular or continuous monitoring and further investigation.*

3.5.2 Ambient Noise Standards

As per the EHS guidelines of IFC, for residential, institutional and educational area, the one hourly equivalent noise level (Leq hourly) for daytime (7.00 a.m. to 10.00 p.m.) is **55 dB (A)** while the Leq hourly for night time (10.00 p.m. to 7.00 a.m.) is prescribed as **45 dB (A).** Noise standards notified by the MoEF&CC vide gazette notification dated 14th February 2000 based on the *A- weighted equivalent noise level (Leq)* are as presented in table below.

Table 3-9: Ambient Air Quality Standards in respect of Noise*

Area Code	Category of Area	Limits in dB(A) Leq	
		Day time	Night Time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent Authority
Day time shall mean from 6.00 a.m. to 10.00 p.m. and night time shall mean from 10.00 p.m. to 6.00 a.m.

3.5.3 Noise Standards for Occupational Exposure

Noise standards in the work environment are specified by Occupational Safety and Health Administration (OSHA-USA) which in turn are being enforced by Government of India through model rules framed under the Factories Act.

Table 3-10: Standards for Occupational Noise Exposure

Total Time of Exposure per Day in Hours (Continuous or Short-term Exposure)	Sound Pressure Level in dB(A)
8	90
6	92
4	95
3	97
2	100
3/2	102
1	105
¾	107
½	110
¼	115
Never	>115

No exposure in excess of 115 dB (A) is to be permitted.
For any period of exposure falling in between any figure and the next higher or lower figure as indicated in column (1), the permissible level is to be determined by extrapolation on a proportionate scale.

3.5.4 Water Quality Standards

The designated best use classification as prescribed by CPCB for surface water is as given in table below.

Table 3-11: Primary Water Quality Criteria for Designated Best Use Classes

Designated-Best-Use	Class	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	• Total Coliforms Organism MPN/100ml shall be 50 or less • pH between 6.5 and 8.5 • Dissolved Oxygen 6mg/l or more • Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organised)	B	• Total Coliforms Organism MPN/100ml shall be 500 or less • pH between 6.5 and 8.5 • Dissolved Oxygen 5mg/l or more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	• Total Coliforms Organism MPN/100ml shall be 5000 or less • pH between 6 to 9 • Dissolved Oxygen 4mg/l or more • Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Propagation of Wild life and Fisheries	D	• pH between 6.5 to 8.5 • Dissolved Oxygen 4mg/l or more • Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	• pH between 6.0 to 8.5 • Electrical Conductivity at 25°C micro mhos/cm Max.2250 • Sodium absorption Ratio Max. 26 • Boron Max. 2mg/l
	Below-E	• Not Meeting A, B, C, D & E Criteria

Source: Central Pollution Control Board

4. Environmental and Socio-Economic Baseline

This section of the report presents information on the baseline condition of the physical, chemical, biological and social environment within the project area. Primary baseline information was collected on site from project area and area of influence. Existing information sourced from scientific literature (both published and unpublished), engineering studies, technical reports and community socio-economic studies were used wherever available. Activities that facilitated establishment of the baseline data in the report include site survey, ecological survey, social consultations and interviews, environmental monitoring, processing of satellite imagery and secondary data review from established sources such as Indian Meteorological Department (IMD) and Census of India amongst others.

4.1 Environmental Baseline

Area within the 5-kilometre (km) radius from the project centre is considered as AoI of the project, for primary data collection. Nearby villages which fall under AoI are Kolua Khurd village, Bilkhiriya village, Jhiriya kheda village and Padariya village. Primary data was collected for one (01) week duration between 16th to 20th May 2022 and 13th October 2022. Environmental baseline monitoring was undertaken through an external laboratory, M/s Netel (India) Limited, which is accredited through National Accreditation Board for Testing and Calibration Laboratories (NABL) for ambient air quality, surface water quality, drinking water quality, ambient noise levels and traffic survey. Client had undertaken soil & groundwater sampling in Oct 2022 and results of that the same study are also incorporated in sections below.

Parameters monitored are given in table below.

Table 4-1: Environmental Parameters Monitored for Baseline Data Collection

S. No.	Aspect	Details
1.	Ambient Air Quality	Information on ambient air quality was collected through monitoring of ambient air quality for 48 hrs continuously at 5 different locations measuring parameters such as Particulate Matter (PM-10), PM-2.5, Oxides of Nitrogen (NO_x), Sulphur Dioxide (SO_2), O_3, Ammonia, CO, Lead, Benzene, Benzo Alpha Pyrene, Arsenic, Nickel.
2.	Surface, Drinking and ground water Quality	Surface, drinking and ground water samples were collected for analyses of following parameters: - Organoleptic and physical parameters: Colour, Odour, pH, Taste, Turbidity, Total Dissolved Solids (TDS), Electrical Conductivity (EC); and - General parameters: Total Hardness, Total Alkalinity, Aluminium (as Al), Ammonia, Anionic detergents (as MBAS), Barium (as Ba), Boron (as B), Calcium (as Ca), Free residual Chlorine (as Cl_2), Chloramines, Chloride (as Cl), Copper (as Cu), Fluoride (as F), Iron (as Fe), Magnesium (as Mg), Manganese (as Mn), Nitrate (as NO_3), Phosphorus (as P), Selenium (as Se), Silver (as Ag), Sulphate (as SO_4), Sulphide (as S^{2-}), Zinc (as Zn), Cadmium (as Cd), Cyanide (as CN), Lead (as Pb), Mercury (as Hg), Molybdenum (as Mo), Nickel (as Ni), Pesticides, Polychlorinated Biphenyls, Total arsenic (as As), Total chromium (as Cr), Phenolic Compounds, Mineral Oil, PAHs.
3.	Soil Quality[11]	Soil samples were collected for analysis of following parameters: Moisture, pH, EC, Carbonates, Chlorides, Sulphates as SO4, Phosphorous, TOC, Potassium, Iron, Manganese, Zinc, Copper, Arsenic, Cadmium, Total Chromium, Mercury, Nickel, Lead, Total Nitrogen, VOCs
4.	Leachate[12]	pH, Suspended Solids, Oil & Grease, BOD, Ammonical Nitrogen, Arsenic, Mercury, Lead, Cadmium, Total Chromium, Copper, Zinc, Nickel, Cyanide, Chloride, Fluoride, Phenolic compound
5.	Ambient Noise Quality	Ambient noise quality was monitored to determine hourly equivalent noise levels. The noise sampling will be done once during the study period continuously for 48 hours, selected on the basis of the site sensitivities within the study area. The results of the findings were analysed to work out Leq hourly, Leq day and Leq night.

[11] *Source: AECOM Monitoring data (monitoring done in the month of February and October)*
[12] *Source: AECOM Monitoring data (monitoring done in the month of February and October)*

S. No.	Aspect	Details
6.	Traffic monitoring analysis	Traffic data was monitored for 24 hrs. Monitoring was performed for the vehicles using the dedicated road for waste carrying and National Highway.

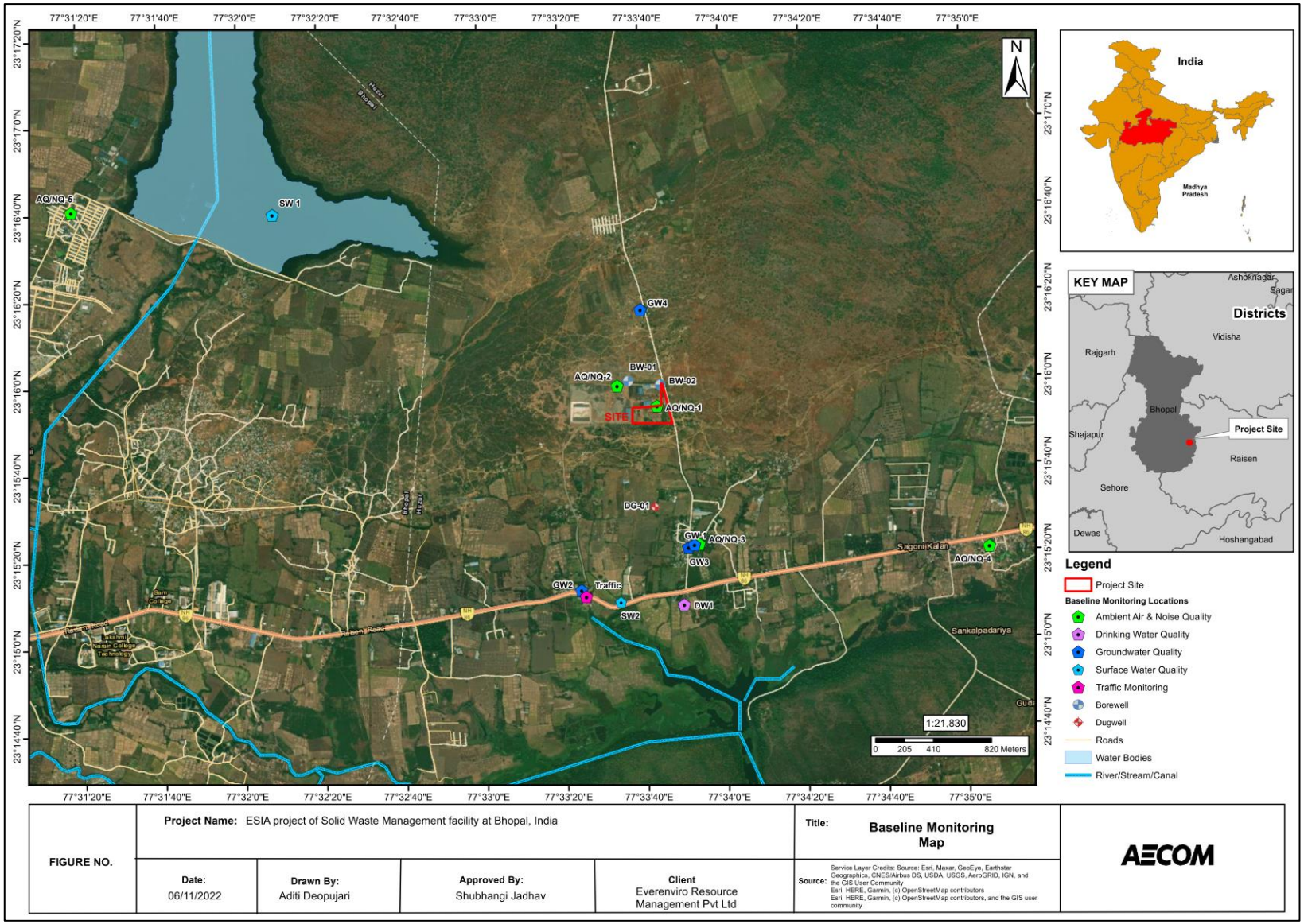


Figure 4-1: Map Showing Baseline Monitoring Locations

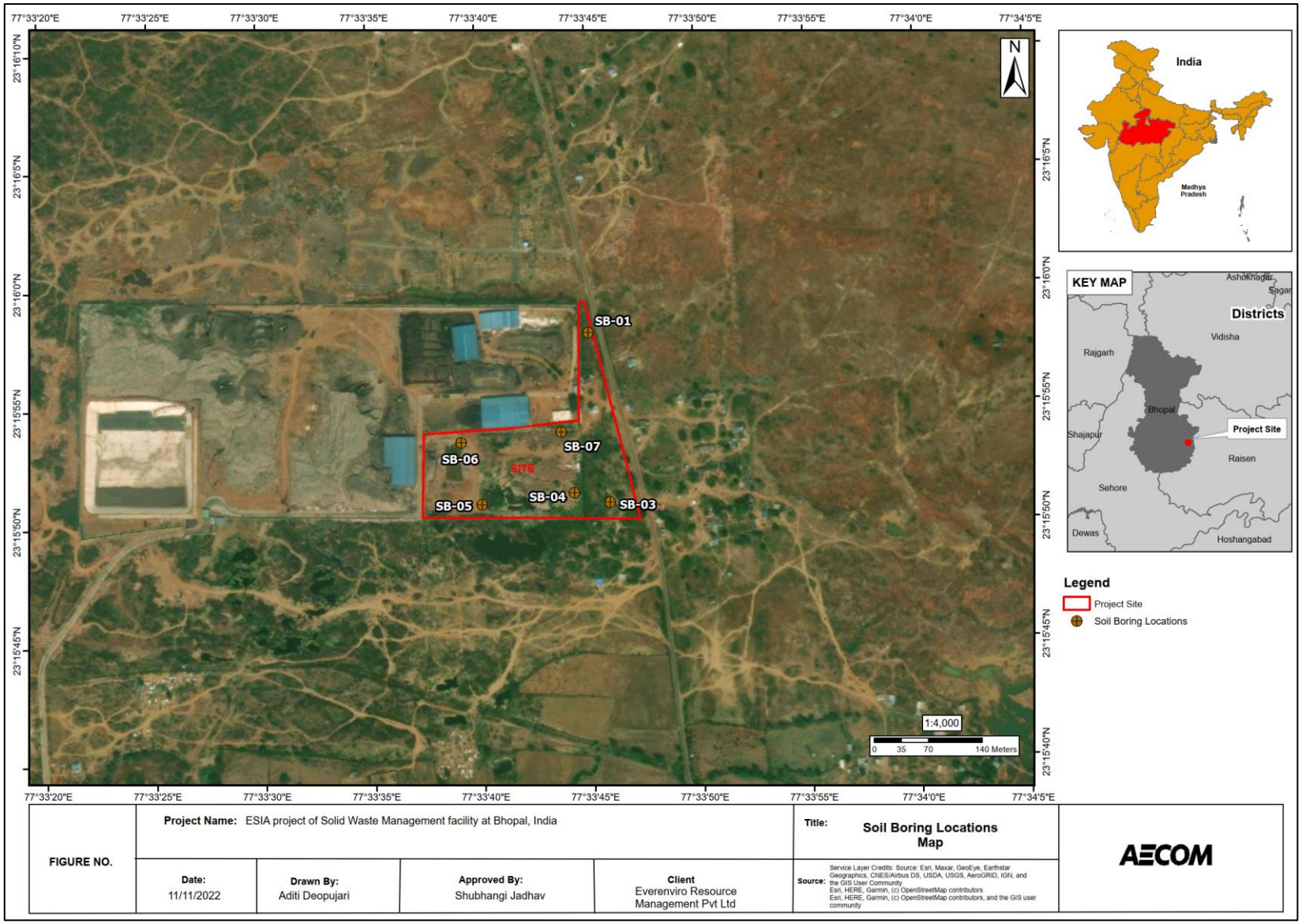


Figure 4-2: Map Showing Soil Boring Locations

Table 4-2: Environmental Monitoring Locations

S. No.	Aspect	Monitoring Location/ Code	Latitude/Longitude	Distance from Gate No.1 (in kms.)	Monitoring Location	Direction from the project site	Rationale
1.	Ambient Air	AAQ 1	23°15'54.08"N 77°33'43.49"E	0	Gate No. 1 (Project site)	Project site	Air quality at the project site
		AAQ 2	23°15'58.86"N 77°33'33.51"E	0.35	Gate No. 2 (Project site)	North-west of the project site	Air quality at the project site
		AAQ 3	23°15'22.06"N 77°33'53.30"E	1.06	Padariya village	South-East of the project site	Air quality at the downwind of the project site
		AAQ 4	23°15'20.75"N 77°35'5.68"E	2.54	Bilkheriya Village	South-East of the project site	Air quality at the south-east if the project site
		AAQ 5	23°16'43.81"N 77°31'19.66"E	4.4	Ghoda Pachad dam	North-west of the project site	Air quality at the upwind of the project site
2.	Ground Water	GW 01	23°15'22.302"N 77°33'48.068"E	1	Padariya village	South of the project site	Monitoring of ground water quality in the vicinity of the project area
		GW 02	23°15'11.99"N 77°33'23.85"E	1.4	Kolua Khurd village	South of the project boundary	Ground water quality at the downstream of the project boundary
		GW 03	23°15'22.12"N 77°33'52.17"E	1	Padariya village	South-east of the project boundary	Ground water quality at the downstream of the project boundary
		GW 04	23°16'16.41"N 77°33'39.63"E	0.7	Rudrapur village	North of the project boundary	Ground water quality at the upstream of the project boundary
3.	Ground Water – Dug Well	DG-01	23°15'30.97"N, 77°33'42.54"E	0.74	Near Padariya village	South of the project site	South of the project site
4.	Drinking water	DW-01	23°15'9.34"N 77°33'49.30"E	1.42	Christ church college, Kolua Khurd village	South of the project site	Monitoring of drinking water quality in the vicinity of the project area
5.	Ground Water - Boring water	BW-01	23°15'59.06"N 77°33'44.27"E	0.12	Project site	North–east of the project site	Monitoring of bore ground water quality in the project area
		BW-02	23°15'60.00"N 77°33'36.28"E	0.28	Project site	North of the project site near (Gate No. 2)	Monitoring of bore ground water quality in the project area
6.	Surface Water	SW-01	23°16'39.67"N 77°32'8.38"E	3.2	Ghoda Pachad Dam	North-west of the project boundary	Water sample from the reservoir of the dam situated at the upstream of the project site
		SW-02	23°15'9.05"N 77°33'33.60"E	1.5	Kolua Khurd village	South of the project site	Water sample from the waterbody at the downstream of the project site

S. No.	Aspect	Monitoring Location/ Code	Latitude/Longitude	Distance from Gate No.1 (in kms.)	Monitoring Location	Direction from the project site	Rationale
7.	Ambient Noise	AAQ 1	23°15'54.08"N 77°33'43.49"E	0	Gate No. 1 (Project site)	Project site	Noise level at the east of project site
		AAQ 2	23°15'58.86"N 77°33'33.51"E	0.35	Gate No. 2 (Project site)	North west of the project site	Noise level at the North of the project area
		AAQ 3	23°15'22.06"N 77°33'53.30"E	1.06	Padariya village	South-East of the project site	Noise level at the south-east of the project area
		AAQ 4	23°15'20.75"N 77°35'5.68"E	2.54	Bilkheriya Village	South-East of the project site	Noise level at the south-east of the project area
		AAQ 5	23°16'43.81"N 77°31'19.66"E	4.4	Ghoda Pachad dam	North-west of the project site	Noise level at the North – west of project area
8.	Soil Quality	SB-01	23°15'58.01"N 77°33'44.87"E	0.08	Within project boundary	Project site	Soil quality of project area
		SB-03	23°15'50.84"N 77°33'45.75"E	0.14	Within project boundary	Project site	Soil quality of project area
		SB-04	23°15'51.26"N 77°33'44.13"E	0.12	Within project boundary	Project site	Soil quality of project area
		SB-05	23°15'50.83"N 77°33'39.90"E	0.18	Within project boundary	Project site	Soil quality downstream of the project boundary
		SB-06	23°15'53.46"N 77°33'38.99"E	0.16	Within project boundary	Project site	Soil quality downstream of the project boundary
		SB-07	23°15'53.84"N 77°33'43.57"E	0.05	Within project boundary	Project site	Soil quality upstream of the project boundary
9.	Traffic Survey	T1	23°15'10.52"N 77°33'25.01"E	1.5	Junction where the road connects gate 3 with NH 146	South to the project site	Access road to be used for carrying construction equipment and material

4.1.1 Physiography

Large part of the Bhopal district is uneven. Hills range located in the northern part of the district extend in north-south direction. A high-altitude zone exists in the east of Baen river. Southern part of the district is a plateau region dissected by the streams. The average height of the district is between 472 and 630 meters above the mean sea level. The district can be divided in to two broad regions (i) Berasia shrubby Forests and (ii) Bhopal plateau, on the basis of the physio- cultural characteristics.

Geomorphologically Bhopal district forms the part of Malwa plateau with generally an undulating topography. The Vindhyan hill range occupies the eastern part of Phanda block, including a major part of Bhopal city. In ancient days the range was known as Vindhyyandri, forming the southern boundary of the Madhy Desha or middle region. The highest elevation of 622 m amsl in the district is recorded at Singar Choli, a hillock of Vindhyan range near Bhopal airport. The lowest elevation in the district is recorded about 421 m amsl near village Padariya Jat in Phanda block. Project land is in Padariya village which is 1 kms away from the waste management facility.[13]

[13] (cgwb.gov.in)

4.1.2 Geology

General geological successions in the Bhopal district are mentioned in the table below.

Table 4-3: General Geological Successions of Bhopal district[14]

Age	Stratigraphic unit	Lithology
Quaternary to recent		Alluvium and laterite
	----------Uniformity----------	
Upper Cretaceous to Lower Eocene	Deccan trap	Basalt
Upper Proterozoic	Vindhyan super group (Bhander group)	Sandstone and shale

Refer to section 4.2.4 of the report for environmental study performed at site. As per the California bearing ratio test performed by the client in the month of October at two different locations showed that maximum dry density was around 1.8 gm/cc and optical moisture content was 10.8% whereas CBR value was observed to be around 7.05%. Apart from the CBR test, electrical resistivity test was also performed where it was concluded that resistivity value recorded is normal in the range between 21 to 131 ohm-m.

As per the district resource map of Bhopal by Geological Survey of India, the geology of AoI consists of black, fine to medium grained, moderately porphyritic, hard rock. The geological map of the Bhopal is represented below.

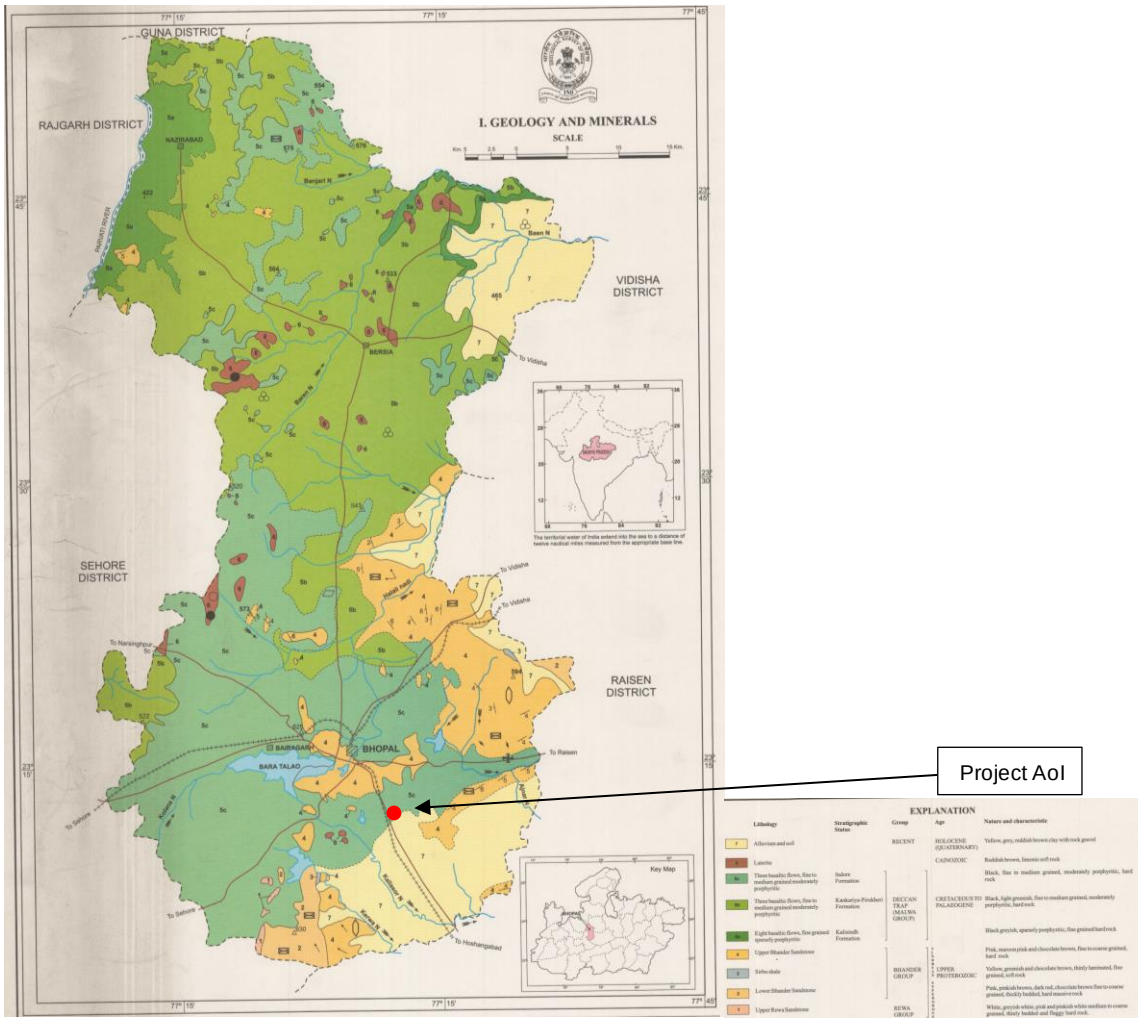


Figure 4-3: Geological Map of Bhopal

[14] (cgwb.gov.in)

4.1.3 Drainage

Bhopal district covers part of two river sub-basins - Betwa river sub basin covers 82 % of the area and lower Chambal basin covers 18 % area of district. The district is drained by river Betwa with its main tributaries like Kaliasot, Kerwa, Ajnal, Bah, Halali and Kolans. River Parwati forms the northwestern boundary of the district and its main tributaries Mawal and Ulti drain the area.

In 5 km study area, there is Ghoda Pachad dam and other streams but there is no drainage passing through project site.

As per preliminary site observation, from North to South ground level difference is around 5mtrs with Northern side at a higher altitude and majority of the land is low-lying area. As per the below figure, 1st order stream is also passing just adjacent to the west phase of the project boundary. There is a small seasonal drain running from north to south inside eastern boundary of proposed project site. Detailed flood risk assessment needs to be undertaken with suitable measures enclosed as the outcome of the study.

The drainage map of Study Area has been represented below in the figure below.

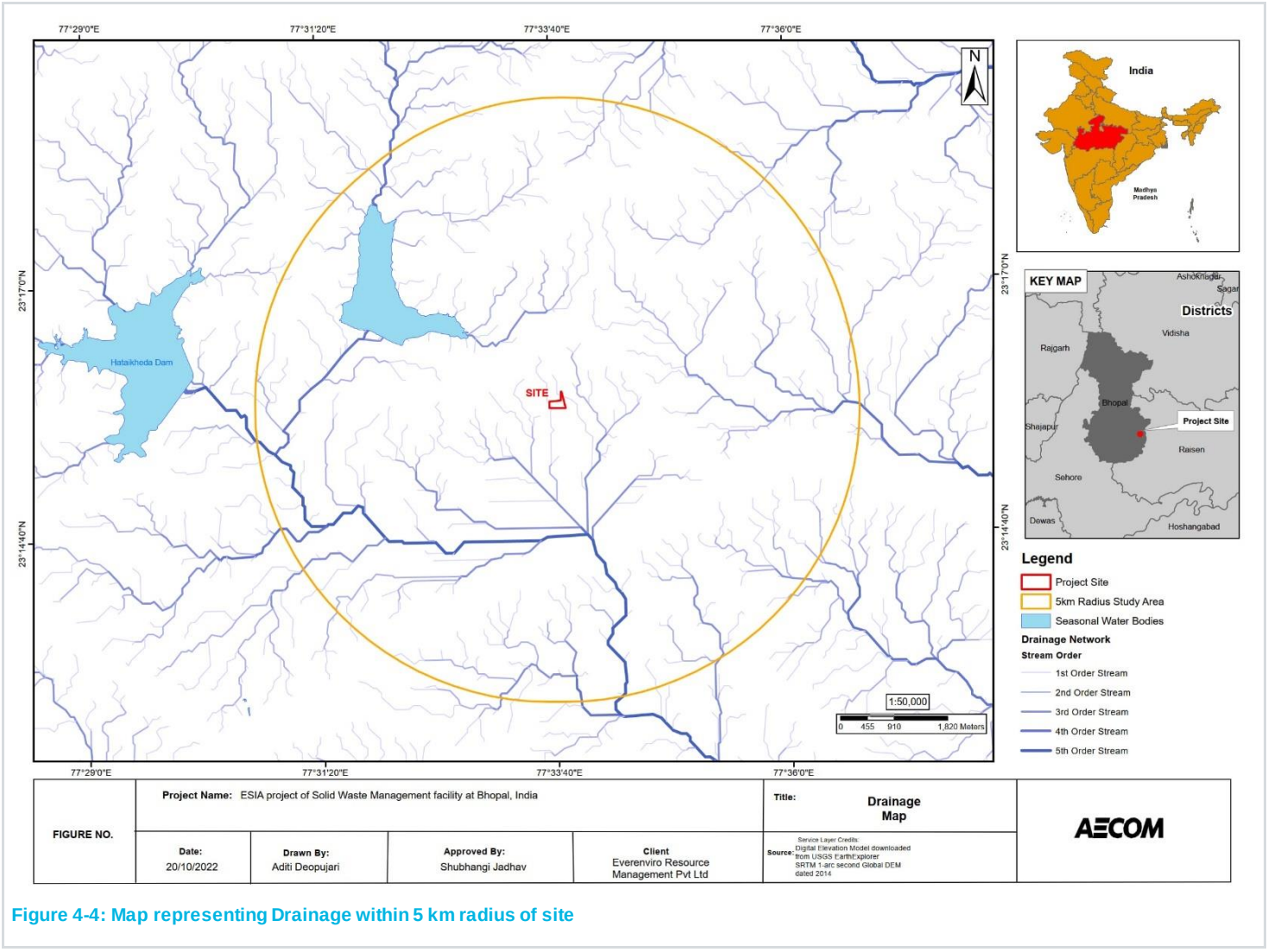


Figure 4-4: Map representing Drainage within 5 km radius of site

4.1.4 Ground Water Levels

The project AoI comes under Phanda block of Huzur tehsil of Bhopal. As per district ground water information booklet – Bhopal by Central Ground Water Board (CGWB), 2013, the pre-monsoon depth to water level in Bhopal district ranged between 5.15 m bgl at Balrampurghati to 18.4 m bgl at Islamnagar in Phanda block. The most part of block had water level in the range of 10-18 m bgl during the pre-monsoon. The eastern part of district in Phanda block have the water level in the range of 5-10 m bgl.

During post-monsoon period, most part of the district the water level lied between 5 to 10 m bgl. In the central part of Phanda block the water level lied between 10-13 m bgl. However in the eastern part of Phanda block and south-eastern part of Berasia block the water level lied between 0.5-6 m bgl.).[15]

A comparison of pre-monsoon water level data with the post-monsoon water level data reveals that there is rise of water level in entire district during post-monsoon (0.02-2.5 m/year rise) while fall during pre-monsoon(0.08-0.37m/year fall).

The net annual ground water available in the Bhopal district and ground water draft from all uses for both the blocks of Bhopal is shown below. Project site fall under Phanda block which is categorised as semi-critical.

S. No	District/ Assessment Unit	Sub-unit Command/ Non-Command/	Net Annual Ground water Availability (ham)	Existing Gross Ground water Draft for Irrigation (ham)	Existing Gross Ground water Draft for Domestic & Industrial water Supply (ham)	Existing Gross Ground water Draft for All uses (ham)	Provision for domestic, and industrial requirement supply to next 25 year (2033) (ham)	Net Ground water Availability for future irrigation development (ham)	Stage of Ground water Development (%)	Category
	Bhopal									
2	Phanda	Command								
		Non-Command	16535	13905	1516	15420	2047	583	93	Semi Critical
		Block Total	**16535**	**13905**	**1516**	**15420**	**2047**	**583**	**93**	Semi Critical
		District Total	**32724**	**24326**	**2289**	**26614**	**3146**	**5253**	**81**	

4.1.5 Land Use and Land Cover

The most parts of Bhopal district are either hilly or plains. The bulk population of district depends on agriculture. In the district different types of soils are found. The soils are classed locally by their appearance, situation, crop bearing properties, etc. There are two principal classes namely Kalmat (Black) and Blmawar. Either of these soils is capable of bearing both autumn (Kharif) and spring (rabi) corps.[16] The land use pattern of the district has been provided below:

Table 4-4: Land use Classification of Bhopal district (area in hectares)

S.No.	Type	Subtype	Area in hectares
1	Geographical area		277880
2	Forests		44106
3	Not available for cultivation	Area under non-agricultural uses	31097
		Barren and unculturable land	3947
		Total	35044
4	Other uncultivated land excluding fallow land	Permanent pastures and other grazing land	33051
		Land under misc tree crops and groves not included in net area	27
		Culturable waste land	4949

[15] (cgwb.gov.in)
[16] District Census Handbook, Bhopal, Part XII- A & B, Series-24 (lsi.gov.in)

S.No.	Type	Subtype	Area in hectares
		Total	38027
5	Fallow land	fallow land other than current fallows	3546
		Current fallow	4711
		Total	8257
6	Net area sown		152446
7	Total cropped area		214718
8	Area sown more than once		62272
9	Net irrigated area		85600

Source: Department of Land Resources, Madhya Pradesh[17]

The Project site specific land use within 5 km radius of the proposed project site and the land use of the project site has been presented in the following table and figure.

Table 4-5: Land use specific to Project AOI

S. No.	Habitat Classes	Total Area (sq.km)	Percent Area (%)
1	Arable Land	33.53	40.25
2	Degraded Forest	3.51	4.21
3	Excavation Sites	1.18	1.42
4	Forest	37.22	44.67
5	Inland Wetland	2.98	3.58
6	Plantation	0.02	0.03
7	Urban Areas & Rural Habitation	4.87	5.84
8	Grand Total	83.31	100

[17] Madhya Pradesh_SPSP.pdf(dolr.gov.in)

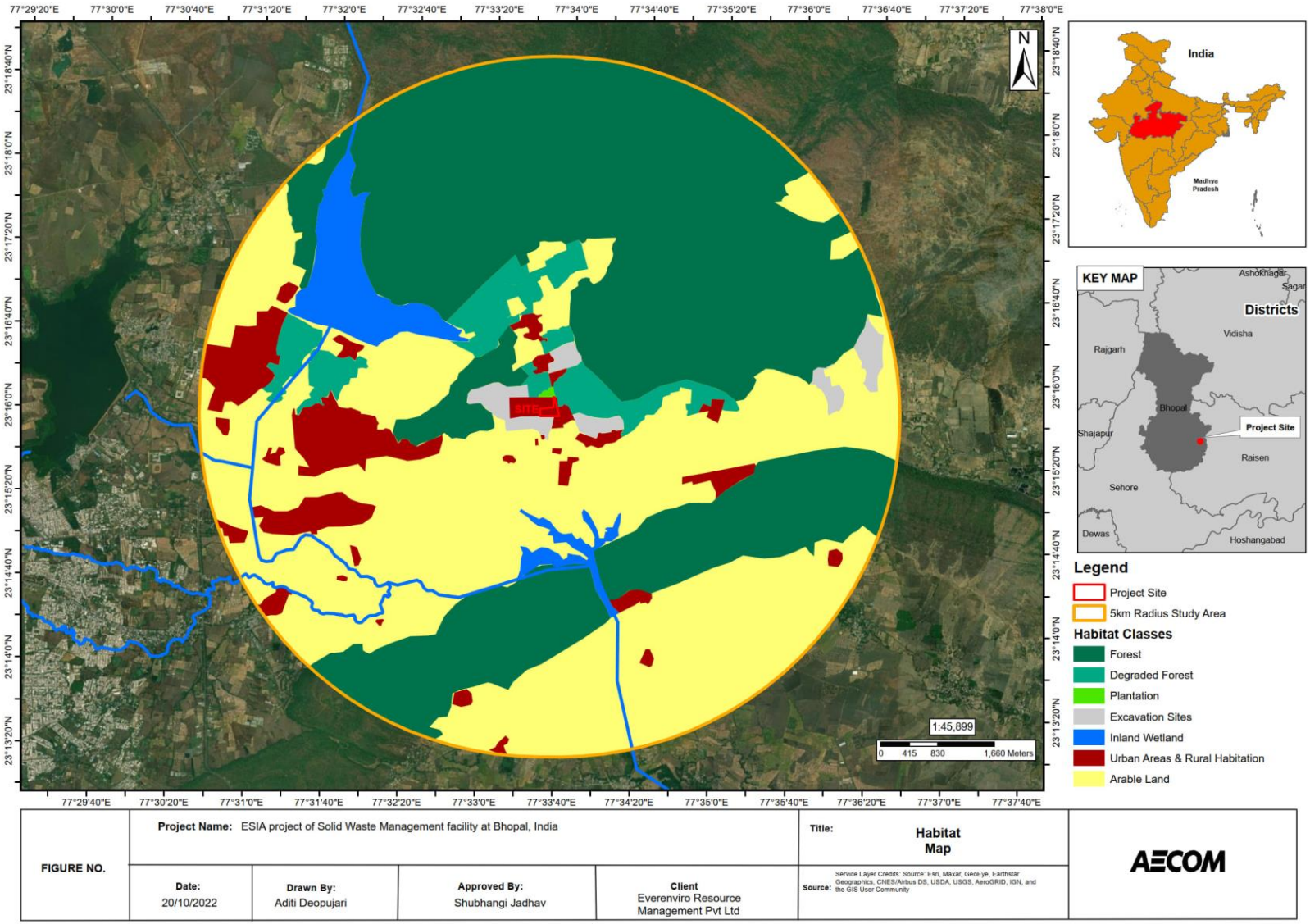


Figure 4-5: Map showing Land use within 5 km radius of the Proposed Project site

4.1.6 Climate and Meteorology

The climate of Bhopal district is characterized by a hot summer and well distributed rainfall during the southwest monsoon season. The year can be divided in to four seasons. The winter commences from middle of November and lasts till the end of February. The period from March to about first week of June is the summer season. May is the hottest month of the year. The southwest monsoon starts from middle of June and lasts till end of September. October and middle of November constitute the post monsoon or retreating monsoon season.[18]

Based on IMD Climatological Normals (1981-2010), Bhopal (Bairagarh) has highest daily temperature ranges between 31.9 to 19.0 degree Celsius. Average mean humidity is 60%.

4.1.6.1 Rainfall

There are nine rain gauge stations of IMD in the district. One is maintained by IMD at Bairagarh, one by revenue department at Berasia, one by agriculture department at Bhopal and 6 other by irrigation department. All these stations are having long-term rainfall data. On the basis of Bairagarh and Berasia rainguage stations data, the average annual rainfall of Bhopal district is about 1126.7 mm, while based on IMD station at Bairagarh; the annual normal rainfall of Bhopal is 1260.2 mm. Bhopal receives maximum rainfall during southwest monsoon period. About 92 % of the total rainfall takes place only during the monsoon period. The maximum rainfall (about 39 %) takes place during the month of July. In winter occasional rainfall of about 6 % takes place. During summer only about 2 % of the annual rainfall takes place. Thus, from October to middle of June only about 8 % of the annual rainfall takes place.

Recent data for 5 years collected from India Meteorological Department (IMD), Bhopal shows large variation in rainfall as shown in table below.

Table 4-6: Average Annual Rainfall (in mm) for Bhopal District

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
2016	21.0	0.4	5.4	0.0	9.0	150.1	660.5	531.3	122.2	76.9	0.0	0.0
2017	3.4	2.8	1.0	0.0	17.6	102.9	334.5	126.2	217.4	0.0	0.0	0.2
2018	0.0	13.3	1.5	3.7	0.5	113.5	352.9	264.5	75.3	12.9	0.0	0.0
2019	0.0	0.4	0.0	14.2	1.0	101.1	641.9	493.2	520.3	132.6	0.6	21.6
2020	6.5	0.0	27.6	0.1	35.5	416.3	111.5	585.4	136.3	22.7	0.1	12.2

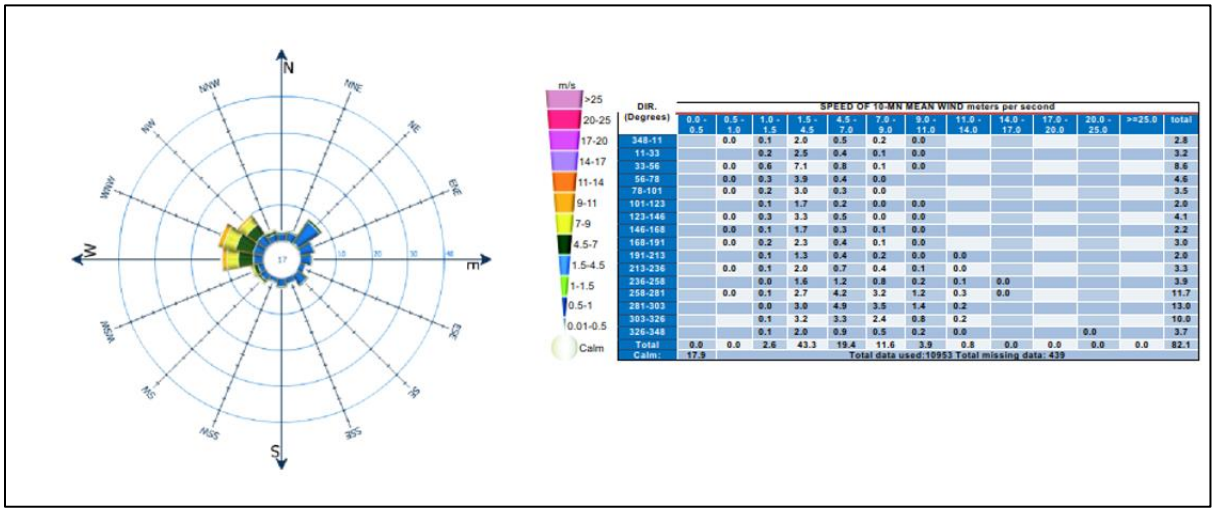
Source: IMD (http://hydro.imd.gov.in/hydrometweb/(S(rzx21qm1n5eyvwabunouztag))/DistrictRaifall.aspx)

Note:
(1) The District Rainfall in millimeters (R/F) shown are the arithmetic averages of Rainfall of Stations under the District.
(2) Blank Spaces show non-availability of Data

4.1.6.2 Wind

The windrose for Bhopal (Bairagarh) IMD station (year 1971-2000) shows that prominent wind is from North North-west (NNW) direction whereas the annual strongest winds, those greater than 7 mps (metre per second) come from northwest (NW) or northeast (NE).

[18] (cgwb.gov.in)



DIR. (Degrees)	SPEED OF 10-MN MEAN WIND meters per second												
	0.0 - 0.5	0.5 - 1.0	1.0 - 1.5	1.5 - 4.5	4.5 - 7.0	7.0 - 9.0	9.0 - 11.0	11.0 - 14.0	14.0 - 17.0	17.0 - 20.0	20.0 - 25.0	>=25.0	total
348-11		0.0	0.1	2.0	0.5	0.2	0.0						2.8
11-33			0.2	2.5	0.4	0.1	0.0						3.2
33-56		0.0	0.6	7.1	0.8	0.1	0.0						8.6
56-78		0.0	0.3	3.9	0.4	0.0							4.6
78-101		0.0	0.2	3.0	0.3	0.0							3.5
101-123			0.1	1.7	0.2	0.0	0.0						2.0
123-146		0.0	0.3	3.3	0.5	0.0	0.0						4.1
146-168		0.0	0.1	1.7	0.3	0.1	0.0						2.2
168-191		0.0	0.2	2.3	0.4	0.1	0.0						3.0
191-213			0.1	1.3	0.4	0.2	0.0	0.0					2.0
213-236		0.0	0.1	2.0	0.7	0.4	0.1	0.0					3.3
236-258			0.0	1.6	1.2	0.8	0.2	0.1	0.0				3.9
258-281		0.0	0.1	2.7	4.2	3.2	1.2	0.3	0.0				11.7
281-303			0.0	3.0	4.9	3.5	1.4	0.2					13.0
303-326			0.1	3.2	3.3	2.4	0.8	0.2					10.0
326-348			0.1	2.0	0.9	0.5	0.2	0.0			0.0		3.7
Total	0.0	0.0	2.6	43.3	19.4	11.6	3.9	0.8	0.0	0.0	0.0	0.0	82.1
Calm:	17.9	Total data used:10953 Total missing data: 439											

Figure 4-6 Windrose for Bhopal (Bairagarh) IMD Station

4.1.7 Natural Hazards

Wind Hazard

Bhopal district falls under high damage risk category with wind speed (V_b)= 47 m/sec. as seen in the figure below.

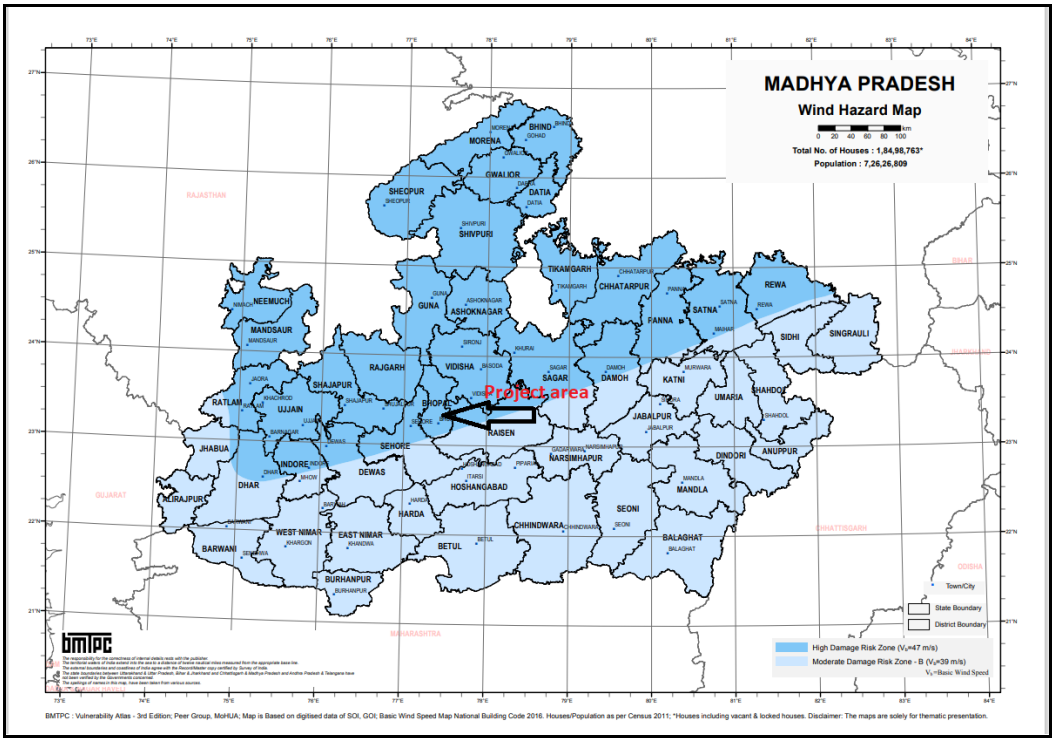


Figure 4-7: Wind Hazard map of Madhya Pradesh state

Source: Building materials and technology promotion council (BMTPC)[19]

Seismicity

[19] WIND_madhya pradesh.pdf (bmtpc.org)

The proposed project site in Bhopal district falls under low damage risk zone (MSK VI or less).

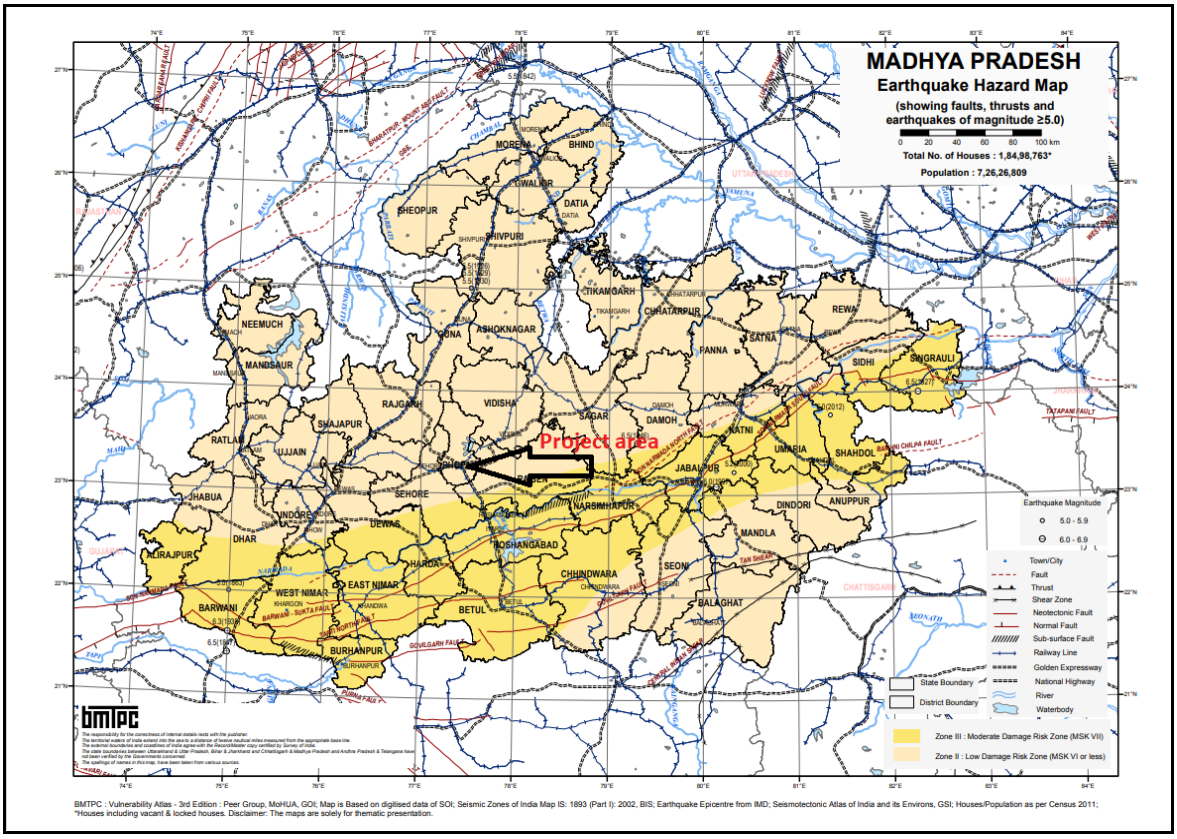


Figure 4-8: Earthquake Hazard Map of Madhya Pradesh state

Source: Building materials and technology promotion council (BMTPC)[20]

4.2 Air, Water, Noise and Soil Baseline

In order to evaluate the environmental baseline of the study area, baseline environmental monitoring was carried out for one (1) week in the month of May 2022.

4.2.1 Ambient Air Quality

Ambient air was monitored in the project area in the month of May 2022 to estimate the quality of ambient air around the project site. The air quality and noise quality were analysed at five (05) locations as mentioned in table below to estimate the concentration of primary pollutants in the ambient air. The sampling locations were selected considering the presence of habitation nearby, their accessibility, upwind and downwind directions, electricity availability and security of equipments. The ambient air quality results were compared to the National Ambient Air Quality Standards (NAAQS, 2009) for rural and residential area and the analysis results of air quality have been presented below.

[20] EQ_MADHYA PRADESH.pdf (bmtpc.org)

Table 4-7: Results of Ambient Air Monitoring

Pollutant	Time Weighted Average	Concentration in Ambient Air (Industrial, Residential, Rural and Other Areas)	AAQ-1 (Project site Gate No 1)	AAQ-2 (Gate No 2)	AAQ-3 (Padariya)	AAQ-4 (Bilkheriya)	AAQ-5 (Ghoda Pachad dam)
Sulphur Dioxide (SO_2), µg/m^3	24 Hours	80	10.95	11	8.9	9.15	8.7
Nitrogen Dioxide (NO_2), µg/m^3	24 Hours	80	17.15	16.7	16	15.3	15.45
Particulate Matter (size less than 10 µm) or PM_{10}, µg/m^3	24 Hours	100	63.6	62.1	58.4	55.35	53.9
Particulate Matter (size less than 2.5 µm) or $PM_{2.5}$, µg/m^3	24 Hours	60	25.2	24.85	23.35	22.25	21.55
Ozone (O_3), µg/m^3	8 Hours	100	4.1	4.1	4.8	4.4	3.95
Lead (Pb), µg/m^3	24 Hours	1	<0.1	<0.1	<0.1	<0.1	<0.1
Carbon Monoxide (CO), mg/m^3	8 Hours	2	0.525	0.475	0.345	0.37	0.32
Ammonia (NH_3), µg/m^3	24 Hours	400	10	10.25	8.8	8.85	9.15
Benzene (C_6H_6), µg/m^3	Annual	5	2.65	2	1.4	1.2	<1
Benzo (O) Pyrene (BaP), particulate phase only, ng/m^3	Annual	1	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic (As), ng/m^3	Annual	6	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel (Ni), ng/m^3	Annual	20	<0.1	<0.1	<0.1	<0.1	<0.1

Source: Laboratory Results, May 2022

BDL: Below Detectable Limit

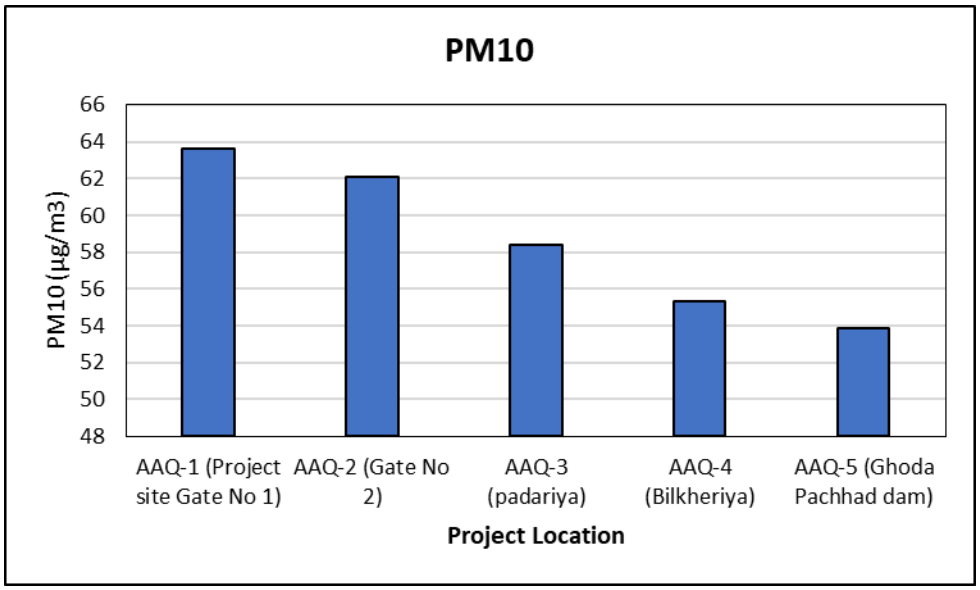


Figure 4-9: PM_{10} Concentration Comparison For Different Locations

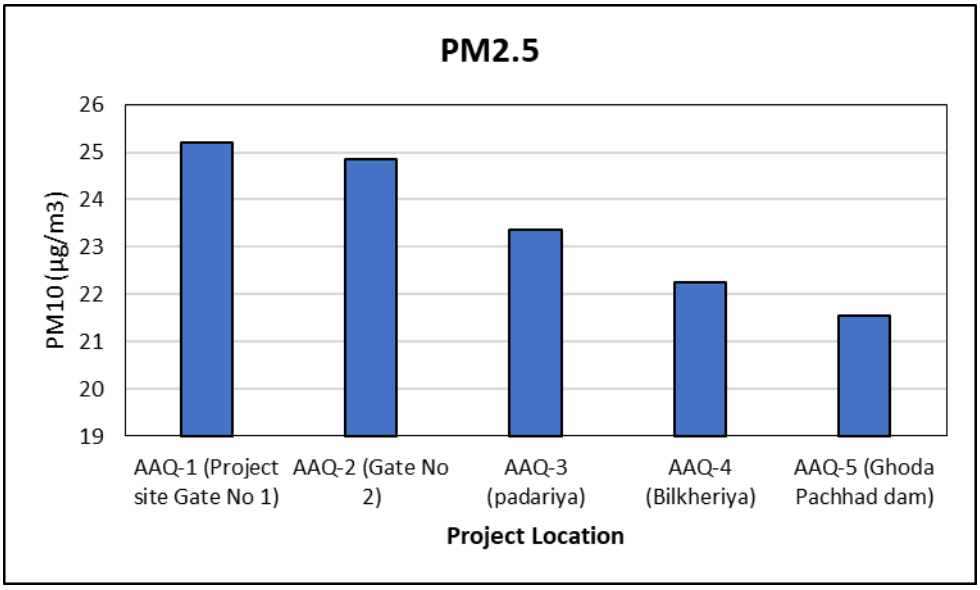


Figure 4-10: $PM_{2.5}$ Concentration Comparison For Different Locations

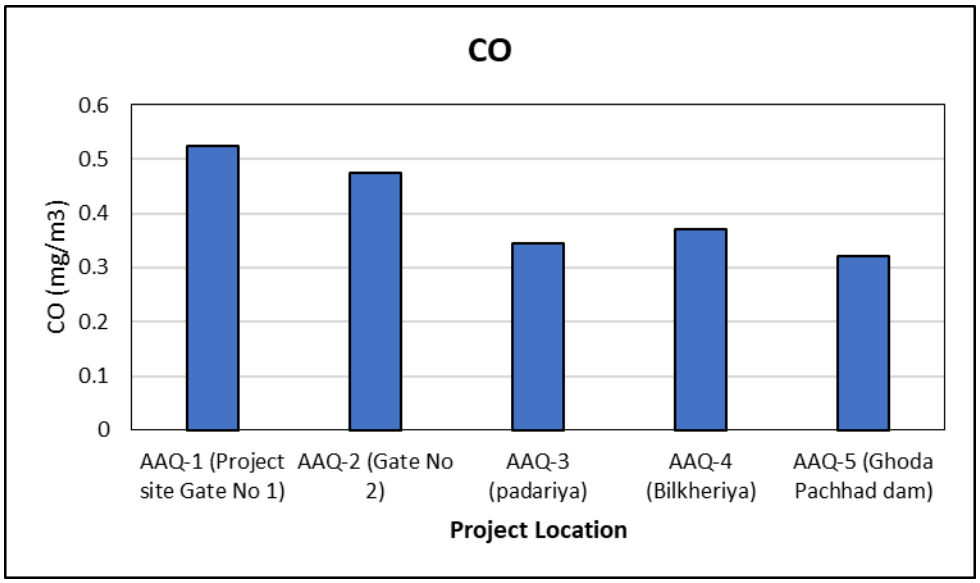


Figure 4-11: CO Concentration Comparison for Different Locations

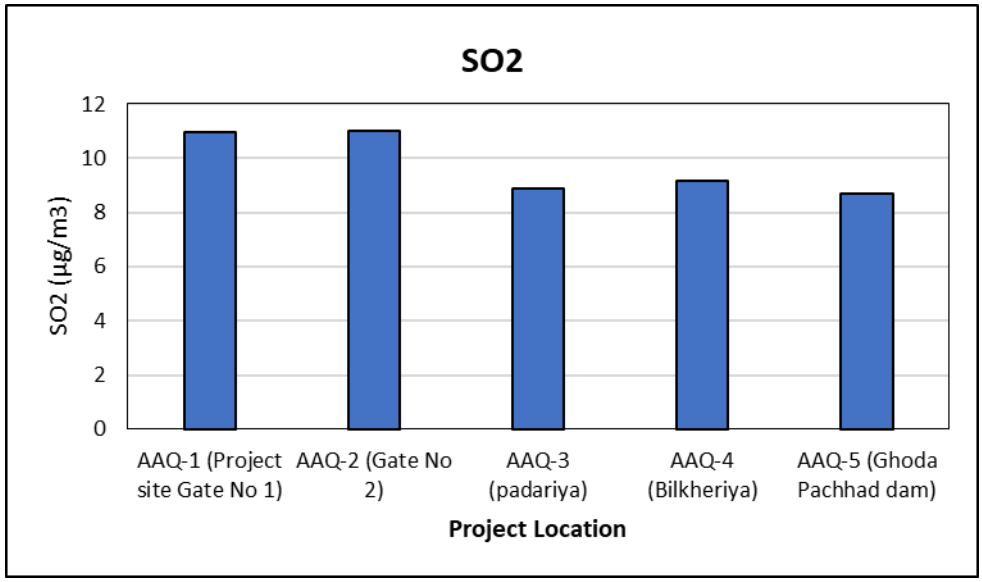


Figure 4-12: SO_2 Concentration Comparison For Different Locations

Inference

The project site is situated at the out skirts of the Bhopal city near Adampur chawni area. There are no industries and significant emission sources within 5 km radius of the Project Site. The parameters measured for ambient air quality were noted to be well within the permissible limits of the National Ambient Air Quality Standards (NAAQS), as defined by MoEF&CC. $PM_{2.5}$, PM_{10}, SO_2, CO, NH_3, Lead and Ozone were noted to be well within the National Ambient Air Quality Standards, 2009.

4.2.2 Ambient Noise Quality

Ambient noise level was monitored continuously for 24 hours at five (05) locations around the project area using Sound Level Meter at the identified receptor locations mentioned in table below. The noise levels obtained were analysed to arrive at the equivalent continuous noise level (Leq) for day and night-time. The day and night-time hours ranged from 06:00 to 22:00 hrs and 22:00 to 06:00 hrs respectively.

The sampling locations can be categorised as residential area. Therefore, the results of the ambient noise level monitoring are compared with National Ambient Air Quality Standards (NAAQS) in respect of noise limits for daytime and night-time for residential area.

Table 4-8: Results of Ambient Noise level Monitoring on weekday

Location Code	Noise Standard (Residential Area)	NQ-1 (Project site Gate No 1)	NQ-2 (Gate No 2)	NQ-3 (Padariya)	NQ-4 (Bilkheriya)	NQ-5 (Ghoda Pachad dam)
L_{min}		52.4	45.5	45.9	50.5	46.3
L_{max}		65	58.4	63.1	65.2	64.5
L_{eq} Day dB (A)	55	**62.7**	**54.8**	**58.3**	**60.6**	**59.9**
L_{eq} Night dB (A)	45	**56.3**	**49.9**	**51.8**	**53.4**	**50.4**
L_{DN}		64.3	57.2	59.8	61.7	60.1

Source: Laboratory Results, May 2022

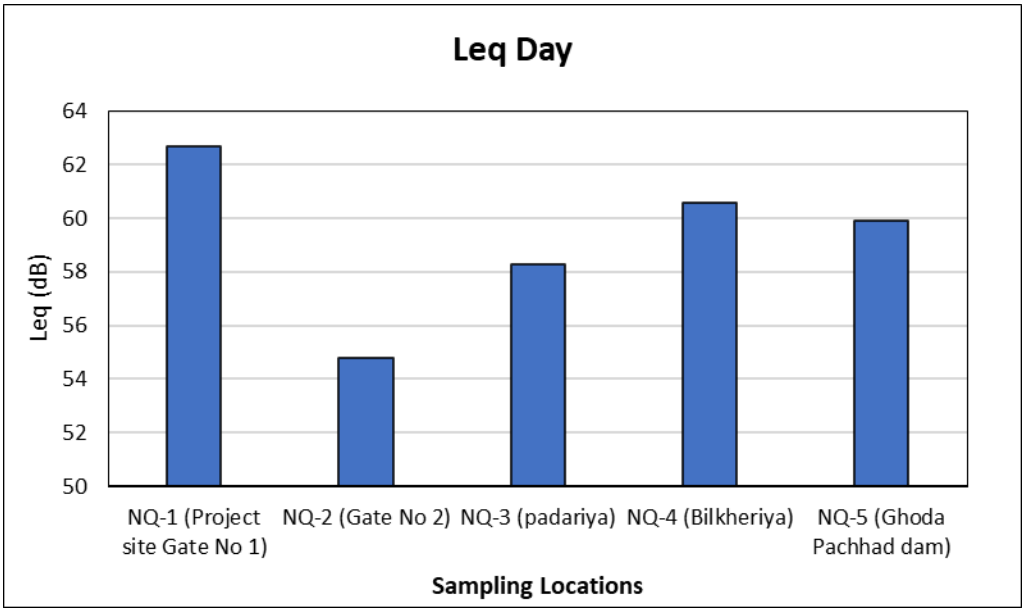


Figure 4-13: Noise level (L_{eq}) Day Comparison At Different Locations

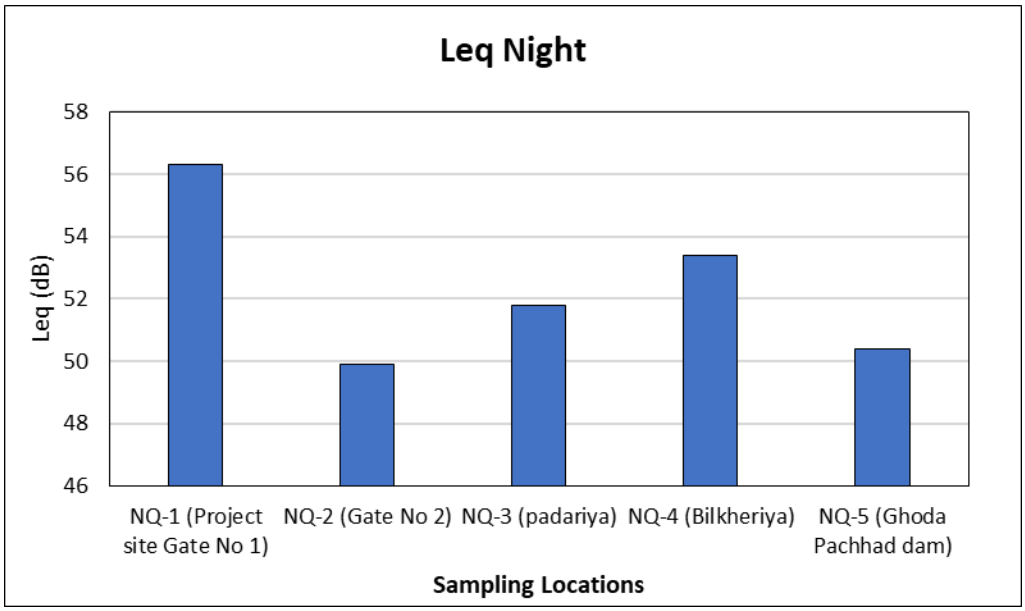


Figure 4-14: Noise level (L_{eq}) Night Comparison at Different Locations

Inference

The ambient noise level at all the locations were noted to be higher than permissible standards of noise levels prescribed by with National Ambient Air Quality Standards (NAAQS) in respect of noise limits for day and night-time. The high noise level can be attributed to vehicular movements, heavy vehicles shifting waste from one place to another. Gate No. 1 which happens to be the main gate from where the official vehicles arrive has higher noise levels than Gate No 2 which is in the north direction of the site and doesn't have many traffic movements or any operations happening. The high level of noise in villages could be due to anthropogenic activities.

4.2.3 Water Quality

4.2.3.1 Ground Water Quality

Sample of groundwater from site and nearby areas were collected and analysed by client in Oct 2022. This study outputs are presented in this section. This study examined groundwater samples for physico-chemical, heavy metals and biological parameters and compared to drinking water standards, IS 10500: 2012 and table below presents the results.

Table 4-9: Results of Ground Water Quality Analysis

S. No.	Parameters	Unit	AL(PL)	DG-01	BW-02	BW-01	GW-01	GW-02	GW-03	GW-04
1.	Colour	Hazen	5 (15)	<1	<1	<1	<5	<1	<1	<1
2.	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3.	Taste	-	Agreeable	Not Agreeable	Not Agreeable	Not Agreeable	Agreeable	Not Agreeable	Not Agreeable	Not Agreeable
4.	Turbidity	NTU	1(5)	<1	<1	<1	<1	<1	<1	<1
5.	pH	-	6.5-8.5 (NR)	6.68	5.36	6.02	7.30	7.01	6.82	6.64
6.	Biological Oxygen Demand (BOD)	mg/l	-	<5	<5	<5	<5	<5	<5	<5
7.	Chemical Oxygen Demand (COD)	mg/l	-	10.08	10.08	60.48	<10	16.8	12.6	<5
8.	Total Dissolved Solids	mg/l	500 (2000)	394	76	408	234	480	360	89
9.	Total Alkalinity as $CaCO_3$	mg/l	200 (600)	59.7	33.8	135.3	98.3	194	82.5	24.3
10.	Total Hardness as $CaCO_3$	mg/l	200 (600)	58.8	<2	21	144.4	**248.5**	131.3	38.3
11.	Chloride as Cl	mg/l	250 (1000)	115.9	6.7	108.3	118.3	52.7	76.4	4.9
12.	Sulphate as SO_4	mg/l	200 (600)	26.59	<1	15.24	3.7	21.02	1.24	5.06
13.	Fluoride as F	mg/l	200 (600)	<1	<1	<1	<0.2	<1	<1	<1
14.	Nitrate as NO_3	mg/l	250 (1000)	37.06	11.27	7.96	2.7	16.7	4.89	3.69
15.	Phenolic Compound as C_6H_5OH	mg/l	0.001 (0.002)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
16.	Sulphide as S^{2-}	mg/l	0.05 (NR)	<0.05	<0.05	<0.05	<0.2	<0.05	<0.05	<0.05
17.	Calcium as Ca	mg/l	75 (200)	16.8	<1	6.7	39.5	**84.2**	36.4	9.7
18.	Magnesium as Mg	mg/l	30 (100)	4.08	<0.5	6.12	10.9	9.33	9.82	3.44
19.	Iron as Fe	mg/l	0.3 (NR)	**6.25**	<0.1	**12.71**	<0.1	<0.1	<0.1	**0.46**
20.	Mercury as Hg	mg/l	0.001 (NR)	**4.08**	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
21.	Cadmium as Cd	mg/l	0.003 (NR)	<0.001	<0.001	<0.001	<0.003	<0.001	<0.001	<0.001

S. No.	Parameters	Unit	AL(PL)	DG-01	BW-02	BW-01	GW-01	GW-02	GW-03	GW-04
22.	Arsenic as As	mg/l	0.01 (0.05)	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
23.	Lead as Pb	mg/l	0.01 (NR)	<0.001	<0.001	<0.001	<0.01	<0.001	<0.001	<0.002
24.	Manganese as Mn	mg/l	0.1 (0.3)	**0.377**	<0.02	**4.75**	<0.1	<0.02	**0.321**	<0.02
25.	Zinc as Zn	mg/l	5 (15)	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.1
26.	Total Chromium as Cr	mg/l	0.05 (NR)	<0.02	<0.02	<0.02	<0.01	<0.02	<0.02	<0.02
27.	Copper as Cu	mg/l	0.05 (1.5)	<0.02	<0.02	<0.1	<0.04	<0.02	<0.02	<0.02
28.	Boron as B	mg/l	0.5 (1.0)	<0.5	<0.5	<0.5	<0.4	<0.5	<0.5	<0.5
29.	Nickel as Ni	mg/l	0.02 (NR)	<0.02	<0.02	<0.02	<0.01	<0.02	<0.02	<0.02
30.	Selenium as Se	mg/l	0.01 (NR)	<0.001	<0.001	<0.001	<0.01	0.001	0.001	<0.001
31.	Free Residual Chlorine	mg/l	0.2 (1.0)	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	<0.2
32.	Aluminium as Al	mg/l	0.03 (0.2)	**1.745**	<0.02	1.944	<0.03	<0.02	<0.02	**0.985**
33.	Ammonia as N	mg/l	0.5 (NR)	**1.11**	**1.67**	**5.57**	<0.4	<0.3	<0.3	<0.3
34.	Barium as Ba	mg/l	0.7 (NR)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
35.	Pesticides	-	- (NR)	<0.1	<0.1	<0.1		<0.01	<0.01	<0.01
36.	Mineral Oil	mg/l	0.2 (NR)	<0.1	<0.1	<0.1				
37.	Silver as Ag	mg/l	0.1 (NR)	<0.02	<0.02	<0.02	<0.05	<0.02	<0.02	<0.02
38.	Cyanide as CN	mg/l	0.01 (NR)	<0.02	<0.02	<0.02	<0.001	<0.02	<0.02	<0.02
39.	Molybdenum as Mo	mg/l	0.07 (NR)	<0.02	<0.02	<0.02	<0.05	<0.02	<0.02	<0.02
40.	Chloramines as Cl_2	mg/l	4.0 (NR)	<0.2	<0.2	<0.1	<4	<0.2	<0.2	<0.2
41.	Polychlorinated Biphenyl (PCB)	mg/l	0.005 (NR)	<0.00001	<0.00001	<0.00001	<0.0005	<0.00001	<0.00001	<0.00001
42.	Polynuclear aromatic hydrocarbons (PAH)	mg/l	0.0001 (NR)	<0.00001	<0.00001	<0.00001		<0.00001	<0.00001	<0.00001
43.	Anionic Detergents as MBAS	mg/l	0.2 (1.0)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

S. No.	Parameters	Unit	AL(PL)	DG-01	BW-02	BW-01	GW-01	GW-02	GW-03	GW-04
44.	Total Coliform	MPN/100 ml	Shall not be detectable in any 100 ml sample				Absent	Absent	Absent	Absent
45.	E. Coli	-	Shall not be detectable in any 100 ml sample				Absent	Absent	Absent	Absent

Source: Data provided by client, Note: ND- Not Detected, AL- Acceptable Limit; PL – Permissible Limit; NR – No Relaxation as per IS10500:2012

Groundwater sampling of the above 7 locations shows that majority of the parameters were under the permissible limits IS 10500: 2012. Iron exceeded acceptable limit at DG-01, BW-01, GW-04. Total Hardness and Calcium exceeded acceptable limit at GW-02. DG-01 showed exceedance acceptable limit of Mercury. DG-01, BW-01 and GW-03 showed exceedance permissible limit of Manganese. DG-01 and GW-04 showed exceedance than permissible limit to Aluminium. DG-01, BW-02 and BW-01 showed exceedance to acceptable limit of Ammonia.

Though the TDS, total hardness, total alkalinity and calcium of the locations are within the permissible limit, sample (GW-04) shows that as compared (GW-01, GW-02, DG-01) of the project site, ground water quality is good. TDS of the water sample collected from Kolua Khurd was found to be more as compared to two samples collected from Padariya village.

4.2.3.2 Drinking Water Quality

Sample of drinking water from nearby area of project site was collected and analysed for physico-chemical, heavy metals and biological parameters and compared to drinking water standards, IS 10500: 2012 and table below presents the results.

Table 4-10: Results of Drinking Water Quality Analysis

Sr. No.	Parameters	Unit	Christ College (DW)
1	Colour	Hazen	<5
2	Odour	---	Agreeable
3	Taste	---	Agreeable
4	Turbidity	NTU	<1.0
5	pH @ 27°C	---	7.30
6	Total Dissolved Solids	mg/lit	234
7	Total Alkalinity	mg/lit	98.3
8	Total Hardness	mg/lit	144.4
9	Chloride	mg/lit	118.3
10	Residual Free Chlorine	mg/lit	<0.1
11	Sulphate	mg/lit	3.7
12	Fluoride	mg/lit	<0.2
13	Nitrate	mg/lit	2.7
14	Iron	mg/lit	<0.1
15	Manganese	mg/lit	<0.1
16	Mercury	mg/lit	<0.001
17	Cadmium	mg/lit	<0.003
18	Selenium	mg/lit	<0.01
19	Arsenic	mg/lit	<0.001
20	Cyanide	mg/lit	<0.001
21	Lead	mg/lit	<0.01
22	Zinc	mg/lit	<0.2
23	Aluminium	mg/lit	<0.03
24	Copper	mg/lit	<0.04
25	Boron	mg/lit	<0.4
26	Total Chromium	mg/lit	<0.01
27	Nickel	mg/lit	<0.01
28	Silver	mg/lit	<0.05
29	Magnesium	mg/lit	10.9
30	Calcium	mg/lit	39.5
31	Ammonical Nitrogen	mg/lit	<0.4
32	Anionic Detergents	mg/lit	<0.1
33	Total Coliform	MPN/100ml	<1.8
34	E Coli	--	Absent

Sr. No.	Parameters	Unit	Christ College (DW)
35	Barium	mg/lit	<0.5
36	Chloramines	mg/lit	<4
38	Sulphide	mg/lit	<0.2
39	Polychlorinated biphenyls	mg/lit	<0.0005
40	Molybdenum	mg/lit	<0.05
41	Phosphorus	mg/lit	<1
42	BOD	mg/lit	<5
43	COD	mg/lit	<10

Source: Laboratory Results, May 2022

Inference:
The drinking water sample collected at Christ Collage indicated that parameters were within acceptable limit of IS 10500: 2012.

4.2.3.3 Surface Water Quality

Sample of surface water from water body located on southern side of nearby areas was collected and analysed by client in Oct 2022. Apart from this surface waste sample from Ghoda Pachad dam was collected and analysed during this ESIA study. This outputs of both these sample analysis are presented in this section.

Table 4-11: Results of Surface Water Quality Analysis of Surface Water Body

S. No.	Parameters	Unit	AL(PL)	SW-01 (Ghoda Pachad Dam)	SW-02 (South of Project Site)
1.	Colour	Hazen	5 (15)	<5	<1
2.	Odour	-	Agreeable	Agreeable	Agreeable
3.	Taste	-	Agreeable	Agreeable	Not agreeable
4.	Turbidity	NTU	1(5)	**9**	<1
5.	pH	-	6.5-8.5 (NR)	7.16	6.87
6.	Biological Oxygen Demand (BOD)	mg/l	-	<5	NA
7.	Chemical Oxygen Demand (COD)	mg/l	-	<10	NA
8.	Total Dissolved Solids	mg/l	500 (2000)	82	308
9.	Total Alkalinity as $CaCO_3$	mg/l	200 (600)	49.1	59.7
10.	Total Hardness as $CaCO_3$	mg/l	200 (600)	41.8	151.2
11.	Chloride as Cl	mg/l	250 (1000)	11.8	24.7
12.	Sulphate as SO_4	mg/l	200 (600)	10.6	12.86
13.	Fluoride as F	mg/l	200 (600)	<0.2	<1
14.	Nitrate as NO_3	mg/l	250 (1000)	<0.5	4.64
15.	Phenolic Compound as C_6H_5OH	mg/l	0.001 (0.002)	-	<0.001
16.	Sulphide as S^{2-}	mg/l	0.05 (NR)	<0.2	<0.05
17.	Calcium as Ca	mg/l	75 (200)	<0.04	45.4
18.	Magnesium as Mg	mg/l	30 (100)	11.2	9.19
19.	Iron as Fe	mg/l	0.3 (NR)	**0.4**	<0.1
20.	Mercury as Hg	mg/l	0.001 (NR)	<0.001	<0.001

S. No.	Parameters	Unit	AL(PL)	SW-01 (Ghoda Pachad Dam)	SW-02 (South of Project Site)
21.	Cadmium as Cd	mg/l	0.003 (NR)	<0.005	<0.001
22.	Arsenic as As	mg/l	0.01 (0.05)	<0.01	0.001
23.	Lead as Pb	mg/l	0.01 (NR)	<0.05	<0.001
24.	Manganese as Mn	mg/l	0.1 (0.3)	0.13	0.025
25.	Zinc as Zn	mg/l	5 (15)	-	<0.1
26.	Total Chromium as Cr	mg/l	0.05 (NR)	<0.04	<0.02
27.	Copper as Cu	mg/l	0.05 (1.5)	<0.04	<0.02
28.	Boron as B	mg/l	0.5 (1.0)	<0.4	<0.5
29.	Nickel as Ni	mg/l	0.02 (NR)	<0.02	<0.02
30.	Selenium as Se	mg/l	0.01 (NR)	<0.005	0.00
31.	Free Residual Chlorine	mg/l	0.2 (1.0)	<0.1	<0.2
32.	Aluminium as Al	mg/l	0.03 (0.2)	<1	<0.02
33.	Ammonia as N	mg/l	0.5 (NR)	<0.4	3.34
34.	Barium as Ba	mg/l	0.7 (NR)	<0.5	<0.5
35.	Pesticides	-	- (NR)	<0.0001	<0.1
36.	Mineral Oil	mg/l	0.2 (NR)	-	<0.1
37.	Silver as Ag	mg/l	0.1 (NR)	<0.05	<0.02
38.	Cyanide as CN	mg/l	0.01 (NR)	<0.001	<0.02
39.	Molybdenum as Mo	mg/l	0.07 (NR)	<0.05	<0.02
40.	Chloramines as Cl_2	mg/l	4.0 (NR)	-	<0.1
41.	Polychlorinated Biphenyl (PCB)	mg/l	0.005 (NR)	<0.0005	<0.00001
42.	Polynuclear aromatic hydrocarbons (PAH)	mg/l	0.0001 (NR)	-	<0.00001
43.	Anionic Detergents as MBAS	mg/l	0.2 (1.0)	<0.1	<0.1
44.	Total Coliform	MPN/100 ml	Shall not be detectable in any 100 ml sample	430	
45.	E. Coli	-	Shall not be detectable in any 100 ml sample	40	

Inference

Surface water samples collected were analysed and found that the physical/chemical parameters were observed not to meeting surface water quality criteria for class A, B, C, D & E.

4.2.4 Soil Environment

Sample of groundwater from site and nearby areas were collected and analysed by client in Oct 2022. This study outputs are presented in this section. Soil samples from six locations were collected. The results of soil quality analysis have been presented below:

Table 4-12: Results of Soil Quality Analysis

S.No.	Parameters	Unit	SB-01	SB-03	SB-04	SB-05	SB-06	SB-07
1	Moisture	%	27.20	25.34	17.99	17.39	35.99	16.81
2	pH		6.12	6.29	8.22	8.10	5.67	7.91
3	EC	µs/cm	187.90	99.84	1708.00	957.40	8580.00	2010.00
4	Carbonates	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
5	Chlorides	mg/kg	148.00	236.00	552.00	394.00	2168.00	1892.00
6	Sulphates as SO4	mg/kg	159.80	432.80	1049.20	893.20	3019.60	745.80
7	Phosphorous	mg/kg	233.94	419.69	174.97	148.34	942.90	181.20
8	TOC	%	0.26	0.17	0.28	0.29	2.43	0.19
9	Potassium	mg/kg	424.00	378.59	1398.53	1394.20	1334.02	952.94
10	Iron	mg/kg	56216.15	24211.89	40140.85	49870.49	3689.07	24791.50
11	Manganese	mg/kg	2497.03	359.44	785.76	2297.27	60.04	821.88
12	Zinc	mg/kg	12.30	19.15	5.06	8.17	88.64	15.59
13	Copper	mg/kg	35.66	17.06	27.87	26.10	25.45	18.96
14	Arsenic	mg/kg	15.21	6.60	12.38	12.69	<1.00	7.74
15	Cadmium	mg/kg	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
16	Total Chromium	mg/kg	47.18	31.40	57.49	31.90	8.68	32.27
17	Mercury	mg/kg	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00
18	Nickel	mg/kg	33.20	14.27	14.58	25.86	3.31	13.31
19	Lead	mg/kg	28.64	17.70	15.16	21.49	14.04	14.59
20	Total Nitrogen	mg/kg	1538.40	1146.87	1229.69	5357.00	2263.33	932.97
21	VOCs	mg/kg	-	-	-	-	-	-
I	Dichlorodifluoromethane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
II	Chloromethane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
III	Vinyl Chloride		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
IV	Bromomethane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
V	Chloroethane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
VI	Trichlorofluoromethane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
VII	1,1-Dichloroethylene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
VIII	Methylene Chloride		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
IX	Trans-1,2-Dichloroethylene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
X	1,1-Dichloroethane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XI	Cis-1,2-Dichloroethylene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XII	2,2-Dichloropropane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XIII	Bromochloromethane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

S.No.	Parameters	Unit	SB-01	SB-03	SB-04	SB-05	SB-06	SB-07
XIV	Chloroform		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XV	1,1,1-trichloroethane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XVI	1,1-Dichloropropylene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XVII	Carbon Tetrachloride		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XVIII	Benzene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XIX	1,2-Dichloroethane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XX	Trichloroethylene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XXI	1,2-Dichloropropane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XXII	Dibromomethane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XXIII	Bromodichloromethane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XXIV	Cis-1,3-Dichlropropylene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XXV	Toluene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XXVI	Trans-1,3-Dichloropropylene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XXVII	1,1,2-Trichloroethane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XXVIII	Tetrachloroethylene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XXIX	1,3-Dichloropropane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XXX	Dibromochloromethane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XXXI	1,2-Dibromoethane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XXXII	Chlorobenzene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XXXIII	Ethylbenzene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XXXIV	1,1,1,2-Tetrachloroethane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XXXV	M-Xylene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XXXVI	P-Xylene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XXXVII	O-Xylene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XXXVIII	Styrene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XXXIX	Bromoform		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XL	Isopropylbenzene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XLI	1,1,2,2-Tetracloroethane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XLII	1,2,3-Trichloropropane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XLIII	Bromobenzene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XLIV	N-Propylbenzene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XLV	2-Chlorotoluene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XLVI	1,3,5-Trimethylbenzene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XLVII	4-Chlorotoluene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

S.No.	Parameters	Unit	SB-01	SB-03	SB-04	SB-05	SB-06	SB-07
XLVIII	Tert-butylbenzene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
XLIX	1,2,4-trimethylbenzene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
L	Sec-butylbenzene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
LI	4-isopropyltoluene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
LII	1,3-dichlorobenzene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
LIII	1,4-dichlorobenzene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
LIV	N-Butylbenzene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
LV	1,2-dichlorobenzene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
LVI	1,2-dibromo-3-chloropropane		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
LVII	1,2,4-trichlorobenzene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
LVIII	Hexachlorobutadiene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
LIX	Naphthalene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
LX	1,2,3-trichlorobenzene		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

BDL= Below Detection Limit

Inference

It can be inferred from the results that the soil samples show different characteristics. The pH values of the soil sample vary from 5.67 to 8.22. Collected soil samples were not compared with any reference Indian standards in absence of the same.

4.2.5 Leachate

One leachate sample from excavated pit was collected and analysed by client in Oct 2022. The analysis results of same are presented below.

Table 4-13: Results of Leachate Analysis

S.No.	Parameters	Unit	LN1	LN2
1	pH		7.59	7.26
2	Suspended Solids	mg/l	126.00	74.00
3	Oil & Grease	mg/l	<5	<5
4	BOD	mg/l	1735.00	2420.00
5	COD	mg/l	5248.80	7678.80
6	Dissolved Solid	mg/l	16342.00	7896.00
7	Ammonical Nitrogen (as N)	mg/l	702.50	664.00
8	Arsenic	mg/l	<0.1	<0.1
9	Mercury	mg/l	<0.1	<0.1
10	Lead	mg/l	0.34	0.13
11	Cadmium	mg/l	<0.1	<0.1
12	Total Chromium	mg/l	0.27	0.14
13	Copper	mg/l	0.51	0.12
14	Zinc	mg/l	1.93	<1
15	Nickel	mg/l	0.26	0.22
16	Cyanide	mg/l	<0.1	<0.1
17	Chloride	mg/l	1576.90	1133.40
18	Fluoride	mg/l	<1.0	<1.0

S.No.	Parameters	Unit	LN1	LN2
19	Phenolic Compound	mg/l	<0.1	<0.1

Inference

Collected leachate samples from the site could not be compared with any reference Indian standards in absence of the same.

4.2.6 Traffic

The project will involve transportation of construction material and other unit components on trucks/trailers through village roads during peak construction phase. During the operation phase, traffic movement for the project activities will be restricted only to the movement of project vehicles and materials for maintenance. The project site can be accessed through NH 146 from Bhopal. From NH 146, site can be accessed through village road. There are 3 gates provided at BMCWPP facility.

Assessment of existing traffic conditions in the project area was undertaken to identify the problems with respect to traffic movement and to formulate the possible alternative solutions and the need for organizing the same in an efficient and economical manner. A traffic volume count survey was conducted at a junction which connects the road accessed by waste carrying vehicles with NH 146.

The traffic monitored has been divided into the following four (4) categories/classes:

- Two wheelers (motor cycle, scooters);
- Three wheelers (auto rickshaw, motorized cart);
- Light commercial vehicle (LCV);
- High commercial vehicle (HCV);
- Non motor vehicle;

Since the vehicles are of different types, a factor needs to be accounted for each of them in order to express them at par in single unit terms. The factors, commonly known as Passenger Car Unit (PCU) factors that are generally adopted have been given in the following table.

Table 4-14: PCU Factors Adopted for Traffic Volume Survey

Vehicle Type	PCU Factor
Two Wheelers (Motorcycle, Scooter etc.)	0.75
Three Wheelers (Autorickshaw, motorised carts etc.)	1.2
Four Wheelers/Light Vehicles (Passenger cars, Pickup vans etc.)	1
Six Wheelers/Heavy Vehicles (Light Commercial vehicles, Trucks and Buses etc.)	3.7
Bicycles	0.5
Others (Carts etc.)	2

Source: The Indian Roads Congress Code – IRC 109-1990

The hourly traffic volume counts have been furnished in the figure below.

Table 4-15: Hourly Traffic Volumes (Junction Where the Road Connects Gate 3 with NH 146)

Time	PCUs IN 24 Hrs, (Hourly Data)				
	Two wheelers	Three wheelers	LCV	HCV	Non-motor vehicle
06:00 - 07:00	106.5	16.8	175	310.8	26
07:00 - 08:00	168	40.8	196	333	10
08:00 - 09:00	198	51.6	161	407	16
09:00 - 10:00	190.5	48	154	384.8	8
10:00 - 11:00	183	46.8	153	381.1	10
11:00 - 12:00	183.75	62.4	149	381.1	16
12:00 - 13:00	189.75	37.2	161	277.5	12
13:00 - 14:00	188.25	38.4	218	462.5	14
14:00 - 15:00	197.25	33.6	219	414.4	12
15:00 - 16:00	181.5	45.6	218	418.1	8
16:00 - 17:00	162.75	43.2	201	492.1	16
17:00 - 18:00	154.5	36	214	466.2	10
18:00 - 19:00	157.5	21.6	174	395.9	14
19:00 - 20:00	135.75	40.8	150	273.8	10
20:00 - 21:00	113.25	45.6	133	247.9	6
21:00 - 22:00	108.75	25.2	110	214.6	0
22:00 - 23:00	85.5	25.2	98	173.9	4
23:00 - 00:00	59.25	22.8	79	173.9	8
00:00 - 01:00	45.75	14.4	36	133.2	0
01:00 - 02:00	43.5	13.2	26	88.8	0
02:00 - 03:00	33	14.4	10	59.2	2
03:00 - 04:00	17.25	2.4	2	33.3	0
04:00 - 05:00	15.75	4.8	0	22.2	0
05:00 - 06:00	7.5	4.8	7	18.5	0

Source: Laboratory Results, May 2022

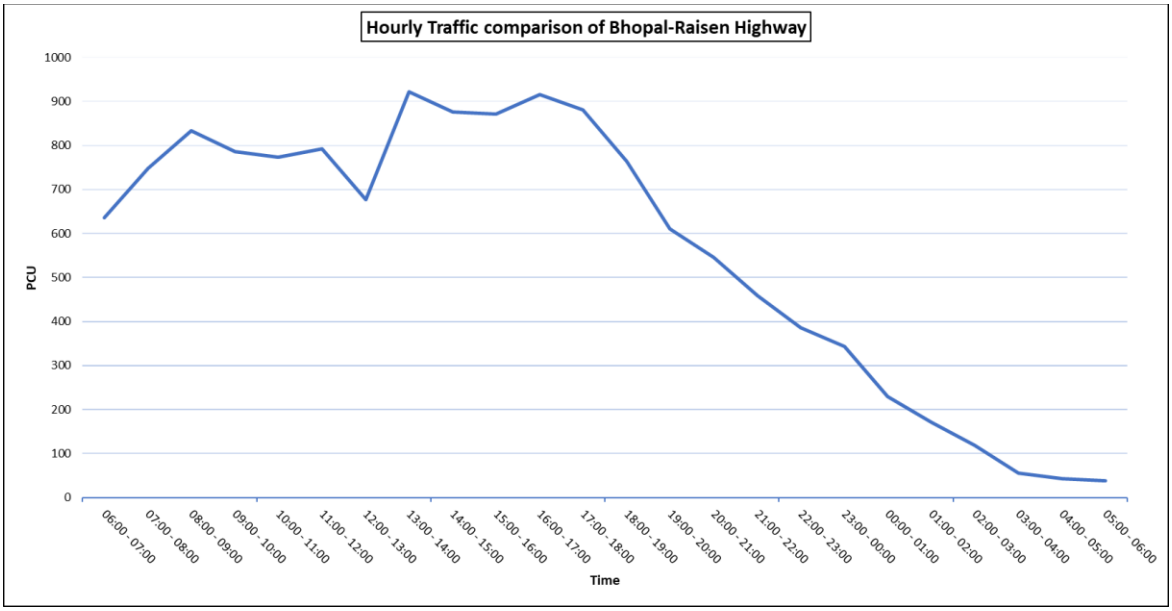


Figure 4-15: Hourly traffic comparison at NH 146 (junction where the road connects gate 3 with NH)

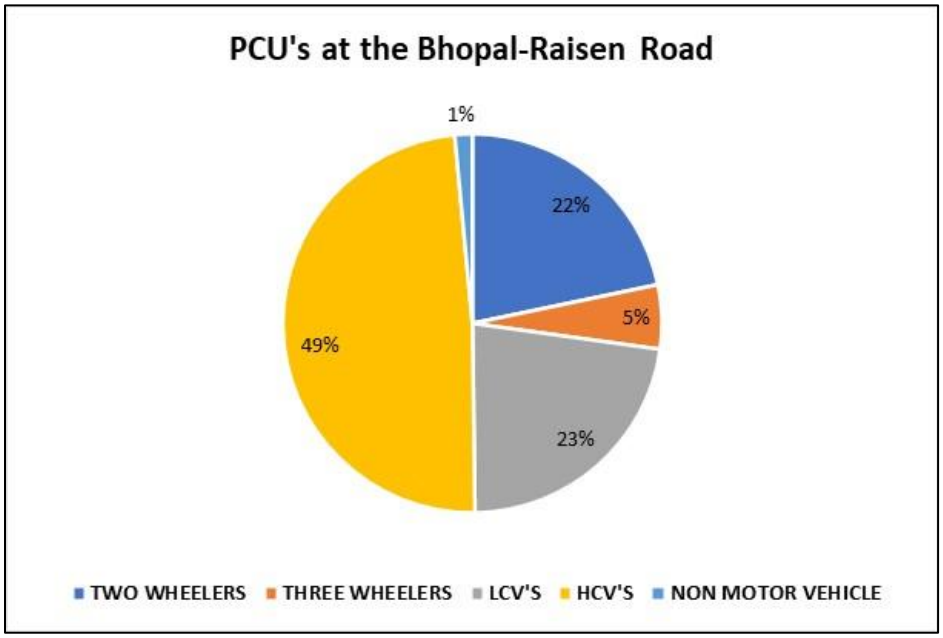


Figure 4-16: Passenger car unit comparison (PCU) of different categories

Inference

Peak traffic was seen twice a day between 1:00 PM – 2:00 PM and 3:00 PM – 4:00 PM and from there it starts to decrease which can be due to the decreasing no. of LCV and HCV. Maximum influx and outflux was observed for high commercial vehicle and light commercial vehicle. These two categories followed by two wheelers while 3-wheelers and non-motor vehicle are very less in number.

4.3 Biodiversity Profile

This section of the report summarizes the biodiversity baseline study carried out towards the ESIA. It delineates the study area covered by the assessment, describes the methodology used for the assessment and establishes a biodiversity baseline which covers the species, habitats, and ecosystem services of the study area, any invasive alien species present in the study area and the designated areas in closest proximity to the study area. This biodiversity baseline forms the basis for predicting the potential impacts of the project on the biodiversity of the study area and suggesting mitigation measures to manage the predicted impacts.

4.3.1 Delineation of the Study Area

This sub-section delineates the study area covered by the biodiversity assessment. It also briefly describes the geographical and ecological status of the delineated study area.

The overall area covered by the assessment includes the following constituent areas:

a) Area of Direct Influence: The area coinciding with the footprint of the Project (estimated to contain the potential receptors of any direct Project-related ecological impacts), hereafter referred to as the 'Project Site'; and
a) Area of Indirect Influence: The area extending 5 km outward from the project site boundary (estimated to contain the potential receptors of any indirect Project-related ecological impacts), hereafter referred to as the 'Buffer Area'

The Area of Direct Influence and the Area of Indirect Influence are collectively termed as 'Study Area'.

Geographically, the Study Area is located north of the Vindhya Range in the Central Indian landscape. Ecologically, the Study Area represents a tract of Northern Tropical Dry Deciduous Forest, a forest-type typical to Central India.

The terrain of the Study Area is generally flat, with scattered hillocks, an overall gentle slope from north to south, and an average elevation of 440-540 m above mean sea level. The land is drained mainly by a few shallow streams, with rainwater tending to settle in natural depressions as well as man-made structures, creating small and large wetlands.

The land-use in the Study Area is dominated by forest, arable land, inland wetlands, stone excavation sites, urban areas and rural habitation. Crops commonly cultivated in the Study Area include *Cicer arietinum* (Chana), *Triticum sativum* (Wheat), *Oryza sativa* (Rice) and *Vigna radiata* (Moong).

4.3.2 Approach and Methodology

This section outlines the approaches used to address the different components of the Study and the methodologies applied to achieve the objective of each.

4.3.2.1 Desk-based Assessment

Approach

The approach adopted for establishment of the biodiversity baseline involved the following strategy:

a) Conducting a generic assessment using the Integrated Biodiversity Assessment Tool (IBAT) to obtain numbers of IUCN Red List-assessed species potentially occurring within 50 km radius of the Project Site.

b) Extracting the corresponding list of IUCN Red List assessed species having ranges overlapping the Study Area to obtain a master-list of species potentially occurring within the Study Area.

c) Conducting a brief visit to the Study Area to verify the habitat profile therein, as also, the presence of any significant natural habitat, through walk-through and/or drive-through surveys.

d) Consulting the local Forest Department officials, as well as the local community, to verify occurrence of potential CH trigger species and habitats in the Study Area.

e) Establishing a habitat baseline consisting of those habitat types, as recognized by the IUCN Habitat Classification Scheme, noted through primary observations during the visit to the Study Area.

f) Establishing a species baseline consisting of those species for which suitable habitat-types are present within the Study Area, as verified during the visit to the Study Area.

The approach adopted for screening of species involved the following strategies:

a) Prior exclusion of entire groups of species, such as lower flora and fauna, for which screening-relevant data is known to be unavailable in the public domain.

b) Inclusion of only IUCN Red List designated globally threatened species during identification of potential CH triggers, with non-threatened species being included only if they are trigger species with respect to any KBAs overlapping the Study Area.

c) Screening out of potential CH trigger species based mainly on unavailability of adequate extent of suitable habitat-types or elevation range vis-à-vis the species-specific threshold number required to trigger CH.

The approach adopted for screening of habitats involved the following strategies:

a) Use of satellite imagery of the Study Area, as available in Google Earth, in conjunction with governmental maps of the Land Use Land Cover (LULC) of the corresponding area to characterize the habitat types therein

b) Use of governmental maps of notified Protected Areas and Eco-sensitive Zones, as available in governmental notifications, to identify boundaries of the nearest designated areas that are legally protected.

c) Use of the Integrated Biodiversity Assessment Tool (IBAT), along with Key Biodiversity Areas (KBA) maps to identify boundaries of the nearest designated areas that are internationally recognized, but not legally protected.

Methodology

The methodology applied for setting a biodiversity baseline for the Study Area involved the following steps:

i. Establishing a habitat baseline consisting of those habitat types, as recognized by the IUCN Habitat Classification Scheme, noted through primary observations during the visit to the Study Area.

ii. Establishing a species baseline consisting of those species for which suitable habitat-types are present within the Study Area, as verified during the visit to the Study Area.

iii. Establishing an ecosystem services baseline, focused mainly on provisioning and cultural ecosystem services, based on inputs received from the local community.

The methodology applied for CH screening with respect to species involved the following steps:

i. Excluding lower floral and faunal species from the screening exercise, considering the known unavailability of relevant screening data on the same, and including only higher floral species, namely Angiosperms, and higher faunal species, namely, Vertebrates, that is, Mammals, Birds, Reptiles, Amphibians, and Fishes.

ii. Screening out species that are not designated by the IUCN Red List as globally threatened, considering that non-threatened species are less likely to meet the applicable CH trigger thresholds, except for species that are triggers with respect to any KBAs overlapping the Study Area, considering that such species are more likely to meet the applicable CH trigger thresholds.

iii. Identifying the CH Criteria as per which each screened in species qualifies as a potential CH trigger with respect to the Study Area.

iv. Evaluating the identified potential CH trigger species, based on extent of occurrence (EOO), estimated global population, suitable habitat types and elevation range, to screen in any likely CH triggers as per CH Criteria 1, 2 and/or 3.

The methodology applied for CH screening with respect to habitats involved the following steps:

i. Conducting a generic assessment using the Integrated Biodiversity Assessment Tool (IBAT) to obtain numbers of internationally recognised Designated Areas situated within 50 km of the centre of the Project Area.

ii. Identifying, mainly from IUCN-associated websites, any internationally recognised designated areas that qualify as potential CH triggers, in terms of overlapping the Project Site and being classified as highly threatened or unique ecosystems, situated within the Study Area.

iii. Identifying, mainly from governmental maps, any nationally designated legally protected areas that qualify as potential CH triggers, in terms of overlapping the Project Site and being classified as highly threatened or unique ecosystems, situated within the Study Area.

iv. Evaluating the identified potential CH trigger habitats within the Study Area to screen in any likely CH triggers as per CH Criteria 4 and/or 5.

4.3.2.2 Field-based Assessment

Approach

The approach to the field-based assessment involved collection of primary data through walk-over surveys at accessible locations within the Study Area and collection of secondary data through opportunistic, informal interviews with local Project personnel, government officials and community members.

Methodology

The Study Area was visited during 16-20 May 2022. Primary data on species and habitats was collected through sampling of floral and faunal species at. The timings of the primary data collection covered the diurnal faunal activity-period, from early morning till late evening, but excluded the nocturnal faunal activity-period.

Qualitative data on floral and faunal species was recorded through the visual encounter method. Records were based on direct sightings of species, as well as, indirect evidence, such as flowers, pods, calls, nests, burrows, droppings, scats, moults and tracks.

Figure below presents the locations of the biodiversity sampling sites vis-à-vis the Study Area.

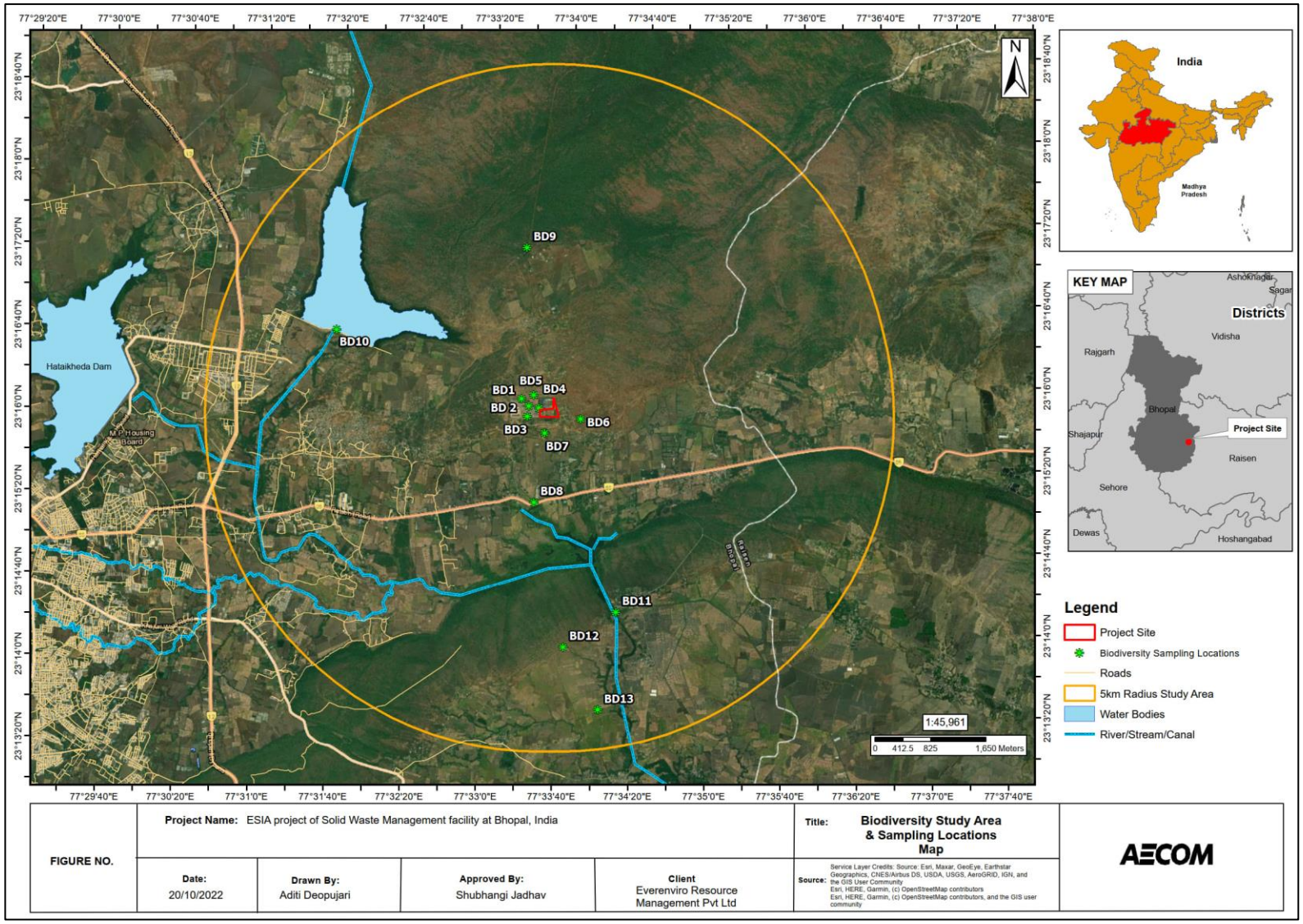


Figure 4-17: Map indicating Study Area and Biodiversity Sampling Sites

Table 4-16: Biodiversity Sampling Sites

Sampling site code	Location Coordinates	Elevation (meters)	Distance & Direction from Project Site	Habitat Type
BD1	23° 15' 59.40"N, 77° 33' 27.80"E	477	0.31 km Northwest	Urban Area
BD2	23° 15' 55.90"N, 77° 33' 31.50"E	471	0.17 km Northwest	Urban Area
BD3	23° 15' 50.80"N, 77° 33' 30.60"E	466	0.21 km Southwest	Urban Area
BD4	23° 15' 54.70"N, 77° 33' 36.70"E	467	Within the site	Urban Area
BD5	23° 16' 01.00"N, 77° 33' 34.10"E	478	0.22 km North	Plantation
BD6	23° 15' 49.10"N, 77° 33' 58.60"E	463	0.32 km East	Excavations
BD7	23° 15' 42.50"N, 77° 33' 39.50"E	461	0.24 km South	Excavations
BD8	23° 15' 09.10"N, 77° 33' 33.30"E	451	1.28 km South	Arable Land
BD9	23° 17' 12.70"N, 77° 33' 32.00"E	501	2.29 km North	Forest
BD10	23° 16' 34.70"N, 77° 31' 51.30"E	471	3.41 km Northwest	Wetland
BD11	23° 14' 15.00"N, 77° 34' 15.20"E	449	3.03 km South	Wetland
BD12	23° 13' 58.50"N, 77° 33' 47.20"E	453	3.43 km South	Forest
BD13	23° 13' 27.80"N, 77° 34' 04.80"E	448	4.42 km South	Arable Land

Study Area-specific secondary data was collected through formal consultations with the following sources –

Madhya Pradesh Forest Department

a) Mr. Pavnesh Tripathi, Deputy Ranger, Kanhasaiya Range
b) Mr. Shamim Muzamma Khan, Deputy Ranger, Uttar Padhariya Range
c) Mr. Shivpal, Range Forest Officer, Samardha Range
d) Mr. Alok Pathak, District Forest Officer, Territorial Forest, Bhopal

Bhopal Municipal Corporation

a) Mr. MP Singh, Additional Commissioner, Bhopal Municipal Corporation

Water Resources Department

a) Mr. Saxena, Water Resources Department
b) Mr. Shirole, Water Resources Department

Project Personnel

a) Mr. Santosh Jarunde, ERMPL

In addition, opportunistic informal consultations were conducted with a few members of the local community.

4.3.3 Species Profile of the Study Area

This sub-section describes the reported and recorded floristic and faunal species of the Study Area.

4.3.3.1 Floral Species

4.3.3.1.1 Reported Floral Species

According to the Champion and Seth Classification of Indian Forests, the natural vegetation of the Study Area is classifiable into the following forest-types:

Type 5A/C1b Dry Teak Forest [Sub-Type C1- Dry Teak-bearing Forests of Sub-group 5A- Southern Tropical Dry Deciduous Forests of Group 5 – Tropical Dry Deciduous Forests]

These forests are seen throughout the Indian Peninsula, with exception of the Western Ghats. It is thus encountered in Madhya Pradesh, Gujarat, Maharashtra, Andhra Pradesh, Mysore and Madras. The typical annual rainfall is 1000-1300 mm, down to 850mm. A long dry season is experienced with little to no rain for six months. The type is developed on any variety of rock and soil, especially characteristic of sandy soils, lateritic and shallow clay soils. The terrain is undulating with plateaus at 450-600m.

It is formed by mixture of trees, all of which are deciduous during the dry season. The lower canopy is likewise almost entirely deciduous, with some evergreens and sub-evergreens. Undergrowth of shrubs and grass growth is also present. Bamboos are often present but no luxuriant. Canes and palms are absent, climbers are comparatively few and epiphytes and ferns are quite inconspicuous.

The typical plant species associated with these forests include:

Trees such as *Tectona grandis, Anogeissus latifolia, Diospyros tomentosa, Pterocarpus marsupium, Dalbergia latifolia, Butea monosperma, Wrightia tinctoria, etc.;*

Shrubs such as *Nyctanthes arbor-tristis, Woodfordia fruticosa, Helicteres isora, Carissa sp., Holarrhena antidysenterica, Lantana camara*;

Herbs such as *Cassia tora, Xanthium strumarium, apluda mutica, Heteropogon contortus, Themeda quadrivalvis;*

Climbers such as *Abrus precatorius, Combretum decandrum, Cryptolepis buchanani, Tinospora cordifolia, Ventilago calyculata.*

Source: H.G. Champion & S. K. Seth (2005). A Revised Survey of the Forest Types of India. Natraj Publishers, Dehradun

4.3.3.1.2 Recorded Floral Species

A total of 34 floral species were recorded in the Study Area during the primary survey. These include 28 woody species, which would be part of the perennial groundcover of the Study Area, and 6 non-woody species, which would be part of the annual or seasonal groundcover of the Study Area.

The table below presents the details of these floral species, including the scientific, common name of each species, its habit or morphological form and the conservation status assigned to it as per the IUCN Red List.

Table 4-17: Recorded Floral Species

SN	Scientific Name	Common Name	Habit	IUCN Status*
Woody Species				
1	*Ailanthus excelsa*	Mahanimb, Indian Tree of Heaven	Tree	NE
2	*Azadirachta indica*	Neem, Margosa	Tree	LC
3	*Buchanania cochinchinensis*	Chironji	Tree	NE

SN	Scientific Name	Common Name	Habit	IUCN Status*
4	*Butea monosperma*	Palash, Flame of the forest	Tree	LC
5	*Calotropis procera*	Aak, Rubber Bush	Shrub	NE
6	*Cassia fistula*	Amaltash, Indian Labernum	Tree	LC
7	*Delonix regia*	Gulmohar	Tree	LC
8	*Dalbergia sissoo*	Shisham, Indian Rosewood	Tree	LC
9	*Diospyros melanoxylon*	Tendu, Timru, Black Ebony	Tree	NE
10	*Eucalyptus sps*	-	Tree	-
11	*Ficus benghalensis*	Banyan Tree	Tree	NE
12	*Ficus racemosa*	Cluster Fig	Tree	LC
13	*Ficus religiosa*	Peepal	Tree	NE
14	*Ficus tsjakela*	Karal Fig	Tree	NE
15	*Holoptelea integrifolia*	Indian Elm	Tree	NE
16	*Ipomoea carnea*	Bush Morning Glory	Shrub	NE
17	*Lantana camara*	Raimuniya, Lantana	Shrub	NE
18	*Madhuca longifolia var. latifolia*	Mahua, Indian Butter Tree	Tree	NE
19	*Mangifera indica*	Aam, Mango	Tree	DD
20	*Phoenix sylvestris*	Silver Date Palm	Tree	NE
21	*Phyllanthus emblica*	Amla, Indian Gooseberry	Tree	LC
22	*Polyalthia longifolia*	False Ashok	Tree	NE
23	*Pongamia pinnata*	Karanj	Tree	LC
24	*Prosopis juliflora*	Junglee Kikar, Algaroba	Tree	NE
25	*Senegalia catechu*	Khair, Black Cutch	Tree	LC
26	*Sterculia urens*	Indian Gum Tragacanth	Tree	NE
27	*Tectona grandis*	Saag	Tree	NE
28	*Terminalia anogeissiana*	Dhaura, Axlewood	Tree	NE
29	*Terminalia arjuna*	Arjun	Tree	NE
30	*Terminalia elliptica*	Asan, Indian Laurel	Tree	NE
31	*Trema orientale*	Indian Charcoal Tree	Tree	LC
32	*Ziziphus nummularia*	Jhar Beri	Shrub	NE
33	*Ziziphus mauritiana*	Indian Jujube	Tree	LC
Non-woody Species				
34	*Blumea sps*	-	Herb	-
35	*Cynodon dactylon*	Bermuda Grass	Herb	NE
36	*Eichhornia crassipes*	Water Hyacinth	Herb	NE
37	*Sida acuta*	Baraira, Common Wireweed	Herb	NE

SN	Scientific Name	Common Name	Habit	IUCN Status*
38	*Sida rhombifolia*	Sahdev, Cuban jute	Herb	NE
39	*Tridax procumbens*	Tridax Daisy	Herb	NE

**Status assigned by the International Union for Conservation of Nature and Natural Resources, where DD - Data Deficient, LC – Least Concern and NE - Not Evaluated.*

Source: AECOM Primary Survey; IUCN 2022. The IUCN Red List of Threatened Species. Version 2021-3, The Plant List (2013). Version 1.1. Published on the Internet; http://www.theplantlist.org/

The photolog below presents photos of some of the tree species observed in the Project Site.

Polyalthia longifolia

Butea monosperma

4.3.3.2 Faunal Species

This section of the report presents the higher faunal species, namely vertebrates, comprising mammals, birds, reptiles, amphibians and fish, having recorded ranges that include the Study Area. The detailed species-tables are provided as annexures to this report. Each annexed table gives the scientific and common names of each species, the conservation status assigned to it by the International Union for Nature and Natural Resources (IUCN) and the Schedule of the Wildlife Protection Act, 1972 (WPA) under which it is listed. Names of the species recorded during the field studies appear in **bold** font in each table.

Mammals

At least 60 species of mammals have reported ranges that fully or partially overlap the Study Area.

Significant species with respect to the IUCN Red List include 2 species designated as Endangered, 4 as Vulnerable and 3 as Near Threatened. Significant species with respect to the WPA include 9 species listed in Schedule I.

Appendix A lists the mammal species of the Study Area.

Birds

At least 313 species of birds, including 205 resident and 108 migratory species, have reported ranges that fully or partially overlap the Study Area.

Significant species with respect to the IUCN Red List include 5 species designated as Critically Endangered, 6 as Endangered, 8 as Vulnerable and 13 as Near Threatened, out of which 1 Endangered and 1 Vulnerable species were recorded during the primary survey. Significant species with respect to the WPA include 11 species listed in Schedule I, of which 1 species was recorded during the primary survey.

In all, 23 resident species and 1 migratory bird species were recorded in the Study Area during the primary survey.

Appendix B lists the resident bird species of the Study Area, with the names of any species recorded during the primary survey appearing in bold font.

Reptiles

At least 55 species of reptiles have reported ranges that fully or partially overlap the Study Area.

Significant species with respect to the IUCN Red List include 1 species designated as Endangered, 3 as Vulnerable and 3 as Near Threatened. Significant species with respect to the WPA include 5 species listed in Schedule I of the WPA.

Appendix C lists the reptile species of the Study Area.

Amphibians

At least 9 species of amphibians have reported ranges that fully or partially overlap the Study Area.

None of these species is designated by the IUCN as globally threatened or near-threatened or is listed in Schedule I of the WPA.

Appendix D lists the amphibian species of the Study Area.

Fish

At least 36 species of fish have reported ranges that fully or partially overlap the Study Area.

Significant species with respect to the IUCN Red List include 2 species designated as Vulnerable and 2 as Near Threatened. None of these species is listed in Schedule I of the WPA.

Appendix E lists the fish species of the Study Area.

4.3.3.3 Invasive Alien Species

At least two (02) species, comprising one (01) floral species and one (01) faunal species, reported from the Study Area, are designated as invasive alien species with respect to the Study Area. Both these species were recorded in the Study Area during the primary survey.

Table below lists the invasive alien species of the Study Area, along with the vernacular name of each species, the conservation status assigned to it by the International Union for Nature and Natural Resources (IUCN) and its native range. The floral and faunal species are listed in separate sections

Table 4-18: Invasive Alien Species of Study Area

SN	Scientific Name	Vernacular Name	IUCN Status*	Native Range
Floristic Species				
1	*Prosopis juliflora*	Vilayti Kikkar	NE	Central and South America

Faunal Species				
2	*Columba livia*	Kabootar	LC	Europe

***Status assigned by the International Union for Conservation of Nature and Natural Resources, where – LC – Least Concern and NA – Not Evaluated.*

Sources: AECOM Primary Survey; IUCN 2022. The IUCN Red List of Threatened Species. Version 2021-3; Global Invasive Species Database, Invasive Species Specialist Group, IUCN; CABI Invasive Species Compendium; Invasive Alien Species of India, National Biodiversity Authority, Ministry of Environment, Forests and Climate Change, Government of India.

4.3.4 Habitat Profile of the Study Area

The habitat-profile of the Study Area represents a mosaic of natural and modified habitats, while the Project Site itself is situated in modified habitat. The chief habitat-fragmenting features of the Study Area consist of metalled roads, dirt roads and dirt tracks. The aerial envelope of the Study Area is interrupted mainly by power transmission pylons and cables.

Figure below presents a map indicating the habitat profile of the Study Area.

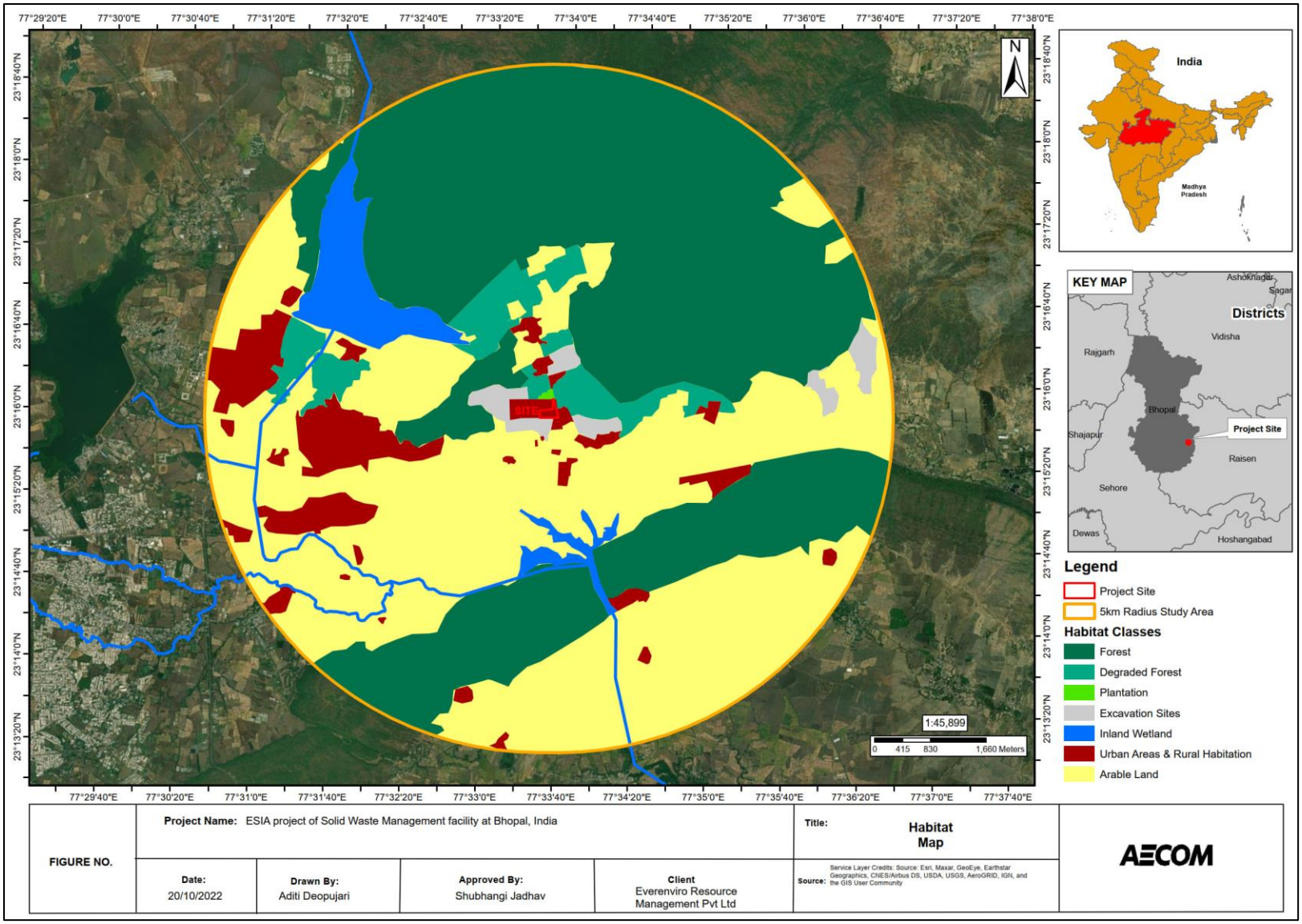


Figure 4-18: Map indicating Habitat Profile of the Study Area

4.3.4.1 Natural Habitats

Trees which are either relics of the previous vegetation or planted in and around the Project Site form the natural habitat near the Project Site. Natural habitats constitute approximately 52% of the Study Area. These include tracts of tropical dry forest and inland wetlands. These habitats are likely to be supporting mainly habitat-specialist species.

	
Tropical Dry Deciduous Forest in the Study Area	**Ghoda pachad Reservoir, an inland wetland in the Study Area**

Sources: AECOM Primary Survey

4.3.4.2 Modified Habitats

The Project Site contains modified habitat with regenerated vegetation composed of a mixture of alien and native species. Modified habitats constitute approximately 48% of the Study Area. These include arable land, rural habitation, excavation sites (stone quarries), roads and artificial inland wetlands. These habitats are likely to be supporting mainly generalist species.

	
Plantation near Project Site	**Abandoned excavation site in the Study Area**
	
Arable Land in the Study Area	**Existing waste near the Project Site**


Regenerated vegetation in the Project Site

Sources: AECOM Primary Survey

4.3.4.3 Critical Habitats

As per the IFC PS6 Critical Habitat (CH) Criteria 1, 2 and 3, habitats, either natural or modified, that are critical for the survival of IUCN Red List-designated globally threatened species, endemic or restricted range species and migratory and/or congregatory species are potential CH triggers. As per the IFC PS6 CH Criteria 4 and 5, highly threatened or unique ecosystems, as well as, spatial features that support key evolutionary processes, are also potential CH triggers.

CH Screening

The species of the Study Area were screened against CH Criteria 1, 2 and 3, while the habitats of the Study Area were screened against the Criteria 4 and 5.

CH Criterion 1 – Globally Threatened Species

Globally Threatened Species are defined as species designated by the IUCN Red List as Critically Endangered (CR), Endangered (EN) or Vulnerable (VU). As per CH Criterion 1, an area that supports a globally important concentration of a CR or EN species, as well as an area that supports a globally important concentration of a VU species, the loss of which would lead to the species being designated as EN or CR, both qualify as potential CH.

Thresholds stipulated for triggering CH Criterion 1 are:

(a) Areas that support globally important concentrations of an IUCN Red-listed CR or EN species (0.5% of the global population containing 5 reproductive units of a CR or EN species);

(b) Areas that support globally important concentrations of an IUCN Red-listed VU species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds specified in (a);

(c) As appropriate, areas containing nationally/regionally important concentrations of an IUCN Red-listed CR or EN species.

At least 27 species, that were screened in for evaluation as potential CH triggers and have geographic ranges overlapping the Study Area, are designated by the IUCN Red List as globally threatened. These include 5 species designated by the IUCN Red List as Critically Endangered (CR), 9 as Endangered (EN) and 13 as Vulnerable (VU).

The said 27 species qualify as potential CH triggers with respect to the Study Area as per CH Criterion 1.

Ch Criterion 2 – Endemic/ Restricted Range Species

Species which occur in a limited area are referred to as Endemic or Restricted Range species.

The species reported from the Study Area have first been evaluated as endemic or restricted range species based on their extent of occurrence (EOO), described as follows:

(a) For terrestrial vertebrates and plants, a restricted-range species is defined as those species that have an EOO less than 50,000 km^2

(b) For marine systems, restricted-range species are provisionally being considered those with an EOO of less than 100,000 km^2

(c) For coastal, riverine, and other aquatic species in habitats that do not exceed 200 km width at any point (e.g., rivers), restricted range is defined as having a global range less than or equal to 500 km linear geographic span (i.e., the distance between occupied locations farthest apart).

None of the species reported from the Study Area meet any of the said definitions. Thus, none of the said species qualify as potential CH trigger species with respect to the Study Area as per CH Criterion 2.

CH Criterion 3 – Migratory and/or Congregatory Species

Migratory Species are defined as species of which a significant proportion of its members cyclically and predictably move from one geographical area to another, including within the same ecosystem. At least 7 such globally threatened Migratory Species, all birds, have reported ranges that include the Study Area, which may serve as wintering/summering destination, staging site or flight-corridor for these species.

Species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable basis are known as congregatory species. At least 14 globally threatened species, consisting of both resident and migratory species, which are known to form large congregations, have recorded ranges that include the Study Area.

Thresholds stipulated for triggering CH Criterion 3 are:

(a) areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle; and

(b) areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.

The Study Area is located within the Central Asian Flyway. Owing to the presence of wetlands in the Study Area, it is likely that migratory waterbirds occur in the Study Area during the September to March period every year, which coincides with the chief annual migratory season with respect to the Indian sub-continent.

The 27 globally threatened species having geographic ranges overlapping the Study Area include 13 species classified by the IUCN Red List as migratory and/or congregatory. Therefore, only the said 13 migratory and/or congregatory species are deemed potential CH triggers with respect to the Study Area as per CH Criterion 3.

The existing organic waste contained within the Project Site reportedly serves as a regular food source for globally threatened vulture species, which constitute a group of congregatory and dispersive scavenging species, including both resident and migratory species. Approximately 30 individuals of one of the said species, namely *Neophron percnopterus* (Egyptian Vulture; IUCN Red List Status: Endangered), were recorded around the Project Site during the site visit. As per inputs received from the local community, significantly higher numbers of vultures occur in & around the Project Site during winter, the chief annual migratory season with respect to the Study Area.

It is likely that the Study Area may be used periodically by migratory and/or congregatory vulture species such as *Gyps bengalensis* (White-rumped Vulture, IUCN Red List Status: Critically Endangered), *Gyps indicus* (Indian Vulture, IUCN Red List Status: Critically Endangered), *Sarcogyps calvus* (Red-headed Vulture, IUCN Red List Status: Critically Endangered) and *Neophron percnopterus* (Egyptian Vulture; IUCN Red List Status: Endangered) as feeding ground,

resulting in congregations of the said species that are large enough to trigger CH. However, data on numbers of the said species occurring regularly or cyclically in the Study Area is unavailable in the public domain, hindering CH determination.

Considering their geographic ranges, global populations and suitable habitat types, it is less likely that the habitats of the Study Area support the threshold numbers of the rest of the concerned migratory and/or congregatory species, as would be required to trigger CH Criterion 3.

CH Criterion 4 – Highly Threatened and/or Unique Ecosystems

Assessment of the Study Area towards Criterion 4 is based on national/regional level assessments carried out by governmental bodies, recognized academic institutions and/or internationally recognized NGOs.

Thresholds stipulated for triggering CH Criterion 4 are:

(a) areas representing ≥5% of the global extent of an ecosystem-type meeting the criteria for IUCN status of CR or EN; or

(b) areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning.

No part of the Study Area is assessed by IUCN towards the IUCN Red List of Ecosystems. No habitats designated for biodiversity value are situated within the Study Area. Hence, the habitats of the Study Area are less likely to qualify as potential CH triggers as per CH Criterion 4.

CH Criterion 5 – Key Evolutionary Processes

Assessment of the Study Area towards CH Criterion 5 is based on structural attributes such as topography, geology, soil, temperature and vegetation or combinations of these variables, which can influence evolutionary processes that give rise to regional species-configurations or ecological properties. The overall aim of evaluating the Study Area against this criterion is to conserve genetic and species diversity, as also, processes which drive speciation, for the purpose of ensuring evolutionary flexibility in a rapidly changing climate.

Features associated with key evolutionary processes include:

- Landscapes with high spatial heterogeneity, which drive speciation
- Ecotones, which aid speciation and are associated with high species and genetic diversity
- Edaphic interfaces, which drive formation of unique plant communities characterized by endemism and rarity
- Connectivity between habitats, which facilitates migration and gene flow, aiding conservation of meta-populations in fragmented habitats.

The study Area is dominated by natural and slightly to highly modified habitats that are neither known to support isolated sub-populations of any species nor form a corridor for metapopulations of any species. Thus, the Study Area is not associated with any features that drive speciation.

Hence, habitats of the Study Area are less likely to qualify as a CH Criterion 5 trigger with respect to the Study Area.

Legally Protected or Internationally Recognized Areas

Assessment of the Study Area towards this criterion is based on overlap of the Project Site with a Legally Protected Area (LPA) or Internationally Recognized Area (IRA). As per PS6 Point 20, if a proposed project is located within an LPA or IRA, it would need to meet PS6 requirements for CH, depending on the qualifying biodiversity values present in the concerned LPA (including areas officially proposed for protection) or IRA.

For an area to be considered as an LPA towards this assessment, it must meet the IUCN definition: “A clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-

term conservation of nature with associated ecosystem services and cultural values." Areas proposed by governments for such designation must also be treated as LPAs. LPAs that meet the criteria of the IUCN's Protected Area Categories Ia, Ib and II are more likely to qualify as potential CH.

For the purposes of this assessment, an IRA is exclusively defined as a UNESCO Natural World Heritage Site, UNESCO Man and the Biosphere Reserve, Key Biodiversity Area and/or wetland designated under the Convention on Wetlands of International Importance (the Ramsar Convention).

Thus, project sites that are located fully or partially within nationally and/or internationally designated areas of high biodiversity value qualify as potential CH.

As per the IBAT output, there is one Protected Area situated within 50 km radius of the centre of the Project Site.

Figure below presents the IBAT result on Designated Areas which are Legally Protected Areas.

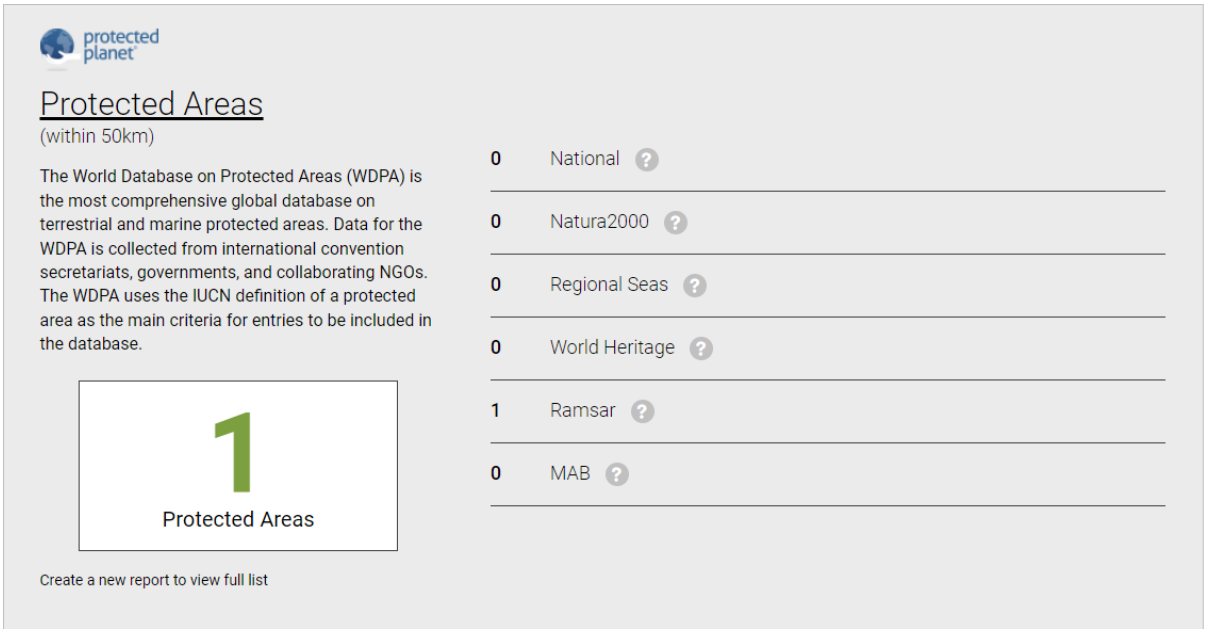


Figure 4-19: IUCN-listed Protected Areas situated within 50 km of the Project Site centre

Note: The IBAT output fails to identify the Van Vihar National Park, which is situated within 50km of the Project Site centre.

As per the IBAT output, there are 4 Key Biodiversity Area (KBA) situated within 50 km radius of the centre of the Project Site.

Figure below presents the IBAT result on Designated Areas which are Internationally Recognized Areas, but not legally protected.

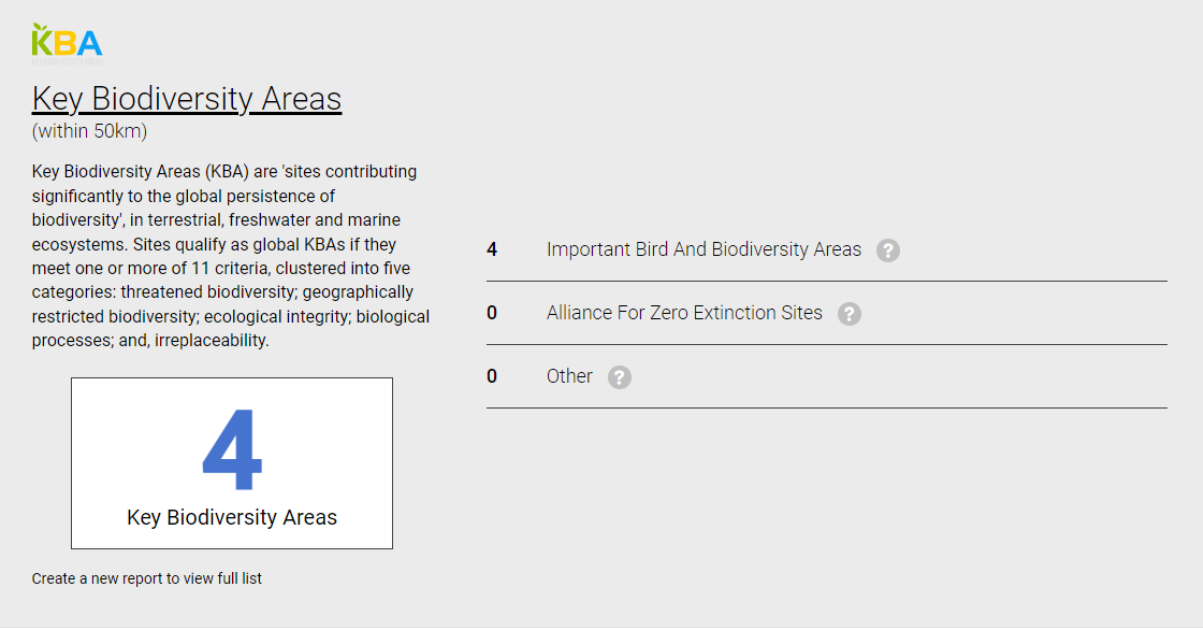


Figure 4-20: Key Biodiversity Areas situated within 50km of the Project Site centre

The LPA and IRA nearest to the Project Site are as follows:

Reserve Forest

As per inputs received from the Range Forest Officer, Samardha Range, the nearest LPA with respect to the Project Site is an unnamed Reserve Forest, a nationally designated minor legally protected area qualifying as a Category VI IUCN Protected Area. The said LPA is situated 120 m east and 1.6 km northwest respectively of the nearest points of the Project Site. The Reserve Forest consists of natural habitat represented by tropical dry forest, as well as modified habitats, represented by stone quarry sites and encroachments.

Van Vihar National Park

The nearest major LPA with respect to the Project Site is the Van Vihar National Park, a nationally designated legally protected area qualifying as a Category II IUCN Protected Area. The main protected area occupies an area of approximately 4.45 sq km, approximately 0.83 sq km of land around which is notified as its Eco-sensitive Zone (ESZ). The said ESZ boundary is situated approximately 18.8 km west of the nearest point of the Project Site.

Source: http://moef.gov.in/en/rules-and-regulations/esz-notifications/

Bhoj Wetland Ramsar Site and KBA+IBA

The nearest IRA with respect to the Project Site is Bhoj Wetland, a Key Biodiversity Area (KBA) encompassing an Important Bird and Biodiversity Area (IBA). It is also a Ramsar Site. It consists of 2 contiguous man-made reservoirs, namely the Upper Lake and the Lower Lake. It is situated 16.2 km west of the nearest point on the Project Site. Significant occurrence of migratory and resident waterbirds is reported from the said LPA and IRA.

The trigger species for this KBA are *Fulica atra* (LC), *Grus antigone* (VU) and *Haliaeetus leucoryphus* (VU).

Sources: Key Biodiversity Areas Partnership (2022) Key Biodiversity Areas factsheet: Bhoj wetland. Extracted from the World Database of Key Biodiversity Areas. Developed by the Key Biodiversity Areas Partnership: BirdLife International, IUCN, American Bird Conservancy, Amphibian Survival Alliance, Conservation International, Critical Ecosystem Partnership Fund, Global Environment Facility, Global Wildlife Conservation, NatureServe, Rainforest Trust, Royal Society for the Protection of Birds, World Wildlife Fund and Wildlife Conservation Society. Downloaded from http://www.keybiodiversityareas.org/ on 28/05/2022; Ramsar Site Information Service, https://rsis.ramsar.org/ris/1206

There is no overlap between the Project Site and any of the said LPA or IRA. Hence, the LPA and IRA nearest to the Project Site do not qualify as potential CH with respect to the Project.

Figure below presents a map indicating the LPA and/or IRA nearest to the Project Site.

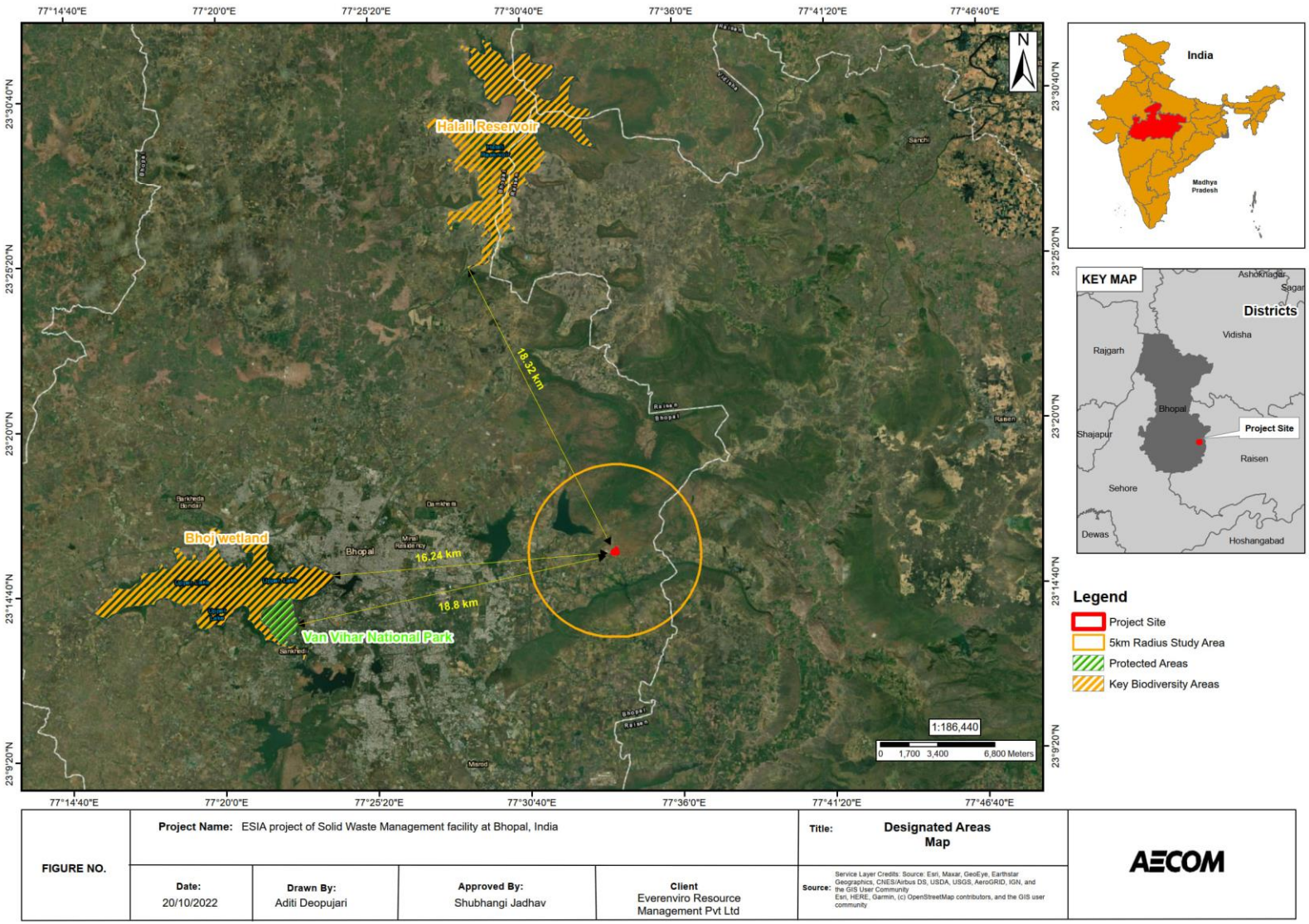


Figure 4-21: Map indicating Designated Areas near the Project Site

Thus, potential CH triggers identified with respect to the Study Area consist of 27 species and no habitats.

Table below presents details of potential CH trigger species along with details such as the applicable CH criterion, extent of occurrence (EOO), global population, suitable habitat type(s) and elevation.

Table 4-19: Potential CH Trigger Species

SN	Scientific Name	Applicable CH Criteria	EOO (km2)	Global Population (Mature)	Habitat Types*	Elevation (in meters)
Critically Endangered						
1	*Gyps bengalensis*	1a, 3a	73,70,000	6,000-9,000	F/S/Sh/G	0-1,500
2	*Gyps indicus*	1a, 3a	21,50,000	(5,000-15,000)	F/S/Sh/G/R	0-2,000
3	*Sarcogyps calvus*	1a, 3a	52,30,000	3,500-15,000	F/S/Sh/G	0-2,500
4	*Sypheotides indicus*	1a	5,20,000	356-1,228	G	-
5	*Vanellus gregarius*	1a, 3a	16,20,000	16,000-17,000	G/D/W	0-300
Endangered						
8	*Aquila nipalensis*	1a, 3a	1,26,00,000	78,042-1,10,193	F/S/G/D/R	0-3,000
6	*Cuon alpinus*	1a	-	(949-2,215)	F/Sh/G	0-5,300
9	*Falco cherrug*	1a, 3a	1,91,00,000	12,200-29,800	F/Sh/G/W/M	0-4,700
10	*Haliaeetus leucoryphus*	1a	17,40,000	1,000-2,499	W	?-5,000
7	*Manis crassicaudata*	1a	-	-	F/S/Sh/G	0-1,850
11	*Neophron percnopterus*	1a, 3a	5,01,00,000	18,600-54,000	S/Sh/G/D/R/W	0-4,500
14	*Nilssonia gangetica*	1a	-	-	W	20-1,000
12	*Rynchops albicollis*	1a	14,00,000	3,700-4,400	W/M	0-500
13	*Sterna acuticauda*	1a, 3a	44,90,000	10,000-25,000	W	?-700
Vulnerable						
15	*Amandava formosa*	1b	9,34,000	6,667-13,333	F/Sh/G/A	-
16	*Aquila rapax*	1b, 3a	5,27,00,000	1,00,000-9,99,999	F/S/Sh/G	0-3,000
17	*Aythya ferina*	1b, 3a	5,48,000	11,40,000-11,80,000	W	0-2,690
18	*Clanga clanga*	1b, 3a	1,53,00,000	(3,900-10,000)	F/Sh/G/W/M	0-1,400
19	*Clanga hastata*	1b	65,60,000	3,500-15,000	F/W/A/P	?-1,000
20	*Columba eversmanni*	1b	30,50,000	15,000-30,000	Sh/D/C/W	-
21	*Grus antigone*	1b, 3a	1,38,00,000	19,000-21,800	G/W	-
22	*Sterna aurantia*	1b, 3a	-	10,000-25,000	W	?-700
23	*Crocodylus palustris*	1b	-	(5,700-8,700)	W/M	?-420
24	*Lissemys punctata*	1b	-	-	W	0-500
25	*Pangshura tecta*	1b	-	-	W	0-500
26	*Bagarius yarrelli*	1b	93,87,540	-	W	-
27	*Wallago attu*	1b	1,04,46,620	-	W	-

**C- Caves & Subterranean Habitats, A-Arable Land, D-Desert, F-Forest, G-Grassland, M- Marine, P-Plantation, R-Rocky Areas, S-Savanna, Sh-Shrubland and W-Inland Wetland*

Source: IUCN 2022. The IUCN Red List of Threatened Species. Version 2021-3. https://www.iucnredlist.org

Considering the geographic ranges, global populations and extent of suitable habitat types of the concerned globally threatened species, along with inputs received through stakeholder consultations, it is less likely that the habitats of the Study Area support the threshold numbers of most of the said species required to trigger the applicable CH Criteria with respect to the Study Area.

The primary and secondary data available to this assessment indicates that the organic waste contained within BMCWPP Site serves as food source for globally threatened vulture species, which constitute a group of congregatory species, including both resident and migratory species. Thus, it is likely that the said vulture species, such as *Gyps bengalensis* (White-rumped Vulture, IUCN Red List Status: Critically Endangered), *Gyps indicus* (Indian Vulture, IUCN Red List Status: Critically Endangered), *Sarcogyps calvus* (Red-headed Vulture, IUCN Red List Status: Critically Endangered) and *Neophron percnopterus* (Egyptian Vulture; IUCN Red List Status: Endangered) may be using the Study Area as a feeding habitat, which may result in congregations of the said species large enough to trigger CH.

Approximately 30 individuals of one of the said species, namely *Neophron percnopterus* (Egyptian Vulture; IUCN Red List Status: Endangered), were recorded around the Project Site during the site visit in May 2022. As per inputs received from the local community, significantly higher numbers of vultures occur around the Project Site during winter, the chief annual migratory season with respect to the Study Area. It may be noted that no roosting / breeding habitat was observed on project site during AECOM's site visit.

As per the citizen science portal, eBird, 11 individuals of *Neophron percnopterus* have been reported from the Project Site in November 2021. As per a paper published in 2020 by Jha et al, 130 to 440 individuals of different vulture species were recorded from Bhopal District. A habitat suitability study published in 2020 by Jha and Jha classifies the Study Area as slightly to moderately suitable for all four vulture species.

Hence, the said 4 species qualify as likely CH triggers with respect to the Study Area as per CH Criterion 1.

However, sufficient data on numbers of the said species occurring regularly or cyclically in the Study Area is unavailable in published literature, news articles or citizen science portals such as eBird, iNaturalist or GBIF, hindering CH determination.

Source: Jha, K., M. Campbell and R. Jha (2020). Vultures, their population status and some ecological aspects in an Indian stronghold. Notulae Scientia Biologicae 12(1):124-142; Jha, K. and R. Jha (2020). Habitat suitability mapping for migratory and resident vultures: A case of Indian stronghold and species distribution model. Journal of Wildlife and Biodiversity 4(3): 91-111; eBird checklist https://ebird.org/checklist/S92409828;

4.3.5 Ecosystem Services

This section presents an overview of the significant ecosystem services provided by the ecosystems of the Study Area to the local community, which consist of mainly priority provisioning ecosystem services, details of which are provided in this section. Besides these, the ecosystems of the Study Area would also be providing generic or standard regulating and supporting ecosystem services, such as groundwater recharge, surface water purification, soil erosion control, temperature regulation, soil replenishment, primary production, pollination and pest control.

4.3.5.1 Provisioning Services

The chief provisioning services provided by the Study Area to the local community include surface water & groundwater water for domestic use & crop irrigation, soil for crop cultivation and naturally occurring plants that provide food, fuelwood, fodder & fertilizer.

The soil of the Study Area is used to cultivate crops, such as *Cicer arietinum* (Chick Pea or Chana), *Triticum sativum* (Wheat or Gehu), *Oryza sativa* (Rice or Dhaan) and *Vigna radiata* (Green Gram or Moong). Arable land in some parts of the Study Area is cultivated twice annually. Some cultivation is dependent on rain, while some is dependent on surface and groundwater for crop irrigation.

The Ghoda Pachad Dam Reservoir, a water storage situated approximately 1 km northwest of the Project Site & proposed as the main water source for the Project, is used for crop irrigation by the local community, thus qualifying as a Type I & Type II priority provisioning ecosystem service with respect to the Project. Commercial fishing is done in the reservoir.

As per inputs received from local governmental officials, the Ajnaal Weir Reservoir, a water storage situated approximately 2 km downgradient of the Project Site, is a major source of crop irrigation water for the local community. The fish reported to be consumed in the Study Area are *Labeo rohita* (Rohu), *Catla catla* (Catla), *Anguilla bengalensis* (Baam), etc. The water of the reservoir is also used by cattle and other livestock.

As per inputs received from the Range Forest Officer of Territorial Division, Samardha, a small proportion of the local community, including the Affected Community, is dependent on forest land around the Project Site for food, fodder, fuel wood and saleable produce. Wild foods collected from the forests include fruits of *Diospyros melanoxylon* (Timru), flowers of *Madhuca longifolia* (Mahua) and *Buchanania lanzan* (Chironji/Chaar). Saleable forest produce collected by the local community includes leaves of *Diospyros melanoxylon* (Tendu).

4.4 Socio-economic Profile

4.4.1 Socio-Economic Environment

The purpose of the baseline is to draw a profile of socio-economic indicators of the study area, to inform the impact assessment exercise and determine appropriate measures to minimise or mitigate negative impacts and enhance positive ones for a smooth functioning of the project.

The socio-economic baseline is formed using secondary data and supported by primary data collected through on-site consultations. Among the secondary sources of data, is Census of India 2011 database. Due to unavailability of census data 2021, the former data set has been used. However, wherever available, most recent information from various other sources has been provided.

4.4.2 Study area

The study area for this baseline comprises of villages, where the project is located and those within 5 km radius around the project location.

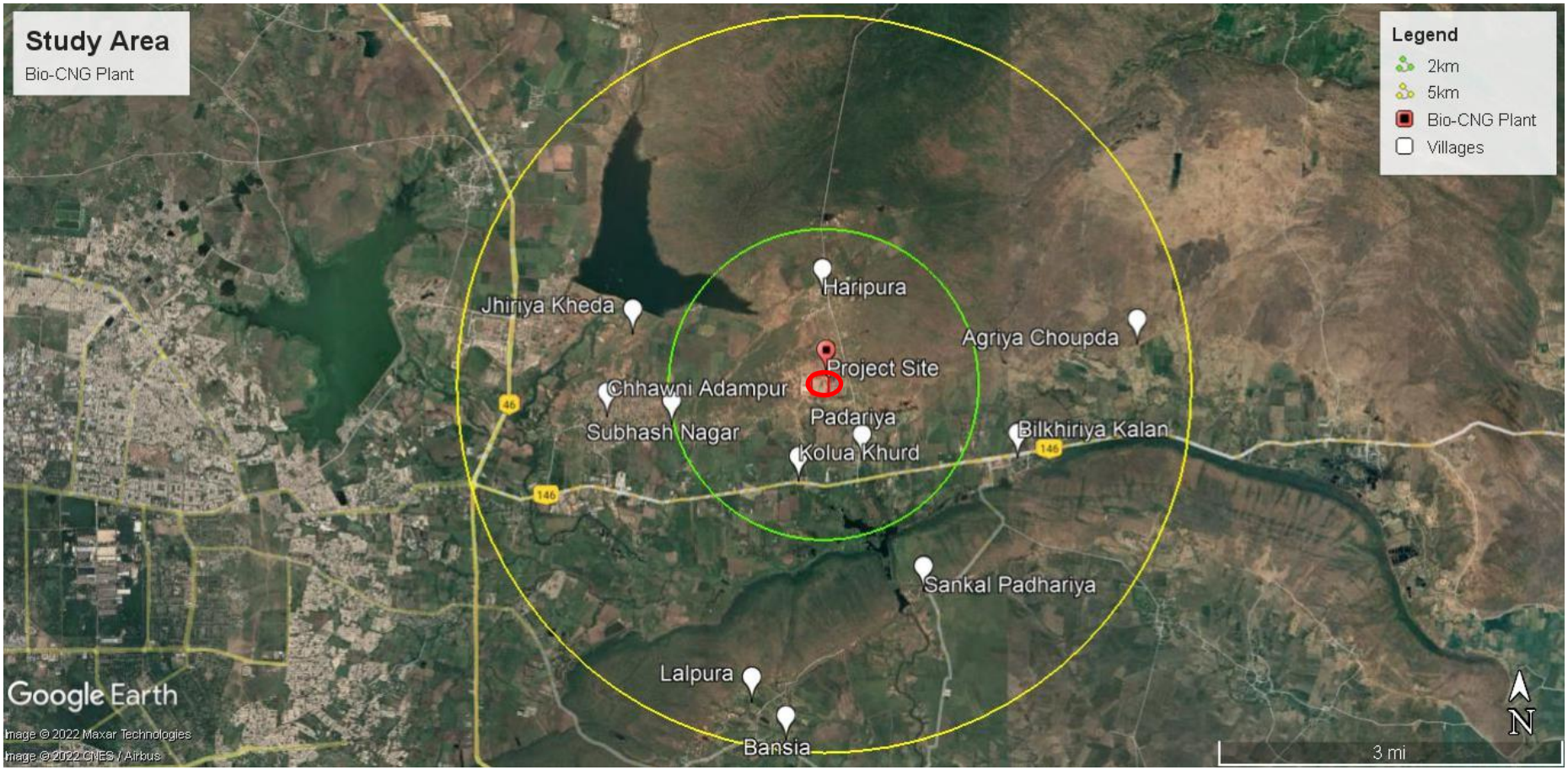


Figure 4-22: Study area for socio-economic baseline

Source: Prepared by AECOM, May 2022

4.4.3 Administrative Framework

Madhya Pradesh state is located centrally in India surrounded by five states which are Rajasthan in the North West, Uttar Pradesh at its North East, Chhattisgarh from East to South East, Gujrat at the West and Maharashtra spread over South and South West. Majority of the state's unused area is covered under plateaus, valleys and hills. The five popular plateaus in the state are Kaimur, Vindhyan, Satpura, Malwa and Nimar.

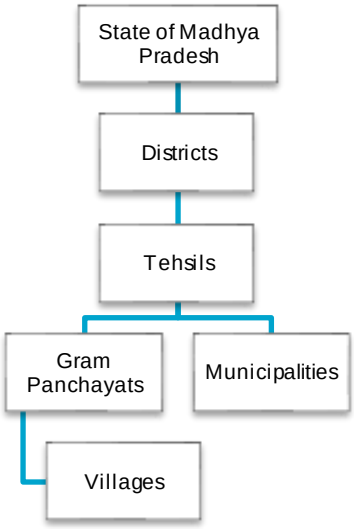


Figure 4-23: Administrative Levels in Madhya Pradesh

There are 51 districts in the state out of which the project study area falls within Bhopal district. There are 342 tehsils and 313 blocks in the entire state, out of which the study area falls under Huzur tehsil. The subsequent governmental body is formed of Nagar Parishads. There are 258 such bodies in the state. The village level governmental body is known as Gram Panchayat. Each gram panchayat consists of one or more villages (group gram panchayat). There are 23043 such bodies in Madhya Pradesh, out of which 5-6 gram panchayats are part of the study area. To further narrow it down, the study area falls under 12 settlements (villages & hamlets), 5 in the core zone and 7 in the buffer zone.

4.4.4 Key Demographics

The table below provides information against key demographic indicators for the study area along with comparative figures for the districts and the state.

Table 4-20: Key Demographic Details

Sr N	Location	Level	Total Population (number)	Population Density (persons per sq.km.)	Family size	Scheduled Caste Population (percentage)	Scheduled Tribe Population (percentage)	Sex Ratio	Literacy Rate (percentage)	Female Literacy Rate (percentage)
1.	Madhya Pradesh state	State	7,26,26,809	235.6	4.8	15.6	21.1	930.9	59	41.3
2.	Bhopal district	District	23,71,061	855.4	4.7	15.1	2.9	918.1	70	44.6
3.	Huzur tehsil	Tehsil	21,07,523	1547.6	4.7	14.2	3.0	920.4	72	45.1
					Core zone					
4.	Kolua Khurd	Village	505	203.6	4.2	8.7	1.0	1048.0	81.1	77.8
5.	Chhawni Adampur	Village	3842	220.7	4.2	16.5	0.2	1072.0	79.2	75.7
					Buffer zone					
6.	Agariya	Village	1078	129.7	4.1	10.0	0.1	1076.9	84.2	82.9
7.	Jhiriya Kheda	Village	182	132.8	4.0	9.1	0.2	1042.9	86.1	84.3
8.	Bilkhiriya Kalan	Village	1372	348.2	4.1	8.6	1.5	1053.9	84.3	82.0
9.	Sankalpadariya	Village	2306	362.6	4.0	8.2	3.4	1051.3	84.5	82.5
10.	Bansiya	Village	787	98.0	3.9	6.0	0.1	1057.7	87.8	86.5
11.	Lalpura	Village	100	40.5	4.2	5.7	0.2	1046.7	86.4	85.2

Source: Census of India 2011

Note: Haripura and Subhash nagar hamlets are part of Chhawni Adampur village in revenue records. For Padariya village and Agriya Nagar hamlet, information is not available. It is likely to be covered under one of the villages listed in the study area; however, the district administration could not confirm which village it is a part of, hence, that could not be confirmed.

4.4.4.1 Population Density

Total population in the study area is 10,172 and on an average 192 people live in every sq.km. of the land. The study area is sparsely populated compared to the overall population density in Bhopal district and Madhya Pradesh state. As of 2021, the population density in Madhya Pradesh state is approximately 274 persons per sq.km of land[21].

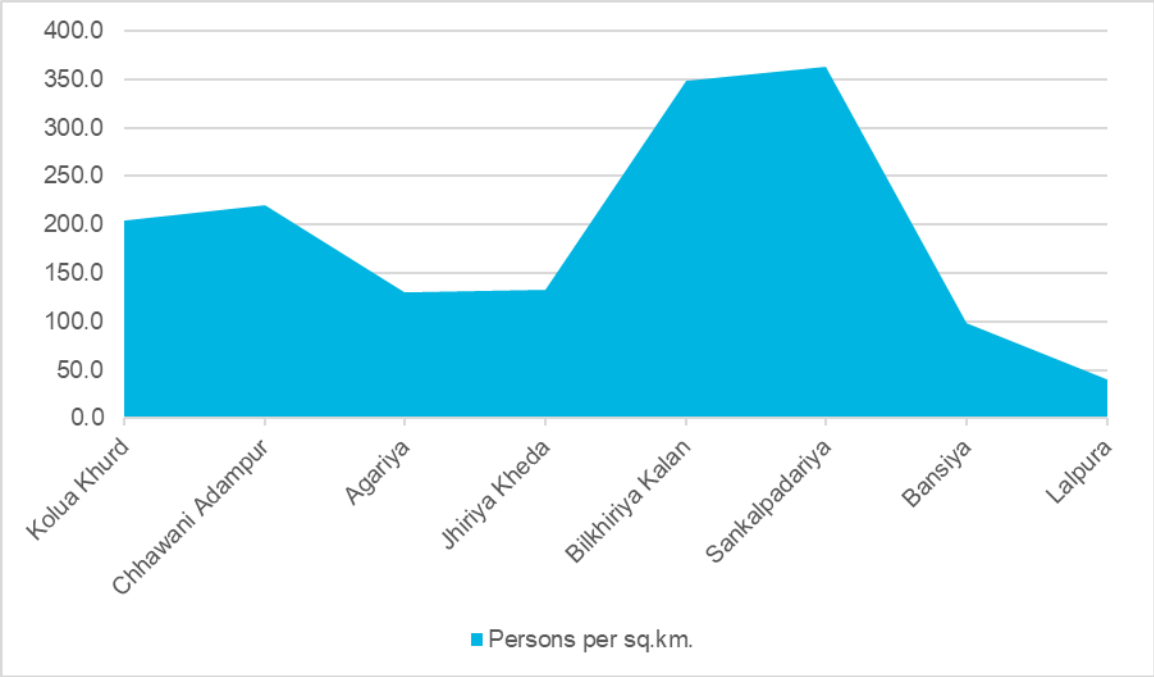


Figure 4-24: Population density in the study area

Source: Census of India 2011

The highest density is in Sankalpadariya and Bilkhiriya villages in the buffer zone of the study area. The settlement closest to the project site that is Agriya Nagar is being displaced due to a proposed NTPCL Project and all the households (nearly 70 at present) are likely to be rehabilitated elsewhere within the tehsil.

4.4.4.2 Scheduled Caste and Scheduled Tribe Population

About 23% of the total population in the study area belongs to Scheduled Caste community, and 6.9% belongs to Scheduled Tribe community. Chhawni Adampur is the village with highest share of its population (16.5%) that falls under the SC community and Sankalpadariya village has the highest (3.4%) ST community population in the study area. A similar trend of SC and ST population is recorded at the tehsil and district levels too. Huzur tehsil has 14% of SC population and 3% of ST population, whereas Bhopal district has 15% of SC population and 2.9% of ST population. Madhya Pradesh state has 15.6% of SC population aligning with the same pattern as other lower administrative levels; however, the state records 21% of its total share falling under ST community, which is the highest proportion of STs among all other village, tehsil, and district levels.

[21] Population Projection Report 2011-2036 by Census of India

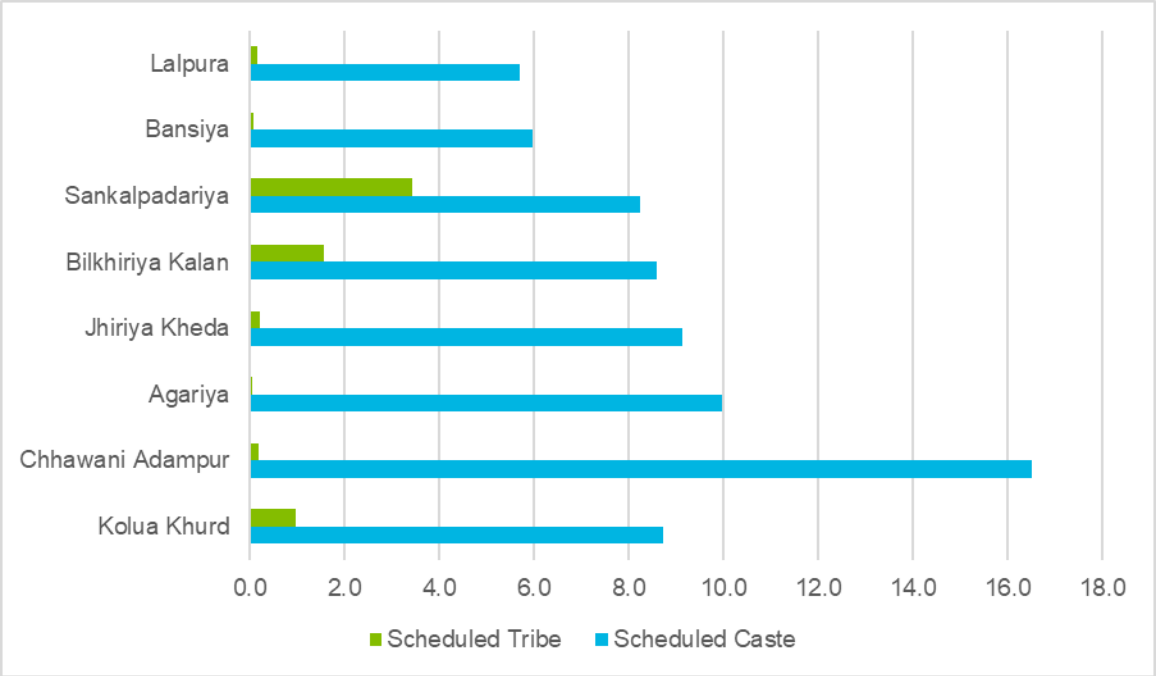


Figure 4-25: Percentage of SC and ST Population (percentage)

Source: Census of India 2011

There are 5 households belonging to Gond tribal families, located in the Agriya nagar settlement, part of Chhawni Adampur village for administrative purposes. Gonds are categorised as Particularly Vulnerable Tribal Groups (PVTG) by the Government of India for their backward status compared to all other tribal groups that is defined by isolation from the non-ST community and distinct culture among other factors. There is lack of clarity on whether these households are also part of the NTPCL rehabilitation program or not. Some of the other ST communities in the study area are Moghiya, Meena, and Seheriya. The caste groups under SC population in the study area include Khuswaha, Jatap, Mehra, Arvar communities.

4.4.4.3 Family Size and Sex Ratio

Average family size in the study area is 4.1 persons. The family size in Huzur tehsil and Bhopal district is 4.7 persons each and 4.8 persons per family in Madhya Pradesh overall. Therefore, the study area along with being sparsely populated, also has smaller families compared to the average in tehsil, district, and state levels.

The figure below shows the sex ratio across study area.

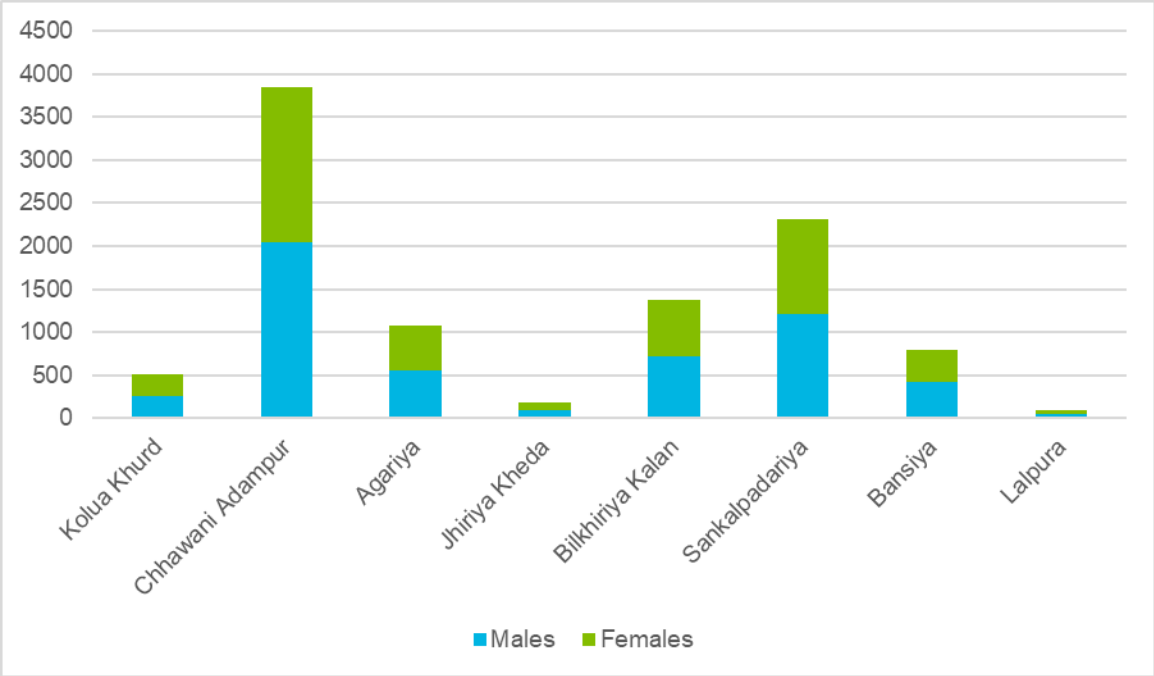


Figure 4-26: Sex Ratio (number of males and females)

Source: Census of India 2011

There are 1056 females per 1000 males in the study area. The sex ratio in Huzur tehsil and Bhopal district is 920 and 918 females per 1000 males, respectively. The state marked a sex ratio of 931 females per 1000 males. The sex ratio in the study area is greater than the average ratio across all its higher administrative levels. Within the study area, highest sex ratio is recorded in Chhawni Adampur village at 1072 females per 1000 males, followed by Sankal padariya village at 1051 females per 1000 males. The lowest sex ratio is recorded in Lalpura village at 1046 females per 1000 males. Even the lowest sex ratio in the study area is higher than the average ratio at the tehsil and district levels.

4.4.4.4 Literacy Rates

The literacy rate of the study area is 53.8%. Females comprise of 39% of the total literates, while 45% of total females are literates; showing a scope of major improvement in both overall and female literacy rates. The literacy rate in Huzur tehsil is 72% and female literacy rate is 45%. The same in Bhopal district is 68% and 65% respectively. Madhya Pradesh state recorded 59% of total literates while 51% of female literates. The female literacy rates are consistently low across study area, tehsil and the state. Apart from Huzur tehsil which marks 72% of its population being literate; the study area, district, and state level literacy rates are significantly low.

4.4.5 Working Population and Occupations

Less than half of total population (42%) in the study area is engaged in work, out of which 69% are males and 31% are females. Out of the total workers, 65% find work for more than six months in a year and they are referred to as *main workers*. Whereas the rest of workers get to work for maximum six months, in one year – these are referred to as *marginal workers*. While the data shows that a large section of total workers (65%) finds work for major part of the year, this involves out-migration to other districts and even to other states e.g. Rajasthan for daily wage work at construction sites, roadside restaurants, labour work on others' farms etc. At least 10-15 households from all villages, majority households from Sankalpadariya village and entire population from Haripura hamlet migrate every year for minimum 3 months and as long as 8 months in search of work. These families usually include the landless and the marginal landowners.

Out of the main workers, 78% are males and 22% are females. However, this record is observed to have changed in the last few years, as many women were seen working in all occupations including farming, shopkeeping, labour work, brick kilns etc. In contrast to the male-female ratio among main workers, marginal workers show a larger proportion (56%) of females than males (44%).

Farming among the landowners and agriculture labour work among the landless are two primary occupations of people living in the study area, followed by labour work at brick kilns, shopkeeping, and casual work found during migration. Few people are employed at government jobs, which include teacher in government schools, staff at Bhopal municipal corporation etc. People in the study area engage in livestock rearing; however, that is limited to consumption of milk at household level and not practiced as an income generation activity. Some of the animals reared by people include cattle, buffalos and goats.

Since 2017, whence the municipal corporation dumping yard was established (at which is the current project site); the study area has attracted in-migration of workers from Gujarat and other tehsils of Bhopal to work as rag pickers. There are presently more than 250 rag pickers working on the segregation of dry waste at the site. These includes women, children, and men. They mainly collect plastic and sell it for INR 18/- per kg. They live in temporary huts near the project site and spend nearly 8 months of a year living here working at the dumping yard.

Table 4-21: Working Population (percentage)

Sr N	Location	Total Workers	Main workers					Marginal workers				
			Total	Cultivators	Agricultural Labourers	Household Industry Workers	Other workers	Total	Cultivators	Agricultural Labourers	Household Industry Workers	Other workers
1.	Madhya Pradesh state	43.5	71.9	36.2	29.2	2.9	31.8	28.1	18.4	62.7	3.5	15.4
2.	Bhopal district	36.6	81.4	8.4	7.8	2.6	81.2	18.6	8.7	31.1	3.8	56.4
3.	Huzur tehsil	35.8	84.2	4.4	4.6	2.8	88.3	15.8	5.9	16.8	4.1	73.3
	Core Zone											
4.	Kolua Khurd	43.1	86.4	25.3	11.8	0.0	62.9	42	2.4	4.8	0.0	92.9
5.	Chhawni Adampur	41.8	81.4	10.2	17.0	3.1	69.7	474	2.3	15.4	1.1	81.2
	Buffer Zone											
6.	Agariya	36.2	87.7	49.5	45.6	0.3	4.7	47	12.8	78.7	2.1	6.4
7.	Jhiriya Kheda	46.1	88.5	21.3	0.0	1.3	77.3	13	7.7	0.0	0.0	92.3
8.	Bilkhiriya Kalan	40.4	88.5	7.3	2.8	4.2	85.6	81	3.7	6.2	3.7	86.4
9.	Sankalpadariya	41.2	83.0	17.1	15.3	2.7	64.9	839	1.5	56.4	1.4	40.6
10.	Bansiya	39.5	87.3	52.3	44.5	0.0	3.2	0	0	0	0	0
11.	Lalpura	39.0	91.9	2.1	93.6	4.3	0.0	0	0	0	0	0

Source: Census of India 2011

The main and marginal workers are further divided into four (4) groups each consisting of Cultivators[1], Agricultural Labourers[2], Household Industry Workers[3], and Other workers[4]. In the study area, 'other workers' form the majority of workforce both among main and marginal workers. Cultivators and Agricultural Labourers are similar in proportion, among main workers (with the exception of Lalpura village in the buffer zone).

All landowners in the study area engage in two seasons (*kharif and rabi*) of farming, accounting for availability of work for major part of the year. So, it can be assumed that cultivators among main workers represent landowning farmers. Individuals from marginal landholding families and landless families engage as agricultural labourers on others' farmlands. There are more marginal landowners and landless individuals compared to medium landowners in the study area. As a result, there is more demand for work than availability of work in the farm sector. Evidently there is larger representation of agricultural labourers among marginal workforce (who work for only few months in a year) than among main workforce (who find work for major part of the year).

There are less than 5% of workers engaged in household industry work in the study area.

Lalpura and Bansiya are anomalies, because majority of people in Bansiya village own land. Therefore, people in Bansiya (as cultivators) and people from Lalpura (as agricultural labourers) have availability of work throughout the year. The data shows no presence of marginal workers in these villages. And the proportion of 'other workers' in Bansiya and Lalpura villages is merely 3% and 0% respectively.

4.4.6 Land Use and Landholding Pattern

The total geographics area of the study area is 8,381 ha. The geographically largest village in the study area is Chhawni Adampur, in the core zone, followed by Agariya, Bansiya, and Sankalpadariya villages in the buffer zones. The smallest village is Jhiriya Kheda in the buffer zone of the study area.

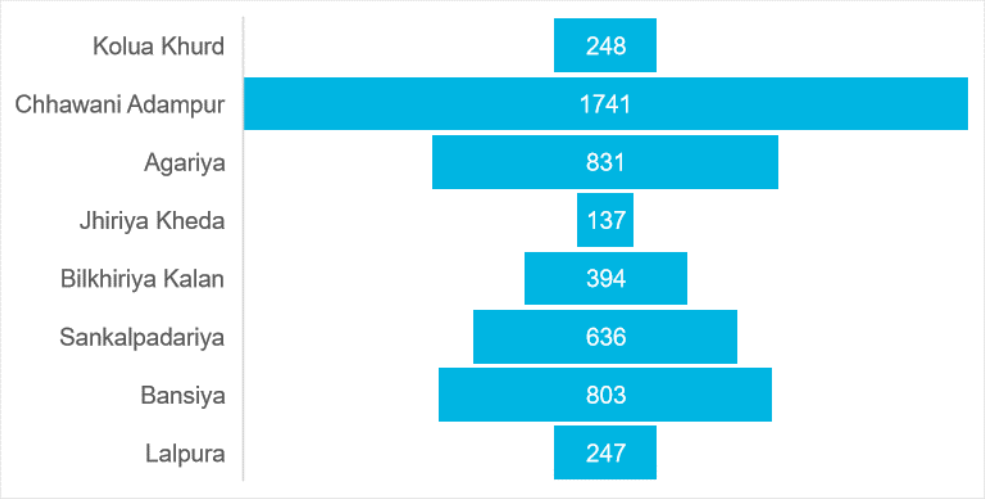


Figure 4-27: Total geographical cover of the study area

Source: Census of India 2011

Agriculture and Forests occupy the largest proportion of land in all villages of the study area that accounts for more than 90% of total area in 2 villages, between 75-85% of total area in 5 villages, and 62% of total area in a

[1] A person was considered working as cultivator if he or she was engaged either as employer, single worker, or family worker in the cultivation of land owned or held from Government or from private person or institution for payment in money, or in kind or on the basis of sharing of crops. Cultivation also included supervision or direction of cultivation.
[2] A person who worked on another person's land for wages in money, kind or share of crop was regarded as an agricultural labourer.
[3] Household Industry was defined as an industry conducted by the head of the household himself or herself and/or by the members of the household at home or within the village in rural areas and only within the precincts of the house where the householder lives in urban areas. The larger proportion of workers in household industry consists of members of the household including the head. This industry is not run on the scale of registered factory. Household industry relates to production, processing, servicing, repairing, or making and selling (but not merely selling) of goods.
[4] All workers i.e., those who had been engaged in some economic activity during the year preceding numeration and who were not cultivators or agricultural labourers or household industry workers were termed as other workers. The type of workers that came under this category included factory workers, plantation workers, those in trade, commerce, business, transport, mining, construction, political or social work, all government servants, municipal employees, teachers, priests, entertainment artists, etc. In fact, all persons who work in any field of economic activity, other than cultivation, agriculture labour or household industry, were covered in this category.

village. The rest of the area is occupied by Non-agriculture and Cultivable waste lands. Non-agricultural use comprises of buildings, roads and railways or under water e.g. rivers and canals, and land put to use other than agriculture. Cultivable waste land refers to land available for cultivation, but not cultivated during the last five years or more in succession including the current year for some reason or the other. Such land may be either fallow or covered with shrubs and jungles, which are not put to any use. They may be accessible or inaccessible and may lie in isolated blocks or within cultivated holdings.

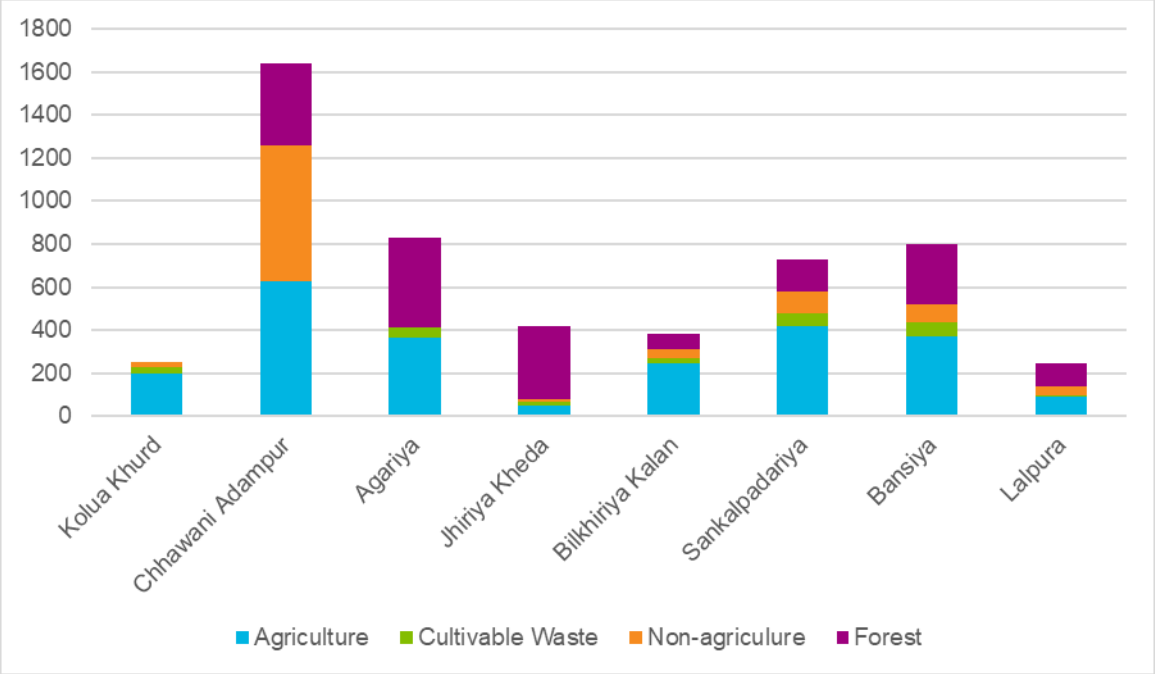


Figure 4-28: Land Use Pattern Of The Study Area

Source: Census of India 2001

As of 2001, an average of 12% of land across study area villages, which can be cultivated was not being cultivated. In other words, the proportionate share of Cultivable Wastes out of a total area under Agricultural and Cultivable wastes ranges between 6% and 27%, deriving an average of 12% area that despite of being available for agriculture is not put to agricultural use. Since, statistics after 2001 are not available, the latest trend of what proportion of total cultivable land is used for agriculture, cannot be known.
This pattern has an exception of Chhawni Adampur village; wherein the entire land available for agriculture is being used for agriculture.

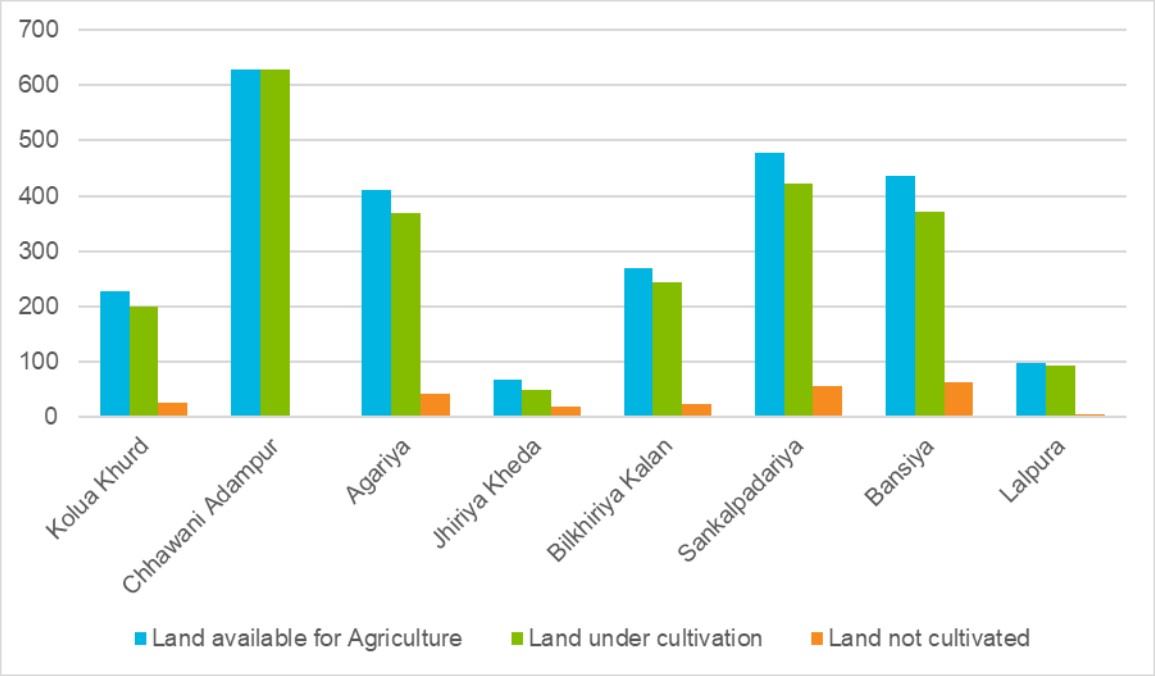


Figure 4-29: Cultivable Waste

Source: Census of India 2001

The two villages in the core zone of the study area show a contrasting pattern of irrigated and un-irrigated area. In Kolua Khurd the proportion of irrigated land is significantly higher than un-irrigated land whereas in Chhawni Adampur, the proportion of un-irrigated land is greater than irrigated land. In the buffer zone, 5 out of 6 villages have recorded larger area under irrigation, while 1 village (Agariya) has a similar pattern as Chhawni Adampur.

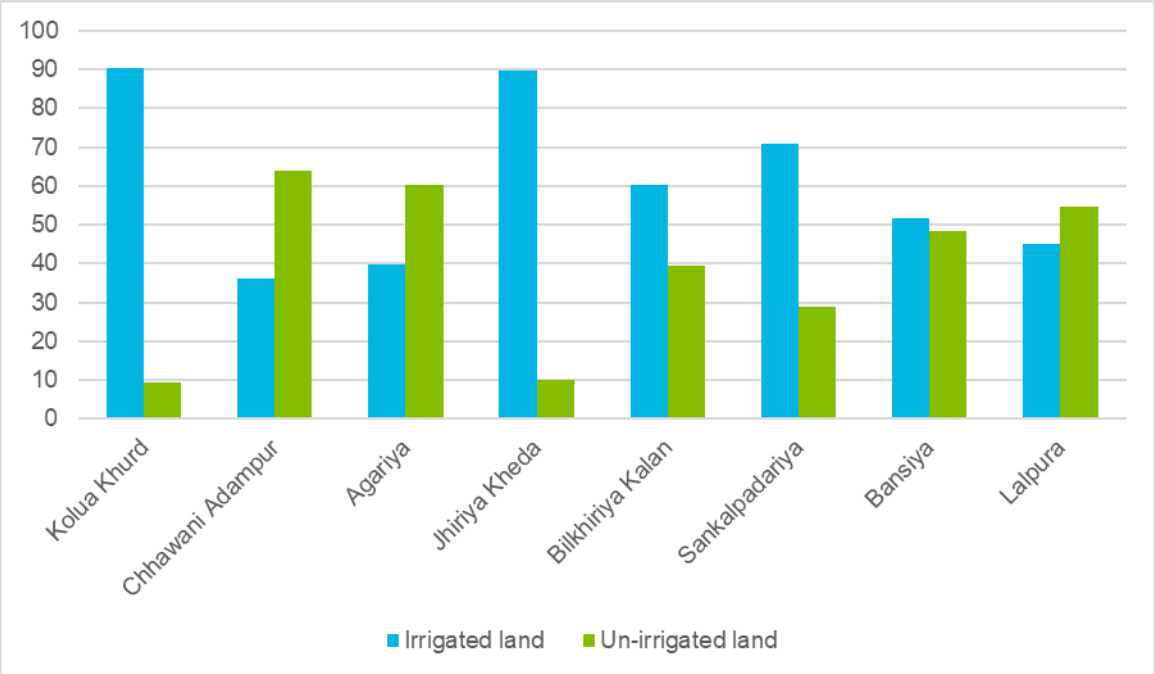


Figure 4-30: Irrigated and Non-irrigated land

Source: Census of India 2001

Jhiriya Kheda village being closest settlement to the canal shows highest amount of irrigated land. This pattern continues to Kolua Khurd village in the core zone of the study area. The village is located at one of the lowest

elevations of 1495 ft among all the villages in the study area, seconded only by Bansiya (1478 ft) located at far south to the study area.

Landholding in the study area ranges between 2 and 5 acres, therefore, the study area has marginal and small landowners. This includes people belonging to Scheduled Tribe community who were allotted land for farming by the government. While majority of ST families do not own any land. There is a large section of landless households in the study area, majority of which are formed by families from SC and ST community. The landless constitute 10-15 households in Jhiriya Kheda village, 20-25 households in Sankalpadariya village, 100 households in other hamlets of Kolua Khurd gram panchayat. In other villages too, approximately 10-15 households are landless.

4.4.7 Social Infrastructure: Education

The study area falls under Phanda block for education-related administrative purposes in the government records. There are total 253 government educational institutes and 196 private educational institutes in the entire block.

The study area has 17 government schools and 11 private schools between the primary and higher secondary standards. There is also a college for bachelor's degree in education, commerce, and arts. However, there are no locals studying in the college due to lack of higher secondary education which is a pre-requisite for further education at a college level.

Table 4-22: Formal education infrastructure

Sr N	Location	Government				Private			
		Primary	Upper Primary	Higher Secondary	Total	Primary	Upper Primary	Higher Secondary	Total
					Block				
1.	Phanda – Rural	-	-	-	253	-	-	-	196
					Core zone				
2.	Kolua Khurd	5	1	0	6	0	0	0	0
3.	Chhawni Adampur	2	2	0	4	0	6	0	6
					Buffer zone				
4.	Agariya	2	1	0	3	0	1	0	1
5.	Bilkhiriya Kalan	2	1	0	3	2	2	0	4
6.	Sankalpadariya	1	1	1	1*	0	0	0	0

Source: Census of India 2011
**Note: All standards in one school.*

There are more government schools in the study area than there are private schools. There is at least one government school for primary and upper primary levels in every village. Whereas, private schools in the study area mostly offer upper primary level education and the schools are concentrated in villages with larger population only.

The locals prefer to send their children to private schools; however, those who cannot afford the school fees enrol their children in public schools. At the time of enrolment, the male-female ratio is reportedly equal; however, after 5th standard, boys tend to drop out and after 8th standard girls drop out. The reason behind boys dropping out is understood to be lack of interest in formal education and lack of employment opportunities in the nearby areas where education could be beneficial. Instead, majority teenage boys begin supporting their family financially by engaging into daily wage work locally and in other states. Girls tend to attain the highest level of education available within the vicinity of their village; therefore, lack of higher secondary and college education in the area is one of the key reasons behind them dropping out. Similar to boys, girls too start working at an early age to support their families financially.

4.4.8 Social Infrastructure: Health Care

The study area falls under Phanda block for health-related administrative purposes in the government records. The block has 2 Community Health Centres, 4 Primary Health Centres, and 33 Sub-Primary Health Centres. Although there are no records of how many of these government health-care facilities fall within or nearby the study area; based on consultations with the villagers, there is 1 PHC and 2 Sub-PHCs in the study area. The locals prefer to visit the private clinics and hospitals at the city (~15 km) instead of the government facilities. The key reason being government facilities also tend to charge fees for consultations and treatments.

4.4.9 Social Infrastructure: Water

Tube wells and bore wells is the key source of drinking water in the study area. The wells are dug up to 350 ft deep, and water is available at 70-80 ft depth as recorded. During summer season, the water levels deplete increasing pressure on the groundwater resources. Majority of these are sources-shared, made available by the gram panchayat. During summer seasons, the private well owners allow neighbours to fetch water using their sources. The study area heavily depends upon the canal connected to Ghoda Pachad dam for its irrigation needs; while only few farmers have private tube wells, that are mainly used for meeting drinking and other water requirements.

Since late 2017, the Bhopal Municipal Corporation (BMC) has begun periodically providing water to the Kolua Khurd and Agariya nagar settlements, after complaints about contamination of groundwater resources due to the municipal waste dumping yard located in their proximity. However, this provision is not permanent in nature.

5. Stakeholder Mapping & Engagement

5.1 Introduction

Stakeholder mapping refers to the process of identifying individuals or groups having influence over a project and assessing the effects of their actions on the project. Stakeholder mapping helps in identifying the different stakeholders as primary or secondary based on the degree of influence on a project and by analysing the stakes or interest each of them has in the project and the way both the stakeholder group as well as the project can benefit from each other.

Stakeholder identification and their inclusion in the decision-making process is critical in prioritizing, analysing and addressing issues; and developing management systems and mechanisms to address their respective concerns as well as apprehensions. This also helps in instilling trust within stakeholders regarding the project.

AECOM team visited the project site from 16th – 19th May 2022. The team was able to conduct consultations with stakeholders in 8 villages of the study area. For the purpose of the project, stakeholder mapping has been carried out with the following objectives.

- Identify relevant stakeholder groups
- Study the profile and characteristics and the nature of stakes each stakeholder group has;
- Assess their respective influence levels on the project; and
- Appreciate the issues and concerns as well as the expectations from the project that each group possesses.

5.2 Stakeholder Consultation and Disclosure Requirement for the project

The disclosure of project information and consultations with stakeholders has been increasingly emphasized by project finance institutions and government regulatory bodies. A brief overview of the requirements of public disclosure and stakeholder consultation applicable to this project is provided in table below.

Table 5-1: Overview of Disclosure and stakeholder consultation requirement

Institution/ Regulatory Body	Reference Regulation/ Standard	Requirements
IFC	PS-1	• Community engagement is to be undertaken with the affected communities and must be free of external manipulation, interference, or coercion, and intimidation. • Furthermore, in situations where an affected community may be subject to risks or adverse impacts from a project, the proponent must undertake a process of consultation so as to provide the affected communities with an opportunity to express their views on the project risks, impacts, and mitigation measures, as well as allow the proponents to consider and respond to them. • *Informed participation:* For projects with significant adverse impacts on affected communities, the consultation process must ensure that free, prior and informed consultation with affected communities occurs and that processes exist to facilitate participation by those affected. • Apart from such a consultation process, the project proponents are also to establish a Grievance Redressal Mechanism, which will allow the affected communities' concerns and grievances about the project proponent's environmental and social performance to be received and allow for steps to be taken to resolve the same • *Broader stakeholder engagement*: The proponent must identify and engage with stakeholders that are not directly affected by the project but those that have

Institution/ Regulatory Body	Reference Regulation/ Standard	Requirements
		established relationships with local communities and/or interest in the project – local government, civil society organizations, etc. – and establish a dialogue.

5.3 Stakeholder Categorisation

A stakeholder is "any identifiable group or individual who can affect the achievement of an organization's objectives or who is affected by the achievement of an organization's objectives"[1]. Stakeholders thus vary in terms of degree of interest, influence and control they have over the project. While those stakeholders who have a direct impact on or are directly impacted by the project are known as **Primary Stakeholders,** those who have an indirect impact or are indirectly impacted are known as **Secondary Stakeholders**. Keeping in mind the nature of the project and its setting, the stakeholders have been identified and listed below.

Table 5-2: Stakeholder Group Categorisation

Stakeholder Groups	Primary Stakeholders	Secondary Stakeholders
General Community	• Persons living in the core zone of the defined study area	• Persons living in the buffer zone of the defined study area
Businesses in the Community	• Shopkeepers in the core zone of the study area • Resort near BMCWPP	• Civil Society/ Local NGOs
Government Bodies	• Water Works Department, Huzur, • Bhopal Municipal Corporation (BMC)	• College near the waste management site

5.4 Approach and Methodology of Stakeholder Analysis

The significance of a stakeholder group is categorized considering the magnitude of impact (type, extent, duration, scale and frequency) or degree of influence (power and proximity) of a stakeholder group and urgency/likelihood of the impact/influence associated with the particular stakeholder group in the project context. The magnitude of stakeholder impact/influence is assessed taking the power/responsibility[2] and proximity[3] of the stakeholder group and the group is consequently categorized as negligible, small, medium or large. The urgency or likelihood of the impact on/influence by the stakeholder is assessed in a scale of low, medium and high. The overall significance of the stakeholder group is assessed as per the matrix provided below:

Table 5-3: Stakeholder Significance and Engagement Requirement

Magnitude of Project's Impact on Stakeholders	Classification	Stakeholder's influence on the Project		
		Low	Medium	High
	Negligible	Negligible	Negligible	Minor
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Urgent
	Large	Moderate	Urgent	Urgent

1. Freeman, R. and Reed, D. (1983). Stockholders and Stakeholders: A new perspective on Corporate Governance. *California Management Review.* pp. 88 – 106.
2. Power/Responsibility: Those stakeholders to whom the organisation has, or in the future may have, legal, financial, and operational responsibilities in the form of regulations, contracts, policies or codes of practice.
3. Proximity: indicates stakeholders that the organisation interacts with most, including internal stakeholders, those with long-standing relationships and those the organisation depends on its day-to-day operations.

5.5 Stakeholder Analysis

Table below has been used to classify the identified stakeholders (directly or indirectly impacting the project) in accordance to their levels of significance on the project. The influence and priority have both been primarily rated as:

High	***High Significance:*** This implies a high degree of influence of the stakeholder on the project in terms of participation and decision making or high priority to engage with the stakeholder;
Medium	***Medium Significance:*** Which implies a moderate level of influence and participation of the stakeholder in the project as well as a priority level to engage the stakeholder which is neither highly critical nor are insignificant in terms of influence; and
Low	***Low Significance:*** This implies a low degree of influence of the stakeholder on the project in terms of participation and decision making or low priority to engage that stakeholder.

The intermediary categories of low to medium or medium to high primarily imply that their influence and importance could vary in that particular range subject to context specific conditions or also based on the responses of the project towards the community.

The coverage of stakeholders as stated above includes any person, group, institution or organization that is likely to be impacted (directly or indirectly) or may have interest/influence over project. Keeping this wide scope of inclusion in stakeholder category and the long life of project, it is difficult to identify all potential stakeholders and gauge their level of influence over project at the outset of the project. Therefore, the project proponent is advised to consider this stakeholder mapping as a live document which should be revised in a timely manner so as to make it comprehensive for any given period of time.

Table 5-4: Stakeholder Analysis & Engagement*

Sr N	Stakeholder type	Stakeholder group	Stakeholder Profile	Stakeholder's concerns / Impact of existing waste dumping facility and Project or influence on the stakeholders	Expected impacts from the Project	Magnitude of impacts of existing waste dumping facility and Influence on stakeholders by project	Magnitude of Impacts and Influence on project by stakeholders	Stakeholder Significance
1	Primary	Persons living in the core zone of the defined study area	The area within 2 km radius around the project site, is considered as core zone. There are total 4 settlements in the core zone, out of which 2 (Padariya and Kolua Khurd) fall under one revenue village named Kolua Khurd and 2 (Haripura and Subhash nagar) fall under another revenue village named Chhawni Adampur. The population of the core zone as per Census 2011 is approximately 4,000. The persons belong to Khuswaha, Jatap, Moghiya, Banjara, and Gond communities. Farming and Casual labour work are two key occupations of people living in the core zone. The entire community (other than the residents of Haripura who do not own land for agriculture) uses the water from Ghodapachad dam for irrigation purposes.	The existing BMCWPP facility has a few impacts on this stakeholder group: a) The settlements are located at a lower elevation than the project site. b) Depending upon the wind direction at different times of the day, reportedly an odour from the project site drifts to the settlements in the core zone, creating an unpleasant environment to live in. c) The core zone settlements being the closest to the project site, also observe increased mosquitos and flies in the area, leading to an unhygienic and unhealthy environment for the locals. d) The project site will need an access road that shall passes from within or near the core zone villages, leading to air pollution and traffic congestion on village roads, exposing the locals to risks of road accidents too. The community is not aware about the project, its water requirements or the source of its water. Therefore, there were no concerns shared regarding the dam	The stakeholder group's key concerns from existing project are related to impact on natural resources, hygiene, and ambience of the area. The stakeholders in this area also share a concern about ground water quality as there is reported change in colour & odour of ground water. These ground water sources are source of water for drinking, cooking, cleaning and other purposes. With this upcoming BioCNG project, impacts of existing BMCWPP - waste dumping facility such as odour, mosquitos, etc. are expected to be reduced. As the BioCNG project will be built with proper solid & liquid waste management planning, the impacts related to any soil & ground water pollution are not expected from this project and it will help in reducing such impacts due to unscientific dumping of biodegradable waste.	Large	Low	Moderate
2	Secondary	Persons living in the	The area within 2 km to 5 km of distance around the	Villagers in Sankalpadariya, Jhiriya Kheda, and Chhawni	The stakeholder group's key concerns from existing project are	Medium	Low	Low

Sr N	Stakeholder type	Stakeholder group	Stakeholder Profile	Stakeholder's concerns / Impact of existing waste dumping facility and Project or influence on the stakeholders	Expected impacts from the Project	Magnitude of impacts of existing waste dumping facility and Influence on stakeholders by project	Magnitude of Impacts and Influence on project by stakeholders	Stakeholder Significance
		buffer zone of the defined study area	project site is considered buffer zone. There are total 7 settlements in this area. While Subhash nagar hamlet under Chhawni Adampur village falls under core zone, a larger part of the revenue village falls under buffer zone. The total population of buffer zone is 9,667 persons. The persons belong to Bajara, Meena, Prajapati, Dhobi, Thakur, and Khuswah communities. Similar to core zone, farming and casual labour work are two key occupations of people living in the buffer zone. The community uses the water from Ghodapachad dam for irrigation purposes.	Adampur also face the issue of odour, mosquitoes and flies, that creates an unpleasant, unhygienic environment to live in. The community is not aware about the project, its water requirements or the source of its water. Therefore, there were no concerns shared regarding the dam.	related to impact on natural resources, hygiene, and ambience of the area. With this upcoming BioCNG project, impacts of existing waste dumping facility such as odour, mosquitos, etc. are expected to be reduced. As the BioCNG project will be built with proper solid & liquid waste management planning, the impacts related to any soil & ground water pollution are not expected from this project and it will help in reducing such impacts due to unscientific dumping of biodegradable waste.			
3	Primary	Commercial vendors in the core zone of the study area	There are at least 2-3 shops in every village of the core zone. Through these shops locals sell groceries, vegetables, medicines, snacks & tea, mobile recharge services etc. Considering lack of industrial employment opportunities in the area, combined with small landholdings, commercial vending is one of the few viable livelihood	The project has attracted workers from other parts of Bhopal as well as from neighbouring states to the core zone. About 60-70 families from Gujarat have come to live in the hamlet of Chhawni Adampur village. In addition, there are many fleet workers visiting the project site everyday. The workers purchase meals and things of day-to-day use from the local shops leading to increased sales for the commercial vendors.	Key expectation of this stakeholder is to continue this part of income in the future too. The project, during this construction and operation phase, will need manpower. These manpower can purchase meals and things of day-to-day use from nearby shops.	Medium	Low	Low

Sr N	Stakeholder type	Stakeholder group	Stakeholder Profile	Stakeholder's concerns / Impact of existing waste dumping facility and Project or influence on the stakeholders	Expected impacts from the Project	Magnitude of impacts of existing waste dumping facility and Influence on stakeholders by project	Magnitude of Impacts and Influence on project by stakeholders	Stakeholder Significance
			alternatives in the study area.					
4	Primary	Resort near the waste management site	A farmhouse turned resort is in the core zone of the study area at 600 m towards the south-east direction of the project site. It has 10 rooms, each accommodating 3-4 guests, and a permanent staff of 20 persons.	The resort has 2 bore wells within their premises. The water from these bore wells used to cater to all of their non-drinking/cooking needs including plantation, fishpond, sanitation facilities etc. However, since last 6 months the resort has been sourcing water from a privately owned bore well from Agariya village, located further away in the south-east direction from the project site. Since last 6 months the resort has reduced their dependency on the bore wells because of their concern that ground water pollution is happening due to the existing dumping ground (where the project site is also located) and have begun purchasing water from a nearby private bore well owner. Reportedly, there have been several instances of guests checking out soon after coming for a stay at the resort, owning to the odour from the project site.	The stakeholder's main concerns are losing customers, relying on external groundwater sources permanently and odour. With this upcoming BioCNG project, impacts of existing waste dumping facility such as odour is expected to be reduced. As the BioCNG project will be built with proper solid & liquid waste management planning, the impacts related to any soil & ground water pollution are not expected from this project and it will help in reducing such impacts due to unscientific dumping of biodegradable waste.	Medium	Low	Low
5	Primary	Water Works Department, Huzur	The water works department that looks after Huzur tehsil is in-charge of managing the water storage and water distribution from the Ghoda Pachad dam.	The main purpose of managing the Ghoda Pachad dam is to ensure water supply to villages for irrigation. Ghoda Pachad dam capacity is 11.57 MCM (million cubic metre). 0.55 MCM of water is allocated for integrated solid waste management facility for Bhopal Municipal Corporation.	As the dam is mainly supplying water for irrigation, the diversion of water for non-irrigation purposes can put pressure on the department to maintain water supply for original purpose. The department also will need to answer any grievances from the local farmers after reduction in water supply.	Small	Medium	Low

Sr N	Stakeholder type	Stakeholder group	Stakeholder Profile	Stakeholder's concerns / Impact of existing waste dumping facility and Project or influence on the stakeholders	Expected impacts from the Project	Magnitude of impacts of existing waste dumping facility and Influence on stakeholders by project	Magnitude of Impacts and Influence on project by stakeholders	Stakeholder Significance
				Out of 0.55 MCM, the Project will be supplied with 42 KLD of water.	However Project water demand is only for 42 KLD.			
6	Primary	Bhopal Municipal Corporation (BMC)	The project is being developed to help the BMC manage the wet waste collected from the area under its jurisdiction. The waste volume is 850 tonnes per day out of which nearly 55% constitutes for wet/green waste.	The project will be a positive development for the BMC, as it does not only plan to process the waste, but also turn it into Bio-CNG and shall generate by-products such as compost and liquid fertiliser that can be used or distributed by BMC. Presently, existing dumping facility do not have segregation of biodegradable waste which could be reason for impacts faced by nearby communities like odour, unhygienic conditions, pollution, etc. Reportedly, BMC is providing drinking water to the neighbouring villages on alternate days.	The stakeholder's key expectations will be for the project to be able to process the biodegradable waste with support in reduction of negative impacts from existing dumping ground like hygiene, smell, resource pollution, etc.	Large	High	High
7	Secondary	College near the waste management site	The college is a new establishment in the study area that shifted its base here one year ago. It has a total staff of 28 and up to 500 students. The college is at around 1.5 km distance towards south of site and is at lower elevation than site.	The college uses two groundwater sources, a bore well, which is the primary source and an open well, which is the secondary source used in case of needs. The stakeholder's main concern at present is the odour drifting from the existing dumping site, that creates an unpleasant environment. And they are concerned about water quality.	With this upcoming BioCNG project, impacts of existing waste dumping facility such as odour is expected to be reduced. As the BioCNG project will be built with proper solid & liquid waste management planning, the impacts related to any soil & ground water pollution are not expected from this project and it will help in reducing such impacts due to unscientific dumping of biodegradable waste	Medium	Low	Low
8	Secondary	Rag pickers working at the dumping yard	About 250-300 persons from the state of Gujarat migrate to the study area every year to work at the dumping yard. The persons are engaged on daily wage	Their main concern is continued opportunity of employment at the dumping yard, as this is their primary source of income.	Their work is not related to the project as the project shall handle the wet waste and the stakeholders do not work with wet waste.	-	-	-

Sr N	Stakeholder type	Stakeholder group	Stakeholder Profile	Stakeholder's concerns / Impact of existing waste dumping facility and Project or influence on the stakeholders	Expected impacts from the Project	Magnitude of impacts of existing waste dumping facility and Influence on stakeholders by project	Magnitude of Impacts and Influence on project by stakeholders	Stakeholder Significance
			basis. They collect and segregate plastic, metal from the dry waste section of the dumping yard and sell it for income. They include men, women, as well as children and live in temporary hutment close to the waste dump areas.	They are also concerned about protecting themselves from injuries while working with the dry waste, which sometimes leads to cuts and bruises, especially to the feet and legs while finding their way in the waste.				
9	Secondary	Forest Department	The Project is situated near Forest Land	As informed by the forest department officials, Forest land was situated near the Project Site and was used for illegal stone quarrying. The forest department officials confirmed the presence of Vultures in the Study Area. However, no information on their numbers were available with them. The Forest Department is also not involved in any monitoring of vulture populations in or near the Project Site	No impacts are anticipated on this stakeholder	Nil	Nil	Low

***Note**: It is significant to note that the stakeholder analysis is based on the current situation. The stakeholder influence on the project is dynamic and may change during the project life. Consequently, the stakeholder analysis needs periodical reassessment and updating.*

Summary of overall stakeholder influence is presented in the below.

Table 5-5: Summary of overall stakeholder influence

Stakeholder Category	Relevant Stakeholders	Magnitude of Influence/Impact	Likelihood of Influence on/by Stakeholder	Overall Rating of Stakeholder Influence
Primary stakeholder	Persons living in the core zone of the defined study area	Large	Low	Moderate
	Commercial vendors in the core zone of the study area	Medium	Low	Low
	Resort near the waste management site	Medium	Low	Low
	Water Works Department, Huzur	Medium	Low	Low
	Bhopal Municipal Corporation (BMC)	Small	Medium	Low
Secondary Stakeholders	Persons living in the buffer zone of the defined study area	Large	High	High
	College near the waste management site	Medium	Low	Low

6. Analysis of Alternatives

This section of the report presents the analysis of the alternatives considered for the proposed Bio-CNG project. The following scenarios have been considered.

- No Project Scenario;
- Alternate Location for the Proposed Project;
- Alternate Technology for Proposed Project; and
- Alternate fuel option
- Benefits of projects.

6.1 No Project Scenario

Due to the increase in population, industrialization, economic growth and urbanization there has been a significant increase in the municipal solid waste generation not only in India but worldwide. As per the annual report for the year 2020-2021 under Solid Waste Management Rules, 2016 presented to the Madhya Pradesh Pollution Control Board, total quantity of solid waste generated in the state was 8022.5 TPD out of which 7235.5 TPD was collected, 6472 TPD was treated and 763.5 TPD was in landfill. State has been doing good which gets consolidated by the statement that Madhya Pradesh was ranked 3rd best performing state in 100 urban local bodies (ULBs) category in Swachh Bharat Survekshan 2020.[29]

According to the consolidated annual report for the year 2016-2017 on implementation of solid waste management rules, 2016 total waste generation in the state was about 6773 TPD out of which 5480 TPD waste is collected, 1141TPD is treated and 4339 TPD is landfilled.[30]

Above data suggests that there is going to be an increase in the solid waste quantity in future. Comparing the above two reports, there has been an increase of approx. 1250 TPD and 18.5% in 4 years. Even though the state is working on processing the waste to the best extent possible, there seems to be a progressive deficit. Madhya Pradesh state has quite some number of solid waste processing facilities which includes 130 composting, 33 vermi-composting, 3 biogas and 47 RDF/pelletization facilities. Bhopal amongst all these categories has a composting and bio-gas facility.

The proposed project is an opportunity to utilize the energy potential in the biodegradable waste of the area. A "No Project Scenario" assumes that the project will not be carried out. A "No Project Scenario" will not solve the issue of increasing waste and managing it. An alternative without the project is undesirable, as it would worsen the waste management scenario, which would be a constraint on economic growth. Additionally, continued use of traditional fossil fuel sources for automobile / industrial fuel will have adverse effect on the environment.

6.2 Alternate Location for Proposed Project

Bio-gas plants are energy generating projects and are dependent on the availability of wet waste. The Bhopal city receives good amount of waste as compared to other regions in the state. As per the report published by Madhya Pradesh pollution control board in the year 2017 which includes the anticipated waste generation for the year 2019 and among all the clusters Bhopal district generates most waste of 1055 TPD.[31]

The proposed site was allotted for the project by BMC. As per the report shared by the client, previous 13 acres of land parcel considered for project consisted of 182000 cum of legacy waste present below ground level, 2 lakhs cum of waste below ground, 50% of the land falling in the low-lying area with no structures to be removed whereas the current site under consideration has negligible legacy waste below ground, 72000 cum of waste

[29] A-R-SWM-20-21-final-report.pdf(mp.gov.in)
[30] https://cpcb.nic.in/uploads/MSW/MSW_AnnualReport_2016-17.pdf
[31] SWM-Annual-Report2016-17.pdf(mppcb.nic.in)

above ground, 90% of the land falling in the low-lying area and 2 existing rooms to be removed along with 33kV and 11 kV powerlines which need to be removed out of the plant area.

The following additional criteria are considered for site selection:

- The proposed site is located away from major settlements;
- The proposed land is a government land;
- The site does not fall under any reserved or protected forests and;
- No environmentally sensitive features such as water bodies, forests, archaeological sites are located in the immediate site surroundings.

Therefore, considering all the above details of the location and site settings, the current site is more suitable option compared to earlier land parcel for the project.

6.3 Alternative Technology for Proposed Project

The increasing industrialization, urbanization and changes in the pattern of life, which accompany the process of economic growth, give rise to generation of increasing quantities of wastes leading to increased threats to the environment. In recent years, technologies have been developed that not only help in generating substantial quantity of decentralized energy but also in reducing the quantity of waste for its safe disposal.

The Ministry is promoting all the technology options available for setting up projects for recovery of energy in the form of Biogas/BioCNG/Electricity from agricultural, Industrial and urban wastes of renewable nature such as municipal solid wastes, vegetable and other market wastes, slaughterhouse waste, agricultural residues and industrial/STP wastes & effluents.

Technologies available

Waste-to-Energy (WTE) technologies to recover the energy from the waste in the form of Electricity and Biogas/Syngas are given as below:

Biomethanation:

Biomethanation is anaerobic digestion of organic materials which is converted into biogas. Anaerobic digestion (AD) is a bacterial fermentation process that operates without free oxygen and results in a biogas containing mostly methane (~60%), carbon dioxide (~40%) and other gases. Biomethanation has dual benefits. It gives biogas as well as manure as end product. This technology can be conveniently employed in a decentralized manner for biodegradation of segregated organic wet wastes such as wastes from kitchens, canteens, institutions, hotels, and slaughterhouses and vegetables markets.

The biogas generated from Biomethanation process can be burned directly in a gas boiler/burner to produce heat for thermal application industries and cooking or burnt in a gas engine to produce electricity. Alternatively, the biogas can be cleaned to remove the carbon dioxide and other substances, to produce BioCNG. This can be injected into the national gas grid to be used in the same way as natural gas or used as a vehicle fuel. By using Biomethanation process, 20-25kgs of Cattle dung can generate about 1m3 of biogas and further 1m3 of Biogas has potential to generate 2 units of electricity or 0.4kgs of BioCNG.

Incineration:

Incineration technology is complete combustion of waste (Municipal Solid Waste or Refuse derived fuel) with the recovery of heat to produce steam that in turn produces power through steam turbines. The flue gases produced in the boilers have to be treated by an elaborate air pollution control system. The resultant bottom ash from incineration of solid waste can be used as construction material after necessary processing while the fly residue can be safely disposed of in a landfill. This technology is well established technology and has been deployed in many projects successfully at commercial level in India to treat solid wastes like Municipal Solid Waste and Industrial solid Waste etc. and generate electricity.

Gasification

Gasification is a process that uses high temperatures (500-1800°C) in the presence of limited amounts of oxygen to decompose materials to produce synthetic gas (a mixture of carbon monoxide (CO) and hydrogen (H2)). Biomass, agro-residues, Segregated MSW and RDF pellets are used in the gasifier to produce Syngas. This gas further can be used for thermal or power generation purposes. The purpose of gasification of waste is to generate power more efficiently at lower power level (< 2MW) and also to minimize emissions and hence it is an attractive alternative for the thermal treatment of solid waste.

Pyrolysis

Pyrolysis uses heat to break down combustible materials in the absence of oxygen, producing a mixture of combustible gases (primarily methane, complex hydrocarbons, hydrogen, and carbon monoxide), liquids and solid residues. The products of pyrolysis process are: (i) a gas mixture; (ii) a liquid (bio-oil/tar); (iii) a solid residue (carbon black). The gas generated by either of these processes can be used in boilers to provide heat, or it can be cleaned up and used in combustion turbine generators. The purpose of pyrolysis of waste is to minimize emissions and to maximize the gain.

Thus, bio methanation becomes the favourable option for municipal solid waste. As per the information received from the client, from organic waste, oversize & pre-treatment rejects and solids from the digestor effluent will be processed in the plant to make into FOM (Fermented Organic manure) i.e. high quality compost. Compost will improve soil organic carbon of agricultural soil in the region and also reduce chemical fertiliser requirement and boost efforts on organic farming. Coconut shells in the incoming waste will also be shred and used a biofuel in-plant or sold. The main product from the plant is Bio-CNG which is a green eco-friendly fuel which will be used in automobiles and industries. This will reduce the consumption of associated fossil fuels and the associated GHG emissions and environmental impacts.

6.4 Alternative Fuel Option

Bio-CNG is a renewable fuel obtained by purifying biogas – in contrast to other non-renewable source of energy. So, this will add to the existing renewable energy target of Bhopal city. Also it can help the state in supporting initiative which Madhya Pradesh Power Management Company Limited (MPPMCL) issued an expression of interest where they invited New/Innovative technologies of power generation based on all forms of renewable energy to be set up in the state of Madhya Pradesh dated 2nd July 2021.[32]

Bio- CNG when compared with the LPG has various advantages:

- Calorific value of Bio-CNG and LPG are nearly the same.
- LPG takes up more Oxygen (1:25) against Bio-CNG (1:11).
- LPG is heavier than air, hence, settles down and is a potential fire threat. Bio-CNG being lighter gets dispersed in the air preventing any dangerous situation.
- Bio-CNG is cleaner than LPG and does not leave any soot deposit.
- Bio-CNG more economical than commercial LPG.

Having all these advantages, the project can serve as an alternate fuel possibility for the area.

6.5 Greenhouse Gas (GHG) Emissions

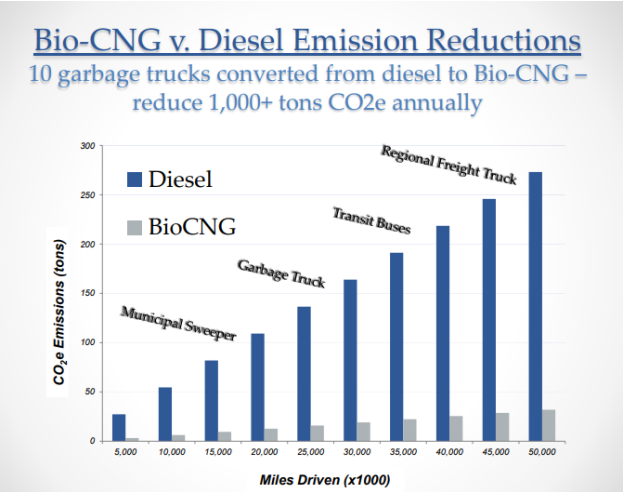
CNG produced from biogas has the lowest greenhouse gas (GHG) emissions of any vehicle fuel; its carbon footprint is lower than CNG produced from natural gas, lower than liquid natural gas (LNG) produced from natural gas, and even lower than LNG produced from biogas. It is also lower than ethanol and biodiesel[33].

Few data on BioCNG projects have found switching from diesel to Bio-CNG leads to a carbon emission saving of over 85%. For Organic waste fraction of MSW derived Bio-CNG this figure could be up to 100% because by capturing methane from the likes of organic waste fraction of MSW it reduces the amount of methane emitted into atmosphere, which is much more harmful than carbon dioxide (up to 34 times more warming). By averting

[32] EoI-Innovative Technologies based on RE for Power Generation_16072021.pdf (mp.gov.in)
[33] https://www.biocng.us/cng-fuel/emissions-reductions/

emissions and converting the captured methane into carbon dioxide, the equivalent amount of carbon dioxide emissions to atmosphere can be reduced.[34]

By displacing Diesel with an renewable fuel, the net amount of carbon dioxide in the atmosphere remains unchanged too[35]. As per case study of 'Landfill Biogas to CNG –The Future is Now', 10 garbage trucks converted from diesel to Bio-CNG – reduce 1,000+ tons CO2e annually.[36]



6.6 Benefits of Project

The key benefits of project are presented below:

- Farmers benefit from very affordable organic fertilizer. The need for organic fertilizer is only going to grow in the Indian economy
- Employment generation among local population due to setup of the unit.
- The greenhouse gas emissions will be significantly reduced leading to a cleaner and greener area
- Reduced load on landfills
- No health hazard caused due to unmanaged organic waste and the leachate thus generated

Other environmental and social benefits of the project are highlighted in the below:

- Likely Avoidance of GHG Emission (CO_2 equiv. TPA): 91133
- Agricultural Land area improved from compost use: around 14600 acres
- Agricultural land benefitted from 1 paddy & 1 wheat crop in a year using only liquid fertilizer as source of nitrogen: around 5770 acres
- Equivalent urea use that can be avoided due to liquid nitrogen fertilizer: 1154043 kg/year

[34] BIO-CNG Fuels - CNG Services
[35] https://www.cngservices.co.uk/bio-cng/
[36] https://www.epa.gov/sites/default/files/2016-05/documents/03_voell_presentation.pdf

7. Impact Assessment

This chapter describes the environmental and social impacts identified by accessing the primary and secondary information gathered. Impacts have been identified based on review of available project information, discussions with representatives of the project and the local community, as well as sector-specific professionals and subject experts. Impacts anticipated during the operation phase have also been included and classified.

Additionally, this chapter evaluates the significance of each identified impact based on the collective severity of its spread, duration, intensity, and nature. Mitigation measures have been suggested for each identified impact evaluated as significant.

7.1 Impact Assessment Criteria

Identified impacts have been appraised along the criteria of spread, duration, intensity and nature. As presented in ***Table 7-1***, each appraisal criterion is further classified based on the level or type of its spread, duration, intensity, or nature, while stating the defining limit of each level or type.

Table 7-1: Impact Assessment Criteria

Criteria	Sub-Classification	Defining Limit	Remarks
Spread: Refers to area of direct influence from the impact of a particular project activity.	Local spread	impact is restricted within the footprints of the Project boundary	In case of biodiversity, the farthest directly impacted habitat or ecosystem service would be considered
	Medium Spread	impact is spread up to 2 km around the project area	In case of biodiversity, the farthest directly impacted habitat or ecosystem service would be considered
	High spread	impact is spread beyond 2 km from footprint boundary of the Project	In case of biodiversity, the farthest directly impacted habitat or ecosystem service would be considered
Duration: Based on duration of impact and time taken by an environmental aspect to recover to its original state	Short Duration	when impact is likely to be restricted for a duration less than 2 years	In case of biodiversity, the anticipated recovery time of impacted habitats or ecosystem services would be considered
	Medium Duration	when impact extends up to five years	In case of biodiversity, the anticipated recovery time of the impacted habitats or ecosystem services would be considered
	Long Duration	when impact extends beyond five years	In case of biodiversity, the anticipated recovery time of the impacted habitats or ecosystem services would be considered
Intensity: Defines the magnitude of impact	Low intensity	when changes in the prevailing (baseline) environmental/social conditions does not exceed 20%	In case of biodiversity, percentage of loss or degradation of habitats and/or ecosystem services would be considered
	Moderate intensity	when changes in the prevailing (baseline) environmental/social conditions does not exceed 30%	In case of biodiversity, percentage of loss or degradation of habitats and/or ecosystem services would be considered
	High intensity	when changes in the prevailing (baseline) environmental/social conditions exceeds 30%	In case of biodiversity, percentage of loss or degradation of habitats and/or ecosystem services would be considered

Nature: Refers to whether the effect is considered beneficial or adverse	Beneficial	-	Useful to Environment and Community
	Adverse	-	Harmful to Environment and Community

Table 7-2 presents the Impact Significance Matrix applied in order to assess the overall significance of the impacts appraised as per the Impact Assessment Criteria outlined in Table 7-1.

Table 7-2: Impact Significance Matrix

Spread	Duration	Intensity	Overall Significance	
			Adverse	Beneficial
Local	Short	Low	Insignificant	Insignificant
Local	Short	Medium	Minor	Minor
	Medium	Low		
	Medium	Medium		
Medium	Short	Low		
Local	Long	Low		
Local	Short	High	Moderate	Moderate
Local	Medium	High		
Local	Long	Medium		
Medium	Short	Medium		
Medium	Medium	Low		
Medium	Medium	Medium		
Medium	Long	Low		
Medium	Long	Medium		
High	Short	Low		
High	Short	Medium		
High	Medium	Low		
High	Medium	Medium		
High	Long	Low		
Local	Long	High	Major	Major
Medium	Short	High		
Medium	Long	High		
High	Short	High		
High	Medium	High		
High	Long	Medium		
High	Low	Low		
High	Low	High		

7.2 Impact Identification

Table 7-3 below presents the Activity-Impact Interaction matrix for pre-construction, construction, operation and decommissioning phases of the project, based on environmental and occupational health and safety variables. Each of the impacts identified has been further discussed and corresponding mitigation measures have been proposed.

Table 7-3: Activity- Impact Interaction Matrix – Pre-Construction, Construction, Operation & Decommissioning Phase

Project Activities	Receptors/Resources										
	Aesthetics and Visual impacts	Ambient Air and Noise Quality	Soil Quality	Surface and Ground water Quality	Water resources	Land Use	Traffic & Transport	Ecological Impact	Social-Economic Impact	Community Health and Safety	Occupational Health and Safety Hazards
Pre-Construction and Construction Phase											
Land Procurement											
Site Clearance, Site Levelling and Grading											
Sourcing and Transportation of Construction Materials and equipment											
Storage and Handling of Raw Materials and Debris											
Civil Works (site preparation, RCC foundations, access road construction etc.)											
Operation of DG sets											
Constructing tanks, laying of Pipelines connecting digester and purifier etc.											
Handling and Disposal of Wastes											
Operation Phase											
Bio-CNG plant operation											
Maintenance of ancillary facilities such as store, yard, site office											
Site Maintenance and Security											
Handling and Disposal of Waste											
Material Handling and Storage											
Water Requirements for employees											
Repair and Maintenance of unit											
Inspection and maintenance of pipelines											
Decommissioning Phase											
Removal of all the tanks, conveyor belts and units											
Removal of Foundations											
Site Restoration											
Waste Management											
Material Handling and Storage											
Loss of Employment											

7.3 Environmental Impacts and Mitigation Measures

7.3.1 Impacts during the Pre-construction and Construction Phase

During the construction phase, the following activities may have impacts on environment:

- Site Preparation;
- Excavation and levelling;
- Hauling of earth materials and wastes;
- Cutting and filling;
- Erection of concrete and steel structures;
- Painting and finishing;
- Clean up operations; and
- Landscaping

7.3.1.1 Ambient Air Quality

Anticipated Impacts

The impact on ambient air quality is anticipated due to the various Project activities. Project components such as site preparation, biogas units' installation, pipeline laying, internal road network, transportation of raw materials and porta cabins, along with land clearing, levelling, excavation, grading activities, vehicle movement and Diesel Generator (DG) sets operation. The main impacts associated with construction activities will be:

- **Dust Generation:** resulting from earthworks such as levelling, grading, excavation works, piling and movement of vehicles across dirt/unpaved roads, especially during windy conditions[37].
- **Exhaust Emissions:** Exhaust emissions of SO_2, NO_X, CO, CO_2 and PM_{10} will be attributed predominantly to the construction of the plant, road activities such as movement of trucks and vehicles during construction works and point source emissions from the batching plant to be installed during construction phase. These emissions will be restricted to the project area and are anticipated to be generated in medium concentration. However, it will be dispersed rapidly within the area leading to an impact of low significance. This implies the effects to be of localized nature and temporary which indicates that any deterioration in air quality at project location is unlikely to be significant and is expected to be transient.

Mitigation Measures

- The ERMPL and contractors shall ensure the reduction and control of air emissions from construction activities by minimizing dust from material handling sources.
- Loading and unloading of raw materials should be carried out in the most optimum way to avoid fugitive emissions. Dust protectors like sheets can be used to cover the area of dust generator.
- Sprinkling of water as and when required to be carried out by the respective contractors to suppress dust from construction activities, but it only be done on waste free areas so that leachate formation can be omitted.
- Best practices such as halting of activity during sustained strong winds should be opted for. It shall be ensured that all stockpiles are covered, and waste storage areas if any are provided with enclosures to minimize dust from open area source.

[37] We understand that site will be allotted to client devoid of any waste.

- Stock piling and storage of construction material will be oriented after considering the predominant wind direction.
- Vehicles engaged for the project will be required to obtain "Pollution under Control" (PUC) certificates.
- Sufficient stack height needs to be provided to D.G. sets (if used during construction) as per the Central Pollution Control Board (CPCB) norms.
- Speed of vehicles on the village road and on the internal roads shall be limited to 10-15 km/hr in order to reduce fugitive dust emissions.
- Allow only covered transportation of material.
- Cease or phase down work if excess fugitive dust is observed, or there is any community grievance related to dust. Investigate the source of dust and ensure proper dust suppression.

Significance of Impact

Table 7-4: Impact Significance – Ambient Air Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Ambient Air Quality	Without Mitigation	Medium	Short	High	Moderate
	With Mitigation	Local	Short	Medium	Minor

7.3.1.2 Soil Quality

Anticipated Impacts

The project site was MSW dumping site and hence majority of area do not have native soil. Few areas, mainly project surroundings area like road will be developed where there is chance of generation of loose topsoil. The intensity of the impact can be considered as low. Soil contamination may result due to accidental spillage and inappropriate storage of diesel or transformer oil, etc.

Mitigation Measures

Following mitigation measures are recommended to reduce impact on soil due to project activities.

- Provide appropriate storage of topsoil, if generated, in an isolated and covered area to prevent its loss during high wind and runoff.
- Allow only covered transportation of material.
- Construction debris to be reused in paving on site approach road to prevent dust generation due to vehicular movement.
- Re-vegetation to be done in the area after the completion of construction, in order to reduce the risk of soil erosion.
- Any excess soil will be disposed as per the C&D Waste management Rules-2016 after obtaining the permission from the authorities.

Significance of Impact

Table 7-5: Impact Significance – Soil Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Soil Quality	Without Mitigation	Medium	Short	Medium	Moderate
	With Mitigation	Medium	Short	Low	Minor

7.3.1.3 Impact on Surface and Ground Water Quality & Quantity

Anticipated Impacts

Surface Water:

As per preliminary site observation, from North to South ground level difference is around 5m with Northern side at a higher altitude and majority of the land is low-lying area. There is a small seasonal drain running from north to south inside eastern boundary of proposed project site.

Any diversion of the natural drain can affect water drainage and usage in downstream. Accidental spillage of hazardous materials, leachate formation during rainy season, improper disposal of solid, liquid and hazardous wastes.

Any spillage of chemicals or disposal of waste in or near surface seasonal streams can cause water pollution issues in nearby areas.

Ground Water:

During the construction phase, labours and workers will be staying on a rent basis and will be using water facility provided by BMC near Gate No.1. Hence generation of domestic wastewater from the labour camp and portable cabins is not anticipated. Improper disposal of sewage and wastewater from worksite can contaminate the groundwater resources in the area.

Project site fall under Phanda block which s categorised as semi-critical for ground water withdrawal. The project intends to use bottled water for drinking purpose during construction phase. The other water need will be fulfilled by taker water supply from local vendors.

Mitigation Measures

- Construction of dedicated storm water drains for reduction any contamination to runoff due to project activities.
- Storm water drains shall be designed considering natural topography and as per required regulations. No material storage, septic tanks, waste storage, labour resting areas, etc. will be located close to this drain and workers will be trained on not using this drain or disposal of any waste in it.
- Proper drainage to be provided for wastewater generated and shall be treated on Site septic tanks and soak pits as per the specifications in IS 2470:1995 (Part I and Part II);
- Periodic monitoring shall be carried out to ensure that the wastewater is not finding its way into surface and ground water;
- All solid wastes such as construction debris, used or waste oil, paint cans, etc. will be stored on impervious surface in secure location to avoid soil and groundwater contamination;
- Paved impervious surface and secondary containment to be used for fuel and chemical storage tanks;
- Loading and unloading protocols should be prepared and followed for diesel oil and used oil;
- Leak proof holding tanks for sanitary wastewater to protect the ground water level.
- Install an effective leachate barrier system that isolates Project-related leachates from the soil and groundwater around the Project Site.

Significance of Impact

Table 7-6 Impact Significance – Impact on Surface and Ground Water Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Surface and Ground Water Quality	Without Mitigation	Medium	Short	Medium	Moderate
	With Mitigation	Medium	Short	Low	Minor

7.3.1.4 Impact on Water Availability

Anticipated Impacts

In the construction phase, water will be required for civil work during the preparation of concrete, construction of the foundation and building structure of all facilities, as well as for worker needs water for their daily use. The Project's water use has the potential to result in decreased water available for other users, particularly in the Project area where known water resource challenges.

The primary source of water in the nearby Padariya village is provided by the BMC. BMC supplies daily 4-5 tankers (approximately 10k ltrs.) which is used for daily activities and drinking both. However, it was also noted that Kolua Khurd village residents use bore well water for daily use.

Mitigation Measures

Water for construction activities, flushing and washing purpose will be met through water supplied from Ghoda Pachad dam. It is to be ensured that pre-treatment is provided to ground water, in case ground water is utilized for drinking. It is also suggested that the quality of water from the bore wells is monitored regularly to check for contamination, if any. The other mitigation measures to be implemented are:

- Conservation of water to be undertaken at all project locations and ancillary facilities and if possible, recycling and reuse of water to be taken utilising every opportunity.
- Restoration plan to accommodate the loss of groundwater to be undertaken, if used.
- Amount of water taken from dam should be kept as minimum as possible though 0.55 MCM of water is allocated for integrated solid waste management facility for Bhopal Municipal Corporation and the Project will need only 42 KLD of water which will be provided by BMC[38]

Significance of Impact

Table 7-7: Impact Significance – Impact on Water Availability

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Water Availability	Without Mitigation	Medium	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor

7.3.1.5 Ambient Noise Quality

Anticipated Impacts

Construction will cause increased noise levels due to activities such as grading, excavating and drilling for foundations, concrete batching, construction of ancillary structures, and operation of diesel generators, material movement and site clean-up, and construction equipment like dozer, scrapers, concrete mixers, generators, pump, rock drills etc. There is potential for disturbance to habitations in proximity of construction site. Movement of traffic during night hours can also disturb the local community. Approximately 90 – 92 dB (A) of noise is expected to be generated from construction activities which will attenuate to less than 45 dB(A) i.e. night time prescribed noise level at about 80 m. The nearest habitations from the proposed Project site include Padariya Village, which is approximately 1 km away.

Additionally, the baseline noise levels measured indicated that the baseline noise is above the Residential Zone standard limits.

Mitigation Measures

- In case of complaints of uncomforting noise received from the inhabitants of nearby settlements there should be considered possibility of putting noise barriers near to the receptor.
- Mobile noise sources such as cranes, earth moving equipment and heavy goods vehicles (HGVs) shall be routed in such a way that there is minimum disturbance to receptors.

[38] As per the information shared by clients

- EPC Contractor shall instruct their safety officers to arrange for inherently quiet construction equipment and machines to maintain the noise level to minimum.
- Only construction activities with low noise shall be carried out during night-time (i.e. no use of machinery).
- The hours of operation for specified pieces of equipment or operations, especially mobile sources operating through community areas should be limited.
- It is also to be ensured that no village road will be utilized for movement of equipment during the night-time. All loud and sudden noises will be avoided wherever possible and fixed noise sources shall be located at least 50 m away from the site boundary.
- Rubber padding/noise isolators will be used for construction equipment or machinery.
- Temporary noise barriers shall be provided surrounding the high noise generating construction equipment.
- The personnel involved in high noise generating activities shall be provided with personal protective devices to minimize their exposure to high noise levels.
- Construction vehicles and machinery will be well maintained and not kept idling when not in use.
- Periodic monitoring of noise level should be conducted and compared with the ambient noise standard. It should also be made sure that the levels do not exceed the national ambient air quality standard (NAAQS) level.

Significance of Impact

Table 7-8: Impact Significance – Ambient Noise Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Ambient Noise Quality	Without Mitigation	Mitigation	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor

7.3.1.6 Solid and Hazardous Waste Management

Anticipated Impacts

Construction waste

The construction activities such as site clearance, excavation works, and construction of various units' installation of modules will generate different types of solid and hazardous wastes. The construction demobilization which will entail removal of machinery, and other temporary structures will also result in generation of waste. The following types of wastes will be generated due to construction of the project:

- Domestic solid waste and sewage due to workers;
- Used oil, oil lined containers, oil-soaked rags from generator and other construction machinery;
- Packaging waste such as gunny bags, plastics, etc.;
- Empty paint containers, metal scrap, chemical lined containers etc.; and
- Construction debris.

The construction debris generated due to the construction activities will have the potential for spread to areas outside the project boundary or getting mixed with the outside waste during construction phase. The dust particles from debris generated during construction activities can be carried along with the wind into nearby areas, thereby increasing the particulate matter in the area. However, this will happen only for a temporary period as the construction activities will be for small duration only. Improper disposal of solid waste from the labour camps and lack of proper sanitation facility for labour can lead to unhygienic conditions due to open defecation and spread of diseases in the area. It can also lead to discontent of local community and result in conflicts with the labour engaged at site.

Improper disposal of packaging materials, boxes, plastics, ropes etc. can lead to littering in the construction site and surrounding areas. Hazardous wastes such as used oil from DG sets, lubricants, hydraulic oil etc. can cause contamination of soil and water bodies if adequate precautions for storage, management and handling are not undertaken. Spillage of chemicals such as paints (if any), curing chemicals can lead to contamination of soil.

Previous Waste Dumped on Site

The BMCWPP is established on approximately 45 acres of land and the Project will be developed on only 9 acre of land parcel out of which approximately 6 acres will be part of 45 acres of land of BMCWPP and remaining approximately 3 acres will be adjoining vacant land of Bhopal Municipal Corporation. BMC will clear the site of any waste (both over and under the ground) and hand over site to client for development of project. Considering this, no mitigation measures related to previous waste on site and structural are recommend here.

Mitigation Measures

- The quantity of domestic waste generated daily from the labours will be small and limited as most of the workers will be hired locally.
- Arrangements for collection of garbage in dustbins and daily disposal to the nearest dumpsite shall be made.
- Provision of segregated toilets for male and female workers (if any) in the ratio of 1:15 and 1:10 (toilet to workers) respectively shall be made at the project site in order to maintain hygienic and clean surroundings.
- Washing and bathing areas should be provided with proper drainage system so that wastewater is not accumulated in the project site.
- Disposal of sewage shall be made through a septic tank – soak pit arrangement.
- Waste/used oil generated from generators and construction machinery and equipment, oil lined containers, oil-soaked rags etc. should be stored on paved surface in a secure location at the project site.

- Appropriate secondary containment capable of containing 110 percent of the content of the largest storage tank should be provided.
- The used oil and oil lined containers, which are characterized as hazardous wastes according to *the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016,* should be sold to SPCB approved vendors at frequent intervals.
- All packaging material should also be collected at the storage area and sold to authorized scrap dealers.
- Storage of oil/chemicals shall be undertaken on paved impervious surface and secondary containment shall be provided for fuel storage tanks.
- Construction debris and excavated material to be stored in a confined area to prevent spread by wind or water. The construction debris to be used for backfilling of excavated areas and for foundation works at site.
- Recyclables viz. paper, plastic, glass, scrap metal waste etc. will be properly segregated and stored in designated waste bins/containers and periodically sold to local recyclers. Any recyclable waste should be encouraged to be recycled at the site.

Significance of Impact

Table 7-9: Impact Significance – Waste Storage and Disposal

Aspect	Scenario	Spread	Duration	Intensity	Overall
Waste Storage and Disposal	Without Mitigation	Medium	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor

7.3.1.7 Traffic and Transport

Anticipated Impacts

The construction phase shall involve transportation of construction materials, conveyors, other machineries and mounting structures. The project site can be accessed through NH 146 which runs between Bhopal (connecting NH 46) to Sagar (connecting NH44). It starts in Bhopal at Khajuri Khurd square and travelling 5kms on this NH leads to Kolua Khurd village from where village road start and project site is 1.5 kms approx. from this junction. There are 3 gates provided at the municipal dumping ground facility. Gate no. 1 is currently used for official purposes and as informed will be continued for this purpose only, while Gate no. 3 is used by the loaded vehicles for dumping the carrying waste. Gate no. 2 opens at adjacent ground. This road is a concrete rad connecting project site to NH 146 near Kolua Khurd village and was specifically constructed for this purpose.

It was noted that the road currently being used by the heavy vehicles connecting to Gate No. 2 will be used for carrying all the construction materials and other machineries. The Project construction activities will lead to additional traffic and increased risk of traffic related accidents and industries to community and to workers. The traffic density along the State Highway is moderate and has adequate carrying capacity to accommodate the additional traffic due to the construction activities. However, the village road connecting the NH to Padariya village and further to project site is narrow (~3-5 m wide) and hence if used for project activities will lead to increased vehicular movements which may have adverse impacts in the community due to increased risk of traffic related accidents and injustices and increased pollution.

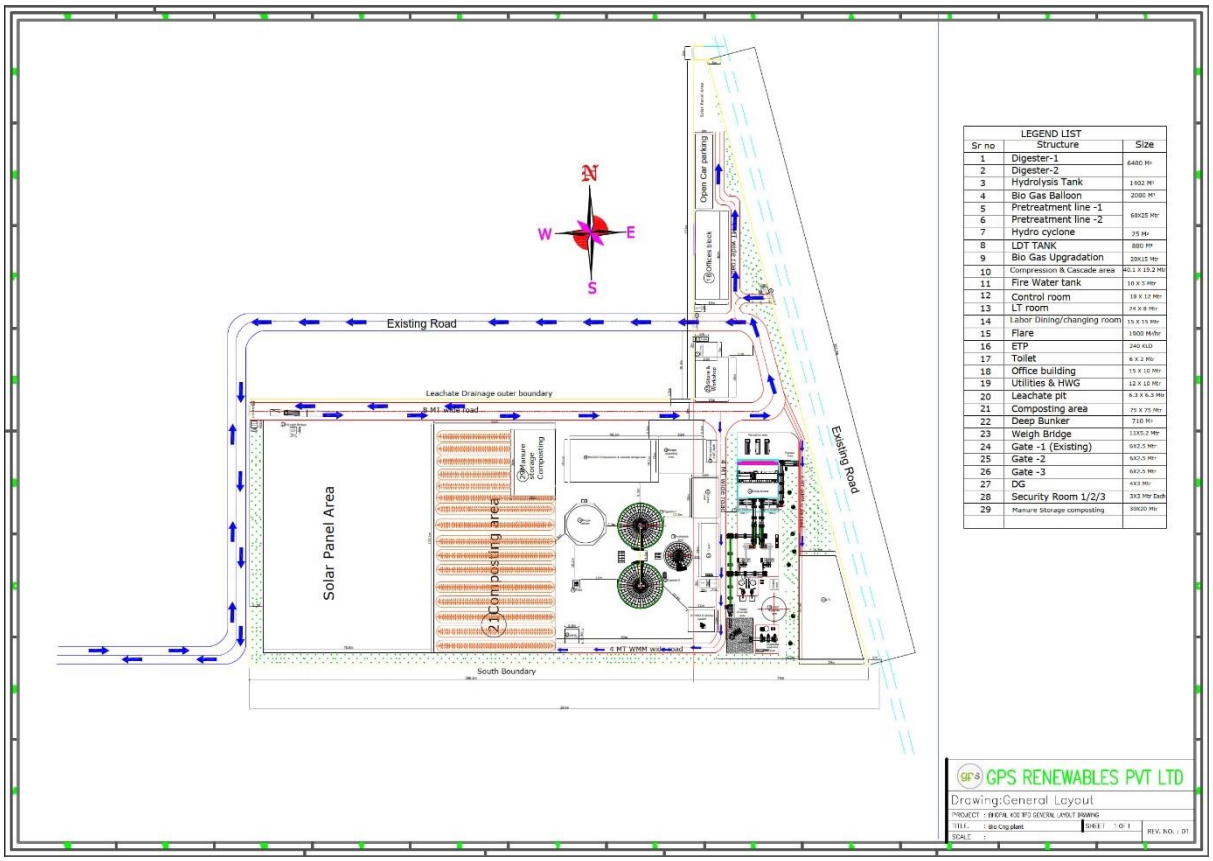


Figure 7-1 Project Layout Map Of Proposed Site

Mitigation Measures

A Traffic Management Plan is required for the management of traffic due to movement of vehicles for transport of equipment and material. Additional traffic on the village road connecting to Project site can be managed by following mitigation measures:

- Only trained drivers with valid license shall be recruited by the EPC Contractor for transfer of material;

- Training program for all the drivers, regarding awareness about road safety and adopting best transport and traffic safety procedures shall be provided before initiation of the decommissioning activities;
- Mitigation measures such as emphasizing on safety amongst drivers, adopting limits for trip duration and arranging driver roster to avoid overtiredness and avoiding dangerous routes and times of day to reduce risk of accident shall also be implemented;
- Regular maintenance of vehicles and use of manufacturer approved parts should be adopted to minimize potentially serious accidents caused by equipment malfunction or premature failure;
- The villagers shall be made aware about the schedule prior to the movement of trucks and transportation in the Project area.

Significance of Impact

Table 7-10 Impact Significance – Impact on Traffic and Transport

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact on Traffic and Transport	Without Mitigation	Medium	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor

7.3.1.8 Occupational Health and Safety

Anticipated Impacts

Occupational Health and Safety (OHS) of workers is important during construction and operation phases where local and migrant workers are involved. The activities included in the construction phase that have potential impact to OHS of workers are land clearance for establishment of temporary structures, access road, mobilisation of equipment and contact with harmful gases or fumes like CO, CH_4, NH_3, H_2S etc.

There are likely to be potential impacts on worker's health and safety due to exposure to risk through the project development activities. The following occupational health and safety risks are frequently present, in particular during the construction phase:

- Mobile vehicles and heavy equipment accidents;
- Heat stress when working in humid and high temperatures;
- Manual handling and musculoskeletal disorders;
- Hand are vibration impacts from concrete breakers, grinders, hammer drills, chipping hammers, chainsaws, scrabbles and needle guns;
- Temporary or permanent hearing loss from noise generated machinery used for excavation or piling work;
- Dermatitis that can rise from contact with small substances such as wet cement and asphalt;
- Tripping due to uneven surfaces and obstacles;
- Falling during working at height;
- Fire due to hot works, smoking and failure in electrical installations; and
- Electrical shocks.
- Presence of gas, odour, leachate, waste, etc. from existing waste on site, if not cleared by BMC

Due to previous waste dump on project land, there is possibility of presence of Methane, Carbon Dioxide, Hydrogen Sulfide, non-methanogenic organic compounds (NMOCs) or leachate. As per details provided by client due to low height of dumping (2 to 3 m) and dumping only for short period (6 months), anaerobic zone would be very small and any quantity of methane generated would be very low.

Mitigation Measures

The above identified risks are typical on any construction site of this nature. Therefore, it is anticipated that the sub-contractor will have the necessary management measures in place to manage potential OHS issues under their responsibility. Appropriate OHS programme and procedures are also expected to be in place to align with the local regulations, as well as IFC PS-2. The procedure will include at minimum, the following measures:

- Develop and implement a Health and Safety (H&S) plan to follow throughout the construction phase;
- Provide occupation health and safety orientation training to all employees and workers consisting of basic hazard awareness, site-specific hazards, safe working practices, and emergency procedures;
- The contractors will be committed to ensure all Health and Safety measures are in place to prevent accidents and reduce the consequences of non-conformance events;
- The contractors will provide training, awareness and supervision to ensure all of its construction workers comply with the OHS procedures;
- The contractor will provide appropriate resources i.e. PPE to workers based on site working and atmospheric conditions;
- An emergency response procedure and infrastructure will be available on Site to ensure provision of first aid for personnel in case of emergency.
- If necessary, the personnel working in poorly ventilated workplaces will be provided with respiratory protective equipment.
- Fire hazard safety norms are required to be strictly followed.
- Site clearance with involvement of BMC before initiating further work.

Heat related Stress

- Heat- related illness can have significant impact on health of the workers engaged at the site. Heat-related illness is a spectrum of disorders due to environmental exposure to heat. It includes conditions such as heat cramps, fainting, convulsion, heat fatigue, rashes, and heat exhaustion as well as the more severe condition known as heat stroke. The heat stress can be due to many factors such as air temperature, humidity, radiant heat, wind speed, workload, physical fitness of the worker, hydration status of the workers and clothing (including PPE that may restrict air flow across the skin and hinder evaporation of sweat).
- Additionally, Ultraviolet (UV) radiation burns occurs when the skin is exposed to UV radiation from been out in the sun or from activities such as welding. The symptoms include reddening and inflammation of the skin and blistering and peeling of the skin in severe cases.

Mitigation Measures

The above identified risks are typical on any construction site of this nature. Therefore, it is anticipated that the EPC contractor will have the necessary management measures in place to manage potential issues under their responsibility. The procedure will include at minimum the following measures:

- Increase air velocity for indoor workers by using natural cross-ventilation from windows and doors or mobile or ceiling fans. This increases both evaporation of sweat and convective heat loss, and may significantly improve thermal comfort at air temperatures as high as 40°C;
- Operate effective general and local exhaust ventilation and air conditioning;
- Avoid non-essential sources of hot ventilation (e.g. air conditioner outlets adjacent to working areas);
- Install a shield between employees and a source of radiant heat such as curtains on windows or other insulating barrier, enclose the heat source, or move the heat source away from employees;
- Provide cooled drinking water as close as possible to the work site;
- Arrange shade for outdoor workers;
- Provide a cool rest area in which workers can take their meal breaks and tea breaks;

- Modify the work schedule or shift times so that outdoor and physiologically demanding work is done in the early morning or late afternoon, when it is generally cooler, and the sun's radiation is less intense than during the middle of the day;
- Allow workers to self-regulate their pace of work. This may involve working continuously at less than full capacity, and/ or working for short periods followed by rest pauses in a cool area;
- Workers should be encouraged to present to work in a well hydrated state, and take frequent small drinks throughout each shift to replace fluid lost through sweating;
- Diuretic Fluids such as tea, coffee, alcohol and some soft drinks should not be used to replenish fluid lost due to heat;
- Use PPE that reduces exposure to ultra violet radiation and heat (such as reflective masks or aprons, large brimmed hat, sunscreen); and
- Workers returning from periods away from hot environments should be given the opportunity to acclimatise before being expected to undertake work in very hot conditions at full capacity.

Significance of Impact

Table 7-11: Impact Significance – Impact to Occupational Health and Safety of Workers

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impact to Occupational Health and Safety of Workers	Without Mitigation	Medium	Short	High	Moderate
	With Mitigation	Local	Short	Moderate	Minor

7.3.2 Impacts during Operation Phase

7.3.2.1 Visual Impacts and Aesthetics

Anticipated Impacts

Visual impacts are assessed with reference to the presence of Bio-gas plant units, reduced vegetation, erection of ancillary facilities. The visual effects are evaluated with reference to passing motorists and fixed settlement, primarily the villages in close proximity to the site.

The Project site is proposed on existing waste dump site. The waste site is visible from considerable distance along the village roads present within the study area. Visual quality of the area resulting from the development of project will improve as the portion of the waste being dumped in ISMW site will be replaced by project setup. Presence of project can provide better visual impact compared to landfill site.

Excess Biogas released during plant breakdown or in any other case of emergency will be burned by flare unit. This can be visually not pleasant.

Mitigation Measures

- The units to be arranged in a systematic manner which will give an aesthetic sense to it.
- Landscaping around project boundary

Significance of Impact

Table 7-12: Impact Significance – Aesthetic and Visual Impacts

Aspect	Scenario	Spread	Duration	Intensity	Overall
Visual and Aesthetics	Without Mitigation	Local	Long	Low	Minor
	With Mitigation	Local	Long	Low	Minor

7.3.2.2 Impact on Soil and Water Quality

Anticipated Impacts Due to Contamination

Compaction of soils nearby and inside the project boundary from increased levelling and grading of areas will result in lower permeability and therefore, decreased infiltration and increased runoff. Without appropriate measures, runoff from these units, compacted areas and hard standing areas in addition to erosion by wind may increase erosion and increase the sediment load in run-off.

Run-off from the plant site with leaked washed wastewater, waste oil, and seepages from hazardous waste stored without secondary containment may affect the ground water quality. Proper septic tanks will be constructed for discharge of wastewater, hence the risk of wastewater runoff into the surface water would be reduced.

Anticipated Impacts Due to Improper Waste Handling

Once the plant is commissioned there will be limited disturbance to soil. With reference to Section 2, solid wastes generated during operation will include domestic solid waste which will mostly be office waste; lubricant, used oil/waste oil and oil contaminated rags. Domestic waste will be collected and disposed of with help local waste collectors.

As segregated waste will be received at facility, there will be no additional waste generation from plant. Any waste received from BMC, which is not suitable for project, will be handed back to BMC.

Mitigation Measures

- Fuel and used oil will be stored in demarcated storage areas with adequate secondary containment and appropriate capacity.
- Spill control and prevention mechanism will be developed, and all the staff will be trained.
- Storage of oil/chemicals shall be undertaken on paved impervious surface and secondary containment shall be provided for fuel storage tanks;
- During the washing and maintenance activities, adequate storage area shall be designed to collect the washed water.

Significance of Impact

Table 7-13: Impact Significance – Impacts on Soil Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impacts on Soil Quality	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	High	Long	Low	Minor

Table 7-14 Impact Significance – Surface Water Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impacts on Surface Water Quality	Without Mitigation	High	Long	Moderate	Moderate
	With Mitigation	High	Long	Low	Minor

7.3.2.3 Impact on Water Availability

Anticipated Impacts

As per the information provided by the Site personnel, the main water supply will be provided by the Bhopal municipal corporation which will be supplied after piping the water from nearby Ghoda Pachad Dam. The total dam capacity is 11.57 MCM (million cubic metre). Currently this water is mainly given for irrigation purpose, 0.11 MCM to ISRO and 0.073 MCM to police facility. It was also noted that 1.85 MCM is allotted for Central Peya Jal Yojna for village drinking water and 0.55 MCM for integrated solid waste management facility.

Total quantity of fresh water required for the project is only 42KLD out of which 2KLD for domestic needs and 40KLD will be required for processing activities.

Mitigation Measures

- Rainwater harvesting system within the plant premises, as feasible
- The water harvested will be stored at the Site and will be used for plant operation, wherever feasible instead of Ghoda Pachad dam water provided by BMC.
- The site office shall be provided with sewage line and the collected sewage shall be channelized to a septic tank with soak pit arrangement.
- Fuel and used oil will be stored in demarcated storage areas with adequate secondary containment and appropriate capacity. Spill control and prevention mechanism will be developed, and all the staff will be trained.

Significance of Impact

Table 7-15: Impact Significance – Impact on Water Availability

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impacts on Water Availability	Without Mitigation	High	Medium	Low	Moderate
	With Mitigation	Medium	Short	Low	Minor

7.3.2.4 Occupational Health and Safety of Workers

Anticipated Impacts due to operations

During the operation phase, the risks will be quite limited due to nature of operation activities; the activities will be limited to guarding and on call and/or onsite technical support (maintenance and cleaning). There will be potential impacts on personnel's health and safety during operation phase due to exposure to risks such as:

- Slipping and tripping;
- Falling during working at height;
- Exposure to hazards such as electric shock and thermal burn hazards;
- Exposure to chemicals, hazardous and flammable materials;
- Exposure to harmful gases like H_2S, CH_4, etc.; and
- Maintenance activities are expected to be carried out in hot weather conditions, thus workers are exposed to dehydration, heat exhaustion and heat stroke.

Also, Pipe failure or any other gaseous leakage can possibly have:

- Short-term effects that can be perceived and may represent a nuisance
- Possible long-term health effects.

The project's operations would require pressurised gas cylinders. The transfer of these cylinders from near the villages makes the locals prone to fire related hazards associated with risks of poor storage and transfer.

Anticipated Impacts Due to Previous Landfill Operation on Project Site

Due to previous waste dump on project land, there is possibility of presence of Methane, Carbon Dioxide, Hydrogen Sulfide, non-methanogenic organic compounds (NMOCs) or leachate. As per details provided by client due to low height of dumping (2 to 3 m) and dumping only for short period (6 months), anaerobic zone would be very small and any quantity of methane generated would be very low.

Mitigation Measures

ERMPL will prepare and implement Occupational Health and Safety Plan (OHSP) with clearly identified roles and responsibilities of the personnel involved within the project. The OHSP to include but not limited to the following: site specific safety plan, electrical safety, fire safety, heat stress, personnel protective equipment, emergency response plan, reporting and investigation and others.

Mitigation measures that will be followed include the following:

- Regular electrical safety training to workers with safety procedures and other safety requirements that pertain to their respective job assignments;
- Implement Lock out/ Tag Out (LOTO) system;
- Use work equipment or other methods to prevent a fall from occurring. Collective protection systems, such as edge protection or guardrails, should be implemented before resorting to individual fall arrest equipment. In addition, safety nets or airbags can be used to minimize the consequences of a fall should it occur.
- Personal Protective Equipment (PPEs) e.g., shock resistant rubber gloves, shoes, other protective gear etc. should be provided to workers handling electricity and related components and monitored that they are used by the employees
- There should be arrangement for hygienic and scientific sanitation facilities for all the labourers working in the site.
- An accident reporting, and monitoring record shall be maintained.
- All joints and penetrations of building structure should be sealed.
- Waterproof/gas resistant geomembrane and passively ventilated underfloor sub-space is recommended as part of protection against human exposure to onsite contaminants.
- Monitoring systems for landfill gas and leachate systems.
- All systems will be designed and operated as per regulations, especially PESO as applicable.
- Regular risk assessment will be conducted including all pressure systems.
- Project specific disaster management plan (DMP) will be developed including on site and offsite elements.
- Inputs from local administration such as police, health facilities, fire station, etc. can be taken for DMP.
- The project is required to develop an off-site emergency plan for safety and security of the community due to any activities induced by the project.
- The project is required to ensure safe storage and transfer measures of the gas cylinders to avoid any fire risks, especially those impacting the local community.
- Firefighting system as per applicable regulations and best practices as storage area will be required for CNG.
- Regular maintenance, inspections and audits of all systems
- Hazard Identification and Risk Assessment for project activities
- QRA and/or HAZOP to be carried out during detailed design stage and the output of the tool should always be presented in a detailed way for various stakeholders

Significance of Impact

Table 7-16: Impact Significance – Occupational Health and Safety of Workers

Aspect	Scenario	Spread	Duration	Intensity	Overall
Occupational Health and Safety of Workers	Without Mitigation	Local	Long	High	Moderate
	With Mitigation	Local	Long	Low	Minor

7.3.2.5 Impact on Air Quality

Excess Biogas released during plant breakdown or in any other case of emergency will be burned by flare unit. This will not be regular activity. There is possibility of impact on air quality and temperature increase due to flaring.

Mitigation Measures

- Client would design and position flaring stack as per wind direction.
- Adequate stack height will be provided
- Flaring stack will be positioned as far away from habitation or vegetation.
- Client will undertake detailed assessment for positioning of flare stack.

Significance of Impact

Table 7-17: Impact Significance – Impacts on Air Quality

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impacts on Air Quality	Without Mitigation	Local	Long	Moderate	Moderate
	With Mitigation	High	Long	Low	Minor

7.3.3 Impacts during Decommissioning Phase

7.3.3.1 Environment and Occupational Health & Safety

Anticipated Impacts

Typical activities during the Bio-CNG facility decommissioning and site reclamation phase include facility removal, breaking up of concrete pads and foundations, removal of access roads that are not maintained for other uses, re-contouring the surface, and re-vegetation.

Dismantling operation however will have impact on environment due to noise and dust arising out of it. During de-installation, a specific strategy shall be adopted to handle each type of item to keep the impact during the actual activity, low. The decommissioning will also have social impact. The impact due to decommissioning on power, social and environmental scenario will be guided by applicable laws and guidelines. The key issues associated with demobilization phase will include:

- Issue of loss of job when the workers will be asked to leave;
- Improper disposal of demolition waste and obsolete machineries will lead to contamination of soil and discontent of community;
- Demolition activity is anticipated to generate dust and exhaust emissions which can be carried downwind to nearby habitations;
- Risks associated with health and safety issues such as trip and fall, release of harmful gases like methane, electrical hazard etc.;
- The decommissioning activities of dismantling the plant units and removing the ancillary facilities can lead to increased noise levels;
- Depending on the technology and chemicals used, chemicals are likely to spill and leach into the soil and water of the area, posing threat to environmental and public health;

Mitigation Measures

Demobilization will require removal of machinery, workers and other structures. The mitigation measures for decommissioning shall include:

- The proponent shall inform the workers and local community about the duration of work;
- The workers shall be clearly informed about the expected schedule and completion of each activity;
- All waste generated from decommissioning phase shall be collected and disposed of at the nearest municipal disposal site or vendor;
- Sprinkling of water is being carried out to suppress dust from decommissioning activities and transport movement, but should be taken care that water sprinkling does not mix with the nearby waste management facility otherwise it might for leachates and habitation at the downside will have an effect;
- All necessary PPEs shall be used by the workers during demolition work;
- ERMPL will be committed to ensure all health and safety measures are in place to prevent accidents and/or reduce the consequences of non-conformance events;
- Institution of suitable training modules for project personnel and labour contractors involved in the dismantling process to ensure avoidance or minimization of any plant unit damage as far as possible and adherence to appropriate decontamination protocols in the event of any unavoidable damage and adhere to proper safe disposal methods.

In addition to above, it is anticipated that the contractor will have the necessary management measures in place to manage potential OHS issues under their responsibility. Appropriate OHS programme and procedures are also expected to be in place to align with the local regulations, as well as IFC PS-2. The procedure will include, at minimum, the following measures:

- Develop and implement a health and safety plan to follow throughout all phases of a project;
- Provide occupation health and safety orientation training to all employees consisting of basic hazard awareness, site-specific hazards, safe working practices, and emergency procedures;
- The contractors will be committed to ensure that all Health and Safety measures are in place to prevent accidents and reduce the consequences of non-conformance events;
- The contractors will provide training, awareness and supervision to ensure all of its construction workers comply with the OHS procedures;
- The contractor will provide appropriate resources i.e. PPE to workers on Site; and
- An emergency response procedure and infrastructure will be available on Site to ensure provision of first aid for personnel in case of emergency

Significance of Impact

Table 7-18: Impact Significance – Environment Occupational Health and Safety Hazards

Aspect	Scenario	Spread	Duration	Intensity	Overall
Environment and Occupational Health and Safety	Without Mitigation	Medium	Short	Moderate	Moderate
	With Mitigation	Medium	Short	Low	Minor

7.4 Ecological Impacts and Mitigation Measures

The following sections present the ecological impacts anticipated directly from the Project in a phase-wise manner, along with corresponding mitigation measures based on international industrial good practices.

7.4.1 Impacts during the Pre-Construction and Construction Phase

Removal of vegetation: Presently, the Project Site shows presence of a few trees, shrubs and herbs that support fauna. Removal of vegetation to clear the Project Site for construction will cause loss of the revegetated modified habitat. This habitat loss at the Project Site may directly cause loss of habitat for scrubland and grassland fauna. The removal of natural vegetation would also indirectly cause exposure of soil to desiccation by

wind and sunlight, loss of soil anchorage and increased vulnerability of soil to erosion by wind and water, leading to changes in the soil regime and the corresponding loss or degradation of the related ecosystem services.

The loss of the natural habitat of the Project Site is of relatively moderate significance owing to presence of alternative comparable habitat around the Project Site.

Mitigation Measures

- Client must undertake quantitative assessment of trees present on site prior to site clearance.
- Client must consider plantation of strictly native tree species along project periphery to compensate for trees removed from the Project Site as part of the site clearing process.

7.4.2 Impacts During the Operation and Maintenance Phase

Removal of organic waste: BMCWPP is existing municipal waste disposal site for BMC. The primary and secondary data available to this assessment indicates that the organic waste contained within BMCWPP Site serves as food source for globally threatened vulture species, which constitute a group of congregatory species, including both resident and migratory species. Approximately 30 individuals of one of the said species, namely *Neophron percnopterus* (Egyptian Vulture; IUCN Red List Status: Endangered), were recorded around the Project Site during the site visit in May 2022.

Use of biodegradable waste by project, which is currently disposed at BMCWPP, may cause complete or partial loss of said food source for the globally threatened vulture species using the area around the Project Site as a feeding habitat.

This impact is of moderate significance owing to the highly globally threatened species likely to be impacted.

Deployment of heavy machinery: The proposed Project operation involves use of heavy machinery to handle the organic waste to be processed. This would create risk of injury and/or mortality to any scavenging fauna, including globally threatened vultures, feeding on or attempting to access the said waste.

This impact is of high significance owing to the highly globally threatened species likely to be impacted.

Use of Ghoda Pachad Dam Reservoir as a water source: The Ghoda Pachad Dam Reservoir, proposed as the main water source for the Project, is planned primarily as a crop irrigation water source for the local farming community. Thus, it qualifies as a shared priority provisioning ecosystem service. This use of reservoir water by the Project operations would amount to reduction in the amount of irrigation water available to the local farming community. This may also lead to future drought conditions adversely impacting both, Project operations and local farm productivity.

This impact is of low significance owing to the quantity of water required for project operations, and the said water source being a Type II priority provisioning ecosystem service.

Spillage of Materials: Spillage of any chemicals used in Project operation would result in leaching of the said chemicals into the local environment, leading to contamination of the natural soil and water resources of the area. This potentially includes the Ajnaal Weir Reservoir, a water storage situated approximately 2 km downgradient of the Project Site, which is a major source of crop irrigation water for the local community.

This impact is of high significance since the Project Site is connected by ecological flows to the ecosystems that provide priority provisioning ecosystem services to the local community.

Mitigation Measures

- Ensure that Project-related waste storage areas are designed to prevent access to scavenging fauna, especially vultures.
- Ensure that heavy machinery and operation systems used in handling organic waste as part of Project operations are equipped/designed to prevent entrapment or injury with respect to scavenging fauna, especially vultures.

- Water sourced from the Ghoda Pachad Reservoir should be used strictly for Project operation processes. Any other Project-related water requirement should be met through other water sources or collected through Project-related rainwater harvesting.
- The quantity of water drawn from the Ghoda Pachad Reservoir should be monitored and regulated to prevent loss of crop irrigation water needed by the local farming community.
- Institute effective training modules and operation systems to prevent spillage of any Project-related chemicals, especially any toxic substances.
- Install an effective leachate barrier system that isolates Project-related leachates from the soil and groundwater around the Project Site.
- Install effective systems for treating leachate to be safe for disposal.
- Liase with concerned authority of any Project-related electrical poles to install perch-excluder devices on, to prevent Vultures from perching on them and being exposed to risk of electrocution, to extent feasible.
- Use native species for all Project-related plantations, including any greenbelt plantation.

7.4.3 Impacts during the Decommissioning Phase

Improper Disposal of Materials: If any materials generated during the dismantling of the Project such as project infrastructure debris, wastewater from effluent treatment plant, etc, are improperly handled or disposed of inappropriately, any polluting substances contained within them are likely to be introduced into the air, water or soil of the disposal site, thereby degrading its natural resources.

This impact is of minor significance since the Project Site is situated in proximity of modified habitats.

Mitigation Measures

- Consider instituting suitable training modules for project-personnel and labour contractors involved in the dismantling process to ensure adherence to appropriate decontamination protocols in the event of any unavoidable damage.
- Institute suitable training modules for project-personnel and labour contractors involved in the dismantling process to ensure adherence to appropriate safe disposal protocols.
- Ensure that the restoration/revegetation program, as part of the closure plan, does not contain any alien, exotic, or invasive species in order to avoid the risk of introduction of invasive alien species. Use native species as part of the revegetation program.

7.5 Socio- Economic Impacts and Mitigation Measures

7.5.1 Impact on Livelihoods & Hygiene

The main water supply for operation phase will be provided by the Bhopal Municipal Corporation which will be supplied after piping the water from nearby Ghoda Pachad Dam. Ghoda Pachad dam capacity is 11.57 MCM (million cubic metre). Currently the water from Ghoda Pachad dam is given mainly for irrigation purpose, 0.11 MCM to ISRO and 0.073 MCM to police facility. It was noted that 1.85 MCM is allotted for central Pey Jal Yojna for village drinking water. 0.55 MCM of water from this dam is allocated for integrated solid waste management facility for Bhopal Municipal Corporation, of which the project is a part of. Out of total allocation of 0.55 MCM, the Project will be supplied with 42 KLD of water.

Every 1 MCM of water from Ghoda Pachad dam irrigates approximately 170 ha of land, as reported by the water department officials.

At 600 m towards the south-east direction of the project site, there is a resort which contains 10 rooms, accommodating 3-4 guests in each room, and a permanent staff of 20 persons. The resort has 2 bore wells within

their premises, which are secondary sources (for plantation, fishpond, sanitation facilities etc.) of water, that are essential for the business. The resort falls within the core zone of the study area. Due to the ground water pollution, the resort had to reduce their dependency on the bore wells. Since last 6 months the resort has been sourcing water from a privately owned bore well from Agariya village, located further away in the south-east direction from the project site. Secondly, the dumping ground generates bad odour that along with light particles of the waste drift to neighbouring areas, including the resort; leading to growth of mosquitoes, flies, and an unpleasant environment to live and function in. As reported, there have been several instances of guests checking out sooner than the planned stay, owning to the odour from the project site. Although it is understood that the project's activities alone are not adequate to have a positive impact on the resort; it is understood that since the project will process the biodegradable waste from the existing dumping site, the project's activities will contribute to the positive impact.

Mitigation Measures

To minimise and mitigate the adverse impacts on local livelihoods, the following measures are recommended.

- Identify alternative seasonal water supply source.
- Harvesting of rainwater on-site, as feasible.
- Give preference to locals from nearby villages during hiring of workers for project work
- The Project will be developed on only 9 acre of land parcel out of which approximately 6 acres will be part of 45 acres of land of BMCWPP and remaining approximately 3 acres will be adjoining vacant land of Bhopal Municipal Corporation. Establishing the Bio-CNG plant, will help in management of biodegradable waste which is being dumped at BMCWPP. This will reduce the spread of smell generating from the wet waste and its effects on locals. This will create a positive impact on the community's health and hygiene.

Significance of Impact

Table 7-19: Impact Significance - Impacts on Livelihoods

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impacts on Livelihoods	Without Mitigation	High	Long	Moderate	Moderate
	With Mitigation	High	Long	Low	Moderate

7.5.2 Impact on Hygiene and Community Health

As reported, dry and wet waste collected from 85 wards under the jurisdiction of Bhopal Municipal Corporation (BMC) is unloaded at this site. This waste collection service caters to a population of approximate 21,25,000. The substantial amount of waste dumped at the site, generates bad odour that along with light particles of the waste drift to neighbouring areas, leading to growth of mosquitoes, flies, and an unpleasant environment to live and function in.

Mitigation Measures

To minimise and mitigate the adverse impacts on local hygiene conditions, the following measures are recommended.

- The Project will be developed on only 9 acre of land parcel out of which approximately 6 acres will be part of 45 acres of land of BMCWPP and remaining approximately 3 acres will be adjoining vacant land of Bhopal Municipal Corporation. Establishing the Bio-CNG plant, will help in management of biodegradable waste which is being dumped at BMCWPP. This will reduce the spread of smell generating from the wet waste and its effects on locals. This will create a positive impact on the community's health and hygiene.
- There needs to be an Occupational Health Centre at the facility that caters to the health issues of the entire workforce engaged for the project or stakeholders affected due to the project.

- The project management can undertake free health check-up camps in the core and buffer zones around the project site, with a focus on women's health conditions, as part of its commitment to gender inclusive interventions.
- The project needs to put in safeguard to ensure that workforce at the site, the workers (rag pickers) working at adjacent site, and the local community is not affected by growth of mosquitoes at the site or due to project activities. Therefore, maintaining good housekeeping at the site is crucial.

Significance of Impact

Table 7-20: Impact Significance - Hygiene and Community Health

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impacts on Hygiene	Without Measures	Medium	Medium	Medium	Moderate
	With Measures	Local	Long	High	Moderate

7.5.3 Impacts on Local Economy and Employment Generation

During the construction phase, the project would require a workforce of ~70-80 persons as well as vendors for vehicles and construction equipment. For the construction of boundary wall, the project has already engaged a local contractor to provide workers. During its operations phase, the project will require 48-50 persons to work at the facility. If hired locally, the project will contribute to the local economy positively.

Mitigation Measures

- It is essential for the project to generate employment locally, instead of hiring workers from outside of the state.
- It is recommended that all contractors are intimated to prioritise employment of locals over migrants for the project.
- Opportunity to engage the rag pickers working at the dumping yard, in the project can be explored.
- Give preference to locals from nearby villages during hiring
- Give preference to local workers including females in employment.

Significance of Impact

Table 7-21: Impact Significance – Aesthetic and Visual Impacts

Aspect	Scenario	Spread	Duration	Intensity	Overall
Local Economy and Employment Generation	Without Mitigation	Local	Long	Low	Minor
	With Mitigation	Local	Long	Low	Minor

7.5.4 Impacts on Local women

Although the project does not have an impact that is specific to a gender, due to the project proponent's commitment to Gender equality, few gender-specific initiatives have been recommended for implementation during the construction and operations phase of the project.

Measures

- Local women should be given preference at all levels of employment generated by the project.
- If required, 2-3 months of training and capacity building should be arranged to impart the skills required to performance the work,

- The project proponent can create and facilitate the functioning of women's Self-Help Groups (SHG) by engaging a Gender and Micro-finance expert or by forming association/partnership with a local women empowerment organisation with good reputation. The agenda for this is to make the local women (especially those from socio-economically vulnerable communities and households) financially literate and independent.

Significance of Impact

Table 7-22: Impact Significance – Aesthetic and Visual Impacts

Aspect	Scenario	Spread	Duration	Intensity	Overall
Impacts on local women	Without measures	Local	Long	Low	Minor
	With measures	Local	Long	Medium	Moderate

7.6 Cumulative Impact Assessment

Cumulative Impact Assessment (CIA) is the process of (a) analyzing the potential impacts and risks of proposed developments in the context of the potential effects of other human activities and natural environmental and social external drivers on the chosen Valued Environmental and Social Components (VECs) over time, and (b) proposing concrete measures to avoid, reduce, or mitigate such cumulative impacts and risk to the extent possible.

Cumulative impacts[39] are a result of effects that act together (including those from concurrent or planned future third-party activities) to affect the same resources and/or receptors as project under consideration (e.g. the combined effect of other similar projects in the general area). An effect to a resource in itself may not be considered significant but may become significant when added to the existing and potential effects eventuating from similar or diverse developments in the area.

There is no other bio CNG plant located within 10 km radius of the project boundary. However, there is one (1) another bio-CNG plant set up by Bhopal Municipal Corporation in Bittan market which uses the daily MSW and produce biogas that will then be utilised to generate electricity for lighting up streetlights. As per the report[40], the plant will be able to process four to five tonnes of segregated organic municipal solid waste daily and produce biogas. As per BMC additional commissioner, it's a PPP model with a private company and once the plant attains its full capacity, the methane can also be sold commercially. This facility is 20kms away from the project area.

In addition to above, there has been a substantial increase in waste to energy projects and it is reported that a NTPC plant is also coming in the same area. Hence it is anticipated that additional projects will come within 50 km radius of the project area boundary. The potential cumulative impacts identified for the project has been highlighted in the following sub sections.

7.6.1 Environmental Impacts

Air Quality and Soil Characteristics

The baseline ambient air quality measured within 5 km radius of the project was noted to be well within the prescribes standards. During operation of the project no fuel of any kind will be burnt, and the gases formed during the anaerobic digestion also will not be released. However, as per the information shared by the client, there will be developments made in the near future which will result in increased fugitive emissions during the construction activities and due to the vehicular movement if the construction period of both the projects coincides.

[39] As per *Good Practice Handbook on Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets by IFC (2013),* cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity (collectively referred to as "developments") when added to other existing, planned, and/or reasonably anticipated future ones. For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognized as important on the basis of scientific concerns and/or concerns of affected communities.

[40] MP biogas: Madhya Pradesh's first waste-to-energy plant inaugurated | Bhopal News - Times of India (indiatimes.com)

However, the construction activity will last for 15-20 months, the cumulative impact on ambient air quality can be considered moderate.

Ambient Noise

The noise from existing surrounding has been captured in the baseline recorded for the project. The baseline noise levels in the area are exceed the prescribed CPCB standards during the day and night-time respectively at the sampled locations.

It is to be noted that ambient noise levels depend on various factors such as the exact number of vehicles/equipment being used at the construction site, number of hours of operation etc. Since construction activities will be temporary in nature and will be carried out during the daytime and will not last for more than 12-15 months so if the timelines of the NTPC project coincides with that of this project then there will be more level of noise produced due to various construction activities and equipment's. Also during the operation phase energy formation will be because of the anaerobic digestion which will not cause any noise pollution, cumulative noise impact is considered low for operation phase.

Soil and Water Quality

There will be wastewater generation from cleaning the bio-CNG tanks. The domestic wastewater may be generated from site office of the operation team. Septic tanks with soak pits should be provided during operation stage. There are less chances of cumulative impact due to the future proposed projects.

7.6.2 Socio-economic Impacts

7.6.2.1 Impacts on Common Property Resources

Dam: The proposed NTPC project is also likely to take water from the Ghoda Pachad dam. Though the quantity of required water is not known; any further diversion of water meant for irrigation for non-irrigation purpose will increase the geographical extent, as well as scale of impact on the locals dependent on farming for income generation. This may result in local discontent questioning authority's decision to divert so much water, impacting local livelihoods. There could be strong discontent from people may influence the decisions of water distribution from Ghoda Pachad dam for all non-irrigation purposes, including the project (though water requirement is only 42 KLD), especially as the dam is not being managed by the BMC authority and they do not have direct involvement in making these decisions.

Water from the borewells present inside BMCWPP can used for project but client will ensure that permission for withdrawal of ground water is available.

Roads: The proposed NTPC project will be located at 1.5km south of the site. The new project will require access to approach roads some of which are likely to be common to the Bio-CNG plant. Any mismanagement of traffic on these common approach roads, leading to incidents or accidents can be mislinked to the Bio-CNG plant or overall developments in area.

Mitigation Measures

- It is recommended that project proponent explores alternative water sources, at least for seasonal supply if not for year-round supply to reduce their dependency on the Ghoda Pachad dam for water.
- Also wherever possible, use the treated water from the effluent treatment plant.
- It is important that the project uses the designated roads and not the village roads of Padariya village for transportation.
- A GRM should be establish as per the ESMS and a Community Liaison Officer needs to be appointed for the implementation of the GRM.

8. Environment and Social Management Plan

8.1 Introduction

The purpose of an Environmental and Social Management Plan is to ensure that social and environmental impacts, risks, and liabilities identified during the ESIA process are effectively managed during the operation and closure of the proposed project. An Environmental and Social Management Plan (ESMP) is an important component of an ESIA as it provides an important tool that can be used to measure and check, in a continuous mode, the efficacy of the mitigation measures and project commitments incorporated in the ESIA to minimize or eliminate identified negative impacts. The ESMP also aligns the schedule for implementation of management plans.

The key objectives of the ESMP are to:

- Formalize and disclose the program for environmental and social management;
- Provide a framework for the implementation of environmental and social management initiatives;
- Monitor the ERMPL's compliance with all the mitigation measures and commitments in the ESIA report;
- Monitor the ERMPL's compliance with legal standards and limits for waste discharge and emissions;
- Provide early warning signals on potential environmental changes, so that appropriate actions can be taken to prevent or minimize environmental and social impacts;
- Put in place a sound and cost-effective contingency plan that can be activated for prompt response to any accidental occurrence;
- Encourage and achieve the highest environmental and socio-economic performance and response from individual employees and contractors throughout the duration of the project; and
- Routinely check all measures/devices put in place for effective monitoring of project functions and activities.

The ESMP delineates the monitoring and management measures to avoid and/or minimize such impacts by allocating management responsibility and suggesting skill requirement for implementation of these measures. Also, the ESMP shall ensure a continuous communication process between ERMPL, project developer, workers (including sub-contractors), local community and other stakeholders.

In addition, the ESMP may also be used to ensure compliance with statutory requirements, and corporate safety & environmental and social management policies.

An ESMP is, therefore, a tool which ensures continuous assessment of the environmental and social impact of a project operation as well as proactive response to the impacts to reduce their overall effect on the identified environmental and social parameters. It makes an organization to do the right thing at the right time rather than responding to situations borne out of statutory or legal compulsion.

In this section, an ESMP is presented to be used throughout the life span of the proposed project. This ESMP will facilitate environmental and social management of the proposed project and procedures are provided to help prevent, avoid, or minimize negative environmental impacts that may occur during project operations and decommissioning phase.

8.2 Organizational Structure (Environment, Social, Health and Safety)

The enforcement and implementation of the project specific ESMP requires a robust manpower network working towards the common goal of ensuring compliance to the commitments towards ESHS standards for the project. Organization structure of ERMPL with project level responsibilities are yet to be developed.

We understand that the overall management and coordination of the project with respect to EHS will be managed through the Project Head at the corporate level. Also, a designated EHS professional/EHS Project (by ERMPL) is assigned at the project level to manage the EHS functions and activities during the construction stage (including supervising the day-to-day activities of the Sub-contractors and their team). The Site level EHS Project will in turn report to client Corporate.

8.2.1 Roles and Responsibilities

This section describes the roles and responsibilities proposed of the key persons responsible for management of the project activities. Based on project progress, client can further refine these.

Project Manger

- Ensure all activities of the ESMP process are completed;
- Ensure ESIA reviews are conducted and incorporated into the decision-making process ;
- ESMP are documented, accepted, and incorporated into the action plans at the site; and
- Report on progress and adherence to ESMP.

Apart from the project related aspects, Site In-charge with open access team will also have additional responsibilities of community lesioning such as:

- Managing all grievances of the project and their outcomes;
- Implementing, monitoring and updating the ESMP;
- Conduct periodic (formal and informal) meetings with local community for understanding their grievances and inform them about the Grievance Redressal Mechanism and ensure effective implementation.

EHS manager

- Ensuring ESMP are implemented and followed-throughout the project lifecycle;
- Ensuring contractors, sub-contractors and vendors adhere to practices in line with ESMP; and
- Monitoring initiatives and progress against ESMP policy to be submitted to the Project Manager at the frequency established.

EPC Contractor (during construction phase)

The HSE officer of the EPC contractor will be overall responsible for management of environmental and social aspects, labour management during the construction phase. The detailed roles and responsibilities of the EPC Contractor have been provided in the table below:

Aspect	Roles and responsibilities
Air Quality Management	• Ensure the reduction and control of air emissions from construction activities by minimizing dust from material handling sources, loading and unloading of materials and stockpiles. • Sprinkling of water to be carried out to suppress dust from construction activities. • Ensure that the vehicles engaged for project have a valid “Pollution under Control” (PUC) certificate and the speed of vehicles shall be limited on village roads to reduce fugitive dust emissions. • Provide sufficient stack height to D.G. sets as per the CPCB norms.
Soil Quality	• Reuse Construction debris in paving on site approach road to prevent dust generation due to vehicular movement. • Re-vegetation to be done in the area after the completion of construction, in order to reduce the risk of soil erosion.
Surface and Ground Water Quality	• Construction of dedicated storm water drains considering natural topography for reduction any contamination to runoff due to project activities. Storm water drains shall be designed to avoid any obstruction to natural flow; • Proper drainage to be provided for wastewater generated from the Porta Cabins and shall be treated on Site septic tanks and soak pits as per the specifications in IS 2470:1995 (Part I and Part II);

Aspect	Roles and responsibilities
	• Provide separate toilets for male and female workers (if any) in the ratio of 1:15 and 1:10 (toilet to workers) at the project site in order to maintain hygienic and clean surroundings. Washing and bathing areas should be provided with proper drainage system so that wastewater is not accumulated in the project site. • Conduct Periodic monitoring to ensure that the waste water is not finding its way into surface and groundwater; • All solid wastes such as construction debris, used or waste oil, paint cans, etc. will be stored on impervious surface in secure location to avoid soil and groundwater contamination; • Paved impervious surface and secondary containment to be used for fuel storage tanks; • Loading and unloading protocols should be prepared and followed for diesel oil and used oil; • Leak proof holding tanks for sanitary waste water to protect the shallow ground water level. • Conservation of water to be undertaken at all project locations and ancillary facilities and if possible, recycling and reuse of water to be taken utilising every opportunity.
Noise Level	• Mobile noise sources such as cranes, earth moving equipment and HGVs shall be routed in such a way that there is minimum disturbance to receptors. • EPC Contractor shall instruct their safety officers to arrange for inherently quiet construction equipment and machines to maintain the noise level to minimum. • Only manual construction activities shall be carried out during night-time (i.e. no use of machinery). It is also to be ensured that no village road will be utilized for movement of equipment during the night-time. All loud and sudden noises will be avoided wherever possible and fixed noise sources shall be located at least 50 m away from the site boundary. • Rubber padding/noise isolators will be used for construction equipment or machinery. • Temporary noise barriers shall be provided surrounding the high noise generating construction equipment. • The personnel involved in high noise generating activities shall be provided with adequate PPEs to minimize their exposure to high noise levels. • Construction vehicles and machinery will be well maintained and not kept idling when not in use.
Solid and Hazardous waste management	• Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste" and ensure that the waste is disposed at a regular interval. • Domestic and construction waste like recyclables viz. paper, plastic, glass, scrap metal waste etc. will be properly segregated and stored in designated waste bins/containers and periodically sold to local recyclers. • Used oil, oil-soaked rags, empty oil lined containers and other hazardous waste should be stored in leak proof containers at designated locations in enclosed structures over impermeable surface with adequate labelling as per the provisions of the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016. Hazardous wastes shall be disposed within ninety days of generation to SPCB approved vendors. • Maintain a register of all hazardous materials used and accompanying MSDS must present at all times. • Spilled material should be tracked and accounted for.
Traffic and Transport	• Only trained drivers with valid license shall be recruited by the EPC Contractor for transfer of material; • Ensure that all the traffic rules are obeyed at all the times and driving under the influence of any drug or alcohol shall be strictly prohibited; • Mitigation measures such as emphasizing on safety amongst drivers, adopting limits for trip duration and arranging driver roster to avoid overtiredness and avoiding dangerous routes and times of day to reduce risk of accident shall also be implemented; • Regular maintenance of vehicles and use of manufacturer approved parts should be adopted to minimize potentially serious accidents caused by equipment malfunction or premature failure; • The villagers shall be made aware about the schedule prior to the movement of trucks and transportation in the Project area.
Occupational Health and Safety	• Implement the H&S plan provided by the project proponent at the site; • Provide occupation health and safety orientation training to all employees and workers consisting of basic hazard awareness, incident management, site-specific hazards, safe working practices, and emergency procedures; • Ensure all Health and Safety measures are in place to prevent accidents and reduce the consequences of non-conformance events; • Provide training, awareness and supervision to ensure all of its construction workers comply with the OHS procedures;

Aspect	Roles and responsibilities
	• Provide appropriate resources i.e. PPE to workers on Site; and • An emergency response procedure and infrastructure will be available on Site to ensure provision of first aid for personnel in case of emergency.
Heat related Stress management	• Increase air velocity for indoor workers by using natural cross-ventilation from windows and doors or mobile or ceiling fans. • Operate effective general and local exhaust ventilation and air conditioning; • Avoid non-essential sources of hot ventilation (e.g. air conditioner outlets adjacent to working areas); • Install a shield between employees and a source of radiant heat such as curtains on windows or other insulating barrier, enclose the heat source, or move the heat source away from employees; • Provide cooled drinking water as close as possible to the work site; • Arrange shade for outdoor workers where practicable; • Provide a cool rest area in which workers can take their meal breaks and tea breaks; • Modify the work schedule or shift times so that outdoor and physiologically demanding work is done in the early morning or late afternoon; • Allow workers to self-regulate their pace of work. • Workers should be encouraged to present to work in a well hydrated state, and take frequent small drinks throughout each shift to replace fluid lost through sweating; • Diuretic Fluids such as tea, coffee, alcohol and some soft drinks should not be used to replenish fluid lost due to heat; • Use PPE that reduces exposure to ultra violet radiation and heat (such as reflective masks or aprons, large brimmed hat, sunscreen); and • Workers returning from periods away from hot environments should be given the opportunity to acclimatise before being expected to undertake work in very hot conditions at full capacity.
Labour Management	• Ensure that no bonded labour, child labour or forced labour are engaged for project-specific construction activities; • Comply with all the applicable regulations concerning labour and working conditions; • Regularly report on issues relating to labour and working conditions to the project proponent; • Provide a platform for raising, processing and redressing grievances of all the contractual workers; • Undertake regular engagements with internal stakeholders with special reference to contractual workers; • Ensure non-discrimination in matters of terms of employment and payment of wages to all contractual workers including migrant workers; • Ensure usage of PPEs by all contractual workers while performing duty at site; and • Ensure that all facilities and basic amenities as required by relevant national legislations and international best practice are provide din the Labour Camp/ Worker Accommodation facilities.

Community Liaison Officer (CLO)

- Manage, review and develop the Social Program to ensure that it fulfils Project requirements, including measures observed in this ESMP and monitor the implementation;
- Co-ordinate and evaluate the effectiveness of all program elements;
- Manage the implementation of community health program, including coordination with HSE team on OHS measures associated with management of impact to community health;
- Coordinating the HSE team on implementation of the Project vehicle safety measures associated with management of impact to community safety;
- Coordinating with Human Resource (HR) team person to ensure implementation of labour related measures required in this ESMP;
- Consultation with community and liaison with relevant stakeholders in implementing the required stakeholder and grievance management measures, including liaison with related government bodies as necessary;
- Leading collaboration to establish and implement the Project grievance mechanism during construction phase, and supervise contractor's social performance as required in this ESMP; and

- Managing social monitoring and reporting the results to the Project Manager.

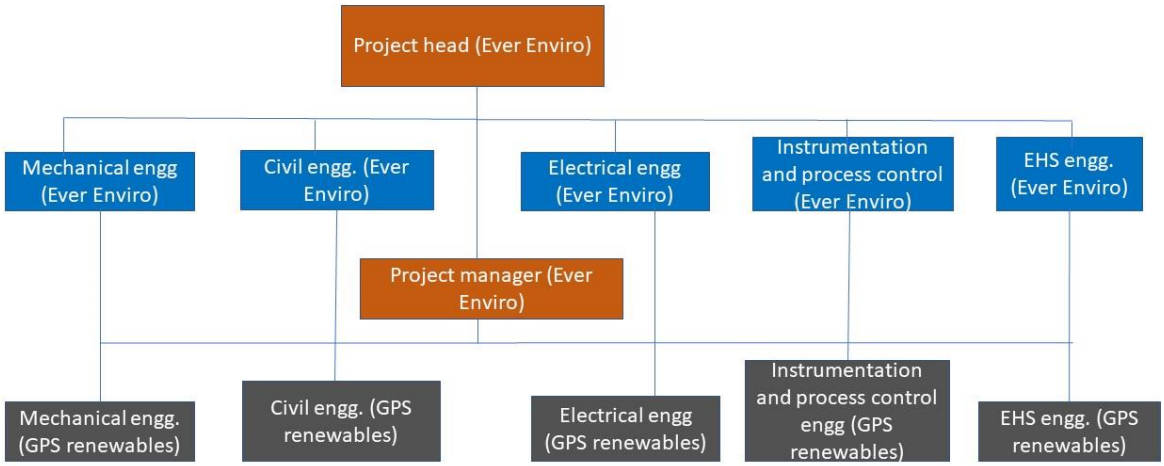


Figure 8-1: On-site organisational structure of client and GPS Renewables

Project head will be assigned by client team with whom all the area specific team will be formed. On the similar line EPC contractors will have their team on site and in coordination with client team. EPC contractors met with the vendors and daily/weekly meetings.

8.2.1.1 Inspection, Monitoring and Audit

Training is one common method of supplying individuals with additional skills and knowledge. In order to be successful in EHSS management, training programs need to be thought out carefully and systematically. A robust social and environmental, health and safety training plan is important for effective implementation of ESMP.

The project team will ensure that the job specific training and EHS induction training needs are identified based on the specific requirements of the ESMP and existing capacity of site and project personnel (including the Contractors and Sub-contractors) to undertake the required actions and monitoring activities. Some of the specific trainings that will be carried out routine basis are as follows:

- ESMP Checklists and procedural guidance;
- Occupational Health & Safety;
- Fire Safety and Prevention;
- Emergency Response Preparedness;
- Operational Training;
- HR Induction Training;
- PPE Training;
- Driver Safety; and
- Implementation of Environmental and Social Management/Action plans

The above listed trainings are the preliminary trainings which will be undertaken at the inception stage once the employee/worker joins the company and/or Project. Post that, monthly refresher trainings will be undertaken, especially for the workers. Other training will be identified and implemented during the project lifecycle as per the need assessment, as part of mitigation measure and also capacity building of the staffs.

An environmental and social management training programme will be conducted to ensure effective implementation of the management and control measures during construction and operation of the project. The training programme will 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
- Aware of the potential risks from the project activities.

In case of contractors or turnkey contractors having sufficiently well-developed standards on EHS management, the training can be sub-let to the same for their respective employees and client will monitor the completion and sufficiency status of these programs. In case of subcontractors, the training and capacity building will be done by the HSE Manager with site responsibilities, along with the contractor's EHS manager to ensure such trainings of the contracted staffs either directly or through trainers of client. Subsequently the responsibility can be passed on to the sub-contractors for all future training programs.

8.3 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 shall be maintained at site:

- Documented Environment Management System;
- Legal Register (maintained at sites and copies available at corporate level);
- Preparation of site specific plans
- Work instructions;
- Incident reports;
- Emergency preparedness and response procedures;
- Resource consumption Records;
- Training records;
- Monitoring reports including ESMP implementation reports and copies of environmental compliance;
- Auditing reports; and
- Complaints register, and issues attended/closed.

8.4 Environment and Social Management Plan and Procedures

At the project level, Indo-enviro's need to develop and implement following plans for management of environmental and social aspects of the project during operation and decommissioning phase:

- Environment and Social Management Plan
- Waste Management Plan
- Storm Water Management Plan
- Occupational Health and safety Plan
- Traffic Management Plan
- Emergency Preparedness and Response Plan
- Environment and Social Monitoring Plan

8.4.1 Environment and Social Management Plan

The environmental and social management plan proposed during planning and designing phase mainly focuses on the aspects related to land procurement and resettlement, permit compliances, procurement of materials and landscaping. Detailed ESMP proposed for the planning and designing phase is given in the sections below.

8.4.1.1 ESMP during Construction Phase

Major environmental, social, and biological aspects considered during the Construction phase are:

- Water resources (ground and surface water) and their quality
- Ambient Air and Noise quality
- Soil quality
- Noise levels
- Solid and hazardous waste generation
- Ecology and biodiversity
- Local Economy of the area

8.4.1.2 ESMP during Operation Phase

The environmental and social management plan proposed during the operation phase has been prepared considering the impacts this project may have on the surround environment and human beings' due operational activities.

The major aspects covered during the operation phase are ambient temperature, solid and hazardous waste generation, wastewater management, ecology and biodiversity.

8.4.1.3 ESMP during Decommissioning Phase

During decommissioning phase, all the environmental, social and biologicals aspects that were considered for the construction phase have been taken into consideration. The major aspects covered in the ESMP proposed during decommissioning phase are land use, air quality, water quality, soil quality, noise levels and solid and hazardous waste generation.

Detailed ESMPs are provided in tables below.

Table 8-1: ESMP during Pre-Construction Phase

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
1.	Permit Compliance	Non-compliance to various Environmental Permits required and pertaining to the proposed Bio-CNG project or there could be legal Implications to ERMPL	Major	• Site has to obtain various Environmental Permits such as no-objection certificate (NOC) for abstraction of ground water under Environment protection Act Environment Protection Act -1986, in case groundwater is used through installation of groundwater abstraction well or bore well, Factory License under Factories Act, 1948, consent from SPCB • Environmental clearance for the project is not required, CTO, CTE to be obtained.	Minor	• ERMPL should ensure Periodic EHS audits should be conducted to verify permit requirements and associated compliances
2.	ESMP Implementation	Inadequate implication of ESMP by Developer/Contractor	Moderate	• Site Specific Environment management system and procedures should be prepared before construction work commences; • Social, Environment, Health and Safety Organization Chart shall be prepared at corporate level and Site-specific level; • Proper procedure shall be developed for training of personnel & contractor, ESMP monitoring and reporting (externally & internally); • ESMP shall be part of the tender and bid documents so that contractor can include cost related to ESMP	Minor	• ERMPL and its contractors should ensure periodic audits should be conducted to verify the implementation and effectiveness of the management systems
3.	Procurement of Machineries and Construction Equipment (such as Diesel Generators, Batching Plant, Concrete mixing plant etc.)	Inadequate implication of ESMP by Developer/Contractor	Moderate	• The contractor shall follow all stipulated conditions for pollution control as suggested in ESMP and as per the regulatory requirements • No such installation by the Contractor shall be allowed till all the required legal clearances are obtained from the competent authority • Equipment's conforming to the latest noise and emission control measures shall be used. • PUC certificates for all vehicles and machinery shall be made available for verification whenever required.	Minor	• Development of EMS management system and procedures before construction work
4.	Waste material present on site	• Soil contamination • Water contamination • Air contamination • Impact on animals getting attracted towards waste	Major	• Before the construction starts it should be made sure that no previous waste is present on site, and everything is cleared. • Waste present under surface should also be cleared in order to prevent soil, water contamination.	Moderate	• Conduct monitoring of the entire land before the start of the construction phase
5.	Biodiversity and Ecosystem Services	• Potential impacts & risks with respect to scavenging fauna, including globally threatened vultures, occurring regularly or cyclically in the Study Area	Major	• Obtain data on species & numbers of globally threatened vultures occurring regularly or cyclically in the Study Area	Moderate	• Conduct primary monitoring in the Study Area, during the appropriate breeding &

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
		• Potential presence of Critical Habitat (CH) in or around the Project Site with respect to CR & EN Vulture species.				migration seasons, to collect data on species & numbers of globally threatened vultures occurring regularly or cyclically therein. Consult a subject matter expert on potential presence of CH in or around the Project Site, as well as potential Project-related impact or risk with respect to the concerned CH-trigger species.
6.	Impacts on livelihoods	• Diversion of 0.55 MCM for the project will directly affect irrigation of 93.5 ha of land. This is likely to have adverse impact on livelihoods of a significant number of farmers and agricultural labourers.	Major	• An analysis of alternatives is recommended. This shall include, following aspects (but not limited to these): Step 1 – identifying alternate sources of water for year-around supply, Step 2 – if a year-round water supply source cannot be found, identify a seasonal water supply source. • Harvest rainwater on-site. • Provide employment to locals from the affected villages.	Moderate	• Monitoring and written documentation against each of the recommendations prior to construction of the project.
7.	Impacts on local women	• Gender-specific initiative	Minor	• The project proponent can create and facilitate the functioning of women's Self-Help Groups (SHG) by engaging a Gender and Micro-finance expert or by forming association/partnership with a local women empowerment organisation with good reputation. The agenda for this is to make the local women (especially those from socio-economically vulnerable communities and households) financially literate and independent.	Moderate	• Number of SHGs formed, • Number of SHGs that sustained after 3 years • Quantifiable improvement in financial conditions of local women

Table 8-2: ESMP during Construction Phase

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
1.	Ambient Air Quality	• Fugitive Dust due to movement of project vehicles and site clearance; and • Emission from Diesel Generators.	Moderate	• The ERMPL and contractors shall ensure the reduction and control of air emissions from construction activities by minimizing dust from material handling sources. • Loading and unloading of raw materials should be carried out in the most optimum way to avoid fugitive emissions. • Sprinkling of water to be carried out by the respective contractors to suppress dust from construction activities. This should be done with a proper plan so that it does not mixes with the wastes on adjacent land • Best practices such as halting of activity during sustained strong winds should be opted for. It shall be ensured that all stockpiles are covered, and storage areas provided with enclosures to minimize dust from open area source. • Stock piling and storage of construction material will be oriented after considering the predominant wind direction. • Vehicles engaged for the project will be required to obtain "Pollution under Control" (PUC) certificates. • Sufficient stack height needs to be provided to D.G. sets as per the CPCB norms. • Waste dumped on site should be kept covered if not in use to avoid spread. • Exhaust emissions of construction equipment to be adhered to emission norms as set out by MoEF&CC/ CPCB. • Speed of vehicles on the village road and on the internal roads shall be limited to 10-15 km/hr in order to reduce fugitive dust emissions. • Cease or phase down work if excess fugitive dust is observed, or there are any community grievance related to dust. Investigate the source of dust and ensure proper dust suppression. • Adequate stack height will be provided for flare & DG stack • Flaring will be positioned as far away from habitation or vegetation. • Client will undertake detailed assessment for positioning of flare stack	Minor	• ERMPL /Contractor to ensure all vehicles used for transportation must have a PUC certificate. • Regular check on the exhaust emissions of the construction equipment's, periodic check on the ambient air quality.
2.	Soil Quality	• Construction Waste	Moderate	• Construction debris to be reused in paving on site approach road to prevent dust generation due to vehicular movement.	Minor	• Vegetation in project boundary areas

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
				• Re-vegetation to be done in the area after the completion of construction, in order to reduce the risk of soil erosion. • Topsoil conservation should be caried out from approximately 3-acre land parcel (without any legacy waste dump)		
3.	Surface and Ground Water Quality & Quantity	• Possibility of contaminated runoff from the site entering ground; • Domestic water runoff from the portable toilets into the ground water can lead to degradation of water quality.	Moderate	• Construction of dedicated storm water drains for reduction any contamination to runoff due to project activities. Storm water drains shall be designed considering natural topography to avoid any obstruction to natural flow. • Proper drainage to be provided for wastewater generated from the Porta Cabins and labour camps and shall be treated on Site septic tanks and soak pits as per the specifications in IS 2470:1995 (Part I and Part II); • Periodic monitoring shall be carried out to ensure that the waste water is not finding its way into surface and groundwater; • All solid wastes such as construction debris, used or waste oil, paint cans, etc. will be stored on impervious surface in secure location to avoid soil and groundwater contamination; • Paved impervious surface and secondary containment to be used for fuel storage tanks; • Loading and unloading protocols should be prepared and followed for diesel oil and used oil; • Drip paned provided to vehicles with leaks to prevent water contamination; • Leak proof holding tanks for sanitary waste water to protect the shallow ground water level. • Install effective systems for treating leachate to be safe for disposal. • Storm water drains shall be designed considering natural topography and as per required regulations. No material storage, septic tanks, waste storage, labour resting areas, etc. will be located close to this drain and workers will be trained on not using this drain or disposal of any waste in it.	Minor	• Regular monitoring of storm water drains to check any contamination into drains; • Regular monitoring of wastewater drains, septic tank and soak pit to check any waste findings or leakage find its way to surface and ground water; • Regular monitoring or inspection of fuel storage area, fuel loading/unloading area and hazardous waste storage area for any spillages or leakages into storage areas
4.	Impact on Water Availability	• Depletion on Ground and Surface water resources due to project water demand	Moderate	• Conservation of water to be undertaken at all project locations and ancillary facilities and if possible, recycling and reuse of water to be taken utilising every opportunity. • Peripheral drains to be provided outside the plant boundary, hence preventing the silt contaminated surface run-off from site to enter into the adjoining lands	Minor	• Water Consumption Records on daily basis; • Water recycling and reuse plan on yearly basis

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
				• No surface run-off from with-in the lands to be directly discharged into any nallah/water body • Any type of chemical or waste to be restricted from mixing into the streams nearby		
5.	Noise Level	• Disturbance to habitants • Vehicular noise from heavy vehicles utilized to deliver construction materials and Bio-CNG plant units • Noise from DG sets • Construction noise from using mobile equipment, and concrete mixing	Moderate	• In case of complaints of uncomforting noise received from the inhabitants of nearby settlements through Grievance Redressal Mechanism (GRM) there should be considered possibility of putting noise barriers near to the receptor. • Mobile noise sources such as cranes, earth moving equipment and HGVs shall be routed in such a way that there is minimum disturbance to receptors. • Contractor shall instruct their safety officers to arrange for inherently quiet construction equipment and machines to maintain the noise level to minimum. • Only manual construction activities shall be carried out during night-time (i.e. no use of machinery). The hours of operation for specified pieces of equipment or operations, especially mobile sources operating through community areas should be limited. It is also to be ensured that no village road will be utilized for movement of equipment during the night-time. All loud and sudden noises will be avoided wherever possible and fixed noise sources shall be located at least 50 m away from the site boundary. • Rubber padding/noise isolators will be used for construction equipment or machinery. • Temporary noise barriers shall be provided surrounding the high noise generating construction equipment. • The personnel involved in high noise generating activities shall be provided with personal protective devices to minimize their exposure to high noise levels. • Construction vehicles and machinery will be well maintained and not kept idling when not in use.	Minor	• Periodic monitoring of noise level should be conducted and compared with the ambient noise standard. It should also be made sure that the levels do not exceeded the national ambient air quality standard (NAAQS) level; • Training to drivers of construction equipment
6.	Solid and Hazardous waste	Contamination of Land and water resources,	Moderate	• Distribute appropriate number of properly contained litter bins and containers properly marked as "Municipal Waste". • Domestic and construction waste like recyclables viz. paper, plastic, glass, scrap metal waste etc. will be properly segregated and stored in designated waste bins/containers and periodically sold to local recyclers. • Any wastage/damaged machinery part of the plant will be sent back to vendor for disposal.	Minor	• Periodic EHS audits should be conducted by client • Training to Solid and Hazardous Waste Handlers

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
				• Used oil should be stored at designated locations in enclosed structures over impermeable surface. • Maintain a register of all hazardous materials used and accompanying MSDS must present at all times. • Spilled material should be tracked and accounted for. • Hazardous wastes shall be stored in leak-proof containers and dispose, to disposal facilities registered with the Central Pollution Board.		
7.	Traffic and Transport	• Community Health and Safety • Traffic related accidents and injuries; • Increased pollution	Moderate	• Only trained drivers with valid license shall be recruited by Contractor for transfer of material; • Training program for all the drivers, regarding awareness about road safety and adopting best transport and traffic safety procedures shall be provided before initiation of the decommissioning activities; • Mitigation measures such as emphasizing on safety amongst drivers, adopting limits for trip duration and arranging driver roster to avoid overtiredness and avoiding dangerous routes and times of day to reduce risk of accident shall also be implemented; • Regular maintenance of vehicles and use of manufacturer approved parts should be adopted to minimize potentially serious accidents caused by equipment malfunction or premature failure; • The villagers shall be made aware about the schedule prior to the movement of trucks and transportation in the Project area. • Vehicles to move slowly once inside the waste management facility as other facilities will also be using the existing road for movement.	Minor	• Traffic management plan; • Maintain records of driving licenses; • Training to drivers; • Grievance Redressal of any complaint received related to traffic
8.	Occupational Health and Safety	• Material handling and storage • Other occupational hazards • Possible injuries associated with working in a biogas plant • Accidents during cutting, chipping and piling • Physical injuries when workers involved in loading/unloading activities and don't adhere to proper ergonomics discipline.	Moderate	• Develop and implement a Health and Safety (H&S) plan to follow throughout the construction phase. Also, ensue that the H&S plan is provided to the EPC contactor for implementation at the site; • Provide occupation health and safety orientation training to all employees and workers consisting of basic hazard awareness, site-specific hazards, safe working practices, and emergency procedures; • The contractors will be committed to ensure all Health and Safety measures are in place to prevent accidents and reduce the consequences of non-conformance events;	Minor	• labour engaged for working at height should be trained for temporary fall • All the workers should be made aware of the possible occupational risks/hazards by the way of an OHS training/awareness program

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
		• Trip and fall hazards • Violation of the privacy and dignity of women involved in the work force. • Other occupational hazards • Diseases due to unhygienic condition		• The contractors will provide training, awareness and supervision to ensure all of its construction workers comply with the OHS procedures; • The contractor will provide appropriate resources i.e. PPE to workers on Site; and • An emergency response procedure and infrastructure will be available on Site to ensure provision of first aid for personnel in case of emergency.		• An accident reporting, and monitoring record should be maintained • Proper hygienic and scientific sanitation facilities for all the labourer's working in the site with spate exclusive arrangements for men & women to ensure the privacy and dignity of all individuals • GRM is properly maintained and followed on site. • Contractor should inform the labour about Emergency Preparedness Plan (EMP) and communication system to be followed during emergency situation.
9.	Biodiversity and Ecosystem Services	• Loss of regular food source for scavenging fauna, especially globally threatened vulture species • Loss of access to feeding habitat for scavenging fauna, especially globally threatened vulture species • Injury/mortality of scavenging fauna, especially globally threatened vulture species, owing to interaction with Project-related heavy machinery	Moderate	• Ensure that machinery used in the construction activities comply with the prescribed noise emission standards. • Liaise with the waste disposal site management to restrict disposal of potential vulture food such as carcasses or offal outside the project and if that has to be doe it should be as far from the Project Site as feasible. • Restrict movement of construction-related heavy vehicles or machinery, strictly to pre-designated routes that are as far from the said carcass and offal disposal area as feasible.	Minor	• Weekly monitoring of carcass/offal
10.	Employment creation and	• The project will require a workforce of at least 70 persons during the	Minor	• The local workers and vendors should be given preference while engaging these third party entities.	Minor	• Local versus Migrant workforce ratio during construction stage

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
	boost to Local economy	construction phase. As well as require to procure/rent vehicles and equipment for construction activities.				
11.	Impact on local women	• Gender-specific initiative.	Minor	• Local women should be given preference at all levels of employment generated by the project. If required, 2-3 months of training and capacity building should be arranged to impart the skills required to performance the work,	Moderate	• Male and female ratio among workforce

Table 8-3: ESMP during Operation Phase

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
1.	Aesthetics and Visual	• Visual and landscape impacts due to presence of Bio-CNG units	Minor	• The plant units to be arranged in a systematic manner which will give an aesthetic sense. • ERMPL to develop greenbelt along the boundaries, roads and in open places. This will help in capturing the emissions, attenuate the noise generated and improve the aesthetics.	Minor	• Ensuring that the green belt is properly designed and maintained
2.	Impact on Soil and Water Quality	• Contamination of land and soil; • Impacts due to improper waste handling	Moderate	• Disturbance to soil from repair and maintenance activity will be limited and will ensure proper restoration of soil wherever excavation is undertaken. • Options of buyback agreements for conveyor belts, plant machinery and for replacement and disposal of transformer oil by the supplier are to be explored, otherwise arrangements for disposal of these units and waste oil to authorized recyclers are to be made. • Fuel and used oil will be stored in demarcated storage areas with adequate secondary containment and appropriate capacity. Spill control and prevention mechanism will be developed, and all the staff will be trained. • During the washing and maintenance of the tanks, adequate storage area shall be designed to collect the washed water or water can also be utilized for gardening purpose • Storage of oil/chemicals shall be undertaken on paved impervious surface and secondary containment shall be provided for fuel storage tanks • Leachate monitoring	Minor	• Periodic checking of solid and hazardous waste storage areas, fuel storage areas, chemical storage areas for checking in spillage or leakages from these areas
3.	Water Availability	• Depletion of water resources due to project water demand	Major	• Rooftop rainwater harvesting system will be provided within the plant premises. The water harvested will be stored at the Site and will be used instead of Ghoda Pachad dam water. • The site office shall be provided with sewage line and the collected sewage shall be channelized to a septic tank with soak pit arrangement. • Fuel and used oil will be stored in demarcated storage areas with adequate secondary containment and appropriate capacity. Spill control and prevention mechanism will be developed, and all the staff will be trained.	Moderate	• Maintaining water consumption records on daily basis; • Prepare programme for water recycling and reuse and minimize Dam water use • There should not be a leakage in the storage tankers for which regular inspections should happen.

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
				• Water treated from the ETP to be used in the hammer mill which will in-turn decrease the total water requirement for the operations		
4.	Occupational Health and Safety of Workers	• Electrocution • Fire due to short-circuit • Possible injuries associated with working at height • Diseases due to unhygienic condition	Moderate	• Regular electrical safety training to workers with safety procedures and other safety requirements that pertain to their respective job assignments. • Implement Lock out/ Tag Out (LOTO) system; • Use work equipment or other methods to prevent a fall from occurring. Collective protection systems, such as edge protection or guardrails, should be implemented before resorting to individual fall arrest equipment. In addition, safety nets or airbags can be used to minimize the consequences of a fall should it occur. • Loading and unloading operation of equipment should be done under the supervision of a trained professional. • All materials will be arranged in a systematic manner with proper labelling and without protrusion or extension onto the access corridor. • Personal Protective Equipment (PPEs) e.g., shock resistant rubber gloves, shoes, other protective gear etc. should be provided to workers handling electricity and related components and monitored that they are used by the employees • The transformer yard should be provided with fire extinguishers and sand buckets at all strategic locations to deal with any incident of fire; and • There should be arrangement for hygienic and scientific sanitation facilities for all the labourers working in the site. • An accident reporting, and monitoring record shall be maintained. • Ensure proper sanitation facilities.	Minor	• Labour engaged for working at height should be trained for temporary fall • All the workers should be made aware of the possible occupational risks/hazards by the way of an OHS training/awareness program • An accident reporting, and monitoring record should be maintained • Proper hygienic and scientific sanitation facilities for all the labourer's working in the site with spate exclusive arrangements for men & women to ensure the privacy and dignity of all individuals • GRM is properly maintained and followed on site. • Contractor should inform the labour about Emergency Preparedness Plan and communication system to be followed during emergency situation.
5.	Impact due to flaring activity	• Local and Global air quality • Visual impact • Noise impact • Odour nuisance	Major	• Setting emission limits for a range of outputs (such as SOx, NOx, CO, dust and HCl). • Monitoring regimes should be specific to the individual flare and location and be designed based on the results of the detailed assessment.	Minor	• Mainly regulation records on weekly/monthly basis

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
				• Failure of some of the flare stack components (flame detector, flame arrestor spark system etc), poor maintenance, operational error or extraordinary operating conditions can cause the release of the biogas to the atmosphere. Regular maintenance of all these components should be done.		
6.	Biodiversity and Ecosystem Services	• Injury/mortality to scavenging fauna, especially globally threatened vulture species, owing to interaction with heavy machinery • Injury/mortality to avifauna, especially globally threatened vulture species, owing to collision/ electrocution related to overhead electrical cables • Loss of priority provisioning services, in terms of crop irrigation water, owing to Project-related water abstraction • Degradation of priority provisioning ecosystem services, in terms of crop-irrigation water, owing to contamination by Project-related leachates • Loss/degradation of plantation habitat owing to eutrophication resulting from disposal therein of	Moderate	• Ensure that Project-related waste storage areas are designed to prevent access to scavenging fauna, especially vultures. • Ensure that heavy machinery and operation systems used in handling organic waste as part of Project operations are equipped/designed to prevent entrapment or injury with respect to scavenging fauna, especially vultures. • Water sourced from the Ghoda Pachad Reservoir should be used strictly for Project operation processes. • The quantity of water drawn from the Ghoda Pachad Reservoir should be monitored and regulated to prevent loss of crop irrigation water needed by the local farming community. • Institute effective training modules and operation systems to prevent spillage of any Project-related chemicals, especially any toxic substances. • Install an effective leachate barrier system that isolates Project-related leachates from the soil and groundwater around the Project Site. • Install effective systems for treating leachate to be safe for disposal. • Install perch-excluder devices on any Project-related electrical poles to prevent vultures from perching on them and being exposed to risk of electrocution. • Use native species for all Project-related plantations, including any greenbelt plantation. • Assess the carrying capacity of the plantation land with respect to the Project-generated wastewater and ensure that the wastewater release schedule is planned to avoid potential eutrophication of the concerned land. • Ensure that any Project-generated wastewater exceeding the planned daily safe disposal quantum is stored and/or disposed appropriately.	Minor	• Monthly monitoring of water sourced by Project from Ghoda Pachad Reservoir • Trainings for Project personnel, contractors and labour to sensitize them towards biodiversity and ecosystem services conservation • Monitoring in and around the Project Site to document effectiveness of mitigation measures

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
		Project-related wastewater.				
7.	Employment creation and boost to Local economy	• The project will require a workforce of at least 30-32 persons during the operations phase. As well as require to procure/rent vehicles and equipment for construction activities.	Minor	• The local workers should be given preference while engaging the operations and maintenance team.	Moderate	• Local versus Migrant workforce ratio during operations stage
8.	Impacts on local women	• Gender-specific initiative	Minor	• The project proponent can create and facilitate the functioning of women's Self-Help Groups (SHG) by engaging a Gender and Micro-finance expert or by forming association/partnership with a local women empowerment organisation with good reputation. The agenda for this is to make the local women (especially those from socio-economically vulnerable communities and households) financially literate and independent.	Moderate	• Number of SHGs formed, • Number of SHGs that sustained after 3 years • Quantifiable improvement in financial conditions of local women

Table 8-4: ESMP during Decommissioning Phase

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
1.	Environment and Occupational Health and Safety	• Issue of loss of job when the workers will be asked to leave; • Improper disposal of demolition waste and obsolete machineries will lead to contamination of soil and discontent of community; • Demolition 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.; • The decommissioning activities can lead to increased noise levels; • During the dismantling of the plant, visual intrusions will be likely by removal of ancillary facilities, but their consequence will be negligible due to fact that such impact would be temporary (over a short period);	Moderate	• The proponent shall inform the workers and local community about the duration of work; • The workers shall be clearly informed about the expected schedule and completion of each activity; • All waste generated from decommissioning phase shall be collected and disposed off at the nearest municipal disposal site; • Sprinkling of water is being carried out to suppress dust from decommissioning activities and transport movement; • All necessary PPEs shall be used by the workers during demolition work; • Client will be committed to ensure all health and safety measures are in place to prevent accidents and/or reduce the consequences of non-conformance events; • Institution of suitable training modules for project personnel and labour contractors involved in the dismantling process to ensure avoidance or minimization of project unit damage as far as possible and adherence to appropriate decontamination protocols in the event of any unavoidable damage and adhere to proper safe disposal methods. Appropriate OHS programme and procedures are also expected to be in place to align with the local regulations, as well as IFC PS-2. The procedure will include, at minimum, the following measures: • Develop and implement a health and safety plan to follow throughout all phases of a project; • Provide occupation health and safety orientation training to all employees consisting of basic hazard awareness, site-specific hazards, safe working practices, and emergency procedures; • The contractors will be committed to ensure that all Health and Safety measures are in place to prevent accidents and reduce the consequences of non-conformance events; • The contractors will provide training, awareness and supervision to ensure all of its construction workers comply with the OHS procedures; • The contractor will provide appropriate resources i.e. PPE to workers on Site; and • An emergency response procedure and infrastructure will be available on Site to ensure provision of first aid for personnel in case of emergency.	Minor	• Waste Management Plan for Decommissioning activities; • Training records to workers; • Waste Disposal Records;

S. N.	Aspects	Impacts	Impact Intensity	Mitigation/ Control Measures	Impact Intensity with Mitigation	Monitoring/ Training Requirements
2.	Improper Waste Disposal	• Contamination of land and soil by hazardous waste • Soil Contamination	Major	• Demolition debris would be properly transported in trucks outside the site with cover to prevent spillage and contamination of local soil • Re-vegetation done in the area after the completion of demolition and dismantling work in order to reduce the risk of soil erosion. • In case of any accidental spill, the soil will be cut and stored securely for disposal with hazardous waste. • Store hazardous material (like used oil) in isolated room with impervious surface. Filling and transfer of oil to and from the container shall be on impervious surface. • Hazardous wastes, when accumulated, be disposed to facilities registered with the SPCB. • Mini Spill Kit shall be provided at site to counter any spill incident. • Cleared or disturbed areas would be rehabilitated as soon as possible to prevent erosion. • Project machineries shall be collected at a designated place and sent back to the manufacture / sold to vendors.	Moderate	• The workforce shall be sensitized to handling and storage of hazardous substances viz. fuel oil, machine oil/fluid etc. • The workers engaged in handling hazardous substances shall be briefed about the possible hazards and the need to prevent contamination.
5.	Labour Rights and Welfare	• Approximately 75% of the total human resources engaged during the operations stage are likely to be on project-specific roles. At the time of closing the project, these persons are likely to lose employment at the Company.	Moderate	• There needs to be a Policy on Retrenchment for the project's decommissioning stage terminations or any other lay-offs. • The company should consider transfer of the persons to other plants before finalising the termination. • The employees shall be given at least 1 month prior notice before the retrenchment or termination and a severance pay in case it is a lay-off. • The entire process of termination per employee should be documented.	Minor	• Documentation of notices, severance pay, termination, reference letters etc.

8.4.2 Waste Management Plan

All project generated wastes will need to be managed and disposed of in a manner to prevent potential impacts on the environment and risks to human health. A Waste Management Plan (WMP) for the proposed project has been developed.

The construction, operation and decommissioning phase of the proposed project will generate various type of waste which will need appropriate collection, transportation, primary treatment and disposal. Hence, to serve the purpose, a Waste Management Plan has been formulated to demonstrate:

- Inventorization of waste in different type of categories like domestic solid waste, construction debris, wastewater, sludge from wastewater septic tanks, hazardous waste, etc.;
- Maintain the site in a clean and tidy state to reduce the attraction of pest species, impacts on the local environment and negative impacts on visual amenity; and
- Suggestion of options for waste handling and disposal during construction and operation phase of the project.

The plan shall be applicable to the ERMPL and O&M Contractor engaged by ERMPL for the proposed project. The elements of the plan will be directly implemented by the O&M staff deployed on site while overall management and responsibility will lie with ERMPL.

8.4.2.1 Waste Type and Quantity Generated

All wastes generated from the project will be categorised as either non-hazardous or hazardous following an assessment of the hazard potentials of the material, in line with local and national requirements.

Construction Phase

The waste will be generated from construction activities like site clearing, levelling, excavation etc. Other categories of waste will be produced daily and comprise of the following:

- Scrap metal;
- Soil waste;
- Food waste from kitchen premises of labour accommodation;
- Construction debris;
- Broken or damaged machinery parts; and
- Sewage from temporary toilets.

The operation phase will require the use of hazardous materials such as diesel or petrol to cater the fuel equipment and vehicles and maintain equipment. The following hazardous wastes will also be produced from construction activities.

- Oily rags;
- Used oil and oil filters - from generators or vehicle maintenance; and
- Scrap and packaging material.

Operation Phase

Operations and maintenance of the Bio-gas plant is not expected to generate any significant amount of waste. Operations will not produce waste during operation except the following:

- Waste from conveyor belt (compostable or hazardous waste);
- Compostable or hazardous waste segregated from the wet waste at the time of laying it over on a conveyor belt;
- Fuel requirements like greasing, transformer oil, and

- Oily contaminated rags from cleaning activities;
- Used oil/ waste oil from DG set or construction machinery.

Decommissioning Phase

Waste generated during decommissioning phase of the project will generate:

- Demolition waste; and
- Obsolete Machinery

8.4.2.2 Waste Management, Handling and Disposal

Following measures to be taken for management of waste:

- A buy back agreement for damaged pipes, conveyor belts is required by ERMPL/O&M contractor;
- A designated area needs to be demarcated within the premises for storage of compost and hazardous waste restricted access and on impervious surface;
- All fuel storage should be equipped with secondary containment and spillage trays;
- It is to be ensured that hazardous waste (used oil, oily rags etc.) is disposed of through SPCB authorized vendor/ recycler;
- Transportation of hazardous waste is required to be undertaken as per the procedures specified by the Manufacture of project units
- Proper PPEs are to be provided to the workers handling the waste;
- The workers at site are also on regular basis appraised about the potential health risks associated with handling of hazardous waste
- Domestic solid waste will be segregated onsite and will be disposed of at site as approved by local authority.
- Wastewater generated from module cleaning will be used for groundwater discharge. Waste from site office and SCADA (Supervisory control and data acquisition) will be disposed through soak pits and septic tank.
- All the hazardous waste needs to be collected and disposed of through approved recyclers in accordance with the Hazardous and other wastes (Management and transboundary Movement) Rules, 2016.

8.4.3 Storm Water Management Plan

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.
- No surface run-off from within the plant site will be directly discharged into any nallah/water body.
- Soils, chemicals, fertilizers, animal waste, leaves, oil and grease, trash and other pollutants need to be restricted from mixing into the streams.
- Adequate arrangements for storm water management during construction period to be made to avoid sediment runoff from the site and to avoid water logging. Storm water channels to be provided with silt traps to avoid sedimentation of the channels;
- Storm water drains shall be designed considering natural topography and as per required regulations.

- No material storage, septic tanks, waste storage, labour resting areas, etc. will be located close to this drain
- Workers will be trained on not using this drain or disposal of any waste in it.

8.4.4 Occupational Health and Safety Plan

OHSP provides a guidance document for identifying the potential risks involved in a project operation. This section provides the OHSP applicable to the proposed project, during operation phase of the proposed project. This section also covers the training requirements and safe work practices to be followed onsite to manage various risks involved during the operation phase of the project.

The occupational health and safety plan (OHSP) will address the following:

- Evaluation and Identification of hazards;
- Defining responsibilities to prevent risks;
- Elimination and removal of hazards;
- Control of Hazards which cannot be eliminated; and
- Recovery from accidents.

8.4.4.1 Risk Assessment

Risk assessment is an important step in protecting workers. Client / O&M Contractor shall ensure a risk assessment to be performed by a competent person before commencement of operations on site. Such an assessment shall as a minimum:

- identify the risks and hazards to which persons may be exposed to;
- analyze and evaluate the identified risks and hazards;
- document a plan of safe work procedures, including the use of any personal protective equipment or clothing and the undertaking of periodic “tool box talks” or inductions before undertaking hazardous work, to mitigate, reduce or control the risks and hazards that have been identified;
- provide a monitoring plan; and
- provide a review plan.

Risk assessment includes:

- Identification of hazards, discuss with workers and employees actually working at site, check manufacturer’s instructions or data sheets for chemicals and equipment, review accident and ill-health records, long-term hazards to health (e.g. high levels of noise or exposure to harmful substances) as well as safety hazards etc.;
- Identify who may be harmed and what type of injury or ill health might occur;
- Evaluate the risks and decide on precautions to protect people from harm. Consider if the hazard can be eliminated and controlled so that harm is unlikely.

8.4.4.2 Control Measures

Operation of project involves many on job hazards which need to be identified and eliminated or minimized to an expectable level in order to achieve a safe and healthy work environment. Following control measures can be implemented to prevent risks identified on project site:

- Organize work to reduce exposure to the hazard;
- Identification of unsafe working conditions, e.g., falls, electrical hazards, heat/cold stress.
- Provide personal protective equipment (e.g. clothing, footwear, goggles etc.);
- Provide welfare facilities (e.g. First aid and washing facilities for removal of contamination);

- Implementation of LOTO; and
- Record the findings by writing down the findings of the risk assessment.

8.4.4.3 Training Requirements

Client to ensure that every employee / worker (direct or contractual) is aware of the EHS risks associated with the work being carried out at the site and is trained and competent in the relevant work practices and maintenance procedures. Client shall also establish procedures to identify training needs and provide adequate safety training for all levels of employees including contractors. The safety training should provide staff with the knowledge and skills necessary for organising and managing occupational safety and health programmes; team leaders with leadership skills and knowledge to lead, implement and apply occupational safety and health activities; and workers with the knowledge, skills and right attitudes to enable them to work safely. Training proposed for the project includes but not limited to:

- Induction Training on Health and Safety covering
- HSE policy;
- Hazards and risks associated with operation and workplace;
- Control measure to eliminate or minimize HSE risks, including safe working systems and procedures; use of personal protective equipment; action to be carried out during emergency;
- Emergency response procedures, such as firefighting and evacuation procedure;
- Tool Box Training or pre-task briefings, highlighting hazards and the method of dealing with them;
- Special Job Hazard Training including entry into confined space and another hazardous environment; and
- Training on first aid

8.4.4.4 Documentation and Record Keeping

Client should maintain data and records concerning the identification of hazards, assessment and control of risks of the ongoing activities. The document should establish and maintain procedures for controlling all relevant EHS documents and data. Such documents can include but not limited to:

- EHS Policy;
- Hazard Identification Records;
- Risk Register;
- Licenses, Certificates, Permits;
- Control Methods including process control and machine design, safe work procedures, in-house work rules;
- Design Drawings;
- Organization Structure;
- HSE group meeting records;
- Training Records;
- Drill Reports;
- Inspection and Audit Records;
- Incident/ Accident Records; and
- Medical and Health Surveillance Records

Client should communicate and inform any person affected by risks about:

- The nature of risks involved; and

- The control measures or safe work procedures to be taken to address the risks involved.

The risk assessment should be reviewed and revised upon the occurrence of any injuries to any person as a result of exposure to a hazard in the workplace; or where there is a significant change in work practices or procedures.

8.4.5 Community Health and Safety Plan

Access control and barricading should be done to prevent the entry of unauthorized persons which protect people from exposure to construction site activities and any possible accidents. Following additional mitigation measures should be incorporated to avoid/reduce the potential impacts:

- Comprehensive traffic management plan should be prepared to avoid traffic congestion in the region.
- Efforts should be made to avoid heavy vehicle movement during peak traffic hours.
- Use of open ground, community properties, etc. for project activities or parking should not be done without proper permissions of concern authorities.
- Efforts should be made to avoid dismantling / misfunctioning of any community infrastructure like road, gas, telecommunication, etc. without prior permission of concern authorities and due intimation to community which will be affected.
- If there is necessary, then contractor should provide other alternative options for locals.
- All community utilities likely to be impacted, such as sources of water, community centre etc. shall be relocated to nearby suitable places.
- The work scheduled should be arranged to avoid any nuisance to nearby communities.
- Work area should be barricaded to ensure public safety and access to such area should be prohibited for locals and passers-by.
- Contractors should display appropriate signage in local language at the construction sites to make the travellers aware of the ongoing work.
- The segregation, storage and disposal of various solid and liquid wastes generated at site should be as per relevant applicable national regulations. Disposal of solid and liquid waste should be done at designated areas with proper permission from concern authorities.
- All construction machinery and equipment's should be operated and maintained regularly in such a way so that air emission, noise or vibration related impacts are minimal on nearby community.

8.4.6 Traffic Management Plan

A Traffic Management Plan is however, required for the management of traffic due to movement of vehicles for transport of equipment and material. Additional traffic on the village road can be managed by measures mentioned below.

- Only trained drivers with valid license shall be recruited by ERMPL/ Contractor for transfer of material
- Training program for all the drivers, regarding awareness about road safety and adopting best transport and traffic safety procedures shall be provided before initiation of the decommissioning activities;
- Mitigation measures such as emphasizing on safety amongst drivers, adopting limits for trip duration and arranging driver roster to avoid overtiredness and avoiding dangerous routes and times of day to reduce risk of accident shall also be implemented;
- Regular maintenance of vehicles and use of manufacturer approved parts should be adopted to minimize potentially serious accidents caused by equipment malfunction or premature failure;
- Turning to the access road from the nearest arterial road to be maintained taking into consideration commuter's safety;

- Drivers will be adequately trained on the requirements of EHS Policy and national & local legal requirements to drive a vehicle.
- All heavy vehicles like JCB, cranes, battery operated trolleys etc. to be provided with reversing siren and locked.
- Vehicles will not be allowed to park anywhere else outside the dedicated parking area. Parking area will be provided with oil and fuel adsorbent materials or drip trays in case of any leakages.
- The villagers shall be made aware about the schedule prior to the movement of trucks and transportation in the project area.
- Appropriate speed limits (20-30km/hr) on community roads for various motor vehicles to be determined as part of the traffic management based on type of roads available en-route the location to and fro of the project component where construction material is to be transported project; and

8.4.7 Environment and Social Monitoring Plan

8.4.7.1 Environmental Monitoring Plan

Regular monitoring of environmental aspects during the project operations phase is important to assess the status of environment with respect to baseline conditions. The monitored data can serve as an indicator for any change in environmental quality due to the project activities, and further to take adequate mitigation measures to safeguard the environment.

Monitoring indicators have been developed for each of the activity considering the mitigation measures proposed. The locations can used as per baseline monitoring of this ESIA or at least at project site and adjacent settlement / receptor. Monitoring results would be documented, analysed and reported internally. Monitoring requirements (including monitoring frequency) have been presented below.

Table 8-5: Environmental Monitoring Plan

S. No.	Environmental Attribute	Monitoring Parameters	Frequency of Monitoring	Responsibility
1.	Ambient Air Quality	As per CPCB guidelines	Every Six Months	Site Manager
2.	Ambient Noise quality	Measurement of Noise Pressure Level in dB(A)	Every Six Months	Site Manager
3.	Soil Quality	Physico-chemical parameters monitored for baseline data collection	Every Six Months	Site Manager
4.	Water Resources	Physico-chemical parameters monitored for Surface and Ground water baseline data collection	Every Six Months	Site Manager
		Water meter readings to be maintained on daily basis	Monthly	Site Manager
5.	Waste	Waste inventory for both hazardous and non-hazardous waste, Waste Labelling, storage and disposal records Visual inspection for spilling/ leakages in the waste storage area	Weekly	Site Manager
		Agreements with vendors for waste collection and storage for both hazardous and non- hazardous waste	Every Six Months	Site Manager
6.	Biodiversity	Visual inspection of Project Site to document any injury/death of any globally threatened vulture species due to interaction with Project-related heavy machinery or electrical cables.	Weekly	Site Manager
		Visual inspection of Project Site to record any spillage/leakage of Project-related chemicals/wastewater.	Monthly	

8.4.7.2 Social and Health and Safety Monitoring Plan

Working conditions on site with respect to health and safety of the workers and concerns from the communities are required to be monitored regularly to ensure the positive impacts of the mitigation and management measures taken for the anticipated impacts.

Table 8-6: Social and Health and Safety Monitoring Plan

S. No.	Attribute	Monitoring Parameter	Monitoring Frequency	Responsibility
1	Health and Safety Risks	• Sanitation status of onsite office building • Potable nature of drinking water with respect to BIS drinking water standards 10500:2012; • Usage of adequate PPEs; • Ambient air quality testing • Water quality test • Adequate Health and Safety Training to workers • Fire Safety measures on site • Incident/ Accident Records • Permit to Work Records • LOTO records	Monthly	Site Manager

8.4.7.3 Monitoring Plan during Decommissioning Phase

Following aspects are required to be monitored throughout during the decommission phase, regularly by the Site Manager.

- Local community and workers shall be informed for the duration of works;
- All waste generated from decommissioning phase shall be collected and disposed of to the authorized vendor;
- All necessary PPEs shall be used by the workers during demolition work;
- Vehicle maintenance records, accident records
- Visual inspection of waste storage area;
- Broken/defunct plant units shall be disposed of to authorized vendor through buy back agreements (if possible);
- It is to be ensured that dismantling is carried out during non-monsoon season and all the drainage channels will keep intact by creating bunds around them;
- ERMPL should ensure that retrenchment packages are provided for all staff who stand to lose their jobs when the plant is decommissioned.

8.4.8 Emergency Preparedness and Response Plan

The primary objective of formulating Emergency Preparedness and Response Plan (EPRP) is to undertake immediate rescue and relief operations and stabilize the mitigation process as quickly as possible. The main parameters of a response plan based on such mechanism include:

- Identification and declaration of potential emergencies;
- Signal/warning mechanism;
- Activities and their Levels;
- Command and control structure;
- Individual roles and responsibilities of each specified authority to achieve the activation as per response time;

- Emergency procedures;
- Alternate plans & contingency measures; and
- Co-ordination with external parties

8.4.8.1 Responsibilities

The Project Manager and EHS manager 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

8.4.8.2 Identification of Emergencies

All the anticipated hazards and risks associated with each project activity, which may lead to an emergency are identified in the section, along with the required actions to be taken before or after the emergency arises. This section identifies the hazardous areas and activities in the operation phases. Probable emergencies that might arise due to these hazards for the duration of the project have been listed below.

Hazardous Areas

Following potentially hazardous areas and activities have been identified at the construction site:

- Fuel storage areas
- Electrical installations – improper laying of cables
- Hazardous waste storage area

Emergency Situations

The possible emergency situations identified for the operation phases of the Project are as listed below:

Fire and Explosion

- Leakage of fuel from storage areas; and
- Short-circuit at project site.
- Valves of digestor/post digestor/tanks
- Biogas storage tank

Mechanical and Electrical Hazards

- Accidentally dropped object;
- Feeder

Occupational Hazards

- Handling of chemicals;
- Electrocution;
- Accidents due to vehicle movement; and
- Vandalism.

8.4.8.3 Declaration of Emergencies

Level 1 (Minor Emergency)

All events with no escalation potential and which can be controlled and contained by the action of Safety Officer / EHS manager at the site will be considered as Level 1. In such cases of local alert, Site EHS Manager will be notified. Some typical incidents are:

- Vehicle collision (involving no loss of life);
- Equipment damage;
- Medical Evacuation (not very serious cases);
- Minor fires.

Level 2 (Serious Emergency)

All events with escalation potential, depending on the effectiveness of the local response will be considered as Level 2. These incidents may impact the entire project operations or have cascading effect. For such type of incidents Site/Project Manager will take the lead. Some typical incidents are:

- Substantial security incident / Vandalism;
- Structural collapse;
- Minor Flooding;
- Serious damage to structures;
- Substantial fire; and
- Cultural conflict.

Level 3 (Major Emergency)

The crisis that requires assistance from external resources in order to save lives, minimize damage and to bring the abnormal situation back under control are Level 3 emergencies. These incidents have the potential to impact beyond the project footprints and affect the community. In such cases appropriate government / regulatory authorities will be informed and involved. Some typical Level 3 incidents are:

- Major fire/explosion;
- Fatality;
- Severe flooding.

Personnel on site will know that a Major Emergency has been declared if the site fire alarm siren and /or the local fire alarm systems are activated. The Emergency Siren Modes will be demonstrated and shared with all workers to identify with them.

Level 2 and level 3 will be declared using emergency siren and evacuation shall be done.

8.4.8.4 Emergency Equipment

The following points should be implemented to tackle emergency situations:

- Onsite emergency equipment such as first aid boxes, firefighting equipment, PPEs etc. shall be maintained at project site;
- The adequacy and availability of emergency equipment shall be assessed at periodic intervals by the EHS Manager;
- Inventory and locations of respective emergency equipment shall be displayed at project office building and other work areas;
- It is to be ensured that the site staff is trained on usage of each type of emergency equipment.

First Aid Boxes

First aid boxes shall be provided at identified locations within the plant premises. A first aid box shall contain, but not limited to the following articles:

- Cotton wool
- Sterile gauze
- Antiseptic lotion

- Box of adhesive dressing (Plasters) for small wounds
- Blunt-ended scissors
- Tweezers for removing splinters
- Triangular bandages (for making a sling or emergency bandage)
- Safety pins
- Sterile eye dressings
- Crepe bandages
- Aspirin/ Paracetamol tablets
- Skin creams for treating burns
- Anti-histamine cream for insect bites and stings

Fire Fighting Equipment

During operation phase, fire extinguishers and sand buckets shall be provided at critical areas such as fuel storage area, waste storage area, areas with electrical installations and project office.

Other firefighting systems to be installed should include:

- Heavy-duty ABC powder type fire extinguishers kept at important electrical equipment areas;
- Portable CO2 extinguishers provided throughout the plant
- Other systems as per project design and applicable regulations

Provision of Personal Protective Equipment (PPE)

Onsite workers and site staff should be provided with adequate number of personal protective equipment (PPEs) to deal with emergency situations. The PPEs shall be stored at the designated Emergency Control Centre (ECC) in the plant premises and will be easily accessible during times of emergency. Training of proper use of PPEs shall be provided to all working personnel on periodic basis.

Assembly Area

Safe assembly area shall be identified and marked and employees to be instructed to gather at the assembly area during emergencies.

Codification of Sirens

The following codes of siren will be following during emergencies:

Table 8-7: Codification of Siren

S. No.	Siren	Indicate	Authority
1.	120 seconds Continuous Whelming Sound	On Site Emergency (Alert) for evacuation	Plant Head/ EHS Manager
2.	30 + 30 + 30 seconds Sound with an interval of 5 seconds each	Emergency controlled	Site Manager/ Site EHS Manager

Below points shall be noted during prevalence of emergency situation:

- Emergency siren to be sounded only if required.
- The sensors (gas and fire detectors) must be appropriately positioned, calibrated, wired and maintained
- All staff shall be prior informed of use of emergency sirens during mock drills.
- No worker will leave the emergency spot unless 'all clear' siren blown.

8.4.8.5 Coordination with External Agencies

During emergency situations, Site/Project Manager and Site EHS Manager shall form the Emergency Control Centre (ECC). Site EHS Manager shall coordinate with the following departments:

- Fire brigade;
- Police department;
- Hospitals/ Ambulance Services;
- Utility departments (electricity and water);
- Technical departments such as MPPCB, Factory Inspectorate etc.
- Local Authorities and District Administration
- District Disaster Control Room, Bhopal

8.4.8.6 Emergency Response Team

- The Emergency Response Team (ERT) shall be set up immediately for the project;
- Each personnel identified as part of the ERT shall be designated specific roles and responsibilities for handling emergency situations.
- The ERT at the operating site under its control will have following role:
- Control the emergency and render the facility premises safe by the application of local resources; and
- Support the local response effort by coordinating additional equipment, personnel, and other external resources for the direct response effort.
- The ERT will comprise of the following personnel:
  - Site / Project Manager;
  - Site EHS Manager;
  - Safety Officer(s); if any
  - Evacuation Officer; if any
  - Employee/Workers

8.4.8.7 Emergency Response Procedure

Effective command and control start with a clear definition of the overall command and control structure, and description of the duties of key personnel with specific responsibilities for emergency response. The control of emergencies will consider the minimum number of persons required to provide an adequate response to emergencies.

All emergencies occurring as a result of project activities shall be managed according to the following order of priorities:

- Preservation of Life (self, team, community);
- Protection of the Environment;
- Protection or Property/assets; and,
- Preservation of Evidence.

8.4.8.8 Reporting and Documentation

The following aspects need to be communicated for the emergency reporting:

- While witnessing or receiving notification of an emergency, as much information as possible should be taken and/or conveyed to the relevant emergency activation authority;

- Where possible, all information should be logged in written form with time and date included and provided to EHS Manager;
- Personnel working on the site may, at any time, be exposed to an emergency which could take many forms, for example (but not limited to):

Injuries and/or fatalities

Fires and/or explosions

Extreme weather

- When an emergency occurs, an appropriate and prompt response is required, providing precise action to control, correct and return the site to a safe condition. Timely action will also be required to protect people, the environment and property from damage; and
- All near misses and unsafe acts will be written in logbooks / reported in the 'near miss, unsafe acts, hazards and sub-standard conditions report' and verbally communicated to the concerned Site Supervisor within a reasonable time.

9. Subsurface Assessment - Sample Analysis

9.1 Soil Sample Collection

The samples of soil / fill material were collected from seven (7) locations from site. The locations where samples were collected are shown in Figure 9-1. Sub surface strata as observed on these locations is attached as Appendix H. The samples were collected with the help of backhoe / excavator from the refusal point or at the depth to the reach of excavator arm.

Figure 9-1: Sampling Locations Map

9.2 Sample Analysis and Discussion

The samples collected from the Site were sent to Eureka Analytical Services Pvt Ltd for chemical analysis in line with the TOR. Eureka Analytical Service Pvt. Ltd. is a CPCB / MoEFCC approved and NABL accredited laboratory.

These samples were tested for various parameters included “Leachate parameters as per SWM Rules, 2016” and “Parameters for Soil Testing” and “Leachate testing” as per RFP. The lab tests results of these samples may be referred in Appendix I.

The samples collected from SB-01, SB-02 and SB-03 were collected from the section of land parcel on eastern side of the site, the trapezium shaped section has mostly native soil. However, probably small area around SB-02 was observed to be filled with some municipal solid wastes till 0.6m bgl.

The section of the site on the western side of the site, which may be identified as remaining land parcel of rectangular shape, where samples SB-04, SB-05, SB06 and SB-07 were collected. This section of the site was observed with Municipal Solid Wastes (MSW) till 3.1m, 3.4m, 3.5m and 2.8m respectively.

9.3 Site Subsurface Conditions - Findings and Way Forward

As per the TOR, 7 (seven) soil samples (SB-01 through SB-07), 2 (two) leachate sample (LN-01 &LN-02) were collected as a part of environmental baseline study. The land has been divided into two parts for discussion purpose the eastern part i.e. Trapezium and western part, i.e. Rectangle. The Trapezium part of the land parcel has mostly native soil while rectangle part was observed with MSW wastes underlying in the subsurface strata at minimum depth of 3m below ground surface. Annexure H & I give details about bore logs of sampling points and laboratory analysis respectively.

10. Conclusion

The Environmental and Social Assessment study for the proposed 400 Tons Bio-CNG Project to be developed by EverEnviro Resource Management Pvt. Ltd. at Bhopal, Madhya Pradesh, India has been undertaken in accordance with International Finance Corporation (IFC) Sustainability Framework (Policy and Performance Standards on Environmental and Social Sustainability) 2012 and the associated World Bank Group Environmental Health and Safety Guidelines.

The ESIA study aimed to identify and evaluate potential environmental and social impacts associated with all aspects of the proposed project. The conclusion and recommendations of this study are result of on-site inspections, evaluation of impacts identified, and the process of stakeholder consultation. The proposed project is an opportunity to utilize waste and convert to energy.

Categorisation of Project as per IFC Environment and Social Sustainability Standards:

Applying the criteria stipulated by the IFC Policy on Environmental and Social Sustainability for environmental and social categorization of projects, ERMPL's proposed Bio-CNG project may be assigned as '***Category B***' with respect to environmental and social impacts. This is so basis the primary data available to date which indicates that the environmental and social risks and impacts of the proposed project activities are expected to be few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures, which supports the *'**Category B**'* classification.

Additional rationale for the above categorization is as below:

- Bio-CNG is a clean technology project using waste and converting it to form energy;
- There is no land acquisition for the project;
- The Project Site does not coincide or overlap with any Designated Area; and
- Available data suggests that the construction, operation and decommissioning of the proposed project are likely to have limited environmental and social impacts which can be readily addressed with mitigation measures.

Appendix A Participant list of Stakeholder Consultations

S.No	Stakeholder Type	Date of Consultation
1	Site Representatives	16th May 2022
2	Site Representatives	17th May 2022
3	Site Representatives	18th May 2022
4	Site Representatives	19th May 2022
5	Panchayat Representatives	17th May 2022
6	Village Representatives	17th May 2022
7	Village Representatives	18th May 2022

Appendix B Mammals of the Study Area

SN	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Macaca mulatta*	Rhesus Monkey	LC	II
2	*Rhinolophus lepidus*	Blyth's Horseshoe Bat	LC	-
3	*Rhinopoma microphyllum*	Greater Mouse-tailed Bat	LC	-
4	*Rhinopoma hardwickii*	Lesser Mouse-tailed Bat	LC	-
5	*Rousettus leschenaultii*	Leschenault's Rousette	NT	-
6	*Lyroderma lyra*	Greater False Vampire	LC	-
7	*Scotophilus kuhlii*	Lesser Asiatic Yellow House Bat	LC	-
8	*Scotophilus heathii*	Greater Asiatic Yellow House Bat	LC	-
9	*Hipposideros fulvus*	Fulvus Leaf-nosed Bat	LC	-
10	*Hipposideros lankadiva*	Indian Leaf-nosed Bat	LC	-
11	*Taphozous nudiventris*	Naked-rumped Tomb Bat	LC	-
12	*Taphozous melanopogon*	Black-bearded Tomb Bat	LC	-
13	*Taphozous longimanus*	Long-winged Tomb Bat	LC	-
14	*Cynopterus sphinx*	Greater Shortnosed Fruit Bat	LC	V
15	*Tadarida aegyptiaca*	Egyptian Free-tailed Bat	LC	-
16	*Scotozous dormeri*	Dormer's Bat	LC	-
17	*Pipistrellus ceylonicus*	Kelaart's Pipistrelle	LC	-
18	*Axis axis*	Chital	LC	III
19	*Muntiacus vaginalis*	Northern Red Muntjac	LC	III
20	*Suncus murinus*	House Shrew	LC	-
21	*Suncus stoliczkanus*	Anderson's Shrew	LC	-
22	*Tatera indica*	Indian Gerbil	LC	-
23	*Vandeleuria oleracea*	Asiatic Long-tailed Climbing Mouse	LC	-
24	*Sus scrofa*	Wild Boar	LC	III
25	*Lepus nigricollis*	Indian Hare	LC	IV
26	*Hyaena hyaena*	Striped Hyaena	NT	III
27	*Herpestes edwardsii*	Indian Grey Mongoose	LC	IV
28	*Herpestes smithii*	Ruddy Mongoose	LC	IV
29	*Mellivora capensis*	Honey Badger	LC	I
30	*Paradoxurus hermaphroditus*	Common Palm Civet	LC	II
31	*Viverricula indica*	Small Indian Civet	LC	II
32	*Antilope cervicapra*	Blackbuck	LC	I
33	*Gazella bennettii*	Chinkara	LC	I
34	*Tetracerus quadricornis*	Four-horned Antelope	VU	I

35	*Felis silvestris*	Wild Cat	LC	-
36	*Prionailurus rubiginosus*	Rusty-spotted Cat	NT	I
37	*Moschiola indica*	Indian Chevrotain	LC	I
38	*Herpestes auropunctatus*	Small Indian Mongoose	LC	II
39	*Cuon alpinus*	Dhole	EN	II
40	*Vulpes bengalensis*	Bengal Fox	LC	II
41	*Rusa unicolor*	Sambar	VU	III
42	*Bandicota bengalensis*	Lesser Bandicoot Rat	LC	-
43	*Bandicota indica*	Greater Bandicoot Rat	LC	-
44	*Boselaphus tragocamelus*	Nilgai	LC	III
45	*Funambulus pennantii*	Five-striped Palm Squirrel	LC	IV
46	*Golunda ellioti*	Indian Bush-rat	LC	-
47	*Millardia meltada*	Soft-furred Metad	LC	-
48	*Mus booduga*	Common Indian Field Mouse	LC	-
49	*Mus terricolor*	Earth-colored Mouse	LC	-
50	*Manis crassicaudata*	Indian Pangolin	EN	I
51	*Canis aureus*	Golden Jackal	LC	II
52	*Canis lupus*	Grey Wolf	LC	I
53	*Lutrogale perspicillata*	Smooth-coated Otter	VU	II
54	*Melursus ursinus*	Sloth Bear	VU	I
55	*Rattus rattus*	House Rat	LC	-
56	*Vulpes vulpes*	Red Fox	LC	II
57	*Pteropus giganteus*	Indian Flying Fox	LC	V
58	*Hystrix indica*	Indian Crested Porcupine	LC	IV
59	*Mus musculus*	House Mouse	LC	-
60	*Felis chaus*	Jungle Cat	LC	II

**Status assigned by the International Union for Conservation of Nature and Natural Resources, where –CR – Critically Endangered; EN – Endangered; LC – Least Concern, NA – Not Assessed; NT – Near Threatened; and VU - Vulnerable.*

***Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

Sources: IUCN 2022. The IUCN Red List of Threatened Species. Version 2021-3; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix C Birds Reported From the Study Area

SN	Scientific Name	Common Name	IUCN Status*	Migratory Status**	Congregatory Status	WPA Schedule***
1	*Tadorna ferruginea*	Ruddy Shelduck	LC	W	C	IV
2	*Netta rufina*	Red-crested Pochard	LC	W	C	IV
3	*Aythya fuligula*	Tufted Duck	LC	W	C	IV
4	*Spatula querquedula*	Garganey	LC	W	C	IV
5	*Mareca strepera*	Gadwall	LC	W	C	IV
6	*Porzana porzana*	Spotted Crake	LC	W	C	IV
7	*Botaurus stellaris*	Eurasian Bittern	LC	W	C	IV
8	***Egretta garzetta***	**Little Egret**	**LC**	**R**	**C**	**IV**
9	*Gallinago stenura*	Pintail Snipe	LC	W	C	IV
10	*Actitis hypoleucos*	Common Sandpiper	LC	W	C	IV
11	*Tringa ochropus*	Green Sandpiper	LC	W	C	IV
12	*Tringa erythropus*	Spotted Redshank	LC	W	C	-
13	*Tringa nebularia*	Common Greenshank	LC	W	C	-
14	*Tringa totanus*	Common Redshank	LC	W	C	-
15	*Tringa glareola*	Wood Sandpiper	LC	W	C	IV
16	*Parus major*	Great Tit	LC	R	-	IV
17	*Pastor roseus*	Rosy Starling	LC	W	-	IV
18	*Monticola solitarius*	Blue Rock-thrush	LC	W	-	IV
19	*Emberiza melanocephala*	Black-headed Bunting	LC	W	-	IV
20	*Oenanthe deserti*	Desert Wheatear	LC	W	-	-
21	*Apus affinis*	Little Swift	LC	R	-	-
22	***Vanellus indicus***	**Red-wattled Lapwing**	**LC**	**R**	**C**	**-**
23	*Alcedo atthis*	Common Kingfisher	LC	R	-	IV
24	*Turnix sylvaticus*	Common Buttonquail	LC	R	-	IV
25	*Ketupa zeylonensis*	Brown Fish-owl	LC	R	-	IV
26	*Francolinus pictus*	Painted Francolin	LC	R	-	-
27	*Coturnix coromandelica*	Rain Quail	LC	R	-	IV
28	*Perdicula argoondah*	Rock Bush-quail	LC	R	-	IV
29	*Galloperdix spadicea*	Red Spurfowl	LC	R	-	IV
30	*Galloperdix lunulata*	Painted Spurfowl	LC	R	-	IV
31	***Pavo cristatus***	**Indian Peafowl**	**LC**	**R**	**-**	**I**
32	*Dendrocygna bicolor*	Fulvous Whistling-duck	LC	W	C	I
33	*Dendrocygna javanica*	Lesser Whistling-duck	LC	R	C	IV
34	*Nettapus coromandelianus*	Cotton Pygmy-goose	LC	W	C	IV

SN	Scientific Name	Common Name	IUCN Status*	Migratory Status**	Congregatory Status	WPA Schedule***
35	*Turnix tanki*	Yellow-legged Buttonquail	LC	R	-	IV
36	*Turnix suscitator*	Barred Buttonquail	LC	R	-	IV
37	*Picoides nanus*	Indian Pygmy Woodpecker	LC	R	-	IV
38	*Leiopicus mahrattensis*	Yellow-crowned Woodpecker	LC	R	-	IV
39	*Micropternus brachyurus*	Rufous Woodpecker	LC	R	-	IV
40	*Picus xanthopygaeus*	Streak-throated Woodpecker	LC	R	-	IV
41	*Chrysocolaptes festivus*	White-naped Woodpecker	LC	R	-	IV
42	*Psilopogon zeylanicus*	Brown-headed Barbet	LC	R	-	IV
43	***Psilopogon haemacephalus***	**Coppersmith Barbet**	**LC**	**R**	**-**	**IV**
44	*Pelargopsis capensis*	Stork-billed Kingfisher	LC	R	-	IV
45	*Merops philippinus*	Blue-tailed Bee-eater	LC	W	-	IV
46	*Clamator jacobinus*	Jacobin Cuckoo	LC	P	-	IV
47	*Clamator coromandus*	Chestnut-winged Cuckoo	LC	W	-	IV
48	*Hierococcyx varius*	Common Hawk-cuckoo	LC	R	-	IV
49	*Cacomantis sonneratii*	Banded Bay Cuckoo	LC	R	-	IV
50	*Eudynamys scolopaceus*	Western Koel	LC	R	-	IV
51	*Taccocua leschenaultii*	Sirkeer Malkoha	LC	R	-	-
52	*Centropus sinensis*	Greater Coucal	LC	R	-	-
53	*Himalayapsitta cyanocephala*	Plum-headed Parakeet	LC	R	-	IV
54	*Zoonavena sylvatica*	White-rumped Spinetail	LC	R	-	IV
55	***Cypsiurus balasiensis***	**Asian Palm-swift**	**LC**	**R**	**-**	**-**
56	*Bubo bengalensis*	Rock Eagle-owl	LC	R	-	IV
57	*Strix ocellata*	Mottled Wood-owl	LC	R	-	IV
58	*Strix leptogrammica*	Brown Wood-owl	LC	R	-	IV
59	*Glaucidium radiatum*	Jungle Owlet	LC	R	-	IV
60	*Athene brama*	Spotted Owlet	LC	R	-	IV
61	*Caprimulgus mahrattensis*	Sykes's Nightjar	LC	R	-	IV
62	*Caprimulgus asiaticus*	Indian Nightjar	LC	R	-	IV
63	*Caprimulgus affinis*	Savanna Nightjar	LC	R	-	IV
64	*Streptopelia orientalis*	Oriental Turtle-dove	LC	R	-	IV
65	*Treron phoenicopterus*	Yellow-footed Green-pigeon	LC	R	-	IV
66	*Grus antigone*	Sarus Crane	VU	R	C	IV
67	*Zapornia akool*	Brown Crake	LC	R	-	IV
68	*Gallicrex cinerea*	Watercock	LC	R	C	IV
69	*Pterocles indicus*	Painted Sandgrouse	LC	R	-	IV
70	*Hydrophasianus chirurgus*	Pheasant-tailed Jacana	LC	R	C	IV
71	*Metopidius indicus*	Bronze-winged Jacana	LC	R	C	IV
72	*Vanellus malabaricus*	Yellow-wattled Lapwing	LC	R	C	-

SN	Scientific Name	Common Name	IUCN Status*	Migratory Status**	Congregatory Status	WPA Schedule***
73	*Cursorius coromandelicus*	Indian Courser	LC	R	-	-
74	*Glareola lactea*	Little Pratincole	LC	R	C	-
75	*Haliastur indus*	Brahminy Kite	LC	R	-	-
76	*Butastur teesa*	White-eyed Buzzard	LC	R	-	-
77	*Ictinaetus malaiensis*	Black Eagle	LC	R	-	IV
78	*Anhinga melanogaster*	Oriental Darter	NT	R	C	IV
79	*Microcarbo niger*	Little Cormorant	LC	R	C	IV
80	***Ardeola grayii***	**Indian Pond-heron**	**LC**	**R**	**C**	**IV**
81	*Threskiornis melanocephalus*	Black-headed Ibis	NT	R	C	IV
82	*Pseudibis papillosa*	Red-naped Ibis	LC	R	C	IV
83	*Mycteria leucocephala*	Painted Stork	NT	R	C	IV
84	*Anastomus oscitans*	Asian Openbill	LC	R	C	IV
85	*Ephippiorhynchus asiaticus*	Black-necked Stork	NT	W	C	IV
86	*Pitta brachyura*	Indian Pitta	LC	R	-	IV
87	*Lanius isabellinus*	Isabelline Shrike	LC	R	-	-
88	*Lanius cristatus*	Brown Shrike	LC	R	-	-
89	*Lanius schach*	Long-tailed Shrike	LC	R	-	-
90	*Corvus macrorhynchos*	Large-billed Crow	LC	R	-	IV
91	*Artamus fuscus*	Ashy Woodswallow	LC	R	-	-
92	*Pericrocotus cinnamomeus*	Small Minivet	LC	R	-	IV
93	*Rhipidura aureola*	White-browed Fantail	LC	R	-	-
94	***Dicrurus macrocercus***	**Black Drongo**	**LC**	**R**	**-**	**IV**
95	*Dicrurus leucophaeus*	Ashy Drongo	LC	R	-	IV
96	*Dicrurus caerulescens*	White-bellied Drongo	LC	R	-	IV
97	*Dicrurus paradiseus*	Greater Racquet-tailed Drongo	LC	R	-	IV
98	*Hypothymis azurea*	Black-naped Monarch	LC	W	-	IV
99	*Aegithina tiphia*	Common Iora	LC	R	-	IV
100	*Aegithina nigrolutea*	Marshall's Iora	LC	R	-	IV
101	*Eumyias thalassinus*	Verditer Flycatcher	LC	W	-	IV
102	*Culicicapa ceylonensis*	Grey-headed Canary-flycatcher	LC	W	-	IV
103	*Saxicola caprata*	Pied Bushchat	LC	R	-	-
104	*Sturnia malabarica*	Chestnut-tailed Starling	LC	W	-	IV
105	*Sitta frontalis*	Velvet-fronted Nuthatch	LC	W	-	-
106	*Cephalopyrus flammiceps*	Fire-capped Tit	LC	W	-	-
107	*Ptyonoprogne concolor*	Dusky Crag Martin	LC	R	-	-
108	*Hirundo smithii*	Wire-tailed Swallow	LC	R	-	-
109	*Petrochelidon fluvicola*	Streak-throated Swallow	LC	R	-	-
110	*Prinia buchanani*	Rufous-fronted Prinia	LC	R	-	-

SN	Scientific Name	Common Name	IUCN Status*	Migratory Status**	Congregatory Status	WPA Schedule***
111	*Prinia hodgsonii*	Grey-breasted Prinia	LC	R	-	-
112	*Prinia socialis*	Ashy Prinia	LC	R	-	-
113	*Prinia inornata*	Plain Prinia	LC	R	-	-
114	*Arundinax aedon*	Thick-billed Warbler	LC	W	-	-
115	*Orthotomus sutorius*	Common Tailorbird	LC	R	-	-
116	*Chrysomma sinense*	Yellow-eyed Babbler	LC	R	-	IV
117	***Argya malcolmi***	**Large Grey Babbler**	**LC**	**R**	**-**	**IV**
118	*Argya striata*	Jungle Babbler	LC	R	-	IV
119	*Eremopterix griseus*	Ashy-crowned Sparrow-lark	LC	R	-	IV
120	*Alauda gulgula*	Oriental Skylark	LC	R	-	IV
121	*Dicaeum erythrorhynchos*	Pale-billed Flowerpecker	LC	R	-	IV
122	*Motacilla maderaspatensis*	White-browed Wagtail	LC	R	-	-
123	*Anthus rufulus*	Paddyfield Pipit	LC	R	-	IV
124	*Anthus godlewskii*	Blyth's Pipit	LC	W	-	IV
125	*Ploceus manyar*	Streaked Weaver	LC	R	-	-
126	*Ploceus philippinus*	Baya Weaver	LC	R	-	-
127	*Emberiza lathami*	Crested Bunting	LC	R	-	IV
128	*Caprimulgus indicus*	Jungle Nightjar	LC	R	-	IV
129	***Coracias benghalensis***	**Indian Roller**	**LC**	**R**	**-**	**IV**
130	*Falco chicquera*	Red-headed Falcon	NT	W	-	I
131	*Butorides striata*	Green-backed Heron	LC	R	C	IV
132	*Phylloscopus humei*	Hume's Leaf-warbler	LC	W	-	-
133	*Clanga hastata*	Indian Spotted Eagle	VU	R	-	IV
134	*Chloropsis jerdoni*	Jerdon's Leafbird	LC	R	-	IV
135	*Chloropsis aurifrons*	Golden-fronted Leafbird	LC	R	-	IV
136	*Rostratula benghalensis*	Greater Painted-snipe	LC	R	C	IV
137	*Anas poecilorhyncha*	Indian Spot-billed Duck	LC	R	C	IV
138	*Burhinus indicus*	Indian Thick-knee	LC	R	C	IV
139	*Sarkidiornis melanotos*	African Comb Duck	LC	R	C	IV
140	***Spilopelia suratensis***	**Western Spotted Dove**	**LC**	**R**	**-**	**IV**
141	*Dinopium benghalense*	Black-rumped Flameback	LC	R	-	IV
142	*Otus bakkamoena*	Indian Scops-owl	LC	R	-	IV
143	*Amaurornis phoenicurus*	White-breasted Waterhen	LC	R	C	-
144	*Spilornis cheela*	Crested Serpent-eagle	LC	R	-	-
145	*Calandrella dukhunensis*	Mongolian Short-toed Lark	LC	W	-	IV
146	*Columba eversmanni*	Yellow-eyed Pigeon	VU	R	-	IV
147	*Sterna acuticauda*	Black-bellied Tern	EN	W	C	-
148	*Ceryle rudis*	Pied Kingfisher	LC	R	-	IV

SN	Scientific Name	Common Name	IUCN Status*	Migratory Status**	Congregatory Status	WPA Schedule***
149	*Palaeornis eupatria*	Alexandrine Parakeet	NT	R	-	IV
150	***Acridotheres tristis***	**Common Myna**	**LC**	**R**	**-**	**IV**
151	*Cisticola juncidis*	Zitting Cisticola	LC	R	-	-
152	*Acrocephalus agricola*	Paddyfield Warbler	LC	W	-	-
153	*Iduna caligata*	Booted Warbler	LC	W	-	IV
154	*Dumetia hyperythra*	Tawny-bellied Babbler	LC	R	-	IV
155	*Carpodacus erythrinus*	Common Rosefinch	LC	W	-	IV
156	*Emberiza bruniceps*	Red-headed Bunting	LC	W	-	IV
157	*Cyornis tickelliae*	Tickell's Blue-flycatcher	LC	W	-	IV
158	*Dicaeum agile*	Thick-billed Flowerpecker	LC	R	-	IV
159	*Motacilla cinerea*	Grey Wagtail	LC	W	-	-
160	*Cecropis daurica*	Red-rumped Swallow	LC	R	-	-
161	*Chlidonias hybrida*	Whiskered Tern	LC	W	C	-
162	*Jynx torquilla*	Eurasian Wryneck	LC	W	-	-
163	*Phylloscopus tristis*	Siberian Chiffchaff	LC	W	-	-
164	*Iduna rama*	Sykes's Warbler	LC	W	-	-
165	*Tephrodornis pondicerianus*	Common Woodshrike	LC	R	-	-
166	*Pericrocotus erythropygius*	White-bellied Minivet	LC	R	-	IV
167	*Mirafra javanica*	Horsfield's Bushlark	LC	R	-	IV
168	*Phylloscopus griseolus*	Sulphur-bellied Warbler	LC	R	-	-
169	*Icthyophaga ichthyaetus*	Grey-headed Fish-eagle	NT	R	-	IV
170	*Esacus recurvirostris*	Great Thick-knee	NT	W	-	IV
171	*Machlolophus xanthogenys*	Black-lored Tit	LC	R	-	IV
172	*Ammomanes phoenicura*	Rufous-tailed Lark	LC	R	-	IV
173	*Mirafra erythroptera*	Indian Bushlark	LC	R	-	IV
174	*Alaudala raytal*	Sand Lark	LC	W	-	IV
175	*Galerida deva*	Sykes's Lark	LC	W	-	IV
176	*Lalage melanoptera*	Black-headed Cuckooshrike	LC	P	-	-
177	*Prinia sylvatica*	Jungle Prinia	LC	R	-	-
178	*Locustella naevia*	Common Grasshopper-warbler	LC	W	-	IV
179	*Rhipidura albogularis*	White-spotted Fantail	LC	R	-	-
180	*Lanius vittatus*	Bay-backed Shrike	LC	R	-	-
181	*Ptyonoprogne rupestris*	Eurasian Crag Martin	LC	R	-	IV
182	***Gracupica contra***	**Asian Pied Starling**	**LC**	**R**	**-**	**IV**
183	*Phylloscopus affinis*	Tickell's Leaf-warbler	LC	W	-	-
184	*Pycnonotus jocosus*	Red-whiskered Bulbul	LC	R	-	IV
185	***Halcyon smyrnensis***	**White-breasted Kingfisher**	**LC**	**R**	**-**	**IV**
186	*Ficedula albicilla*	Red-throated Flycatcher	LC	R	-	IV

SN	Scientific Name	Common Name	IUCN Status*	Migratory Status**	Congregatory Status	WPA Schedule***
187	*Turdus atrogularis*	Black-throated Thrush	LC	W	-	IV
188	***Merops orientalis***	**Asian Green Bee-eater**	**LC**	**R**	**-**	**-**
189	*Cuculus micropterus*	Indian Cuckoo	LC	R	-	IV
190	*Hemiprocne coronata*	Crested Treeswift	LC	W	-	IV
191	*Streptopelia tranquebarica*	Red Turtle-dove	LC	R	-	IV
192	*Oriolus chinensis*	Black-naped Oriole	LC	W	-	IV
193	*Oriolus xanthornus*	Black-hooded Oriole	LC	W	-	IV
194	*Dendrocitta vagabunda*	Rufous Treepie	LC	R	-	IV
195	*Lalage melaschistos*	Black-winged Cuckooshrike	LC	W	-	-
196	*Pericrocotus roseus*	Rosy Minivet	LC	W	-	IV
197	*Perdicula asiatica*	Jungle Bush-quail	LC	R	-	IV
198	*Anthus campestris*	Tawny Pipit	LC	W	-	IV
199	*Francolinus francolinus*	Black Francolin	LC	R	-	-
200	*Francolinus pondicerianus*	Grey Francolin	LC	R	-	-
201	*Coturnix coturnix*	Common Quail	LC	R	-	IV
202	*Anthropoides virgo*	Demoiselle Crane	LC	W	C	IV
203	***Corvus splendens***	**House Crow**	**LC**	**R**	**-**	**V**
204	*Acridotheres ginginianus*	Bank Myna	LC	R	-	IV
205	*Argya caudata*	Common Babbler	LC	R	-	IV
206	*Anthus trivialis*	Tree Pipit	LC	W	-	IV
207	*Amandava formosa*	Green Avadavat	VU	R	-	IV
208	*Euodice malabarica*	Indian Silverbill	LC	R	-	IV
209	*Emberiza stewarti*	White-capped Bunting	LC	W	-	IV
210	*Ficedula parva*	Red-breasted Flycatcher	LC	W	-	IV
211	*Alexandrinus krameri*	Rose-ringed Parakeet	LC	R	-	IV
212	*Spilopelia senegalensis*	Laughing Dove	LC	R	-	IV
213	*Pterocles exustus*	Chestnut-bellied Sandgrouse	LC	R	-	IV
214	***Saxicoloides fulicatus***	**Indian Robin**	**LC**	**R**	**-**	**-**
215	***Oenanthe fusca***	**Brown Rockchat**	**LC**	**R**	**-**	**-**
216	*Sturnia pagodarum*	Brahminy Starling	LC	R	-	IV
217	*Pycnonotus cafer*	Red-vented Bulbul	LC	R	-	IV
218	*Phylloscopus magnirostris*	Large-billed Leaf-warbler	LC	W	-	-
219	*Pomatorhinus horsfieldii*	Indian Scimitar-babbler	LC	R	-	IV
220	*Motacilla alba*	White Wagtail	LC	W	-	-
221	*Cyanecula svecica*	Bluethroat	LC	W	-	-
222	*Hirundo rustica*	Barn Swallow	LC	R	-	-
223	*Calidris temminckii*	Temminck's Stint	LC	W	C	-
224	*Elanus caeruleus*	Black-winged Kite	LC	R	-	-

SN	Scientific Name	Common Name	IUCN Status*	Migratory Status**	Congregatory Status	WPA Schedule***
225	*Aythya nyroca*	Ferruginous Duck	NT	W	C	IV
226	*Spatula clypeata*	Northern Shoveler	LC	W	C	IV
227	*Zapornia pusilla*	Baillon's Crake	LC	W	C	IV
228	*Fulica atra*	Common Coot	LC	R	C	IV
229	*Streptopelia decaocto*	Eurasian Collared-dove	LC	R	-	IV
230	*Motacilla citreola*	Citrine Wagtail	LC	W	-	-
231	*Ardea cinerea*	Grey Heron	LC	R	C	IV
232	*Ardea purpurea*	Purple Heron	LC	R	C	IV
233	*Zosterops palpebrosus*	Indian White-eye	LC	R	-	IV
234	*Himantopus himantopus*	Black-winged Stilt	LC	W	C	IV
235	*Acrocephalus stentoreus*	Clamorous Reed-warbler	LC	W	-	-
236	*Anas platyrhynchos*	Mallard	LC	W	C	IV
237	*Anthus richardi*	Richard's Pipit	LC	W	-	IV
238	*Anthus similis*	Long-billed Pipit	LC	W	-	IV
239	*Platalea leucorodia*	Eurasian Spoonbill	LC	R	C	I
240	*Aquila fasciata*	Bonelli's Eagle	LC	R	-	-
241	*Ardea alba*	Great White Egret	LC	R	C	IV
242	***Bubulcus ibis***	**Cattle Egret**	**LC**	**R**	**C**	**IV**
243	*Charadrius alexandrinus*	Kentish Plover	LC	W	C	IV
244	*Charadrius dubius*	Little Ringed Plover	LC	W	C	IV
245	*Cinnyris asiaticus*	Purple Sunbird	LC	R	-	IV
246	***Columba livia***	**Rock Dove**	**LC**	**R**	**-**	**-**
247	*Galerida cristata*	Crested Lark	LC	R	-	-
248	*Gallinago gallinago*	Common Snipe	LC	R	C	IV
249	*Gallinula chloropus*	Common Moorhen	LC	R	C	IV
250	*Gymnoris xanthocollis*	Chestnut-shouldered Bush-sparrow	LC	R	-	-
251	*Nycticorax nycticorax*	Black-crowned Night-heron	LC	R	C	IV
252	***Passer domesticus***	**House Sparrow**	**LC**	**R**	**-**	**-**
253	*Phalacrocorax carbo*	Great Cormorant	LC	R	C	IV
254	*Phoenicopterus roseus*	Greater Flamingo	LC	W	C	IV
255	*Plegadis falcinellus*	Glossy Ibis	LC	W	C	IV
256	*Porphyrio porphyrio*	Purple Swamphen	LC	R	C	IV
257	*Tachybaptus ruficollis*	Little Grebe	LC	R	C	IV
258	*Tyto alba*	Common Barn-owl	LC	R	-	IV
259	*Vanellus gregarius*	Sociable Lapwing	CR	W	C	-
260	*Ficedula ruficauda*	Rusty-tailed Flycatcher	LC	W	-	IV
261	*Lanius excubitor*	Great Grey Shrike	LC	R	-	-
262	*Monticola cinclorhyncha*	Blue-capped Rock-thrush	LC	W	-	IV

SN	Scientific Name	Common Name	IUCN Status*	Migratory Status**	Congregatory Status	WPA Schedule***
263	*Motacilla flava*	Western Yellow Wagtail	LC	W	C	-
264	*Muscicapa dauurica*	Asian Brown Flycatcher	LC	R	-	IV
265	*Phoenicurus ochruros*	Black Redstart	LC	R	-	-
266	*Phylloscopus burkii*	Green-crowned Warbler	LC	R	-	-
267	*Curruca crassirostris*	Eastern Orphean Warbler	LC	W	-	-
268	*Curruca curruca*	Lesser Whitethroat	LC	W	-	-
269	*Terpsiphone paradisi*	Indian Paradise-flycatcher	LC	R	-	IV
270	*Zoothera dauma*	Scaly Thrush	LC	W	-	IV
271	*Gyps fulvus*	Griffon Vulture	LC	W	C	IV
272	*Coracina macei*	Indian Cuckooshrike	LC	R	-	-
273	*Oriolus kundoo*	Indian Golden Oriole	LC	R	-	IV
274	*Ciconia episcopus*	Asian Woollyneck	NT	R	C	IV
275	*Pelecanus onocrotalus*	Great White Pelican	LC	W	C	IV
276	*Rynchops albicollis*	Indian Skimmer	EN	R	C	-
277	***Sterna aurantia***	**River Tern**	**VU**	**W**	**C**	**-**
278	*Falco jugger*	Laggar Falcon	NT	W	-	I
279	*Saxicola torquatus*	Common Stonechat	LC	R	-	-
280	*Anas crecca*	Common Teal	LC	W	C	IV
281	*Ardea intermedia*	Intermediate Egret	LC	R	C	IV
282	*Nisaetus cirrhatus*	Changeable Hawk-eagle	LC	R	-	IV
283	*Upupa epops*	Common Hoopoe	LC	R	-	-
284	*Ficedula superciliaris*	Ultramarine Flycatcher	LC	W	-	IV
285	***Copsychus saularis***	**Oriental Magpie-robin**	**LC**	**R**	**-**	**-**
286	*Ocyceros birostris*	Indian Grey Hornbill	LC	R	-	-
287	*Accipiter badius*	Shikra	LC	R	-	-
288	*Haliaeetus leucoryphus*	Pallas's Fish-eagle	EN	R	-	-
289	*Pernis ptilorhynchus*	Oriental Honey-buzzard	LC	R	C	-
290	*Accipiter nisus*	Eurasian Sparrowhawk	LC	W	C	IV
291	*Sypheotides indicus*	Lesser Florican	CR	R	-	I
292	*Ninox scutulata*	Brown Boobook	LC	R	-	IV
293	*Circus macrourus*	Pallid Harrier	NT	W	C	-
294	*Asio flammeus*	Short-eared Owl	LC	W	-	IV
295	*Circaetus gallicus*	Short-toed Snake-eagle	LC	R	C	-
296	*Circus aeruginosus*	Western Marsh-harrier	LC	W	C	-
297	*Circus melanoleucos*	Pied Harrier	LC	W	C	-
298	*Aquila rapax*	Tawny Eagle	VU	R	C	-
299	*Clanga clanga*	Greater Spotted Eagle	VU	W	C	-
300	*Falco cherrug*	Saker Falcon	EN	W	C	I

SN	Scientific Name	Common Name	IUCN Status*	Migratory Status**	Congregatory Status	WPA Schedule***
301	*Gyps bengalensis*	White-rumped Vulture	CR	R	C	I
302	*Gyps himalayensis*	Himalayan Griffon	NT	W	C	IV
303	*Gyps indicus*	Indian Vulture	CR	R	C	I
304	*Sarcogyps calvus*	Red-headed Vulture	CR	R	C	IV
305	***Neophron percnopterus***	**Egyptian Vulture**	**EN**	**R**	**C**	**IV**
306	*Aythya ferina*	Common Pochard	VU	W	C	IV
307	*Aquila nipalensis*	Steppe Eagle	EN	W	C	-
308	*Falco amurensis*	Amur Falcon	LC	W	C	IV
309	*Falco peregrinus*	Peregrine Falcon	LC	W	C	I
310	*Falco tinnunculus*	Common Kestrel	LC	W	C	IV
311	*Hieraaetus pennatus*	Booted Eagle	LC	W	C	-
312	***Milvus migrans***	**Black Kite**	**LC**	**R**	**C**	**-**
313	*Pandion haliaetus*	Osprey	LC	W	C	I

**Status assigned by the International Union for Conservation of Nature and Natural Resources, where –CR – Critically Endangered, EN – Endangered, LC – Least Concern, NA – Not Assessed; NT – Near Threatened; and VU - Vulnerable.*

***Migratory Status of the species where R-Resident, W-Winter migrant and P-Passage migrant*

****Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

Sources: R. Grimmett, C. Inskipp & T. Inskipp (2011). Birds of the Indian Subcontinent. Oxford University Press, pp 1 -528; IUCN 2022. The IUCN Red List of Threatened Species. Version 2021-3; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix D Reptiles Reported From the Study Area

SN	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Varanus bengalensis*	Bengal Monitor Lizard	NT	I
2	*Ptyas mucosa*	Oriental Ratsnake	LC	II
3	*Lycodon striatus*	Barred Wolf Snake	LC	IV
4	*Hemidactylus flaviviridis*	Yellow-bellied House Gecko	LC	-
5	*Boiga trigonata*	Indian Gamma Snake	LC	IV
6	*Calotes versicolor*	Changeable Lizard	LC	-
7	*Echis carinatus*	Saw-scaled Viper	LC	IV
8	*Oligodon taeniolatus*	Streaked Kukri Snake	LC	IV
9	*Eryx johnii*	Red Sand Boa	NT	IV
10	*Psammophis leithii*	Leith's Sand Snake	LC	-
11	*Sibynophis subpunctatus*	Dumeril's Black-headed Snake	LC	-
12	*Lepidodactylus lugubris*	Mourning Gecko	LC	-
13	*Liopeltis calamaria*	Calamaria Reed Snake	LC	IV
14	*Dendrelaphis tristis*	Daudin's Bronzeback	LC	IV
15	*Chrysopelea ornata*	Ornate Flying Snake	LC	IV
16	*Indotyphlops porrectus*	Stoliczka's Slender Blind Snake	LC	IV
17	*Rhabdophis plumbicolor*	Green Keelback	LC	-
18	*Lycodon travancoricus*	Travancore Wolf Snake	LC	IV
19	*Fowlea piscator*	Chequered Keelback	LC	II
20	*Oligodon arnensis*	Common Kukri Snake	LC	IV
21	*Eutropis innotata*	Blanford's Mabuya	DD	-
22	*Argyrogena fasciolata*	Banded Racer	LC	IV
23	*Chamaeleo zeylanicus*	Asian Chameleon	LC	II
24	*Eutropis macularia*	Bronze Mabuya	LC	-
25	*Amphiesma stolatum*	Buff Striped Keelback	LC	-
26	*Coelognathus helenae*	Trinket Snake	LC	IV
27	*Lygosoma punctata*	Common Dotted Garden Skink	LC	-
28	*Hemidactylus leschenaultii*	Leschenault's Leaf-toed Gecko	LC	-
29	*Calliophis melanurus*	Slender Coral Snake	LC	IV
30	*Bungarus caeruleus*	Common Krait	LC	IV
31	*Hemidactylus brookii*	Brooke's House Gecko	LC	-
32	*Indotyphlops braminus*	Brahminy Blindsnake	LC	IV
33	*Lycodon aulicus*	Common Wolf Snake	LC	IV
34	*Ahaetulla nasuta*	Long-nosed Tree Snake	LC	IV

35	*Daboia russelii*	Western Russel's Viper	LC	II
36	*Atretium schistosum*	Olive Keelback Water Snake	LC	IV
37	*Boiga forsteni*	Forsten's Cat Snake	LC	IV
38	*Trimeresurus gramineus*	Common Bamboo Viper	LC	IV
39	*Ophisops jerdonii*	Punjab-snake-eyed Lacerta	LC	-
40	*Eutropis carinata*	Keeled Indian Mabuya	LC	-
41	*Python molurus*	Indian Rock Python	NT	I
42	*Sibynophis sagittarius*	Cantor's Black-headed Snake	LC	-
43	*Nilssonia gangetica*	Indian Softshell Turtle	EN	I
44	*Pangshura tecta*	Indian Roofed Turtle	VU	-
45	*Lissemys punctata*	Indian Flapshell Turtle	VU	I
46	*Crocodylus palustris*	Mugger	VU	I
47	*Naja naja*	Indian Cobra	LC	II
48	*Elachistodon westermanni*	Indian Egg-eater	LC	IV
49	*Psammophis condanarus*	Sand Snake	LC	-
50	*Ophisops microlepis*	Small-scaled Lacerta	LC	-
51	*Calotes minor*	Hardwicke's Bloodsucker	LC	-
52	*Sitana spinaecephalus*	Spiny-headed Fan-throated Lizard	LC	-
53	*Eublepharis satpuraensis*	Satpura Eyelid Gecko	LC	-
54	*Cyrtodactylus varadgirii*	Giri's Geckoella	LC	-
55	*Hemidactylus sahgali*	Sahgal's Termite Hill Gecko	LC	-

**Status assigned by the International Union for Conservation of Nature and Natural Resources, where – DD – Data Deficient; LC – Least Concern; NE – Not Evaluated and VU - Vulnerable.*

***Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

Sources: Patel, H., Vyas, R. (2019) Reptiles of Gujarat, India: Updated Checklist, Distribution, and Conservation Status. Herpetology Notes, Vol. 12 pp. 765-777.; The IUCN Red List of Threatened Species. Version 2019-3.; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix E Amphibians Reported From the Study Area

SN	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Duttaphrynus stomaticus*	Marbled toad	LC	-
2	*Microhyla ornata*	Ant Frog	LC	-
3	*Hoplobatrachus tigerinus*	Indian Bullfrog	LC	-
4	*Polypedates maculatus*	Indian Tree Frog	LC	-
5	*Sphaerotheca breviceps*	-	LC	-
6	*Fejervarya limnocharis*	Asian Grass Frog	LC	-
7	*Duttaphrynus melanostictus*	Asian Common Toad	LC	-
8	*Euphlyctis cyanophlyctis*	-	LC	-
9	*Minervarya syhadrensis*	Bombay Wart Frog	LC	-

**Status assigned by the International Union for Conservation of Nature and Natural Resources, where –CR – Critically Endangered and EN - Endangered.*

***Schedules I to VI: Indian Wildlife (Protection) Act, 1972.*

Sources: Vyas, R. (2008) Review of the current diversity and richness of amphibians of Gujarat, India. Indian Forester Vol 134 (10) pp 1381-1392.; The IUCN Red List of Threatened Species. Version 2019-3.; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix F Fishes Reported From the Study Area

SN	Scientific Name	Common Name	IUCN Status*	WPA Schedule**
1	*Channa gachua*	Dwarf Snakehead	LC	-
2	*Cirrhinus mrigala*	Mrigal	LC	-
3	*Gibelion catla*	Catla	LC	-
4	*Nandus nandus*	-	LC	-
5	*Paracanthocobitis botia*	Mottled Loach	LC	-
6	*Rasbora daniconius*	Slender Barb	LC	-
7	*Gymnostomus ariza*	Ariza Labeo	LC	-
8	*Sperata aor*	Long-whiskered Catfish	LC	-
9	*Ompok pabo*	-	NT	-
10	*Labeo bata*	Minor Carp	LC	-
11	*Parachiloglanis hodgarti*	Torrent Catfish	LC	-
12	*Silonia silondia*	Silond Catfish	LC	-
13	*Neotropius atherinoides*	-	LC	-
14	*Oreichthys cosuatis*	-	LC	-
15	*Pseudapocryptes elongatus*	-	LC	-
16	*Nangra nangra*	-	LC	-
17	*Channa marulius*	-	LC	-
18	*Nemacheilus denisoni*	-	LC	-
19	*Schistura dayi*	-	LC	-
20	*Labeo boggut*	Boggut labeo	LC	-
21	*Salmophasia balookee*	Bloch Razorbelly Minnow	LC	-
22	*Esomus danrica*	Flying barb	LC	-
23	*Morone saxatilis*	Striped Bass	LC	-
24	*Rasbora microcephalus*	-	LC	-
25	*Aplocheilus parvus*	Dwarf panchax	LC	-
26	*Notopterus notopterus*	-	LC	-
27	*Channa punctata*	Spotted Snakehead	LC	-
28	*Bagarius yarrelli*	-	VU	-
29	*Channa striata*	Snakehead Murrel	LC	-
30	*Puntius vittatus*	-	LC	-
31	*Monopterus javanensis*	Oriental Swamp Eel	LC	-
32	*Lepidocephalichthys guntea*	-	LC	-
33	*Monopterus albus*	Rice Swampeel	LC	-
34	*Wallago attu*	-	VU	-

35	*Anabas testudineus*	Climbing Perch	LC	-
36	*Ompok bimaculatus*	-	NT	-

Sources: Harinder Singh Banyal, Sanjeev Kumar and R. H. Raina, (2019). Rec. zool. Surv. India: Vol. 119(3)/ 282 -288; IUCN (2019). The IUCN Red List of Threatened Species. Version 2019-2; Schedules I to VI: Indian Wildlife (Protection) Act, 1972.

Appendix G Photo Documentation

Project site

Access road used by Waste Carrying Trucks

Local villagers availing the water facility provided at the Padariya village 1km away from the project site

Segregated waste at one of the transfer stations at Transport Nagar

Consultation with locals and women in Haripura village

Consultation with in-migrant women who work as rag picker at dumping yard, where the project site is located

Consultation with a woman belgonging to Scheduled Tribe community in the core zone of the project study area

Consultation with Forest Rangers

Appendix H Bore Logs of Sampling Points

Appendix I Laboratory Analysis Reports