Draft Environmental Impact Assessment Report for the Proposed expansion of Civil Enclave of Bagdogra International Airport to Enhance the Passenger Handling Capacity up to 10 MPPA at Bagdogra, Dist: Darjeeling, West Bengal

M/s. Airport Authority of India
Bagdogra International Airport, Siliguri, District: Darjeeling
West Bengal -734421

Project activity "7(a)"- Airports
Category: B1
Period of Study: March 2023 – May 2023
Proposal No: SIA/WB/INFRA2/445111/2023

Submitted by

भारतीय विमानपत्तन प्राधिकरण
AIRPORTS AUTHORITY OF INDIA

Prepared by

ABC Techno Labs
India Private Limited
(Accredited by NABL, NABET, MOEF)
(An ISO : 9001, ISO : 14001 & OHSAS : 18001 Certified Company)

ABC Techno Labs
India Private Limited
(Recognised by NABL, NABET & MoEFCC)

Declaration by ABC Techno Labs India Pvt. Ltd.

M/s Airport Authority of India has Proposed Expansion of Civil Enclave of Bagdogra International Airport to Enhance the Passenger Handling Capacity up to 10 MPPA at Bagdogra, West Bengal. In this regard M/s Airport Authority of India appointed ABC Techno Labs India Pvt. Ltd. to conduct the Environmental Impact Assessment (EIA) study as per the Terms of Reference (TOR) for carrying out the EIA/EMP study vide No. 2807/EN/T-II-I/536/2023 dated 13th December 2023 issued by State Level Environmental Impact Assessment Authority (SEIAA), West Bengal.

ABC Techno Labs has taken all reasonable precautions in the preparation of this EIA report. ABC Techno Labs also believes that the facts presented in this report are accurate as on date it was written.

ABC Techno Labs confirm that the mentioned experts prepared the EIA Report for Proposed Expansion of Civil Enclave of Bagdogra International Airport to Enhance the Passenger Handling Capacity up to 10 MPPA at Bagdogra, West Bengal. ABC Techno Labs also confirm that the consultant organisation shall be fully accountable for any misleading information mentioned in this statement.

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Designation: Chairman & Managing Director

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Certificate of Accreditation

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*The organization is accredited as **Category-A** under the QCI-NABET Scheme for Accreditation of EIA Consultant Organization, Version 3: for preparing EIA-EMP reports in the following Sectors –*

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		NABET	MoEFCC	
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2	Offshore and onshore oil and gas exploration, development & production	2	1 (b)	A
3	River Valley projects	3	1 (c)	A
4	Thermal power plants	4	1 (d)	A
5	Mineral beneficiation including pelletisation	7	2 (b)	A
6	Metallurgical industries (ferrous & non-ferrous)	8	3 (a)	A
7	Cement Plants	9	3(b)	A
8	Petroleum refining industry	10	4 (a)	A
9	Leather/skin/hide processing industry	15	4 (f)	A
10	Chemical fertilizers	16	5 (a)	A
11	Petro-chemical complexes	18	5 (c)	A
12	Petrochemical based processing	20	5 (e)	A
13	Synthetic organic chemicals industry	21	5 (f)	A
14	Distilleries	22	5 (g)	A
15	Integrated paint industry	23	5 (i)	B
16	Sugar Industry	25	5 (j)	B
17	Oil & gas transportation pipeline, passing through national parks/ sanctuaries/coral reefs / ecologically sensitive areas including LNG terminal	27	6 (a)	A
18	Airports	29	7 (a)	A
19	Industrial estates/ parks/ complexes/ Areas, export processing zones(EPZs), Special economic zones (SEZs), Biotech parks, Leather complexes	31	7 (c)	A
20	Ports, harbours, break waters and dredging	33	7 (e)	A
21	Highways	34	7 (f)	A
22	Common Effluent Treatment Plants (CETPs)	36	7 (h)	B
23	Common Municipal Solid Waste Management Facility (CMSWMF)	37	7 (i)	B
24	Building and construction projects	38	8 (a)	B
25	Townships and Area development projects	39	8 (b)	B

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RAAC minutes dated June 09, 2023 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no QCI/NABET/ENV/ACO/23/2795 dated July 11, 2023. The accreditation needs to be renewed before the expiry date by ABC Techno Labs India Private Limited, Chennai following due process of assessment.

Sr. Director, NABET	Certificate No.	Valid up to
Dated: July 11, 2023	NABET/EIA/2225/RA 0290	Nov 16, 2025

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PROJECT DETAILS					
Name of Publication	***Environmental Impact Assessment Report for the Proposed expansion of Civil Enclave of Bagdogra International Airport to Enhance the Passenger Handling Capacity up to 10 MPPA at Bagdogra, Dist: Darjeeling, West Bengal by M/s Airport Authority of India***				
Project ID	***ABC/EC/2023/ AAI-BDG -01/00***	***Version***	***1***	***Released***	***December 2023***
CONTACT DETAILS					

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Disclaimer:

ABC Techno Labs has taken all reasonable precautions in the preparation of this report as per its auditable quality plan. ABC Techno Labs also believes that the information presented in the report are accurate as on the date it was written. However, it is impossible to dismiss absolutely, the possibility of errors or omissions. ABC Techno Labs therefore specifically disclaims any liability resulting from the use or application of the information contained in this report. The information is not intended to serve as legal advice related to the individual situation.

Declaration by experts contributing to the Environmental Impact Assessment Report for the Proposed expansion of Civil Enclave of Bagdogra International Airport to Enhance the Passenger Handling Capacity up to 10 MPPA at Bagdogra, Dist: Darjeeling, West Bengal by M/s Airport Authority of India

I, hereby, certify that I was a part of the EIA team in the following capacity that developed the above EIA/EMP.

EIA Coordinator

Name : **Mr. Abhik Saha**
Signature : Abhik Saha

Period of involvement : February 2023 – Till date
Contact information : abc@abctechnolab.com

FUNCTIONAL AREA EXPERTS:

S. No.	Functional Areas	Name of the Expert/s	Involvement (Period)	Signature & Date
1.	WP	Mr. Abhik Saha	February 2023 – Till date	Abhik Saha
2.	SHW		February 2023 – Till date	
3.	EB		February 2023 – Till date	
4.	AP		February 2023 – Till date	
5.	AQ	Mohammad Akhtar	March 2023 – Till date	
6.	RH	Vinod Kumar Gautam	March 2023 – Till date	Gautam
7.	HG	Dr. R.K. Jayaseelan	March 2023 – Till date	
8.	Geo	Dr. S. Veezhinathan	March 2023 – Till date	
9.	NV	Arijit Panja	February 2023 – Till date	Arijit Panja
10.	LU	Arijit Panja	February 2023 – Till date	
11.	WP	Wriddhi Pratim Bose	February 2023 – Till date	Wriddhi Pratim Bose
12.	SHW	Wriddhi Pratim Bose	February 2023 – Till date	
11.	SC	Heambika Balakrishnan	March 2023 – Till date	B Hemambika
12.	SE	Dr. N. Rama Krishnan	March 2023 – Till date	

Declaration by the head of the Accredited Consultant Organization

I, Mr. G. Murugesh, hereby confirm that the above mentioned experts prepared the EIA/EMP Report for the Proposed expansion of Civil Enclave of Bagdogra International Airport to Enhance the Passenger Handling Capacity up to 10 MPPA at Bagdogra, Dist: Darjeeling, West Bengal by Airport Authority of India. I also confirm that ABC Techno Labs India Pvt. Ltd. shall be fully accountable for any misleading information mentioned in this statement.

Signature :	
Name :	**Mr. G. Murugesh**
Designation :	**Chairman & Managing Director**
Name of the EIA Consultant Organization:	**ABC Techno Labs India Private Limited**
NABET Certificate No. & Validity Date:	**NABET/EIA/2225/RA 0290 Date 16th November 2025**

CONTENTS

CHAPTER 1: INTRODUCTION

1.1 PREAMBLE

Bagdogra International Airport also known as Siliguri International Airport, is a customs airport serving the city of Siliguri and northern West Bengal, India. It is located in Bagdogra, 09 km south-west from the centre of the city. It is operated as a civil enclave at Bagdogra Air Force Station of the Indian Air Force. It is the gateway to the hill stations of Darjeeling, Gangtok, Kurseong, Kalimpong, Mirik and other parts of North Bengal region. As a major transport hub in the region, the airport sees thousands of tourists annually. The Government of India conferred limited international airport status to the airport in 2002 with limited international operations to Bangkok–Suvarnabhumi and Paro. This is the second busiest airport in West Bengal. It is situated at about 1 km towards eastern side of NH-27 (Purnea-Siliguri Road). Geographically, airport is located at latitude 26°41'6.22"N, longitude 88°19'31.77"E, and altitude of range 143-150 m above MSL.

Air traffic at Bagdogra crossed 1 million for the first time, growing at 43.6% percent in 2014–15. In 2019–20, the airport served 3.2 million passengers, which was an increase of 11.2% from the previous year, making it the 17th-busiest airport in India. It is one of the few airports in India with zero sales tax on aviation turbine fuel.

M/s. Airport Authority of India is now going to expand the Bagdogra International Airport with the development of Civil Enclave with infrastructure such as New Terminal Building, Car Parking, Apron, Link Taxiways etc. and associated city side / airside infrastructure on approx. 105 Acres of Land is planned which is located at Bagdogra in Darjeeling District, Siliguri sub-division, West Bengal.

The project activity requires fresh Environmental Clearance (EC) under **Category "B1"** of ***Schedule 7(a) - Airports*** from State Environmental Impact Assessment Authority (SEIAA), West Bengal according to the provision of 7(ii) of EIA Notification 2006, vide O.M. No. IA3-22/10/2022-IA-III [E 177258] dated 11.04.2022, the proposed expansion/modernization project is considered by State Expert Appraisal Committee (SEAC), West Bengal.

Airport Authority of India has engaged ABC Techno Labs India Pvt. Ltd., NABET Accredited Environmental Consultant Organization, to carry out Environment Impact Assessment (EIA) study and to prepare an Environment Management Plan (EMP) for obtaining environment clearance for Proposed expansion of Civil Enclave of Bagdogra International Airport to Enhance the Passenger Handling Capacity up to 10 MPPA at Bagdogra, Dist: Darjeeling, West Bengal. The study has been carried out as per the guidelines of Ministry of Environment, Forests & Climate Change (MoEF&CC).

State Level Environment Impact Assessment Authority (SEIAA), West Bengal has issued the Terms of Reference (ToR) for the preparation of the EIA report vide its No. 2807/EN/T-II-1/536/2023 dated 13.12.2023 which is enclosed as **Annexure 1.** This EIA report is prepared complying all the conditions of TOR.

1.2 Identification of the Project

Bagdogra Airport is an international airport and gateway to the hill stations of Darjeeling, Gangtok and other parts of the North Bengal region, located at the western part of the city Siliguri in northern West Bengal. The Airport belongs to IAF and AAI operates Civil Enclave which spreads over an area of 13.77 acres. The airport belongs to the Indian Air force and its civilian operations are overseen by Airports Authority of India. AAI maintains a civil enclave at the Airport. The present Airport has a single runway 18/36 having dimensions of 2744m X 45.75m and belongs to IAF. The existing apron has 05 nos. of parking bays (04 nos. Code C and 01 no. Code D). The existing Terminal Building has an area of 7180 sqm for handing 400 peak hour passengers having an annual capacity of 0.75 MPPA.

The proposed expansion project is Development of Civil Enclave with infrastructure such as New Terminal Building, Car Parking, Apron, Link Taxiways etc. and associated city side / airside infrastructure on approx. 105 Acres of Land is planned. This civil enclave is proposed in two phases, namely:

Phase 1

In Phase-1, terminal building having area of 69162 sqm (including 18050 Sqm Basement) and 6 number aerobridges and 10 Code C apron Apron Bays with 2 Nos. Link Taxi will be constructed. Proposed construction of Phase-1 of New Integrated Terminal Building is expected to be completed by March 2036.

Phase 2

In Phase-2, terminal building having area of 52000 Sqm and 4 number aerobridges and 6 Code C apron Apron Bays will be constructed in future.

1.3 Identification of the Project Proponent

Airport Authority of India (AAI) was constituted by an Act of Parliament and came into being on 1st April 1995 by merging erstwhile National Airports Authority and International Airports Authority of India. The merger brought into existence a single Organization entrusted with the responsibility of creating, upgrading, maintaining and managing civil aviation infrastructure both on the ground and air space in the country.

AAI manages a total of 137 airports which include 24 International airports (3 Civil Enclaves), 10 Custom Airports (4 Civil Enclaves) and 103 Domestic airports (23 Civil Enclaves). AAI provides air navigation services over 2.8 million square nautical miles of air space. During the year 2019-20, AAI handled aircraft movement of 1314.23 Thousand [International 156.0 & Domestic 1158.23], Passengers handled 159.59 Million [International 22.26 & Domestic 137.33] and the cargo handled 909.32 thousand MT [International 452.46 & Domestic 456.85]. Further, all Indian airports taken together have handled aircraft movement of 2587.05 Thousand [International 431.85 & Domestic 2155.20], Passengers handled 341.05 Million [International 66.54 & Domestic 274.51] and the cargo handled 3328.63 thousand MT [International 2003.12 & Domestic 1325.51].

The main functions of AAI inter-alia include construction, modification & management of passenger terminals, development & management of cargo terminals, development & maintenance of apron infrastructure including runways, parallel taxiways, apron etc., Provision of Communication, Navigation and Surveillance which includes provision of DVOR / DME, ILS, ATC radars, visual aids etc., provision of air traffic services, provision of passenger facilities and related amenities at its terminals thereby ensuring safe and secure operations of aircraft, passenger and cargo in the country.

In Airports Authority of India, the basic approach to planning of airport facilities has been adopted to create capacity ahead of demand in our efforts. Towards implementation of this strategy, a number of projects for extension and strengthening of runway, taxi track and aprons at different airports has been taken up. Extension of runway to 7500 ft. has been taken up to support operation for Airbus-320/Boeing 737-800 category of aircrafts at all airports

1.3.1 Need for the Project and Its Importance

Airports play an eminent role in the economic development of a region, as well as the nation. Airports facilitate fast movement of man and materials, thereby fostering trade and commerce. Airports offer increased accessibility, which in turn fuels the tourism sector. With an increase in the number of visitors and airport users, more money flows in to the local economy. With increased economic activity and employment, consumer behaviour changes, raising the standard of living of the people in the region. Thus, the availability of airports provides a thrust to the GDP of the local region, having a positively impact on the national economy.

Air traffic at Bagdogra existing airport crossed 1 million for the first time growing at 43.6% percent in 2014–15. In 2019–20, the airport served 3.2 million passengers which was an increase of 11.2% from the previous year, making it the 17th-busiest airport in India. It is one of the few airports in India with zero sales tax on aviation turbine fuel.

With surging demand for large number of domestic and international companies into the sector, India's aviation industry ensures to witness a phenomenal growth in the near future.

- ***Import Vs Indigenous Production***

The airport has attractive international import market of general cargo for the nearby manufacturing units.

- ***Demand & Supply Gap***

The passenger handling capacity in future may continue to increase. In view of rapid growth in passenger traffic & Aircraft movement, operational infrastructure needs to be upgraded to serve the estimated demand. Improvements in connectivity will effectively contribute to the economic performance of the wider economy through enhancing its overall level of productivity.

The passenger traffic at Bagdogra International Airport is proposed to increase in coming phase up to 10 MPPA.

Traffic Forecast

Table 1.1: Traffic Forecast of Bagdogra International Airport

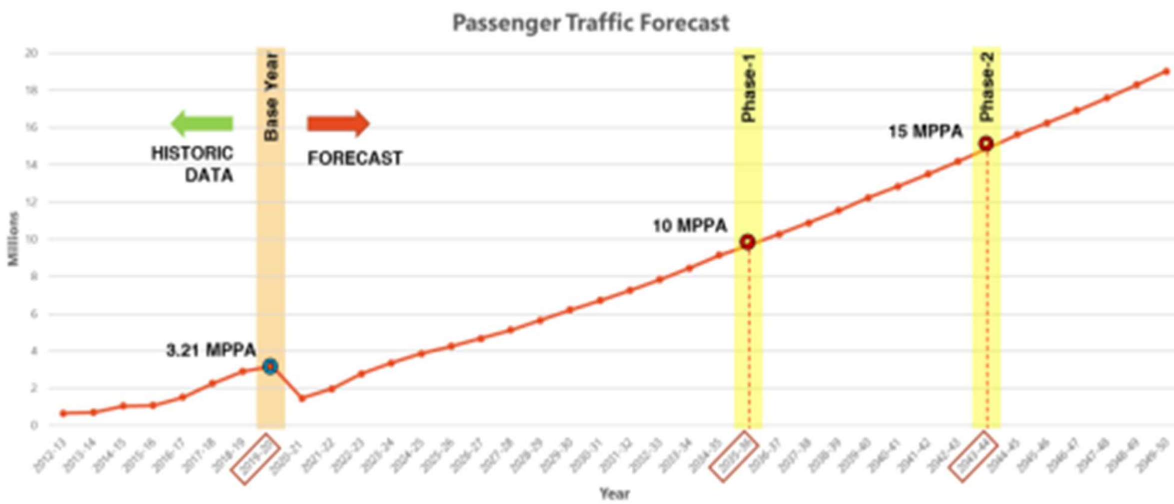
Year	Aircraft Movement			Passenger			Freight		
17-18	384	11,215	11,599	25444	1,499,072	1,524,516	0	4,312	4,312
18-19	456	15,498	15,954	24,563	2,231,205	2,255,768	0	4,986	4,986
19-20	398	22,820	23,218	19,472	3,197,168	3,216,640	0	7,508	7,508
20-21	28	10,756	10,784	678	1,472,632	1,473,310	0	6,024	6,024
21-22	24	16,226	16,250	546	1,979,503	1,980,049	0	8,780	8,780
22-23	278	17,654	17,932	11,966	2,543,339	2,555,305	0	8,997	8,997
% Change	1058.3	8.8	10.4	2091.5	28.5	29.1	0	2.5	2.5

Source: AAI

As seen from the above table, the existing Terminal Building with annual capacity of 2.5 MPPA has saturated. Accordingly, the State Govt. was requested to provide 104.64 acres of land for construction & Development of Civil Enclave.

Traffic Projections for Bagdogra Airport

As per the traffic forecast with base year as 2019-20, the airport is likely to receive passenger footfall of 9.69 Million Passenger by next 15 Years and 19.02 Million Passenger by next 30 Years. To cater to the growing passenger, demand a new civil enclave has been proposed.



Source: AAI

- ***Export Possibility***

The airport has significant growth potential on international export of general cargo, and Ecommerce based domestic air cargo. The airport also has attractive captive international export market for perishables

- ***Domestic Markets***

The airport has currently handled international and domestic air cargo. The airport has several Indian and International airlines operating domestic & international flights. The airport has significant growth potential on international export of general cargo, including readymade garments, and Ecommerce based domestic air cargo. The airport also has attractive captive international export market for perishables and international import market of machinery for the nearby manufacturing units.

1.4 LOCATION OF PROJECT

Bagdogra International Airport falls under Bagdogra and Phansidewa P.S. of Siliguri Sub-Division and Darjeeling District. Geographically, airport is situated at latitude 26°41'6.22"N, longitude 88°19'31.77"E, and altitude of range 143-150 m above MSL. Bagdogra International Airport is located near National highway, NH-27 (Purnea-Siliguri Road) connecting Siliguri with many districts of West Bengal and other states like Assam, Bihar etc. The google image showing the project site is given in Figure 1.2.

Figure 1.1: Location of Project site

1.5 ENVIRONMENTAL SETTING OF THE STUDY

Environmental setting of the study area of 10 km radius around the Airport is tabulated in Table 1.2.

Table 1.2: Environmental Settings of the Area

Sl. No	Particulars	Details
1	Project location	LR Plot Nos. 88/362, 122/364, 439, 440, 444, 137, 138, 123/350, 124, 123, 125, 139, 140, 141, 143/347, 143, 129, Mouza: Abhiram, P.S: Phansidewa, LR Plot No. 121/163, Mouza: Abhiram, PS: Bagdogra, LR Plot Nos. 16, 17, 18, of Mouza: Turibhita , PS: Bagdogra, District: Darjeeling, West Bengal

Sl. No	Particulars	Details
2	Latitude	26°41'06.22"N
3	Longitude	88°19'31.77"E
4	Elevation above MSL	143-150
5	Topography	The topography of the study area is crisscrossed with rivulets, rivers and hills.
6	Climatic Conditions (As per IMD)	May is the hottest month with temperature as high as 37°C while January is the coldest month with temperature as low as 6°C. Annual rainfall in this area is of the tune of 3736 mm and mean relative humidity rises more than 80%.
7	Nearest Highway	NH-27 (Purnea-Siliguri Road), 1.0 Km, East
8	Nearest Railway station	Bagdogra railway Station – 0.4 Km, from the north boundary of the Airport. Siliguri Junction Station- 9.62 Km, ENE
9	Nearest Airport	Pakyong Airport, 62 Km, NNE
10	Nearest Habitation	Bagdogra- 0.3 Km, WNW
11	Nearest Town	Siliguri Town - 9 Km, ENE
12	Forests	Dalkajhar Forest- 7.37 Km, NW
13	Nearest Waterbody	Balason River – 4.5 Km, NNE Mahananda River – 8.1 Km, East
14	Ecologically sensitive zones within 10-km distance	No notified eco-sensitive areas are present within 10 km radius from the project site
15	Historical/ Archaeological places	No historical/ archaeological places within 10 km radius from the project site.
16	National Parks/ Wild Life Sanctuary	No national parks or wild life sanctuary are present within 10 km radius from the Project site.
17	Defense Installation	Bengdubi Military Base- 3.0 Km, North Airforce Station Bagdogra - 0 Km
18	Seismic Zone	Zone V

Source: ABC Technolabs India Pvt. Ltd.

1.6 STATUTORY REQUIREMENTS AND LEGAL ASPECTS

The relevant NOC's and licenses will be obtained from the statutory agencies under the following Acts, Rules and amendments and Airport Authority of India will adhere to the guidelines specified in.

AAI will comply with the prescribed limits laid down for air, effluent and noise emissions for protection of the environment under the following Acts, Rules and amendments:

1. The Water (Prevention and Control of Pollution) Act, 1974
2. The Air (Prevention and Control of Pollution) Act, 1981
3. The Environment (Protection) Act, 1986 which is also called umbrella act or legislation

4. The Environment Impact Assessment, Notification, 2006 issued under Environment (Protection) Act 1986 and Environment (Protection) Rules 1986 and amendments thereafter to date

Table 1.3: Applicable Acts & Guidelines

Sl. No.	Issues	Applicable Legislation
1	Hazardous Substances & Wastes	• The Environment (Protection) Act, 1986 and Rules there under • Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and subsequent amendments; • Guidelines for disposal of solid wastes; • Manufacture Storage and Import of Hazardous Chemicals 1989 and amendments thereafter
		• The Public Liability Insurance Act, 1991 and Rules 1991
		• The Petroleum Act, 1934
2	Water	• The Water (Prevention and Control of Pollution) Act, 1974, and amendments thereafter
		• The Environment Protection Act, 1986 - Standards for liquid discharge
3	Air	• The Air (Prevention and Control of Pollution) Act, 1981 and amendments thereafter
		• The Environment Protection Act, 1986 – Guidelines for discharge for gaseous emissions
		• The Environment (Protection) Second Amendment Rules, 2002 – Emission Standards for New Generator Sets.
		• The Factories Act, 1948 and amendments thereafter.
4	Noise	• The Noise (Regulation & Control) Rules, 2000.

Compliance to State Rules and Notifications will also be ensured.

1.7 Scope of EIA Study

M/s. Airport Authority of India has appointed the services of M/s. ABC Techno Labs India Private Limited, Chennai to carry out EIA study and preparation of Environmental Impact Assessment (EIA) report to assess the anticipated impacts of the proposed expansion project on the environment and suggest suitable mitigation measures for likely adverse impacts due to the activities. The EIA/EMP report has been prepared for the expansion project following the generic structure specified in the EIA Notification, 2006.

An EIA study is useful to understand and mitigate the impact of the proposed expansion project on various parameters of environment. Therefore, the scope of the EIA study includes detailed characterization of the existing status of the land, water, air, biological and socio-economic environment in the expansion project area. It also includes identification of the potential environmental impacts of the expansion project and formulation of an effective Environmental Management Plan (EMP) and monitoring plan. The scope of EIA study includes,

- Literature review and collection of data relevant to the study area;
- Collection of data related to the project related activities;
- Establish the baseline environmental aspects in and around the proposed Integrated project;

- Collate secondary data including socio-economic data from published literature / government publications;
- Identify various existing pollution loads due to various proposed activities;
- Predict incremental levels of pollutants in the study area due to the proposed operations;
- Evaluate the predicted impacts on various environmental attributes in the study area by using scientifically developed and widely accepted environmental impact assessment methodologies;
- Preparation of cost effective and appropriate Environmental Management Plan (EMP) encompassing strategies for minimization of potential adverse impacts on various environmental components along with budgetary provisions for implementation of pollution control measures;
- To delineate measures for human health and safety during operational of proposed expansion project; and
- Delineation of post-study Environmental quality monitoring programme.

The scope also includes all the conditions given in the TORs prescribed by MoEF&CC for the airport. Baseline studies were carried out for a period of three months from 1st March 2023 to 30th May 2023, representing 'Summer' season.

1.8 APPROACH METHODOLOGY

The primary objective of the EIA studies is to internalize and integrate the environmental concerns/aspects and mitigation measures due to the Proposed expansion of Civil Enclave of Bagdogra International Airport to Enhance the Passenger Handling Capacity up to 10 MPPA at Bagdogra, Dist: Darjeeling, West Bengal.

This EIA/ EMP report is based on the observations made by the ABC team during visits to the study area and collection of primary and secondary environmental data. Literatures were reviewed and relevant information was collected for environmental and social baseline. Reconnaissance surveys were conducted to identify the major environmental issues in the study area. The sampling locations were identified on the basis of:

- ✓ Existing topography;
- ✓ Location of water bodies;
- ✓ Location of villages/ towns/ sensitive areas;
- ✓ Accessibility, power availability, security of monitoring equipment;
- ✓ Areas which represent baseline conditions.

EIA study has been carried out with the following objectives:

- A collection of baseline attributes within the study area (10 Km radius of the project site) The EIA covered one season baseline environmental data, as per the guidelines of MoEF&CC, New Delhi. The scope includes a collection of baseline data, identify the various environmental parameters such as Ambient Air Quality, Meteorology, Water Quality, Soil

Quality, Noise levels, Biological Environment, Socio -economic factors, land use factors, within the study area of project site.

- Identification, prediction, evaluation & mitigation of biophysical, social & other relevant effects of project activities on the environment during the operational phase of the proposed project activities using mathematical/simulation models as per applicable Indian law. Accordingly, mitigation measures to be adopted and recommended for critical environment impacts.
- Preparation of Risk Assessment & Emergency Preparedness/Disaster Management Plan for the proposed project activities.
- Preparation of Environmental Management Plan (EMP) to be adopted for mitigation of the anticipated adverse impacts of the proposed project activities during the operational phase.
  - ✓ Pollution control measures proposed to meet the emission, effluent, noise standards etc.
  - ✓ Scheme for effluent recycling, solid/hazardous waste management.
  - ✓ Social welfare schemes.
  - ✓ Post-Project Environmental Quality Monitoring and Management Program.
  - ✓ Occupational health related mitigation measures; etc.
- Delineation of the post-project environmental quality monitoring program as per the requirements of the regulatory authorities.

The EIA/ EMP report is prepared for obtaining Environmental Clearance on the basis of Terms of Reference (TOR) prescribed by the MoEF&CC for generation of site specific baseline data, environment monitoring and surveys within study area of 10 Km radius have been conducted for three (3) months continuously from **1st March 2023 to 30th May 2023** by ABC Techno Labs India Pvt. Ltd. and sampling locations for various environmental parameters were identified on the basis of:

- ✓ *Predominant wind direction expected during the period of baseline monitoring in the study area*
- ✓ *Topography,*
- ✓ *Location of village/towns/sensitive areas*
- ✓ *Identified pollution pockets, if any within the study area*
- ✓ *Areas, which represent baseline conditions;*
- ✓ *Collection, collation and analysis of baseline data for various environmental attributes.*

The study area around project site could have impact on the physical, chemical and biological attributes of surrounding environment. In assessing the environmental impacts, collection, collation and interpretation of baseline data is of prime importance. Environmental impact analysis and assessment carried out at the planning stage itself.

1.9 STRUCTURE OF EIA REPORT

The EIA report has been presented in order to group the environmental parameters under physical, biological, demographic & socio-economic environments, anticipated impacts and mitigation measures. The EIA report has been prepared as contents given in EIA Notification 2006 and subsequent amendments. The structure of EIA Report is as given below:

Executive Summary:	Provided in the beginning of the report
Chapter 1: Introduction	This chapter provides background information, brief location settings of the area along with the scope and objectives of the EIA/ EMP study also been described in this chapter
Chapter 2: Project Description	This chapter deals with project details, project layout, process details, operating parameters, power requirements, water requirement and sources pollution and its management, cost etc.
Chapter 3: Description of the Environment	This chapter presents existing environmental status of the 10 Km. radius of the project site, referred as study area including topography, geological, drainage pattern, water environment, climate & meteorology, ambient air quality, noise levels, flora & fauna, socio-economic, etc.
Chapter 4: Anticipated Environmental Impacts and its Mitigation Measures	This chapter describes the anticipated impact on the environment and mitigation measures for proposed expansion project. It gives the details of the impact on the baseline parameters, both during the site preparation/construction and operational phases and suggests the mitigation measures to be implemented by the AAI, Bagdogra.
Chapter 5: Alternative Analysis	This chapter examines alternatives analysis with respect to site and technology for the proposed project activities.
Chapter 6: Environmental Monitoring Plan	This chapter describes Environmental Monitoring Plan for the proposed project activities during site preparation/ construction and operation phases.
Chapter 7: Additional Studies	This chapter spelled out hazard identification, risk analysis and disaster management plan for an unlikely event of emergency for proposed project activities.
Chapter 8: Project Benefits	This chapter includes the benefits in terms of improvement in physical infrastructure, social infrastructure, employment potential, etc.
Chapter 9: Environmental Cost Benefit Analysis	This chapter includes the Environmental Cost Benefit analysis details and its applicability
Chapter 10: Environmental Management Plan	This chapter describes environmental management plan to mitigate adverse environmental impacts and to strengthen beneficial impacts.
Chapter 11: Summary & Conclusions	This chapter provides overall summary and conclusion of the EIA study
Chapter 12: Disclosure of Consultants	This chapter comprises the details of ABC Techno Labs India Pvt. Ltd. and respective experts engaged and nature of consultancy rendered.

1.1 TOR COMPLIANCE

Compliance of TOR Issued by SEIAA, West Bengal vide no. 2807/EN/T-II-1/536/2023 dated 13th December 2023.

S.No.	Description	Details
A	STANDARD TERMS OF REFERENCE	
1	Reasons for selecting the site with details of alternate sites examined/rejected/selected on merit with comparative statement and reason/basis for selection. The examination should justify site suitability in terms of environmental angle, resources sustainability associated with selected site as compared to rejected sites. The analysis should include parameters considered along with weightage criteria for short-listing selected site	Not Applicable. The proposed expansion will be carried out adjacent to the existing premises.. Details of Alternative Sites is given in EIA in Section **5.2 in Chapter 5**, of the EIA report.
2	Details of the land use break-up for the proposed project. Details of land use around 10 km radius of the project site. Examine and submit detail of land use around 10 km radius of the project site and map of the project area and 1"0 km area from boundary of the proposed/existing project area, delineating project areas notified under the wild life (Protection) Act, L972/critically polluted areas as identified by the CPCB from time to time/notified eco-sensitive areas/inter-state boundaries and international boundaries. Analysis should be made based on latest satellite imagery for land use with raw images.	The primary land area distribution at BIA is discussed in **Table 2.3** under the **section 2.5.3** of **chapter 2** in EIA report. The land use around 10 km radius of the project site is given in **Figure 3.13** in **chapter 3** of EIA report. The Environment setting around the project site are well discussed in the **Table 1.2** of the EIA report.
3	Submit the present land use and permission required for any conversion such as forest, agriculture etc. land acquisition status, rehabilitation of communities/ villages and present status of such activities. Check on flood plain of any river.	Details of land use around 10km radius is discussed in the **section 3.10** of Chapter 3 in EIA report. Total 104.65 acres land acquired/proposed for New Terminal Building out of which 98.72 acres has already been acquired and for 5.93 acres working permission given by IAF. No rehabilitation and resettlement activities involved in proposed project. Land acquisition status Document is given as **Annexure 8.** The Environment setting around the project site are well discussed in the **Table 1.2** of the EIA report.
4	Examine and submit the water bodies including the seasonal ones within the corridor of impacts along with their status, volumetric capacity, quality likely impacts on them due to the project.	Details of the water bodies are given in **Table 1.2** of **Chapter 1** of EIA report.

S.No.	Description	Details
A	**STANDARD TERMS OF REFERENCE**	
5	Submit a copy of the contour plan with slopes, drainage pattern of the site and surrounding area, any obstruction of the same by the airport.	The detailed drainage pattern is discussed in the **chapter 2** in the **section 2.8** of EIA report. Contour plan is given in **Chapter 3** in the **section 3.10.1** of EIA report.
6	Submit details of environmentally sensitive places, land acquisition status, rehabilitation of communities/ villages and present status of such activities	Environmentally sensitive places is detailed in **section 1.5** of **chapter 1**. Land Acquistion status was completed and the details were attached as **Annexure-8.** No rehabilitation and resettlement activities involved in proposed project.
7	Examine the impact of proposed project on the nearest settlements.	The detailed impacts of the proposed project is discussed in the **Chapter 4** of the EIA report.
8	Examine baseline environmental quality along with projected incremental load due to the proposed project/activities	The detailed baseline environmental quality is discussed in the **Chapter 3** of EIA report
9	Examine and submit details of levels, quantity required for filling, source of filling material and transportation details etc. Submit details of a comprehensive Risk Assessment and Disaster Management Plan including emergency evacuation during natural and man-made disaster integrating with existing airport	The detailed filling quantity is discussed in the **Chapter 2** in the **section 2.4** of EIA report. The detailed Risk assessment and disaster management plan is discussed in the **Chapter 7** of EIA report
10	Examine road/rail connectivity to the project site and impact on the existing traffic network due to the proposed project/activities. A detailed traffic and transportation study should be made for existing and projected passenger and cargo traffic.	The detailed assessment of traffic study is discussed in the **chapter 3** in the **section 3.13** of EIA report
11	Submit details regarding R&R involved in the project	The detailed R&R of proposed project is discussed in the **chapter 7** in the **section 7.2.19** of EIA report.
12	Examine the details of water requirement, use of treated waste water and prepare a water balance chart. Source of water vis-i-vis waste water to be generated along with treatment facilities to be proposed.	The detailed water requirement of proposed project is discussed under **section 2.8** of **chapter 2** of the EIA report.
13	Rain water harvesting proposals should be made with due safeguards for ground water quality. Maximize recycling of water and utilization of rain water.	The details is discussed in **Chapter 2** in the **section 2.8** of EIA report.

S.No.	Description	Details
A	STANDARD TERMS OF REFERENCE	
14	Examine details of Solid waste generation treatment and its disposal.	The details is discussed in **Chapter 2** in the **section 2.8** of EIA report.
15	Submit the present land use and permission required for any conversion such as forest, agriculture etc.	The detailed land use land breakup of proposed project is discussed in the **chapter 2** in the **section 2.4.1** of EIA report. Land Details has been given in **Annexure 8**. No forest Land is involved in this project.
16	Examine separately the details for construction and operation phases both for Environmental Management Plan and Environmental Monitoring Plan with cost and parameters.	The detailed Environmental Montioring plan is discussed in the **Chapter 6** & Management Plan is discussed in **Chapter 10** of EIA report.
17	Submit details of a comprehensive Disaster Management Plan including emergency evacuation during natural and man-made disaster.	The detailed Disaster Management plan is discussed in the **chapter 7** in the **section 7.11** of EIA report.
18	Examine baseline environmental quality along with projected incremental load due to the proposed project/activities.	The detailed projected incremental load of baseline quality is discussed in the section **4.7.3** & **4.7.5** of **chapter 4** in EIA report
19	The air quality monitoring should be carried out as per the notification issued on l6th November, 2009.	The detailed air quality monitoring was carried out as per the norms and their details is discussed in the **chapter 3** of EIA report
20	Examine separately the details for construction and operation phases both for Environmental Management Plan and Environmental Monitoring Plan with cost and parameters.	The detailed Environmental Montioring plan is discussed in the **chapter 6** & Management Plan is discussed in **chapter 10** of EIA report.
21	Submit details of need-based EMP as per the office Memorandum issued by the MoEF&CC vide F.No.22-65/2O17-lA, III dated 30/09/2O2O should be strictly followed	Details will be incorporated after the Public Hearinng as per Notification
22	Submit details of the trees to be cut including their species and whether it also involves any protected or endangered species. Measures taken to reduce the number of the trees to be removed should be explained in detail. Submit the details of compensatory plantation. Explore the possibilities of relocating the existing trees.	Details of tree felling is given in **Annexure 9**

S.No.	Description	Details
A	**STANDARD TERMS OF REFERENCE**	
23	Examine the details of afforestation measures indicating land and financial outlay. Landscape plan, green belts and open spaces may be described. A thick green belt should be planned all around the nearest settlement to mitigate noise and vibrations. The identification of species/ plants should be made based on the botanical studies.	The detailed greenbelt development is discussed in **Chapter 10** in the **section 10.5.8** of EIA report
24	Public hearing to be conducted for the project in accordance with provisions of Environmental Impact Assessment Notification, 2006 and the issues raised by the public should be addressed in the Environmental Management Plan. The Public Hearing should be conducted based on the ToR letter issued by the SEIAA, WB and not on the basis of Minutes of the Meeting available on the web-site.	Public hearing to be conducted as per the notification.
25	A detailed draft EIA/EMP report should be prepared in accordance with the above additional TOR and should be submitted to the SEIAA, WB in accordance with the Notification.	Draft EIA/EMP report has been preprared in accordance with the TOR points and has been submitted to SEIAA, WB.
26	Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the Project should be given.	No litigation cases against the proposed project.
27	The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.	The detailed cost study towards EMP is discussed in the **chapter 10** in the **section 10.7** of EIA report.
28	Any further clarification on carrying out the above studies including anticipated impacts due to the project and mitigative measure, project proponent can refer to the model ToR available on Ministry website " http://moef.nic.in/Manual/Airport"	AAI will adhere to the same.

S.No.	Description	Details
B	**ADDITIONAL TERMS OF REFERENCE**	
	Mandatory documents	
1	Consent to Operate from WBPCB along with certified compliance report of consent condition of the existing project as per the Notification issued by MoEF&CC vide F No. lA3-22/1O/2O22-IA.lll [E177258] dated 08.06.2022.	Consent to Operate application has been submitted by AAI referred **Annexure 2.**

S.No.	Description	Details
B	**ADDITIONAL TERMS OF REFERENCE**	
2	A detailed traffic management and traffic decongestion plan should be drawn up to ensure the current level of service on the roads within 5km radius of the project. Car parking space should be exclusively earmarked.	A detailed traffic management plan is given as **Annexure 7.**
3	Statutory clearance as the approvals of storage of ATF fuel from the Chief Controller of Explosives shall be obtained.	Peso License is given as **Annexure 3**.
4	A certificate from the competent authority/agency handling MSW should be obtained indicating the existing civic capacities of handling and their adequacy to cater to the increased quantum of MSW generated from the expansion project.	Details is given in **Annexure 10.**
	Water & waste water	
5	Detailed hydrogeological study report should be submitted. The amount of groundwater flowing blow the project area should be calculated and included in the report. Design of existing bore-wells and groundwater level with respect to ground surface and mean sea level should also be submitted.	Detailed hydrogeological study report is given as **Annexure 10**.
6	Run off from paved surface (aircraft operation and maintenance areas) should be routed through drains to oil separation tanks and sediment basins before those are discharged.	The details of Storm Water Drainage is discussed in **Chapter 2** in the **section 2.8** of EIA report
7	Storm water drains are to be built for discharging storm water from the airfield to avoid flooding, waterlogging in the project area. Domestic and industrial wastewater should not be allowed to be discharged into storm water drains.	
8	A detailed drainage plan for storm water should be submitted.	
9	A certificate from the competent authority for discharging treated effluent/drainage system along with final disposal point should be submitted.	Not Applicable. AAI is committed in implementing the Zero discharge concept for sewage system.
	Need based EMP	
10	EMP as per Office Memorandum of MoEF & CC vide F. No.22-65/2017.14.lll dated 30.09.2020 to be submitted. Consents from the beneficiaries of the social part of EMP should be furnished. Any other local need should be identified.	Will be complied after Public Hearing.
	Noise	

S.No.	Description	Details
B	**ADDITIONAL TERMS OF REFERENCE**	
11	Noise level survey should be carried out as per prescribed guidelines and a report should be submitted along with the EIA report.	The details are given in **Section 3.12** of **Chapter 3** of EIA report
	Land use and physical planning	
12	Existing landform with contours and proposed Grading Plan to be submitted.	The details are given in **Section 3.12** of **Chapter 3** of EIA report
13	Water and soil conservation plans are to be prepared and submitted	The details are given in **Section 4.7.2 & 4.6.5** respectively of **Chapter 4** of EIA report.
14	Topsoil should be isolated, preserved and reused at the same site for landscaping and plantation as per NBC 2015, Part 10.	The details are given in **& 4.6.5** of **Chapter 4** of EIA report.
15	A revised site plan showing buildings / structures, all external services, road layout, greenbelt, and all other relevant information to be submitted.	Details given in **Section 2.5.4** of **Chapter 2** of EIA Report.
16	Individual floor plans of proposed building/s should be furnished, including building sections.	Details gien in **Figure 2.8** of EIA report.
17	Environmental management plan for the existing stream flowing though the site should be submitted. Protection of embankment on both sides of the stream should be done as per guidelines. Water quality of the stream shall be monitored and reported at regular intervals.	Details given in **Annexure 12**.
	Landscape and exclusive tree plantation	
18	An inventory of on-site existing trees to be submitted	Details given in **Section 10.5.8** of **Chapter 10** of EIA report.
19	Attempt should be made to save a maximum number of existing trees. If unavoidable, transplantation of the existing trees to suitable locations within the project site, preferably in the peripheral/ boundary areas, should be carried out.	Details given in **Section 10.5.8** of **Chapter 10** of EIA report.
20	Details of compensatory plantation to be submitted for those trees that could not be saved.	Details is given in **Section 4.6.2** of **Chapter 4** of EIA report.
21	An aesthetic landscape design and its perfect balance features appeals to the eye.	The details is given in **Annexure 13**.
22	Instead of using Palms and other xerophytic plants in the landscape works, thick planting of local ornamental/flowering plants at a closer spacing in pure patches over a considerable stretch willenhance character of the airport lands. To blend the exterior environment with structural colours and make it more appealing, pure patches	Details given in **Section 10.5.8** of **Chapter 10** of EIA report.

S.No.	Description	Details
B	**ADDITIONAL TERMS OF REFERENCE**	
	of trees like Michelia champaca, spathodea campanulata, acrocarpus fraxinifolius, Tabebuia chrysantha, chorisia speciosa, Wrightia tomentosa etc. are to be raised along the road sides as avenue plants and in the exterior side yard and pure thickets of mid sized tress like Cordia sebastina ,Bixa orellana, Tacoma stans, Butea monosperma, Alstonia scholaris, holarrhena anti dysenterica etc. may be planted over a considerable stretch in boulevards and over front yards to get necessary colour effect in different seasons and to gather an impression	
	Building materials and energy consumption	
23	PP shall adopt a bird-safe facade treatment with bird-friendly glass solutions that provide the greatest chance for birds to identify the glazing surfaces and avoid collision.	AAI will adhere to the same.
24	Energy consumption: WBECBC (No. 07-PO/O/C-I11/4M-14/2016 (Part-1) dated 13th January 2020) compliance documents and certificate from competent authority should be furnished.	Details is discussed under **section 2.8** of **chapter 2** of the EIA report.
25	Outdoor lighting shall conform to NBC 2016 and National Lighting Code 2010.	AAI will adhere to the same.
	Misc.	
26	Emergency preparedness plan based on Hazard identification and Risk assessment and Disaster Management Plan shall be implemented.	The detailed Emergency Plan is discussed in the **chapter 7** of EIA report.

1.2 LIMITATIONS

This EIA study has been carried out based on certain scientific principles and professional judgment to certain facts with resultant subjective interpretation. Professional judgment expressed herein is based on the available data and information.

This report has been developed based on the project related information provided by M/s Airport Authority of India with the assumption that the information gathered is representative for the proposed project activities. If information to the contrary is discovered, the findings in this EIA may need to be modified accordingly. The impact assessment for the Project is based on the project configuration as described in chapter 2 on Project Description.

CHAPTER 2: PROJECT DESCRIPTION

2.1 INTRODUCTION

M/s. Airport Authority of India is going to expand the Bagdogra International Airport with the development of Civil Enclave with infrastructure such as New Terminal Building, Car Parking, Apron, Link Taxiways etc. and associated city side / airside infrastructure on approx. 105 Acres of Land is planned which is located at Bagdogra in Darjeeling District, Siliguri sub- division, West Bengal.

These civil enclave is proposed in two phases, namely:

Phase 1

In Phase-1, terminal building having area of 69162 sqm (including 16875 Sqm Basement) and 6 number aerobridges and 10 Code C apron Apron Bays with 2 Nos. Link Taxi will be constructed. Proposed construction of Phase-1 of New Integrated Terminal Building is expected to be completed by March 2036.

Phase 2

In Phase-2, terminal building having area of 50000 Sqm and 4 number aerobridges and 6 Code C apron Apron Bays will be constructed in future.

Table 2.1: Salient Features of the project activities

S. No.	Name of the Infrastructure	Existing Infrastructure	Proposed Infrastructure
1	Land Area	34.68 Acres (13.77 Acres - Existing Civil Enclave Land + 12.91 Acres acquired for Cat-II approach lights + 8 Acres Residential Colony)	104.65 Acres for New Civil Enclave
2	Primary Runway	18/36 – 2743m x 45m Runway Capacity – 8 Mvts/Hr	No change
3	Suitable for	Code D aircrafts	Code D aircrafts
4	Terminal Building Area	9241 Sq. m	119162 sqm (Phase 1 & 2)
5	Apron	5 nos. (Code D – 01, Code 4C – 4)	10 Code C apron
6	Navigational Aids	DVOR, DME	DVOR, DME
7	Visual Aids	PAPI, Runway Lights, HIRL, MIRL	PAPI, Runway Lights, HIRL, MIRL
8	Scheduled Airline Operators Domestic and International	Domestic - Indigo, Air Asia India, Spice Jet, Vistara International – Druk Air	Domestic - Indigo, Air Asia India, Spice Jet, Vistara International – Druk Air
9	Destinations Domestic	Domestic - Bangalore, Mumbai, Kolkata, Delhi, Hyderabad, Chennai, Bangalore, Guwahati, Dibrugarh	Domestic - Bangalore, Mumbai, Kolkata, Delhi, Hyderabad, Chennai, Bangalore, Guwahati, Dibrugarh
10	Scheduled Aircraft Movements	432 Movements per week (Domestic – 424 & International – 8)	1008 Movements per week

S. No.	Name of the Infrastructure	Existing Infrastructure	Proposed Infrastructure
11	Passenger Handling Capacity	2.5 MPPA	10 MPPA
12	Car parking	200	1000 (Multi Level)
13	Green area	Nil	6.15 Acres
14	Employment	600	1400
15	Project Cost	-	INR 1566 Crore
16	Fresh Water Requirement	250 KLD	903 KLD
17	Wastewater Generation	200 KLD	1372.67 KLD (including recycled water)
18	Power Requirement	Maximum Demand: 5.84 MW Transformer: 4 x 2500 KVA (3W + 1S) DG Sets: 5 x 1500 KVA + 1 x 750 KVA	

Source: AAI

2.2 SITE CHARACTERISTICS

2.2.1 LOCATION

Bagdogra International Airport falls under Bagdogra and Phansidewa P.S. of Siliguri Sub-Division and Darjeeling District. Geographically, airport is situated at latitude 26°41'6.22"N, longitude 88°19'31.77"E, and altitude of range 143-150 m above MSL. Bagdogra International Airport is located near National highway, NH-27 (Purnea-Siliguri Road) connecting Siliguri with many districts of West Bengal and other states like Assam, Bihar etc. The location map and google earth image are given in Figure 2.1 and Figure 2.2 respectively.

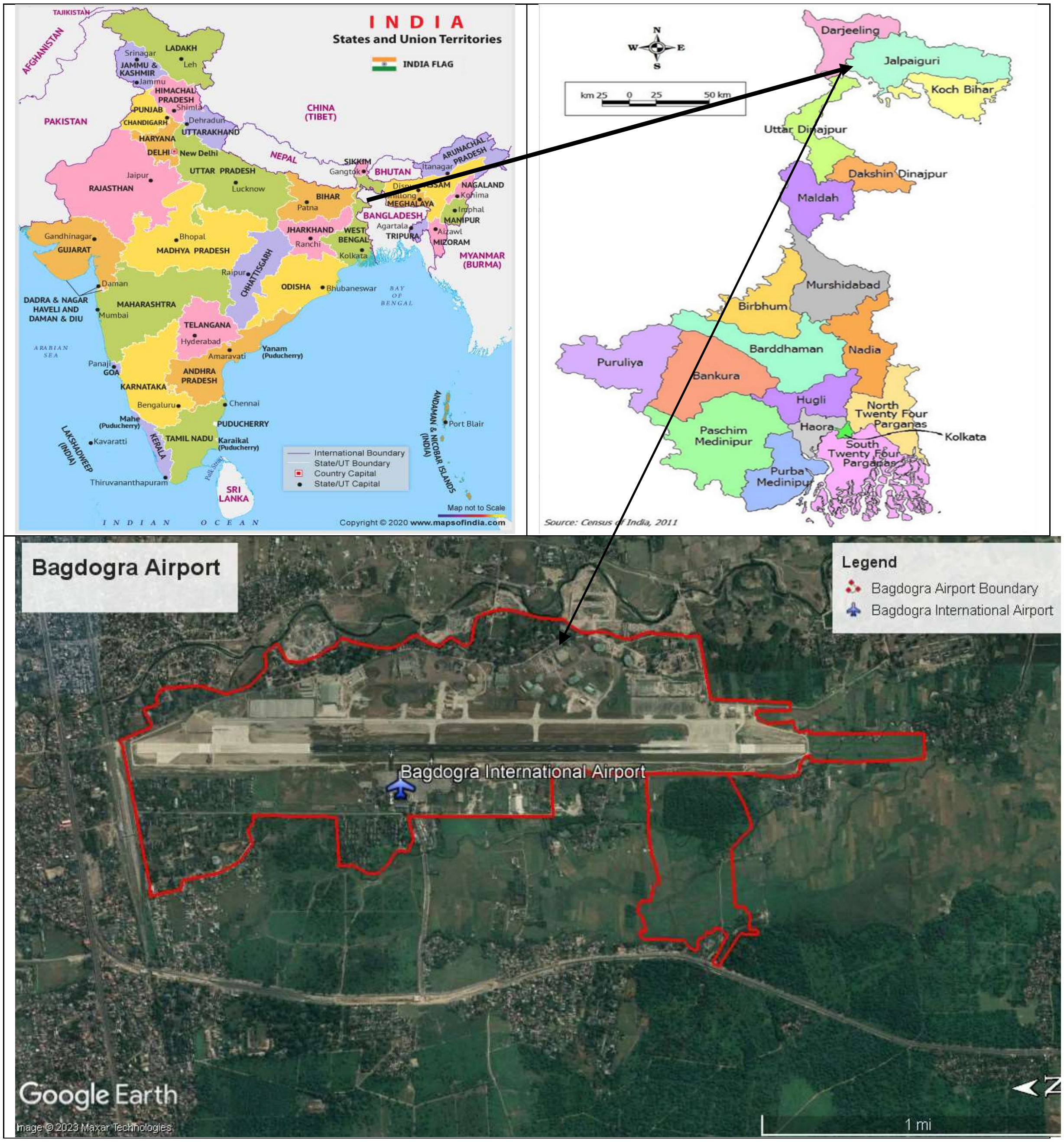
The coordinates of the corners of the plot as given below in Table 2.2

Table 2.2: Coordinates of the Plot area

Point No.	Hemisphere (N or S)	Degree, Minute, Second Latitude	Longitude
1	N	26°40'26.40"N	88°19'3.21"E
2	N	26°40'26.66"N	88°19'4.64"E
3	N	26°40'25.59"N	88°19'4.97"E
4	N	26°40'24.22"N	88°19'5.58"E
5	N	26°40'24.48"N	88°19'11.14"E
6	N	26°40'20.11"N	88°19'12.50"E
7	N	26°40'21.03"N	88°19'23.62"E
8	N	26°40'21.09"N	88°19'27.67"E
9	N	26°40'20.74"N	88°19'32.36"E
10	N	26°40'20.00"N	88°19'33.52"E
11	N	26°40'20.72"N	88°19'33.60"E
12	N	26°40'20.74"N	88°19'35.21"E
13	N	26°40'6.60"N	88°19'34.78"E
14	N	26°40'6.33"N	88°19'32.92"E
15	N	26°40'4.96"N	88°19'32.05"E
16	N	26°40'4.74"N	88°19'30.18"E
17	N	26°40'3.90"N	88°19'26.95"E
18	N	26°40'4.85"N	88°19'26.23"E
19	N	26°40'7.20"N	88°19'22.46"E

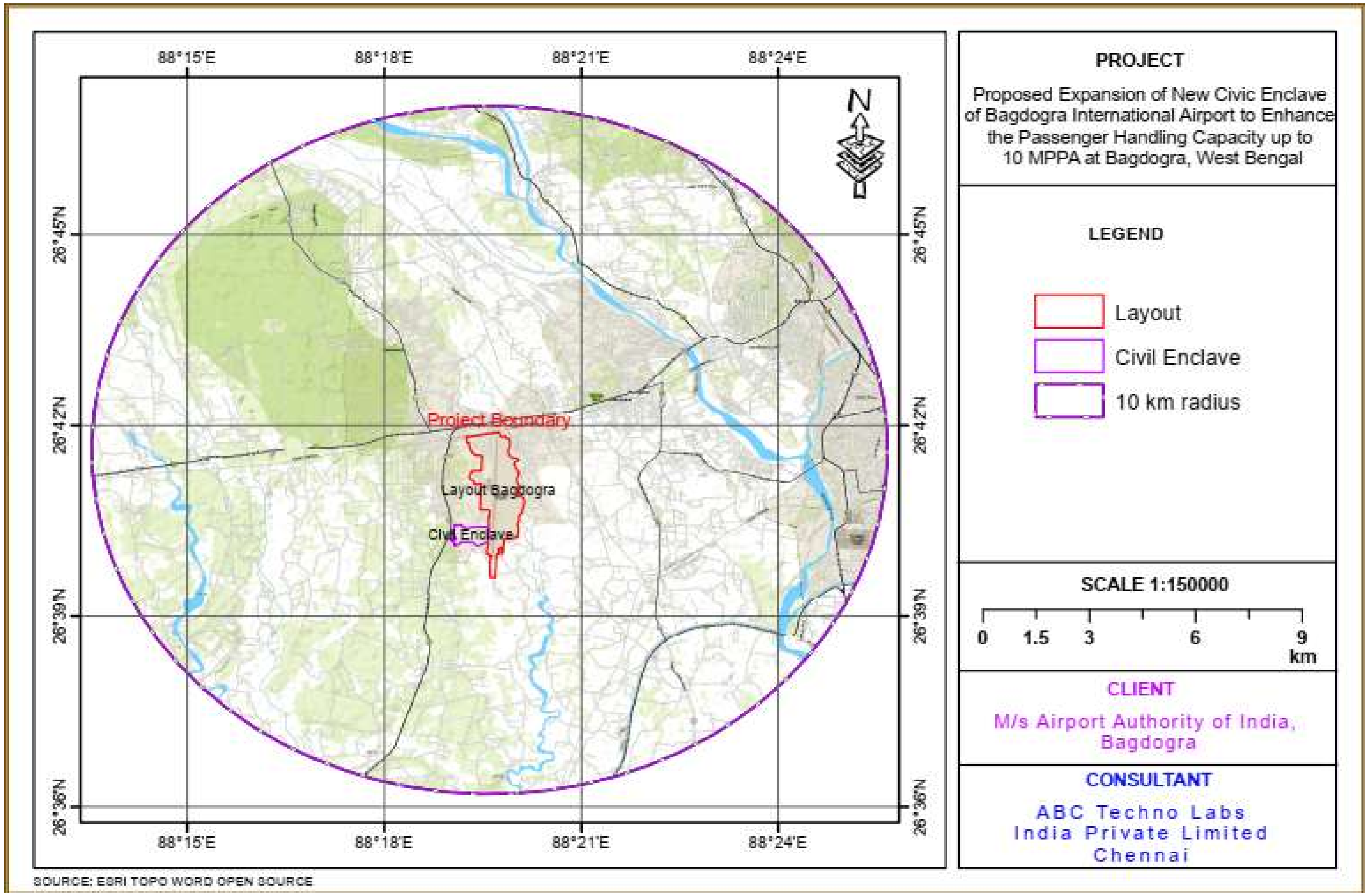
Point No.	Hemisphere	Degree, Minute, Second	
	(N or S)	Latitude	Longitude
20	N	26°40'7.88"N	88°19'18.71"E
21	N	26°40'7.39"N	88°19'16.38"E
22	N	26°40'7.36"N	88°19'14.19"E
23	N	26°40'5.08"N	88°19'13.97"E
24	N	26°40'4.50"N	88°19'6.00"E
25	N	26°40'6.41"N	88°19'5.40"E
26	N	26°40'9.45"N	88°19'4.78"E
27	N	26°40'10.82"N	88°19'2.53"E
28	N	26°40'12.82"N	88°18'58.56"E
29	N	26°40'14.30"N	88°18'59.72"E
30	N	26°40'11.44"N	88°19'3.86"E
31	N	26°40'15.05"N	88°19'3.60"E
32	N	26°40'15.18"N	88°19'3.62"E
33	N	26°40'15.70"N	88°19'1.13"E
34	N	26°40'16.37"N	88°19'1.63"E
35	N	26°40'18.09"N	88°19'2.64"E
36	N	26°40'19.21"N	88°19'3.40"E
37	N	26°40'21.03"N	88°19'3.26"E
38	N	26°40'21.41"N	88°19'2.96"E

Source: AAI



Source: Maps of India and SOI

Figure 2.1: Index Map of Bagdogra International Airport



Source: ABC Techno Labs India Pvt. Ltd.

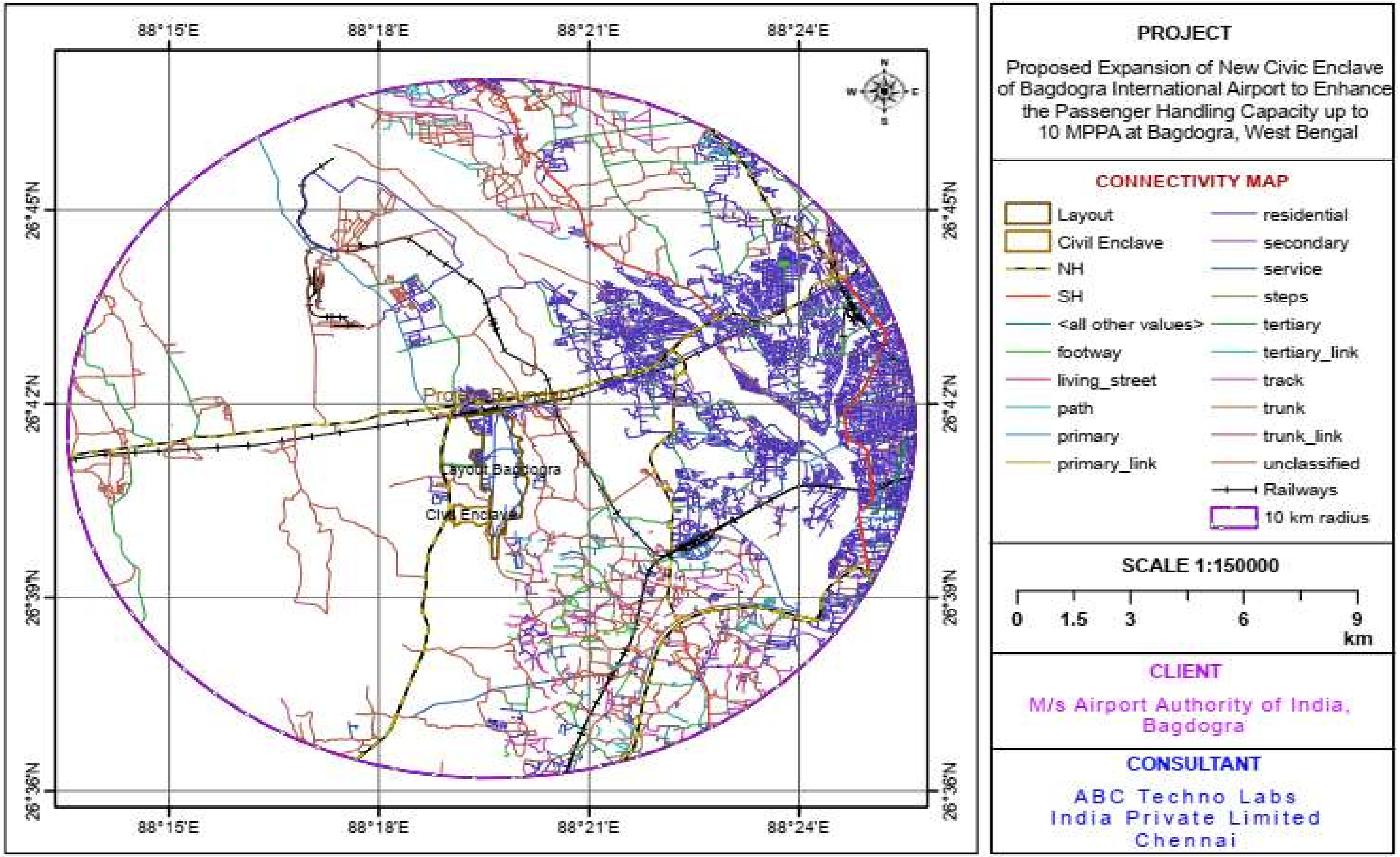
Figure 2.2: Topo map of study area

2.2.2 CONNECTIVITY

The project site is located in LR Plot Nos. 88/362, 122/364, 439, 440, 444, 137, 138, 123/350, 124, 123, 125, 139, 140, 141, 143/347, 143, 129, Mouza: Abhiram–67, P.S: Phansidewa, LR Plot No. 121/163, Mouza: Abhiram-67, PS: Bagdogra, LR Plot Nos. 16, 17, 18, of Mouza: Turibhita , PS: Bagdogra, Dist: Darjeeling, West Bengal.

Road Network:	*The site is well connected to roads. The site location is near the NH-27 connecting to Siliguri Town. Bagdogra has two National Highways: - NH 31 and NH 31C. It also has Asian Highway (AH2) which is connected with Nepal and Bangladesh. It provides a gateway to North - East India*
Railway Network:	*Siliguri Town railway station is one of the oldest railway station (station code SGUT) of the region, opened in 1880 for the Darjeeling, Himalayan Railway (Toy train) connecting Siliguri. Bagdogra railway station (station code BORA) comes under greater Siliguri metropolitan area. It is 10 km from Siliguri junction and is the third largest railway station after NJP and Siliguri Junction. This station serves Bagdogra and adjacent areas.*
Airport Connectivity:	*Nearest airport is Pakyong Airport which is about 62 Km from the proposed project site towards NNE direction. Bagdogra International Airport, (IATA: IXB, ICAO: VEBD) is located in about 16 km west of the city of Siliguri in the Darjeeling district in northern West Bengal, India. It is operated as a civil enclave at Air Force Station Bagdogra.*

The connectivity map showing the road network around the site is given in Figure 2.2.



Source: ABC Techno Labs India Pvt. Ltd.

Figure 2.2: Map showing the connectivity of the project site

2.3 DETAILS OF ALTERNATE SITE CONSIDERED AND THE BASIS OF SELECTING THE PROPOSED SITES

The Proposed project falls majorly within the Airport Zone as classified under Master plan/Zoning Plan by the State Government. Hence, there is no consideration of Alternative Sites, Size or Magnitude of Operation.

The proposed capacity enhancement activity includes works required for relocation, improvement, modification /up-gradation /augmentation and modernization of existing Airside/Landside facilities and infrastructure, and to meet operational safety requirements to facilitate the required infrastructure to serve the projected passenger and cargo traffic in ultimate phase.

2.4 MAGNITUDE OF OPERATION

2.4.1 LAND REQUIREMENT

The proposed expansion project is Development of Civil Enclave with infrastructure such as New Terminal Building, Car Parking, Apron, Link Taxiways etc. and associated city side / airside infrastructure on approx. 105 Acres of Land is planned. The area statement is given in Table 2.3

Table 2.3: Area Statement

Description		Area in Sqm.	
		Area	Ground Coverage
Civil Enclave Site Area		423850	22166
Terminal Building Phase 1	First Floor-Departure Lvl. (Ht. 4500mm)	2836	
	First Floor-Departure Lvl. (Double Ht. 4500mm)	19330	
	Departure Mezzanine- 02 (Ht 4500 mm)	2836	
	Arrival Mezzanine- 01 (Ht 5250 mm)	10712	
	Ground Floor Arrival lvl. (Double Ht. 10500 mm)	9360	
	Ground Floor Arrival lvl. (Ht. 5250 mm)	7213	
	Total Terminal Area PH-1	52897	
	Fixed bridge and satellite- Phase 1 (5.5 mtr)	870	
	Basement- Phase 1 (ht. 6.75 mtr)	16875	
	Basement Ramp	1402	
Kerb amenities (4.0 mtr) (Toilet)		360	
Arrival to Departure link (15.5 mtr) (Lift & Stair Case)		160	
Overhang Roof above Road & kerb – Phase 1		10722	
Arrival Kerb- Ph 1 (Between terminal & Approach road)		5500	3270
Departure kerb (Between terminal & Approach road)		3270	
Airside Kerb		3710	3710
Connecting Pedestrian Bridge Between MLCP & Departure		610	610
MLCP	Ground Floor (4.50 mtr)	20728	20728
	First Floor (4.50 mtr)	20728	
	Terrace Covered pedestrian walkway (3.0 mtr)	1753	
	Mumty (3.0 mtr)	295	
	Machine room (5.0 mtr)	45	
	Pergola	2636	
	Cantilever Planter area	2897	

Description		Area in Sqm.	
		Area	**Ground Coverage**
AAI Office		1740	870
Utility Serices- Phase 1		4125	4100
Solar Farm (on Top of MLCP Roof)		5500	
Line Maintenance & fire Station- deleted fr Scope		920	920
Road Network	14.5 mt wide flyover from 0.00 to 10.5 mt (424 Rmt)	18730	7950
	33.5 Mt wide flyover at 10.50 mt (400 Rmt)		
	On Surface Roads between terminal and main road	57370	57370
Apron Side Area	Apron Phase 1	59890	107020
	Apron Shoulder	13955	
	Taxiway	10920	
	Taxiway Shoulder	4320	
	GSE (Concrete)	6255	
	Airside GSE Movement Corridors- Ph 1	11680	
Commercial & Residential Plots		NA	59555
Landscape	Softscape	NA	30900
	Hardscape including external foodcourt	NA	19980
Phase- II			
Terminal building- Ph II		NA	15665
Overhang Roof above Road & kerb – Phase II		7480	
Arrival Kerb- Ph II (Between terminal & Approach road)		NA	2515
High End Services – Phase II		NA	4495
Fuel Farm		7570	7570
Apron- Phase II		NA	16465
Apron Shoulder & Edges – Phase II		NA	1285
Airside GSE Movement Corridors- Phase II		NA	3980
Other Misc Areas			32726
Total		NA	423850

Source: AAI

For designing of the proposed development activities National Building Code, ICAO guidelines & other regulation/guidelines as applicable will be followed.

2.4.2 Proposed Phasing of Master Plan

Proposed Phasing of Master Plan is given in Table No: 2.4.

Table 2.4: Proposed Phasing of Master Plan

Sl. No.	Phase	Details
1	Phase 1	In Phase-1, terminal building having area of 69162 Sqm (including 16875 Sqm Basement) and 6 number aerobridges and 10 Code C apron, Apron Bays with 2 Nos. Link Taxi will be constructed. Proposed construction of Phase-1 of New Integrated Terminal Building is expected to be completed by March 2036
2	Phase 2	In Phase-2, terminal building having area of 50000 Sqm and 4 number aerobridges and 6 Code C apron Apron Bays will be constructed in future.

Source: AAI

2.5 PROJECT DESCRIPTION

2.5.1 DESCRIPTION OF PROJECT ACTIVITIES

1. Phase 1

Construction of New Terminal Building with an area of 69162 sqm (approx.).

Civil Works:

- Construction of centrally air-conditioned two and half level New Integrated Terminal Building with all modern facilities and amenities as per the layout plan enclosed. The New Terminal Building having an area of 69162 sqm (approx.) (including 50% of Basement area) with capacity to handle 10 MPPA traffic, with saturation year 2036 shall be designed for 3000 passengers at a time (2600 Domestic & 400 International) with the recommended area specifications and to match the level of service "Optimum" as per IATA recommendations. The building will be provided with aesthetically appealing & soothing interior decoration.
- The Terminal building departure area, arrival area, Security hold area and Concourse area are to be provided with adequate nos. of toilets for gents, ladies and differently-abled persons and drinking water facility. Suitable number of ramps to be provided for entry and exit of differently- abled persons in departure and arrival area. Provision of tactile flooring and other standard facilities for persons with reduced mobility including battery operated buggies for senior citizens/differently-abled persons as per requirement.
- The design of Terminal building should include Media planning, Retail area planning, F & B plan, etc. Overall planning of Building should capture local architectural features and it should be part of design features of terminal. The design should include the required arrangement for its regular maintenance. Maintenance friendly roofing & building facade system including provision of regular cleaning with maintenance hoists, hooks, etc. including cat walk/ rope suspended platform/gondola etc. to be provided. Solar power generation viz. solar lighting, solar roofing system, etc. shall be provided.

Departure Area:

- The terminal building with provision for Departure concourse, check-in area with adequate number of check-in counters, baggage conveyor belts, queuing space, segregation railing, back-up offices for Airlines, facilitation counters, weighing machines, counters etc.

Security Hold Area

- Security Hold area with adequate seating arrangements and associated facilities.
- The passenger frisking area in security hold with adequate space for locating required number of body scanners, X-ray machines (ATRS), Inspection Tables for manual checking of hand baggage and adequate space/room for security staff, isolated smoking area etc.

Retail Area/Food & Beverage Area

- Creation of Retail and F & B Islands/Shops along the passenger flow to encourage the generation of non-aeronautical revenue without affecting the passenger movement.

Arrival Area/ Baggage Claim Area:

- In the ground floor baggage claim area, adequate number of baggage conveyor belts of adequate size should be provided.
- Adequate space should be provided in the ground floor for required number of back up offices, money exchange counters, Bank, space for storing of baggage trolleys, space for storage of mishandled baggage for airlines, segregation railing and associated passenger amenities.

Common Concourse Area:

Should have provision for snack bar counter, travel requisite, Pharmaceutical shops, airlines offices & ticket selling counters, ATM/Bank counters etc., meet and greet area, first aid room, facilitation counters, caretaker room with store, Airport Terminal Manager office/Store for lost and found items, Conference Room and other facilities at suitable locations.

- Construction of Surface car park/MLCP for at least 1000 cars and 10 buses, Separate car/scooter park area for AAI and airlines staff at appropriate location.
- Development of elevated vehicular road with canopy covering two lanes in front of the Terminal Building on the city side.
- Furnishing of VIP/CIP lounges, provision of adequate number of chairs, furniture, furnishings etc. in the departure lounge common concourse, check- in area, security hold area and arrival lounge.
- Provision of water supply pumping arrangement system, Water Filtration, water cooler & R.O/U.V. Filters, Sewage Treatment Plant (STP) & Effluent Treatment Plant (ETP) as per norms and as per site conditions.
- Horticulture - landscaping, drainage system, water supply, rain harvesting etc.
- Driver's canteen and toilet facility on the city side. Provision of snack counter and toilet facility for visitors.
- Sub-station, A/C plant room and related service facilities. Provision should be made for the AC Plant Room vertical through AHU rooms back up generators for essential services, etc. in the lower ground floor.
- Provision of acoustics for effective functioning of PA system.
- Providing city side compound wall depicting local architecture and with proper gates.

Electrical works:

- Internal and external electrification for Terminal Building Complex, associated buildings, Car Park and roads.
- Augmentation of main power supply, Substation Equipment, DG Sets for Secondary Power supply and associated ancillary buildings.
- Central air-conditioning with provision of vertical air-conditioning concept with EMS & BMS including ventilation system.

- Provision of conveyor belts with In-line X-ray Inspection System and other equipment at departure area and inclined carousels at Arrival hall.
- Fire detection, alarm and protection system with Fire Control Room and Gas Flooding System.
- Provision of automatic sliding doors at exit & entry points of Terminal Building.
- Escalators & Elevators with staircase.
- Provision of Six Passenger Boarding Bridges (PBB) attached to fixed finger rotunda for the specified parking stands. PBB equipment is not part of PMC Consultancy.
- Provision of adequate number of Signage's of world class standard, inside and outside the terminal building, car park area & City side approach road and airside area for guidance of passengers and visitors.
- Provision of Solar Systems.
- Provision for Facades and Landscaping Lightings.
- Provision of Security System I.e. Bollards, Tyre Killers and Boom Barriers at appropriate locations.
- Provision for VRF & Split Air-conditioning units, Air Curtains, Precision type Air-conditioning system for data control Centre, Hand dryers etc.
- Provision for Automatic Motorized/Hydraulic operated Lift and other equipment's for maintenance works.
- Provision for STP, Water Filtration, RO, Water Supply Pumps, ETP and dewatering pumps including diesel operated dewatering pumps etc.
- Provision of Solid Waste Management Systems.
- Provision of Sanitary Incinerator in ladies Toilet.
- Provision of Sanitary Napkin Vending Machine, Baby Diaper Changing station & Baby Protection Seat.
- Misc. Electrical works, if any.

Airports Systems

- Surveillance Close circuit TV system (SCCTV) and provision of adequate number of close circuit TV monitors, in the Security Control Room, Terminal Manager Room, APD Office etc.
- Public address system and car calling system.
- Provision of Flight Information Display System (FIDS) with adequate number of Display Devices in departure, arrival and security hold area for passenger facilitation.
- Provision of adequate number of X-ray machines for scanning Hand Baggage (HB), including provision of required number of Body Scanners, ETDs, DFMDs, HHMDs, and registered Baggage X-Ray machines (RB) as per BCAS norms.
- Provision of Automated tray retrieval system in security check area.
- Provision of adequate no. of VHF FM Sets (Walkie-Talkie, Base Stations and Mobile Stations).

- Provision of Telephone Exchange/digital EPABX/IP EPABX system for Terminal Building including telephone/intercom instruments, wiring etc.
- Provision of miscellaneous systems such as entertainment TV etc.

IT Systems:

- Computer cable data networking.
- Provision for Digi Yatra requirements as per policy of MoCA. (Baggage Drop & facial identification systems for check-in, Security check and Boarding).
- Passive and Active networking components such as OFC, UTP cabling, Routers, Core& Access switches and accessories. Provision of Raceways, cable trays for conduiting and cabling.
- Server room and adequate space for keeping network switches along with electrical power points & UPS.
- Access Control System as per BCAS requirement.
- Provision of Internet, VPN band width, Wi-Fi system.

Other IT works:

- Set up of LAN, WLAN & WAN by providing Passive and Active Networking Components.

Passive Cabling Works:

- At the Airport campus Integrated Local Area Network shall be provided for all the Voice, Data & Video Data requirement for all the agencies working at the airport, No other line for communication shall be allowed by the other agency. To provide Integrated LAN Points for CCTV, WLAN, Access Control System Internet, FIDS, IPABX and PoS, CUTE, CUSS or any other applications required internet or AAI intranet for all users at Airport in redundant mode. LAN points redundancy shall be applicable for important LAN Devices. CAT 6A or latest Passive cable shall be used for connectivity. The Airport Campus will be having passive works like laying of OFC backbone, UTP and voice cabling installation of racks, cables, conduit, covered cable trays and Raceways.

Active Networking Equipment:

Active Networking Equipment (Router, Firewall, Core Switch & Distribution Switch) shall be provided in HA Mode. All Edge Switches shall be provided with Redundant Power Supply as per the requirement. Dedicated edge switching and fiber connectivity shall be required for CCTV. UPS power supply for 24x7 to all Active Networking Equipment is mandatory. Active Networking Equipment's are required to establish WAN, LAN, WLAN at the airport premises for All Applications including Bio - Metric Access Control system and other applications for all users at Airport. Users of these applications are distributed across various floors of the Airport building and surroundings. PoE + switches are required for wireless access points, CCTV, Voice etc. WAPs for WLAN shall be provided only for BRS and other AAI offices only.

- Setup of Server Room and NOC (Network Operations & Control) Room
- Required space for Central Server Room and the locations of Edge switches and distribution switches shall be marked in the drawing Requisite no. of Servers &Network Racks along

with PDU, Storage, Networking and Other Security Devices, Modular UPS with half an Hour Battery Backup, Precision Air Cooling System, Access Control, CCTV for Data Center, FSAS, Gas Suppression System, Anti• Rodent, WLD, Dedicated Earthing, Dual Power Sources etc. shall be provided in the Server Room by the vendor.

- Required space for NOC Room shall be marked in the drawing with the locations of Display Terminals.
- OEMs Certified Services: Certified Services from OEMs of offered Active Networking Equipment and Security Appliance shall be required for Design and Implementation of VLAN system for all user departments and group of Equipment's, Implementation of IP Schema for Connectivity of network between all official buildings at Airport and AAI Central Data Center at Delhi, Installation and configuration, proper Documentation etc. User familiarization training of the IT system deployed at Airport shall be provided.

Commercial Works:

- Provision of CUTE and CUSS Systems.

2. Phase 2

Terminal building having area of 50000 Sqm and 4 number aerobridges and 6 Code C apron Apron Bays will be constructed in future.

Civil Works:

- Construction of an apron of approximate area 393m x 122m as per the dimensions indicated in the layout drawing with strength suitable for operation of A-321. Shoulders 5.5m wide should be provided for the apron on three sides and the portion of the shoulders adjacent to the area indicated in the drawing for future expansion should be made for full strength as that of the apron to facilitate future expansion.
- Construction of two link taxiways of length 217 m connecting the Runway with the Apron as shown in the diagram. The width of the taxiways shall be 23m with shoulders of 5.5m on either side.
- Provision of fillets at intersection of taxiways with runway and apron for A321 type of aircraft.
- Construction of GSE area of 6212sqm area at the location indicated in the plan.
- Development of taxiway strips and grading/levelling of surrounding areas upto boundary wall as per DGCA CAR specifications.
- Provision of apron, taxiway, mandatory instruction markings and information markings as per DGCA CAR specifications.
- Provision of drainage system for the apron connecting the main storm water drains and culverts below the taxiways or portions of Apron where ever required.
- Provision of hard stand for ramp equipment with mandatory clearances and four lane service road between the apron and the Terminal Building.
- Provision of pipe lines for future installation of fuel hydrant system.

Electrical Works

- Provision of Visual Docking Guidance Systems for parking stands with PBBs and remote nose-in stands.
- Provision of Apron Edge Lights, Taxiway Edge Lights, and lighted mandatory information/information Signs, etc. including cabling works.
- Provision of high mast Apron Flood Lights at appropriate locations to meet the required illumination standards along with raising and lowering device for easy maintenance.

Miscellaneous works:

- All the works are to be carried out as per DGCA CAR/ICAO documents
- Technical evaluation of strength of pavements before & after the completion of work and declaration of strength for commissioning of pavements.
- Provision of water storage and water supply, pump house for overhead water tanks and sump etc. for terminal building and residential colony, preferably by rain water harvesting system
- Construction of sewerage treatment plant of adequate capacity (as per the requirement) with facility for future expansion.
- Construction of boundary wall with embossed AAI logo of height as per letter no. PLG/507ITC/1/15/122 dated 09.02.2015. Construction of Watch Towers /Morcha as per requirement.
- Construction of electrical sub-station building for housing DG sets, stepping down main power supply, transformers etc., storage facility for diesel, equipment, spare parts etc. including Building for A/C Plant and water supply pump.
- Provision of gates to segregate air side and city side area with security guard posts at the entry gate and additional security posts inside the civil enclave operational area at appropriate location in consultation with ATM and Security Dtes.
- Construction of perimeter road of adequate width all along the boundary wall inside civil enclave operational area.
- Construction of CCR room at appropriate location.
- Procurement of furniture, chairs 100% of Dep. PH (i.e 10% for check-in and 90% for Sec. Hold), 10% of Arr. PH and baggage trolleys 60% of total PH. and adequate No. of Dust bins & Planters.
- Provision of Battery operated Buggies for Sr. Citizen and Differently Abled Persons as per requirement.
- Provision of covered drains and culvert (pipe/box) at appropriate location in the operational/non-operational area for crossing of electrical, communication cables, draining of storm water from apron, terminal building and car park area. The strength of culverts must be designed for Code '4C' type of aircraft.
- Horticulture and gardening works on city and airside.

- Construction of 2, 4 or 6 lane roads from city main road up to the terminal building and internal circulation roads.

2.5.2 Details of Airport Infrastructure

Details of Airport Infrastructure is given in Table 2.5

Table 2.5: Phase wise capacity enhancement

Facilities / Infrastructure	Existing Infrastructure	Infrastructure After Reconfiguration Of Terminal (Immediate)**	Phase 1 (Under Planning Stage) (Immediate)	Phase 2 (Execution To Be Undertaken In The Year 2032-33) **
Runway				
Dimension	2743m X 45m	2743m X 45m	2743m X 45m	2743m X 45m
Parallel Taxi Track (PTT)	Available (Under IAF Control)	Available (Under IAF Control)	Available (Under IAF Control)	Available (Under IAF Control)
Capacity (movement / hour)	8	8	15	20
Critical Aircraft	A-321	A-321	A-321	A-321
Apron				
AB-321 IL76	5	5	10	16
Terminal Building				
Area (Sq. m.)	9241	9241	52,287 + 16,875 (Basement) = 69,162	69,162 + 50,000 = 119,162
Peak hour Passenger (PAX) in numbers	810	1350	3000 (2600 Dom + 400 Intl')	6000 (5200 Dom + 800 Intl')
Annual Capacity (MPPA)	2.5	3.5	10	20
Expected year of Saturation	Saturated	2023-24	2035-36	Beyond 2047
City Side				
Surface Parking (cars)	200	200	40	40
Multilevel car parking (MLCP)	-	-	1100	1100
Road in front of terminal (Each lane 3.5 m wide)	4 lane	4 lane	8 lane	8 lane
Approach road	Available	Available	Available	Available
Metro Train	No Metro	No Metro	No Metro	No Metro

Source: AAI

***Phases of developments are to be under taken three years prior to the saturation. Dates given for execution of different Phases are on present estimation of growth. In case of change in growth, these dates can either be preponed or postponed.*

2.5.3 Terminal Development

The ambition for AAI is to cater for sustainable growth and the passenger terminal buildings should accommodate the growth up to planning horizon. The design of a terminal functional layout takes into consideration the following objectives:

- Optimum functionality with sufficient processing stations
- Flexibility in development to meet changing operational demands over time
- Meeting IATA's Level of Service 'Optimum'
- Segregation of arriving and departing passengers

Table 2.6: Details of Integrated Terminal Building

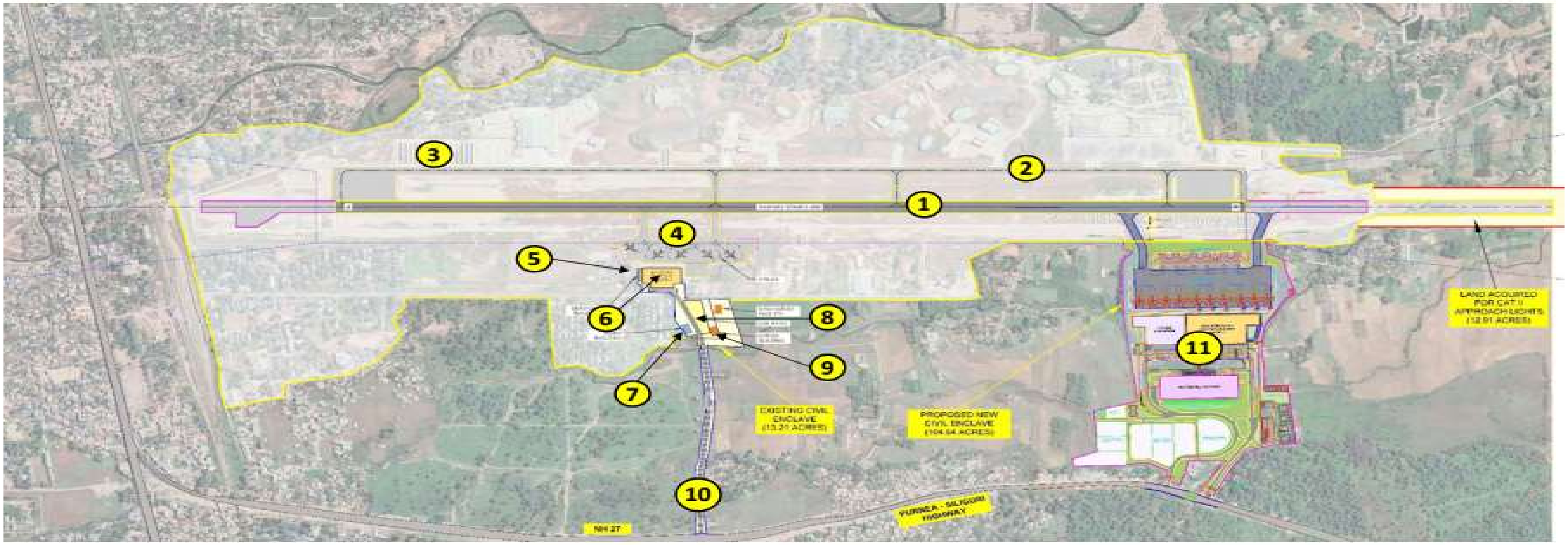
Sl. No	Components	Existing	Proposed
1	Built up Area	Existing Terminal Building – 9241 sqm	New Terminal Building- 69,162 Sqm
2	Annual Capacity	2.50 Million Passengers Per Annum	10 Million Passengers Per Annum
3	Passengers handled (2019-20)	3.21 Million Passengers	
4	Peak Hour Capacity	1360 Pax (1260 Dom. + 100 Intl.)	3000 Pax (2600 Dom. + 400 Intl.)
5	Car Parking	200	1100

Source: AAI

2.5.4 Landside Development

The planning of landside area is primarily driven by operational requirements of terminals and the volume of vehicles is directly related to the number of passenger arrivals and departures handled at the terminals. Other factors, which influence the landside movement/traffic, are airport employee trips, meters/greeters, airport terminal visitors and traffic related to support and other facilities. The landside planning strategy is to have quick access, minimize or eliminate conflicts and achieve optimal utilization of the proposed facilities. The transport infrastructure planned shall allow phase-wise implementation during various planning stages of the terminal development. All planning proposals shall aim to provide delay free access for the time sensitive passenger traffic to arrival and departure kerbs without any conflicts with other traffic.

MLCP is proposed in an area of ~ 2.08 Ha. of Land Area. Construction of MLCP for at least 1000 cars and 10 buses, Separate car/scooter park area for AAI and airlines staff at appropriate location will be done.



01	Runway 2743m x 45m
02	IAF Parallel Taxi Track
03	IAF Apron
04	Apron Bays

05	Existing ATC Tower
06	Terminal Building
07	Admin Building
08	Car Park

09	Cargo Terminal
10	Approach Road
11	Proposed New Civil Enclave

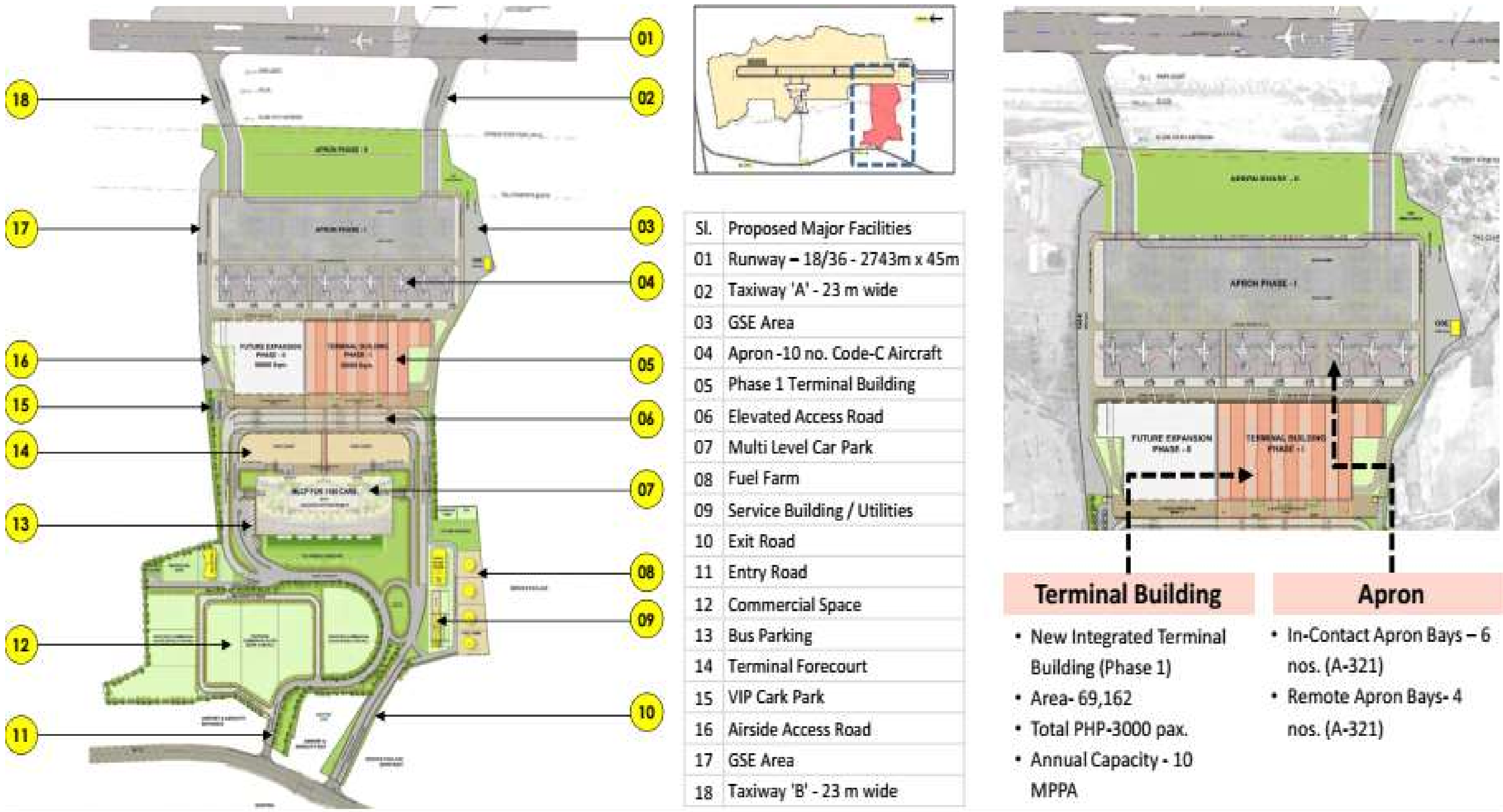
APPROACH TO AIRPORT		
APPROACH ROAD	NH 27 (Kolkata-Siliguri)	
CITY CENTER	16.6 KM	31 MINS
BAGDOGRA RAILWAY STATION	4.9 KM	12 MINS
BAGDOGRA BUS TERMINAL	13.5 KM	29 MINS

(Anil Kumar Pathak)
Member Planning AAI

Sanjeev Kumar
(Sanjeev Kumar)
Chairman AAI

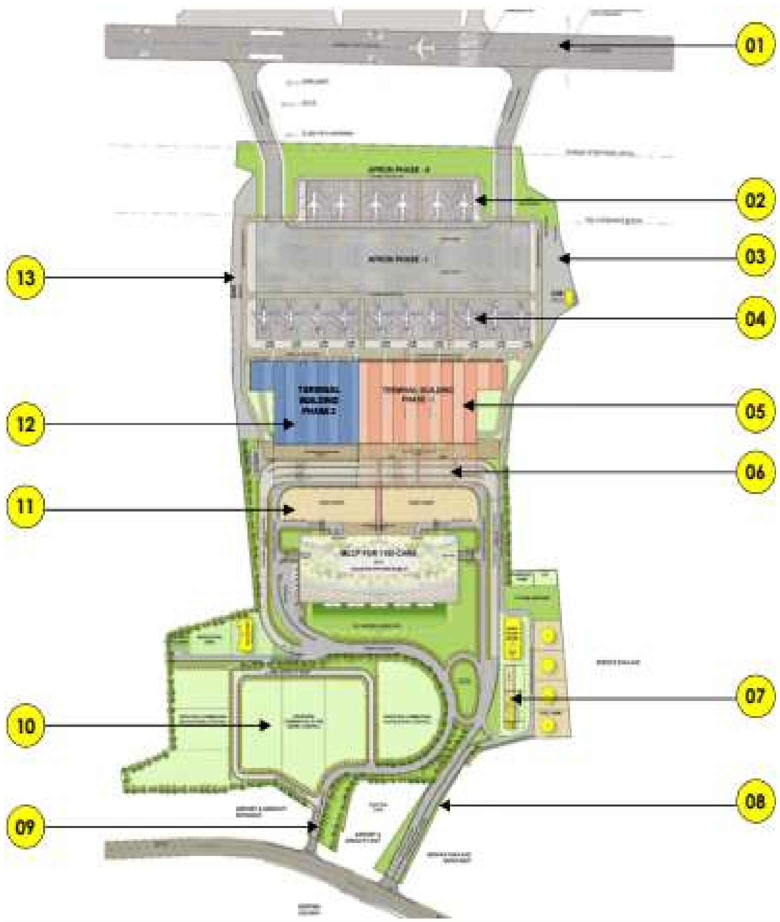
Source: AAI

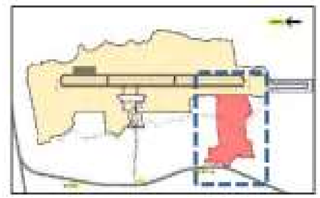
Figure 2.8: Existing Layout Plan



Source: AAI

Figure 2.8: Proposed Master Plan of Civil enclave (Phase 1)

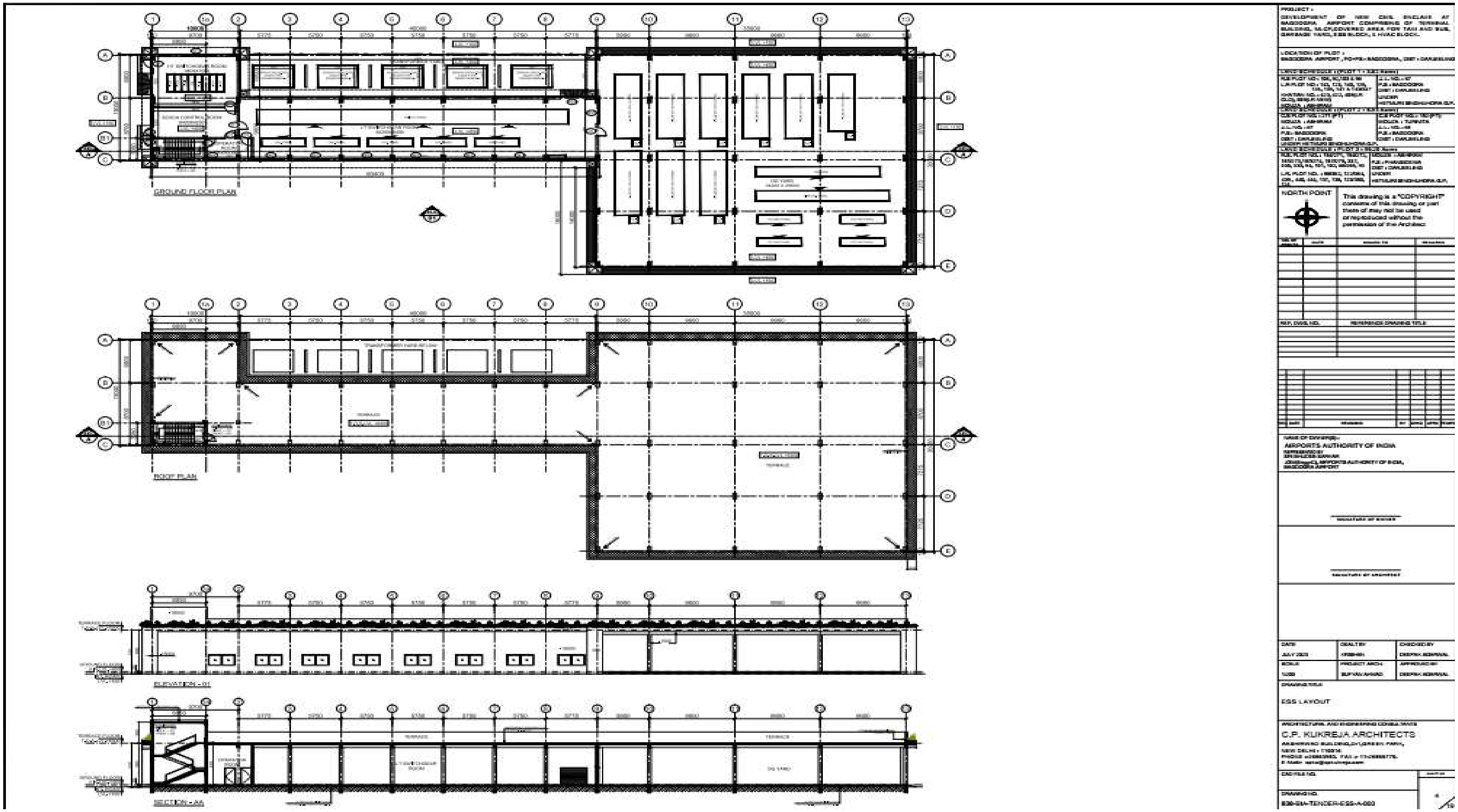




Sl.	Proposed Major Facilities
01	Runway – 18/36 - 2743m x 45m
02	Ph 2 - Apron - 6 no. Code-C Aircraft
03	GSE Area
04	Ph 1 - Apron -10 no. Code-C Aircraft
05	Phase 1 Terminal Building
06	Elevated Access Road
07	Service Building / Utilities
08	Exit Road
09	Entry Road
10	Commercial Space
11	Terminal Forecourt
12	Phase 2 Terminal Building
13	GSE Area

Source: AAI

Figure 2.8: Proposed Master Plan of Civil enclave (Phase 2)


GROUND FLOOR PLAN
ROOF PLAN
ELEVATION - 01
SECTION - AA
NORTH POINT
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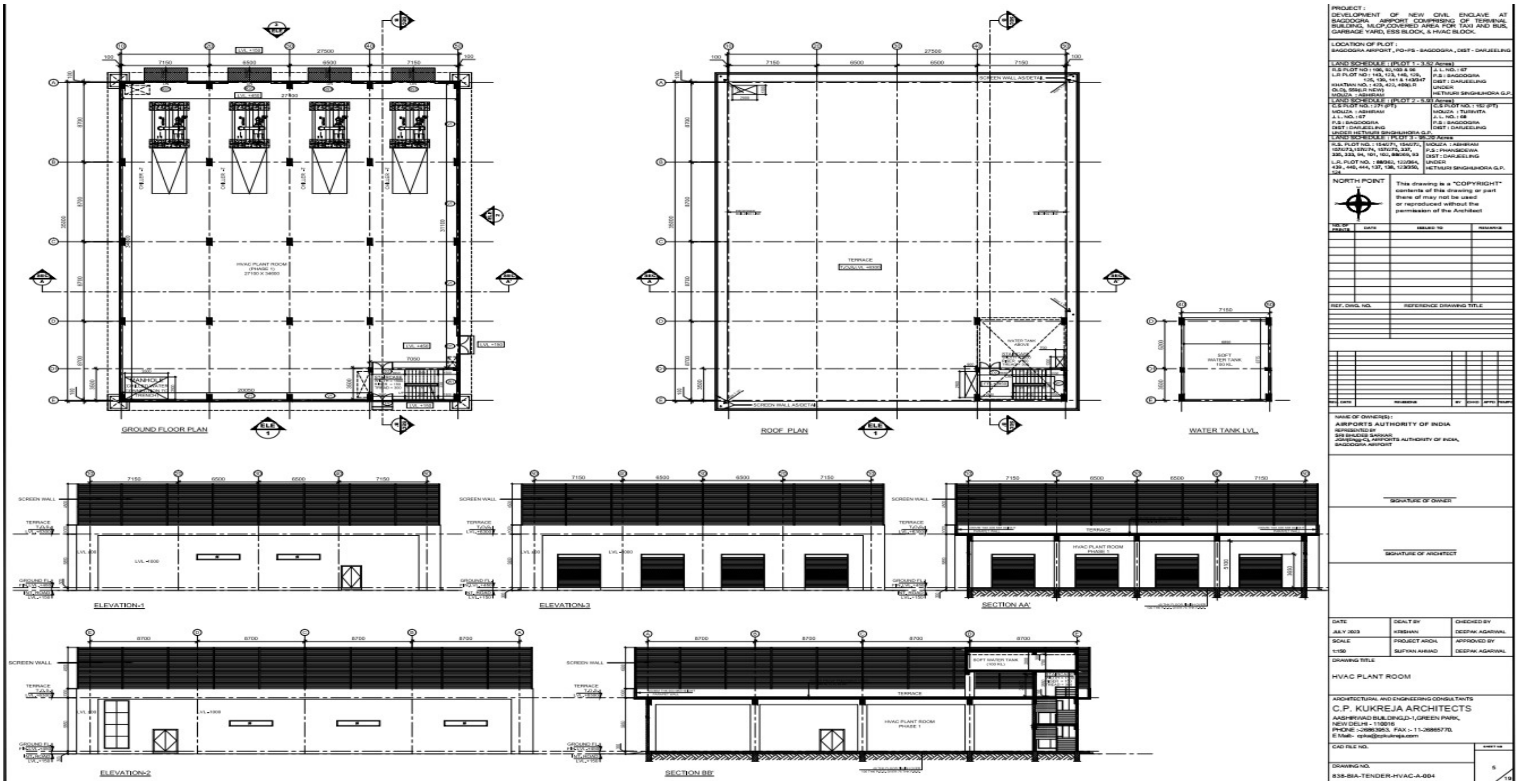
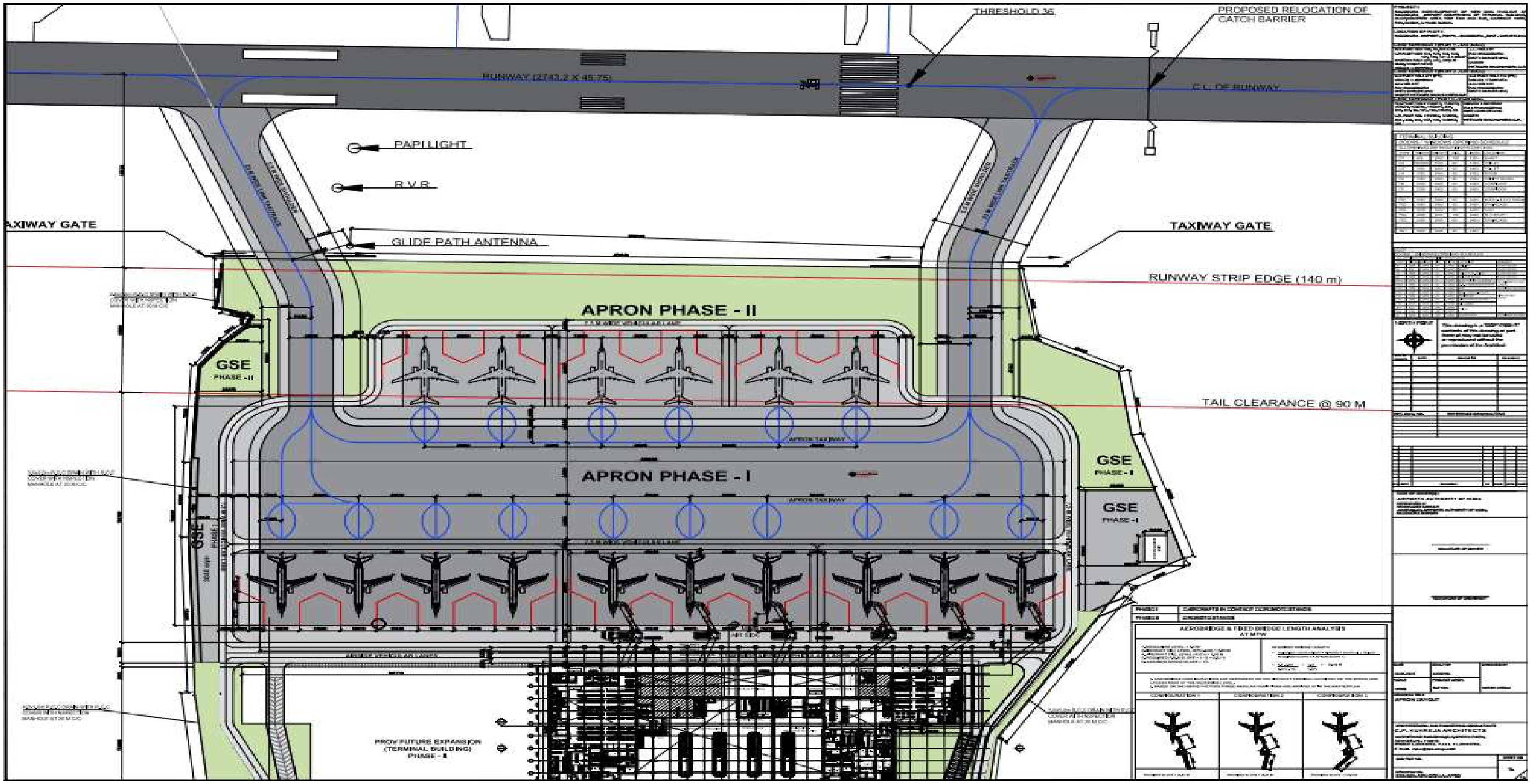
AIRPORTS AUTHORITY OF INDIA
ESS LAYOUT
C.P. KUKREJA ARCHITECTS



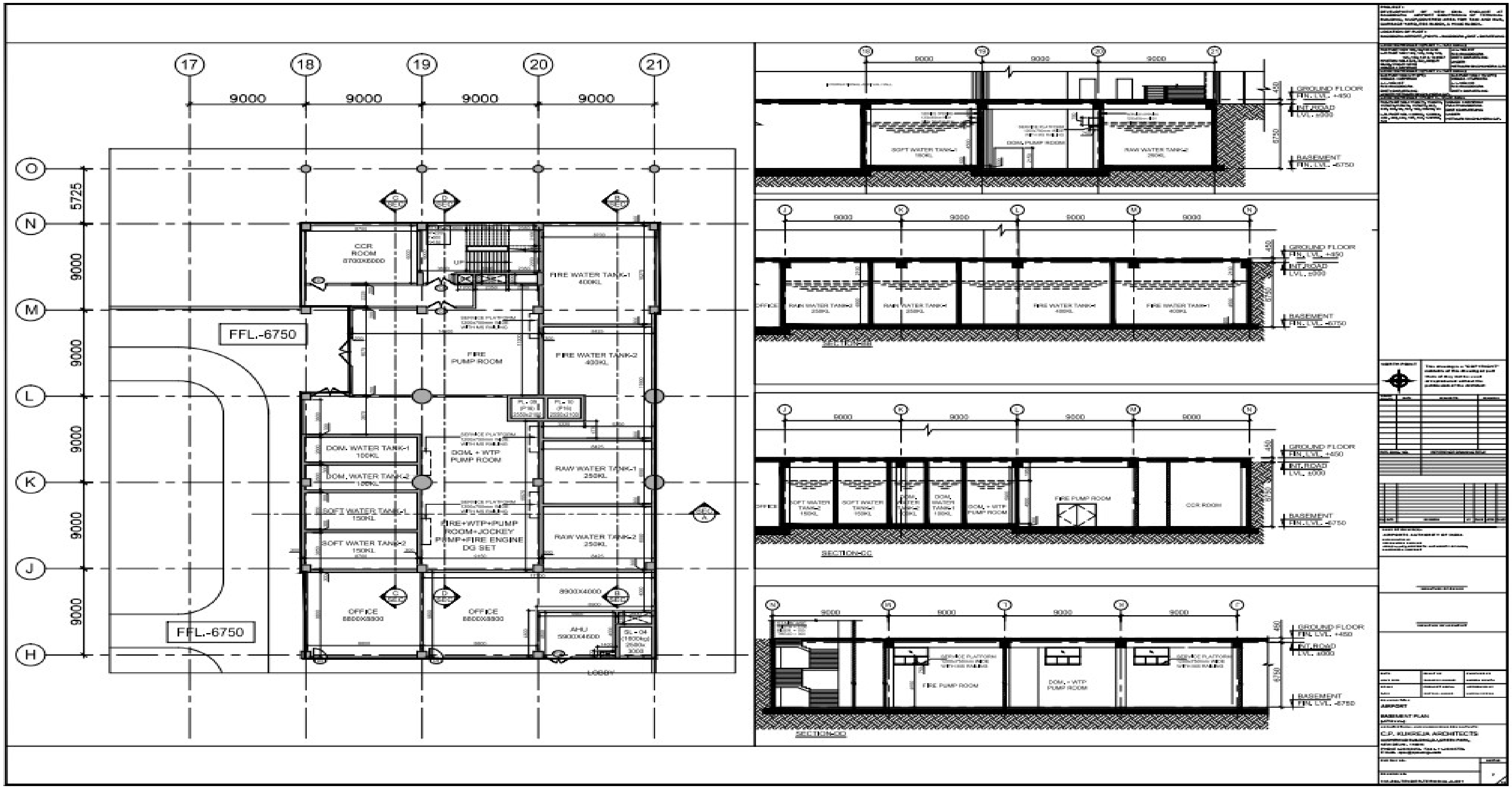
Source: AAI

Figure 2.8: Proposed Floor Plans of Civil enclave



Source: AAI

Figure 2.8: Proposed Apron layout



Source: AAI

Figure 2.8: Proposed Basement layout

2.6 Raw Material Requirement

Airport being a service industry does not process any raw material or deal in production of products. The proposed project is relocation, improvement, modification/up-gradation/augmentation and modernization of Bagdogra International Airport, which requires general construction materials viz. steel, cement, RMC, sand, aggregates, bricks, etc. They will be used for infrastructure development like building construction, road lying, service area development, etc. These materials will be procured from nearby markets as per requirements and transportation facilities will be provided by construction contractor. Quarry material required will be sourced from nearby approved quarries.

2.7 Manpower Requirement

Direct Employment:

Employment generated by activities on site at the Airport. These include the airport operations and management, aircraft maintenance, storage facilities, charter services and leasing activities, airlines, shops and other concessions, catering ground engineering and handling air traffic control and car parking facilities.

Indirect Employment:

Employment generated through activities off site by organizations and companies supplying goods and services to the airport. These jobs may be locally based or more remote from the airport, depending on the nature of supply chain.

Induced Employment:

Employment generated through spending habits of salaried employee both in direct and indirect activities. This category is likely to provide jobs at regional level.

It is expected about 500 direct & indirect employment during construction phase and 2000 direct and indirect employment during operational phase of the project after expansion

2.8 Utilities

All airport facilities planned in the concept master plan use plan rely on the provision of utilities: power, water, sewage discharge etc., which will be development on modular basis inline to the traffic loads.

Table 2.7: Details of Utilities

Sl.No	Components	Quantity after Proposed Development
1	Power	~5.84 MW
2	Total Water requirement	~2540 KLD
3	STP capacity	~1800 KLD
4	Solid Waste	~ 5.12 TPD

Source: AAI

- ❑ **Power Requirement**

The total estimated power demand for Bagdogra International Airport Operations is:

- Maximum Demand: 5.84 MW

- Connected Load: 7.18 MW
- Main Source: WBSEDCL
- Transformer Capacity : 4 x 2500 KVA (3W + 1S)
- DG Sets: 5 x 1500 KVA + 1 x 750 KVA

❑ **Water Requirement**

Construction phase:

Total Domestic water consumption during construction phase for approx. 500 nos. of workers will be 20 KLD, which will be met through existing bore-wells.

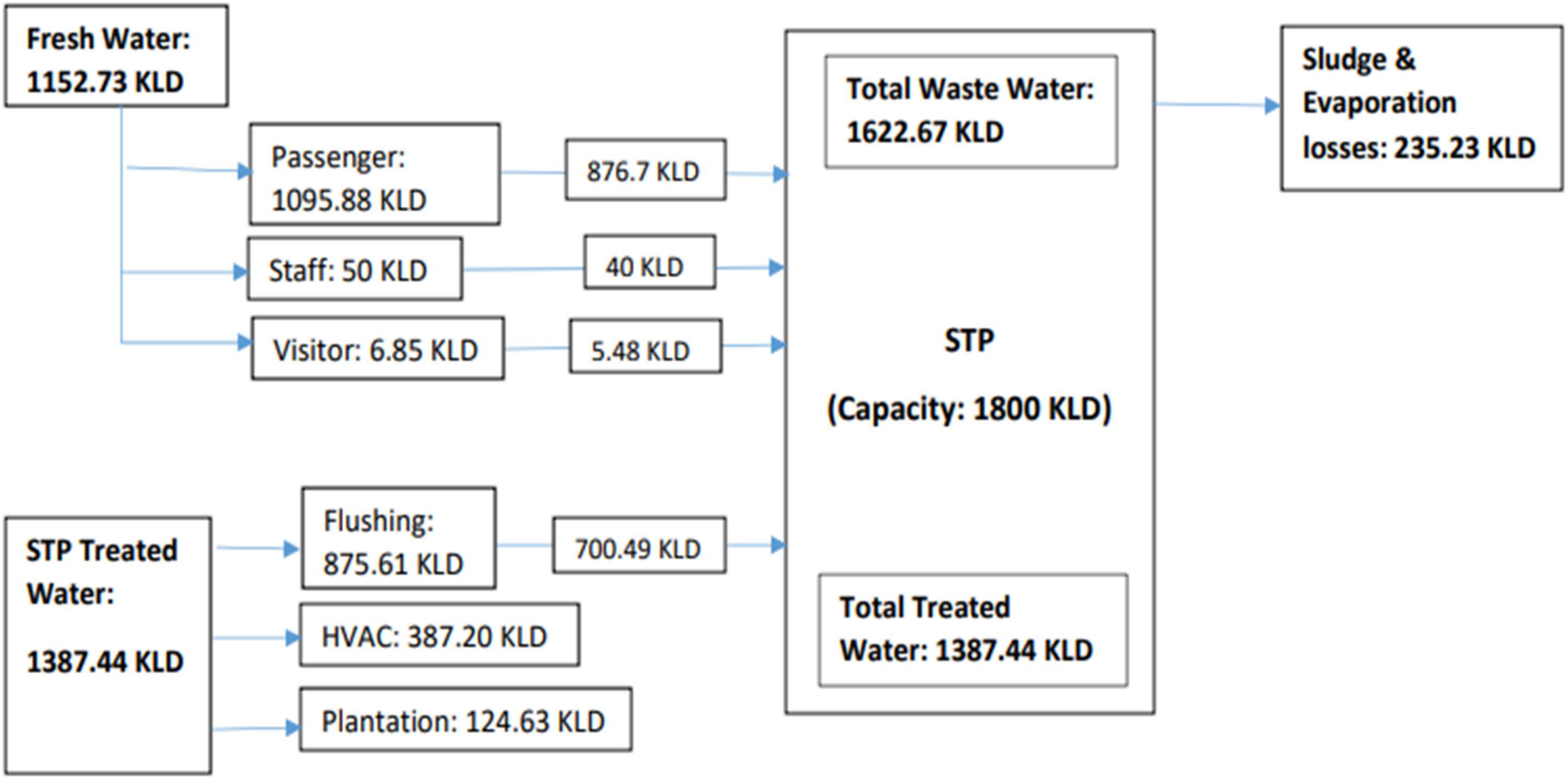
Operation phase:

The daily consumption of water during operation phase after proposed expansion will be about ~2540 KLD out of which ~1153 KLD will be fresh water and ~1387 KLD will be recycled water. The water requirement will be met through ground water (bore-wells). The water requirement for plantation, HVAC & flushing will met through STP Treated water.

Table 2.8: Water Requirement of the Project

WATER DEMAND CALCULATION AS PER NBC								
Sl. No	**Particulars**	**Population/ occupancy**	**Number (Per day) / area**	**Potable water**		**Flushing/Recycle**		**Total (in KLD)**
				Basis (In LPCD)	**Demand (In KLD)**	**Basis (In LPCD)**	**Demand (in KLD)**	
1	Passengers	10 million passenger / annum	27397	40	1095.88	30	821.91	1917.79
2	Staff	@45 LPCD	2000	25	50	20	40	90.00
3	Visitor	5% of total passengers	1370	5	6.85	10	13.70	20.55
4	Green area	@5 Litres / sq. m.	24926	0	0	5	124.63	124.63
5	HVAC	TR refrigerant	2420				387.20	387.20
		litre per TR	10					
		No. of hours	16					
Total					**1152.73**		**1387.44**	**2540.17**

Source: AAI



Source: AAI

Figure 2.4: Water Balance Diagramme

- **Quantity of Wastes to be generated (Solid & Liquid) and scheme for their Management/disposal**

Sewage generation and Management

During operation phase, wastewater generated from Airport premises will be treated in Sewage Treatment Plant (STP) comprising of primary, secondary and tertiary treatment facilities. Sewage treatment plant will be designed considering following inlet and outlet STP Technology & design basis:

Raw sewage inlet Characteristics

- ✓ Daily average flow: ~85% of daily water requirements
- ✓ pH: 7.0 - 8.0
- ✓ BOD: 350 Mg/L
- ✓ Suspended Solids: 250 Mg/L
- ✓ COD: 450 Mg/L
- ✓ Inlet Coliform: 106 – 107 counts / 100 ml

Outlet Characteristics

- ✓ pH: 7.0 - 8.0
- ✓ BOD 5: < 10 PPM
- ✓ Suspended Solids: < 20 mg/l
- ✓ COD: < 50 PPM
- ✓ Coliform: < 100 counts / 100 ml

The treated effluent will be odorless, free from oil & grease and other obnoxious matter.

As a part of existing operations, Soak Pits are used for treatment of waste water. For development of this project 1800 KLD capacity of STP (MBR/MBBR/SBR etc.) is proposed. To reduce the load on fresh water demand AAI is committed in implementing the Zero discharge concept for sewage system. The entire sewage that is generated will be recycled and reused for non-potable purposes. About 1622.67 KLD of wastewater will be generated from airport operations, which will be treated through STP (MBR/MBBR/SBR etc.) total capacity of 1800 KLD, will be developed on modular basis. Treated wastewater will be used for Landscaping or other purposes.

Liquid waste from aircraft needs to be treated at Triturator as a primary treatment & further will be pumped to STP for secondary treatment.

Details of Sewage Treatment Process

As part of selection process for identifying suitable sewage treatment technology and technology which is advantageous for Bagdogra International Airport, a comparative study was made considering various latest sewage treatment technologies available in the field of waste water engineering.

The technologies selected for evaluation include advanced methods of treatment developed in recent years which are giving treated water quality required for reuse and recycle for non-potable uses i.e. HVAC makeup water, toilet flushing, irrigation water for gardening and landscape areas etc. The technologies selected include Advanced Sequencing Batch Reactor (ASBR), Membrane Bio Reactor (MBR) and Moving Bed Bio film Reactor (MBBR). In case of MBBR, post membrane filtration is required to get the desired water quality in addition to secondary biological treatment. The comparative statements are given in Table 2.9 below.

Table 2.9: Comparative statements

Sl. No	Process	Advantages	Disadvantages	Remarks
1.	Advanced Sequencing Batch reactor Process (ASBR)	Proven technology with many plants in operation worldwide. As settling happens in same reactor, no separate secondary settling tank is required. No re-circulation of activated sludge. Less excess sludge generation and sludge is well stabilized. Less power consumption due to optimized aeration cycle.	In case of plants operated with PLC controlled system with automation, trained manpower is required.	In case of sequencing batch reactor area requirement is less. Primary and secondary settling tanks are not required.
2.	Membrane bio reactor process (MBR)	Though the technology is relatively new, many plants are in operation worldwide. Less excess sludge generation and sludge is well stabilized. High quality effluent in terms of low turbidity, bacteria, TSS and BOD. Less footprint.	Power consumption is high. High capital cost and periodic membrane replacement cost. Need to control membrane fouling. Chemical addition and membrane cleaning is required.	In case of membrane bio reactor process, primary settling tank is not provided. MBR process is generally provided where reuse of treated water is considered.
3.	Moving bed bio film reactor (MBBR)	Though the technology is relatively new, many plants are in operation worldwide. Less excess sludge generation and sludge is well stabilized.	In case of plants operated with PLC controlled system with automation, trained manpower is required	In case of moving bed bio film process, primary settling tank is provided. Though many big capacity plants with MBBR technology are operating worldwide, in India, the technology is relatively new.

In case of Bagdogra International Airport STP, the treated water is being used for three different uses i.e. landscaping / gardening, toilet flushing and HVAC makeup. In case of MBR, though the plant will be compact, capital and O&M cost is high. Among the ASBR and MBBR processes, ASBR plant is in operation and are working satisfactorily in many places. Since it is a batch process, it can take shock loads of raw sewage quality and there is better control of treated water quality. Based on the above factors, ASBR technology will be considered for Bagdogra International Airport STP including post UF system required for garden / toilet flushing water and RO system required for HVAC make-up water.

In order to reduce noise pollution from STPs, all the air blowers shall be provided with acoustic hoods and all pumps and other equipment shall be with noise levels as permitted by WBPCB. In order to prevent odour problem at sewage collection wells and pumping stations, the sumps and tanks shall have covered roof with forced ventilation ducts fitted with ozone emission type air purifiers. The typical flow diagram for ASBR STP is shown in Figure 10.1 and typical layout plan for ASBR STP is shown in Figure 10.2.

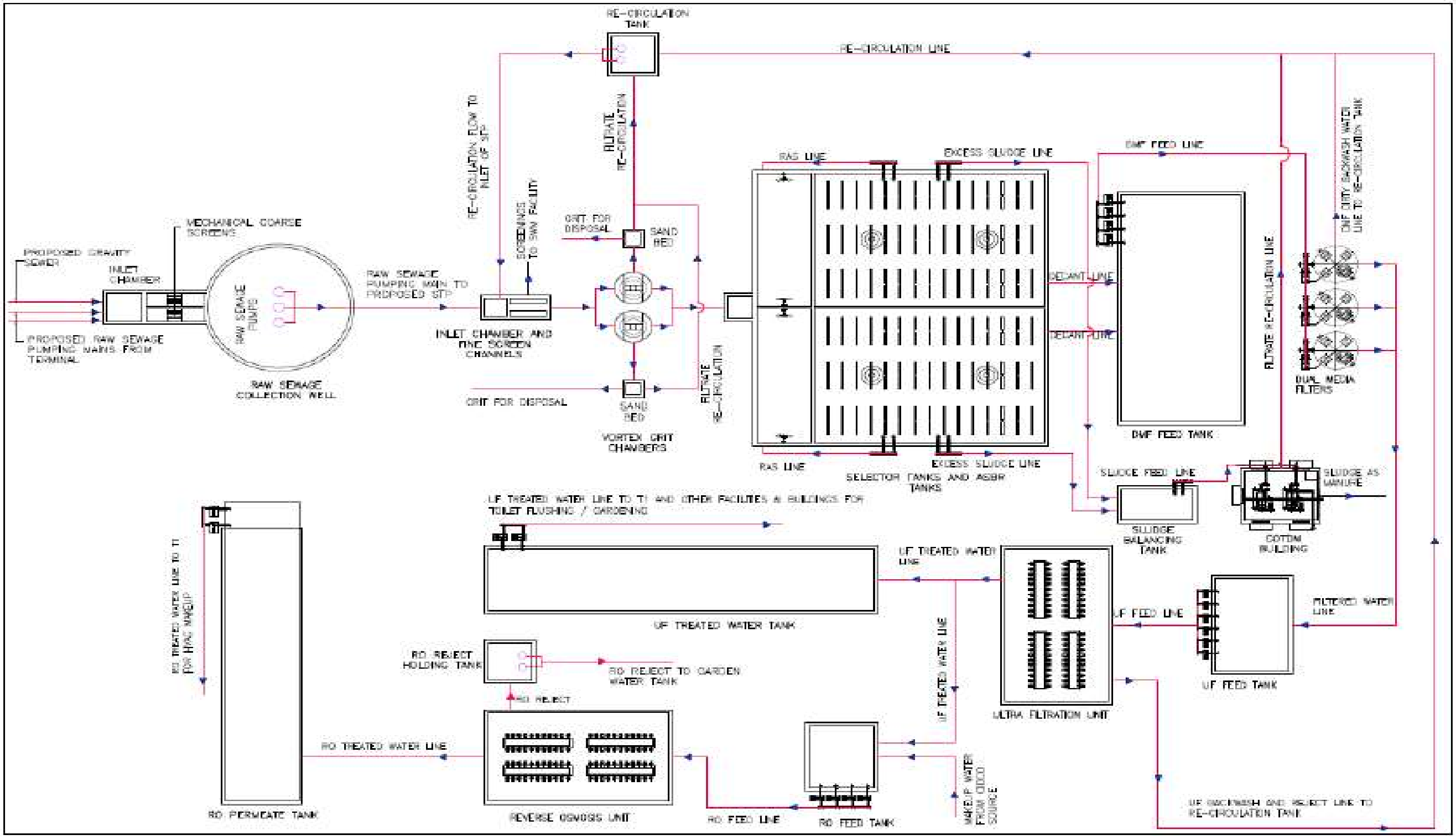


Figure 2.1: Flow Diagram for Sewage Treatment Plant with ASBR Technology

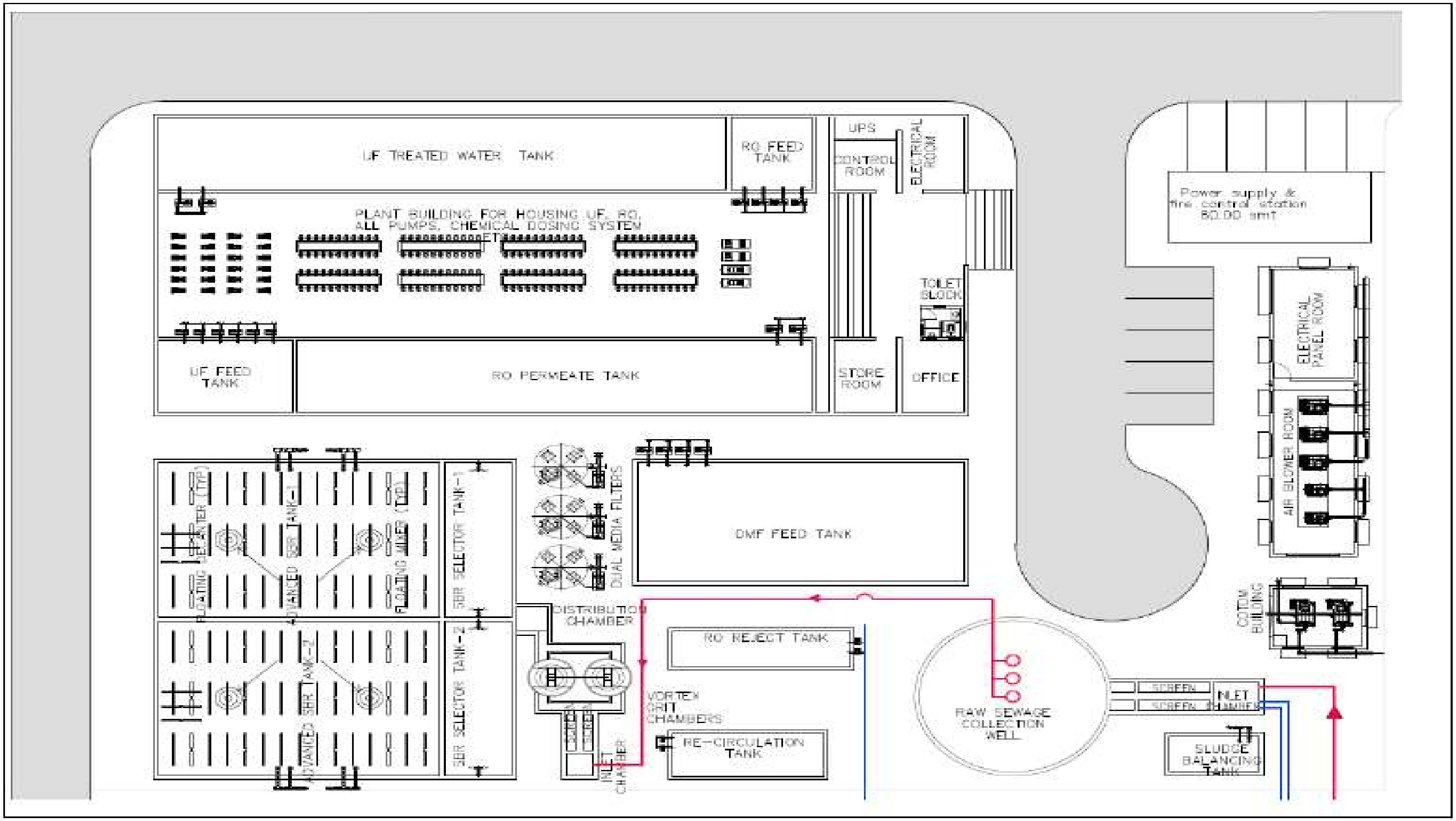


Figure 2.2: Layout Plan of Sewage Treatment Plant with ASBR Technology

❑ Solid Waste Generation and Disposal

Construction Phase

Type of waste	Source	Quantity* (in metric tonne)	Mode of disposal	Mode of transport
Construction waste	Terminal building	24356	As per C&D Waste Rule 2016	Road

Source: AAI

**Source: Guidelines on Environmental management of Construction & demolition (C & D) Wastes, March 2017, CPCB.*

MSW generated from labour camps during construction phase will be handled & disposed off in line with existing waste management practices at Bagdogra International Airport which include waste segregation at source & handing over for final disposal to municipal waste disposal site.

Operation Phase

Solid waste generated from the airport mainly comprises of food waste and garbage waste. Further, small quantities of sludge from STP and other waste are being generated. The solid waste generated will be first segregated as plastic, glass, paper, and other waste separately and disposed of as per applicable Rules.

Table 2.10: Solid Wastes Generation

Particulars	Population	Basis	Quantity of waste generated (in kg/day)
Passengers	27397	0.15	4,109.55
Airport Staff	2000	0.4	800
Visitors (@5% of passengers)	1370	0.15	205.5
Landscaping	9.81	0.2	1.96
Total			**5117.01**

**Source: https://www.iata.org/en/programs/environment/cabin-waste/#tab-3*
https://mohua.gov.in/upload/uploadfiles/files/93.pdf

Table 2.11: Solid Wastes Disposal

Bins	Particulars	Treatment	Disposal
Green	Compostable waste	Collected in green colored bins and converted to manure in OWC	Used as manure within premises
White	Dry/ recyclable waste:	No in-situ treatment. Collected in white colored bins and sent to solid waste collection point.	Segregated waste will be handed over to authorized waste pickers or waste collectors.
Black	Other waste/ Domestic hazardous waste	No in-situ treatment. Collected in Black colored bins and sent to solid waste collection point	

Source: AAI

Solid waste generated from the airport area comprises of Food waste, bottles and cans, newspaper and mixed paper, plastic cups and service ware, food waste, food soiled paper, paper towels, Sludge from STP etc. Total quantity of ~5.12 TPD of Solid Waste will be generated from Bagdogra International Airport Operation. All the waste will be handled inline to 5R principles of waste management (Reduce, Reuse-Recycle-Recover-Reprocess) to avoid the disposal of waste back to the environment, and to be aligned to the vision of Zero Waste to Landfill. The following tasks are accounted as part of Solid waste management methodology.

- ✓ Identification of Waste Generation Sources;
- ✓ Waste collection, storage & transportation;
- ✓ Waste segregation, handling and processing;
- ✓ Waste Quantification and Characterization; and
- ✓ Treatment & Disposal of wastes.

Hazardous waste (0.6 TPD) Used Oil, Contaminated filters, Oily cotton waste, discarded drums etc. will be and will be handled in accordance with HWM rules 2016, amended till date and will be handled in line Hazardous Waste Management Rules, 2016 amended till date.

All other waste including biomedical waste, E-waste, C&D waste and others wastes will be disposed as per the applicable rules amended till date.

- ❑ **Energy Efficiency Measures**

Airports consume significant levels of energy for space cooling in terminals, external and internal lighting systems and the operation of baggage conveyance system. The energy conservation measures such as provision of skylights for terminal building, glass (double seal) façade, installation of Variable Frequency Drives (VFDs) to HVAC secondary pumps & STP air blowers, metal halide bulbs instead of florescent lamps, dual lighting system for main access roads, Waste Heat Recovery (WHR) system to chillers and energy efficient chilling system with non-CFC based refrigerants will enable Bagdogra International Airport to Energy Conservation Building Code (ECBC), 2017 compliant and fulfil commitments becoming green airport and carbon neutral facility. Further, installation of solar / wind or hybrid system will be explored to minimize the usage of conventional energy sources.

Moreover, project will also comply with standards as prescribed in NBC for lighting levels, HVAC, comfort levels of passengers, natural ventilations and other system performance criteria. Other requirements of ECBC 2017 like building envelope, heating ventilation and air conditioning system, lighting schedule will be considered during the construction and operational phase of the Bagdogra International Airport project.

As an airport for future, Bagdogra International Airport will be developed as a green airport, with key objective of environmental sustainability through energy optimization, re-cycling of waste, reduction in carbon footprint, utilization of solar energy, natural day-lighting along with other sustainable measures in planning, development and operations of Bagdogra International Airport.

Solar farm on landside area is proposed to be developed, to utilize natural sunlight to possible extent.

The national Green Aviation Policy of India advocated to all aviation stakeholders should adopt to green infrastructure guidelines (such as GRIHA- Green Rating for Integrated Habitat Assessment or any equivalent standards) while designing, constructing, operating, maintaining, renovating and during demolition of infrastructures. The policy also encourages to adopt energy-efficient operation and use of renewable energy to the best possible extent. During detailed engineering schemes can be developed for generation and use of renewable energy / green energy to the maximum possible extent. Renewable energy source can be used to illuminate the streetlights, parking bay lights, airside lighting etc. The ultimate EPI (Energy Performance Index) of the airport can be reduced by adopting low toxic and low VOC construction materials.

A large part of the energy, required to operate the buildings on site, is required for the conveyance systems, equipment, special systems (such as baggage handling), and HVAC/lighting. In particular HVAC and lighting loads have the potential to be decreased by the use of solar shading (through use of sunshades, for instance), and by daylighting. These strategies should be implemented in the ancillary buildings, as well as the passenger terminal. Energy efficient Air conditioning system with best Coefficient of Performance associated with modern control techniques and energy efficient Lighting should be designed and used.

- **Carbon Neutral Airport**

Terminal Building design should be Carbon Neutral (for Operational level emissions) and GRIHA 5 compliant. Green energy plan for Terminal Building roof top and other areas to be prepared. Monitoring system of power consumption and Power requirement to be planned. The terminal building shall be designed for net zero energy building.

- **Storm Water Drainage**

Presently the Airside area is graded with open surface drain and the outlets of the same is connected to nallah.

Detailed Storm water drainage plan has been studied and covered in the EIA report, prioritizing Rain water pits. New airfield drainage system will be designed in accordance with international design standards and best practices in airport drainage design.

The amount of groundwater flowing blow the project area is as follows: -

The natural water springs are flowing from project site at 5 different locations.

Location – A

Cross sectional size of natural water spring –

Length – 1 meter assumed for volume in 1-meter stretch

Breadth – 18.12 meter

Depth – 0.5 meter
Assumed Velocity – 1 meter/second
Volume of water flowing = L X B X D = 1 X 18.12 X 0.5
= 9.06 cum/second
= 544 cum/minute
= 544000 LPM --------------------------------- (A)

Location – B

Cross sectional size of natural water spring –
Length – 1 meter assumed for volume in 1-meter stretch
Breadth – 16 meter
Depth – 0.5 meter
Assumed Velocity – 1 meter/second
Volume of water flowing = L X B X D = 1 X 16 X 0.5
= 8 cum/second
= 480 cum/minute
= 480000 LPM --------------------------------- (B)

Location – C

Cross sectional size of natural water spring –
Length – 1 meter assumed for volume in 1-meter stretch
Breadth – 9 meter
Depth – 0.5 meter
Assumed Velocity – 1 meter/second
Volume of water flowing = L X B X D = 1 X 9 X 1
= 4.5 cum/second
= 270 cum/minute
= 270000 LPM --------------------------------- (C)

Location – D

Cross sectional size of natural water spring –
Length – 1 meter assumed for volume in 1-meter stretch
Breadth – 2.16 meter
Depth – 0.5 meter
Assumed Velocity – 1 meter/second
Volume of water flowing = L X B X D = 1 X 2.16 X 0.5
= 1.08 cum/second
= 65 cum/minute
= 65000 LPM --------------------------------- (D)

Location – E

Cross sectional size of natural water spring –

Length – 1 meter assumed for volume in 1-meter stretch
Breadth – 3.6 meter
Depth – 0.5 meter
Assumed Velocity – 1 meter/second
Volume of water flowing = L X B X D = 1 X 3.6 X 0.5
= 1.8 cum/second
= 108 cum/minute
= 108000 LPM ---------------------------------- (E)
Total natural water flowing from project area = (A) +(B) + (C) + (D) + (E)
= 544000 + 480000 + 270000 + 65000 + 108000
= 1467000 LPM
= 1467 cum/minute. -------------(F)

Proposed drain channel at project site to carry over this natural water flow, the size will be as follows: -

Length – 1 meter
Breadth – 5 meter
Height – 5 meter
Assumed Velocity – 1 meter/second
Volume of proposed drain = L X B X D = 1 X 5 X 5
= 25 cum/second
= 1500 cum/minute --------------------------------- (G)
Volume at (F) < Volume at (G)

The overall natural discharge volume from all water spring is 1467 cum/minute (F) and the proposed underground drain channel carrying capacity is 1500 cum/minute (G), which is greater than natural water discharge.

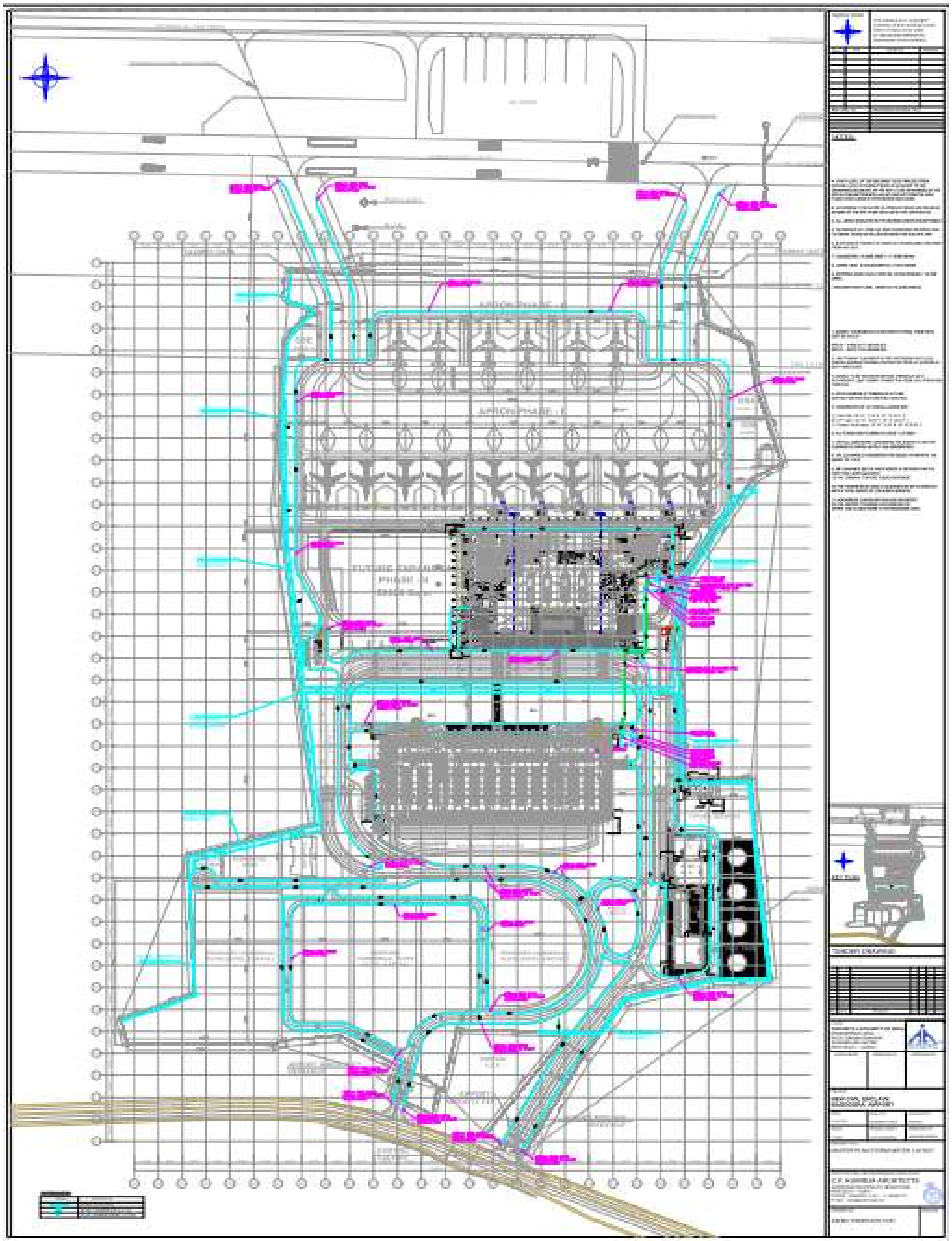


Figure 2.9: Storm Water Drainage layout

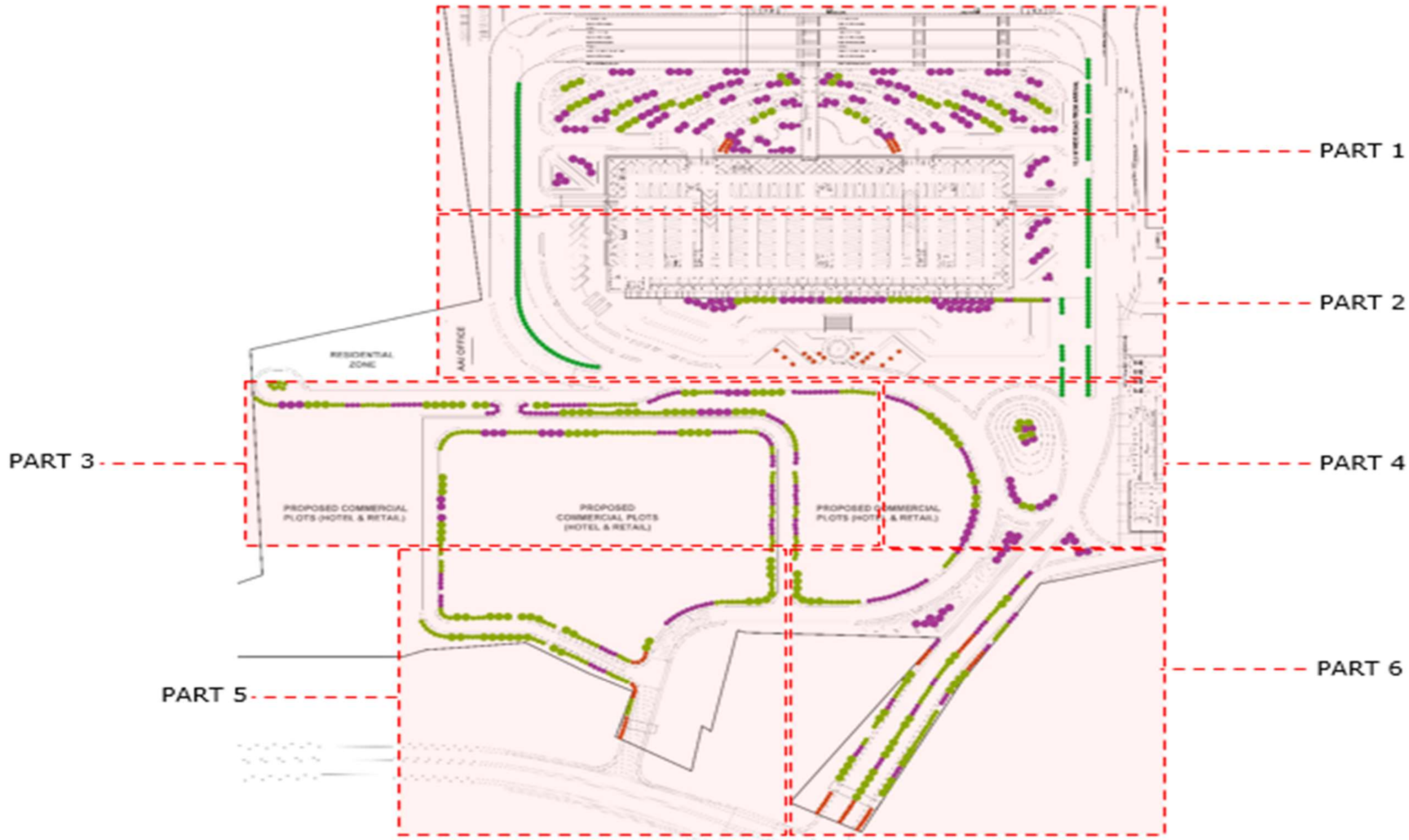
- **Green/Open Space & Landscape Development Plan**

Green/Open Space & Landscape development is an integral part of Bagdogra International Airport Master Plan, and an important element of its environmental sustainability measure. The total area under this zone shall be approximately in 2.49 Ha.

The proposed green spaces shall be developed as per their contextual and functional requirements and overall environmental and landscape planning approach. The proposed Green Space & Landscape development is planned considering key airport related constraints, such as:

- ✓ **Bird Menace:** Trees and shrubs attract insects and birds, which are potential threat to aircraft operations within and around airport. This requires careful selection of trees to be planted on airport premise, as a part of Airport safety measures. The proposed Green Space & Landscape development is planned considering this.
- ✓ **Height Restrictions:** Development of green areas and planting of trees including their types (height at maturity) is guided by height restrictions imposed by Airport Authority of India. Hence, any type of dense vegetation's with very high trees cannot be developed in vicinity of airport. The proposed Green Space & Landscape development is planned considering this.
- ✓ **Restrictions in Operational Area:** As part of airport operational requirements, major land area is defined as Airside or Operational Area where in regular movement of flight movement demands clear and safe area, without any form of vegetation except grass, which may affect the flight operations due to birds attracted by vegetation. The proposed Green Space & Landscape development is planned considering this.

Key objective of proposed Green Space & Landscape development of Bagdogra International Airport is to create a unique, world class green environment for Bagdogra International Airport drawing inspiration from local landscape ensuring sustainability, and offering a memorable experience for passengers, staff and visitors alike. Creation of a strong green identity for Bagdogra International Airport is one of the guiding principles and this approach is reflected in a powerful synergy in landscape by integrating vegetation cover and water bodies in perfect harmony in landside area of Bagdogra International Airport. As a part of landside area ~2.49 Hectares of green area will be maintained.



Source: AAI

Figure 2.10: Overall Plantation Plan

2.9 PROPOSED SCHEDULE FOR APPROVAL AND IMPLEMENTATION

The zero date for start of construction will be after the grant of Environmental Clearance (EC) from SEIAA and SEAC, West Bengal. The proposed construction activities will be carried out in the phases inline to the requirements. The external agencies such as consultant, machinery suppliers, contractors of civil construction and equipment will be selected carefully well in advance. An effective project team has been formulated with an experienced project manager as its leader.

Table 2.12: Project Schedule

Sl. No.	Activity	Timeline (Month) after obtaining EC											
		M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
1	Application for Consent to Establish (CTE) from PCBA												
2	Site development												
3	Design basis finalization												
4	Airport Units												
5	Tankages												
6	Utilities												
7	Pre-Commissioning & Commissioning												

Source: AAI

2.10 STATUS OF REGULATORY COMPLIANCES

The details have been discussed under Chapter 1 section 1.10.2.

2.11 PROJECT COST

Development/Construction Work shall be started after obtaining all statutory clearances from the concerned authorities. The project will be scheduled in the phase inline to the Master Plan. The total estimated Project cost of the proposed project is about **INR 1549 crores.**

CHAPTER 3: DESCRIPTION OF ENVIRONMENT

3.1 INTRODUCTION

Baseline Environmental Studies have been conducted to determine the existing status of various Environmental attributes viz., Climate and atmospheric conditions, ambient air, ambient noise, traffic study, water (ground & surface), soil, hydrogeological, land use pattern, ecological and socio-economic environment of proposed project within the block. This study would help to undertake corrective mitigation measures for the protection of the environment on account of any change, deviation of attributes due to the proposed Project Activities located in Bagdogra, Dist: Darjeeling, West Bengal.

A comprehensive primary and secondary data collection program were undertaken to assess the status of baseline environment conditions within the study area, as per the Terms of Reference (TOR) issued by SEIAA, West Bengal vide no. 2807/EN/T-II-1/536/2023 dated 13th December 2023 for carrying out the EIA/EMP study for one season. The reconnaissance survey of the area around the 10 Km radius of project site located in Bagdogra, Dist: Darjeeling, West Bengal was carried out from **1st March 2023 to 30st May 2023** and the field studies were carried out for one season for the EIA studies to collect baseline primary and secondary data for the present environmental scenario in the study area.

3.2 SCOPE OF BASELINE STUDY

An area, covering 10 Km radius of project site considered to carryout environmental baseline studies. Primary data on Micrometeorology, ambient air, ambient noise, traffic, soil, water, flora-fauna & socio-economic data were collected from the study area by a team of experts. Secondary data were collected from various Departments of State/Central Government Organizations, Semi-Government and Public Sector Organizations. Various environmental attributes considered for formulating environmental baseline are given in Table 3.1 and the frequency and monitoring methodology for various environmental attributes are given in Table 3.2 for reference.

Table 3.1: Environmental Attributes

Sl. No.	Attribute	Parameter	Source of Data
1	Climatology & Meteorology	Wind speed, Wind direction, temperature, Relative humidity, Rainfall, Cloud cover	Indian Meteorological Department and Site-specific Data
2	Geology	Geological history	Published Articles
3	Land Use	Land use for different categories	Secondary data/ Satellite imagery/ Topo sheet etc.
4	Ambient Air Quality	PM10, PM2.5, SO_2, NOx, CO, O_3, Benzene (C_6H_6), Benzo alpha pyrene (BaP), Lead (Pb), Arsenic (As), Nickel (Ni), Ammonia (NH_3)	Primary data acquired in 8 locations

Sl. No.	Attribute	Parameter	Source of Data
5	Ambient Noise Quality	Noise levels in dB (A)	Primary data acquired in 8 locations
6	Surface and Ground Water Quality	Physical and Chemical parameters	Monitored Data (Surface water – 8 locations and Ground water –8 locations)
7	Soil	Soil types and samples analyzed for physical and chemical parameters.	Soil Samples collected from 8 locations and analyzed
8	Ecology	Existing terrestrial flora and fauna, aquatic ecology within the study area	Field survey (at 6 locations) and Secondary sources
9	Socioeconomic Aspects	Socioeconomic characteristics of the affected area	Based on field survey and data collected from secondary sources

Source: ABC Techno Labs India Pvt. Ltd.

Table 3.2: Frequency and Monitoring Methodology

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
A. Meteorology				
Wind speed, Wind direction, temperature, Relative humidity, Rainfall	Project site	Continuous for 3 months	Weather monitors with the database	
B. Air Environment				
Particulate Matter (PM10)	Requisite locations (8) in the project influence area	24 hourly- Twice a week for 3 months in Non-Monsoon season --	Gravimetric (High-Volume with Cyclone)	As per CPCB standards under 18th November 2009 Notification for National Ambient Air Quality Standards (NAAQS)
Particulate Matter (PM2.5)			Gravimetric (High-Volume with Cyclone)	
Oxides of Sulphur (SO_2)			EPA Modified West & Gaeke method	
Oxides of Nitrogen (NOx)			Arsenite Modified Jacob & Hochheiser	
Carbon Monoxide (CO)			Gas Analyzer (NDIR)	
Ammonia (NH_3)			Indophenol Blue Method	
Lead (Pb)			Atmospheric Absorption Spectrometer	
Arsenic (As)				
Nickel (Ni)				

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
Benzene			GC-MS/MS	
Benzo Alpha Pyrene			GC-MS/MS	
C. Noise				
Hourly equivalent noise levels	Requisite locations (8) in the project influence area	Once in season	Instrument: Sound level meter	IS: 9989-1981 (Reaff: 2014)
D. Water				
Parameters for water quality: Colour, Odour, Temperature, pH, Conductivity, Turbidity, TDS, Total Hardness, Total Alkalinity, Cl, SO_4, F, NO_3, NH_3, Na, K, Ca, Mg, Fe, Phenolic compounds, Mn, Cu, Hg, Cd, As, CN, Pb, Zn, Cr, Ni, Se, Al, As, Pb, Zn, COD, BOD, DO, Total Coliform, Fecal Coliform etc.	Set of grab samples At requisite locations for surface water and ground water	Once in season	Samples for water quality collected and analyzed as per IS: 3025 (Part 1) (Physiochemical) and IS:1622-1981 (microbiological) Standard methods for the examination of water analysis published by American Public Health Association.	IS:10500:2012 (GW), CPCB Class C (SW)
E. Land Environment				
Parameter for soil quality: pH, texture, electrical conductivity, organic matter, nitrogen, phosphate, sodium, calcium, potassium and Magnesium.	Requisite soil samples (8 No.s) were collected as per BIS specification within study area	Once in season	Collected and analyzed as per soil analysis reference book, M.L. Jackson	Parameter for soil quality: pH, texture, electrical conductivity, organic matter, nitrogen, phosphate, sodium, calcium, potassium and Magnesium.
F. Biological Environment				
Terrestrial & Aquatic Flora and Fauna.	Requisite locations (6 Locations) in	Once in season	Collected and analyzed as per IUCN Red Data book.	

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
	the study area			

Source: ABC Techno Labs India Pvt. Ltd.

3.3 DISTRICT OVERVIEW

Darjeeling District: Darjeeling is a town and municipality in the northernmost region of the Indian state of West Bengal. Located in the Eastern Himalayas, it has an average elevation of 2,045 metres. To the west of Darjeeling lies the easternmost province of Nepal, to the east the Kingdom of Bhutan, to the north the Indian state of Sikkim. Darjeeling has a temperate subtropical highland climate. The average annual precipitation in Darjeeling is approximately 3,100 mm. Eighty percent of the annual rainfall takes place between the months of June and September, due to the monsoon of South Asia. The "June–May ratio," or the percentage by which the rain increases from May to June, is 2.6 or 260%.

3.4 METEOROLOGY AND CLIMATE

3.4.1 CLIMATIC CONDITION

The study area The amount of rainfall plays a very important role in causing instability of slopes. A very high intensity of rainfall within a short span of time is not uncommon in Darjeeling hill areas. Darjeeling hills is created by orographic factor; causing the vertical zonation of temperature and decline of precipitation. Thus the mountain front is exposed to heavy rainfall, especially the middle parts of the southern hills. The mean annual temperature fluctuate from 24˚C in the plains and drops below 12˚C on the ridge. During summer month the temperature reaches 16˚C -17˚C on the ridge and during winter drops at 5˚C -6˚C.

There is no distinct relation between total rainfall and altitude. The southern slopes of the ridges get much higher (4000-5000mm) precipitation than the leeward sides (2000-2500mm). The next main ridge with Tiger Hill gets 3000mm while to the north the Great Rangit valley receives about 2000mm of rainfall. The annual total rainfall in Darjeeling town fluctuates between 1870-3690mm.

3.4.2 REGIONAL METEOROLOGY (HISTORICAL)

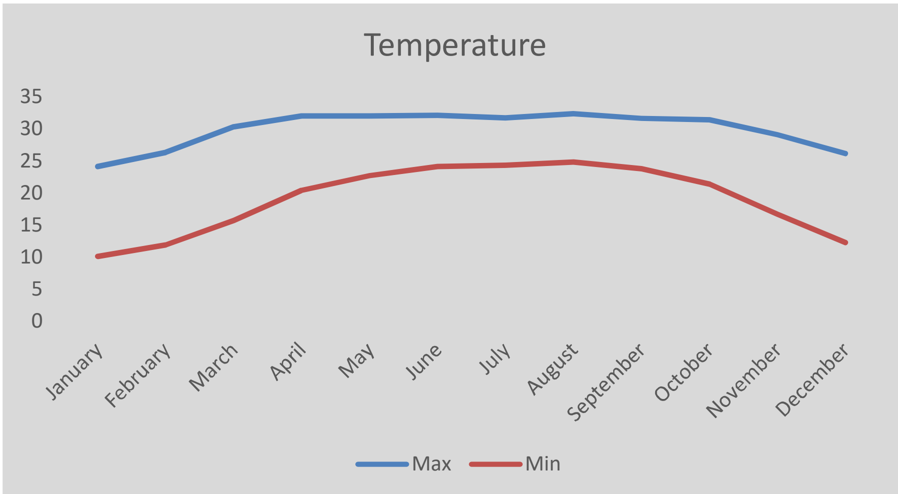
The district enjoys tropical humid type of climate with oppressive summer season and good seasonal rainfall. The summer season extends from March to May followed by monsoon season, which lasts till September. October and November constitute the post monsoon or retreating monsoon season. December to February months experience cold weather conditions.

Summer: March, April, May
Monsoon: June, July, August and September
Post-monsoon: October, November
Winter: December, January and February

The climatologically summary details of parameters like temperature, relative humidity, rainfall, cloud cover, wind speed and wind direction monitored at IMD Jalpaiguri is given below,

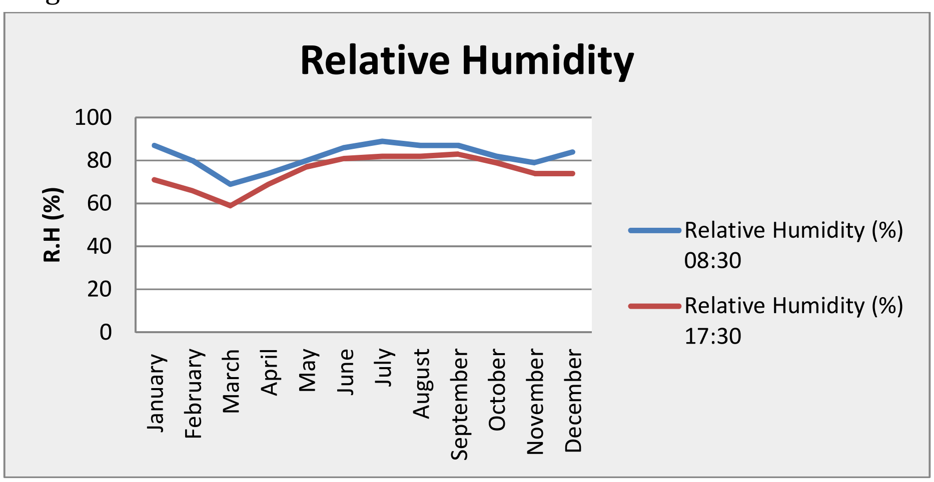
A. Temperature

The monthly mean maximum temperature varied from 24.1°C in January to 32.1°C in June while monthly mean minimum varied from 10.1°C in January to 24.3°C in July indicating January as the coldest while June as hottest month.



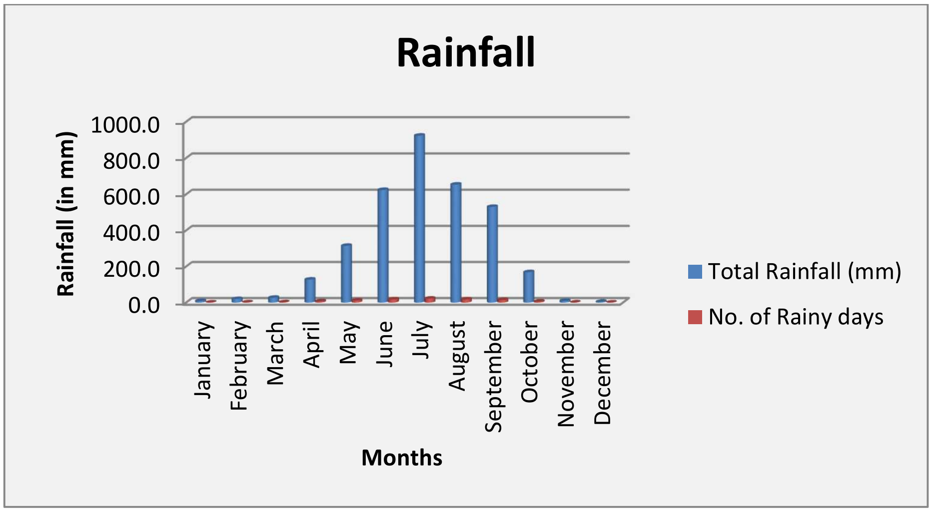
B. Relative Humidity

During the month of August, September, the relative humidity was highest (87%). The annual average Relative humidity is 82% (at 08:30 Hours) and 74.8% (at 17:30 Hours). Generally, the weather during other seasons was observed to be humid.



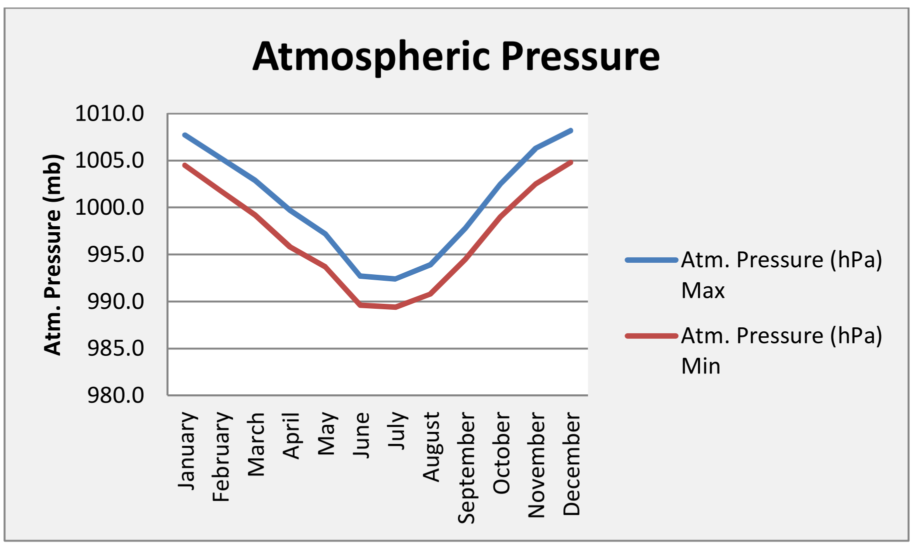
C. Rainfall

The rainfall occurred maximum in July (923.5 mm). The total rainfall received in the year is about 3412 mm. Total rainy days observed about 102.5 days. The monsoon sets in the month of June and continues till September and sometime extends up to mid-October.



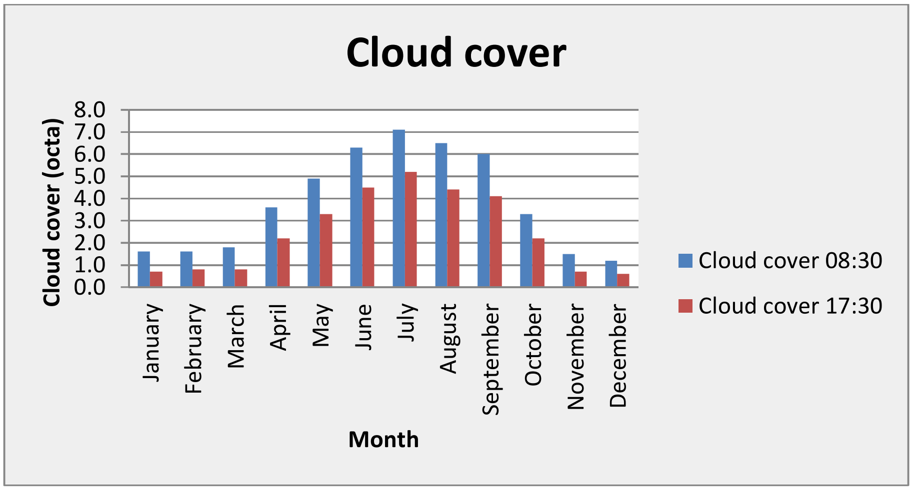
D. Atmospheric Pressure

The maximum pressure observed was 1008.2 hPa occurring during the winter season, in the month of December. The minimum pressure observed was 992.4 hPa occurring during the month of July in the monsoon season. The pressure levels are found to be consistent over the region.



E. Cloud cover

During the month of July, the cloud cover was highest (7.1 Octas). The annual average cloud cover is 3.8 Octas (at 08:30 Hours) and 2.5 Octas (at 17:30 Hours).



F. Wind Speed/ Direction

The maximum wind speed observed during the month of July is 4.2 kmph and minimum wind speed observed during the month of December is 1.8 kmph. The annual average wind speed calculated is 3.4 kmph.

08:30 Hours:

The predominant winds are mostly from Eastern directions. Calm conditions prevailed for 35% of the total time.

17:30 Hours:

The predominant winds are mostly from Eastern directions. Calm conditions prevailed for 52% of the total time.

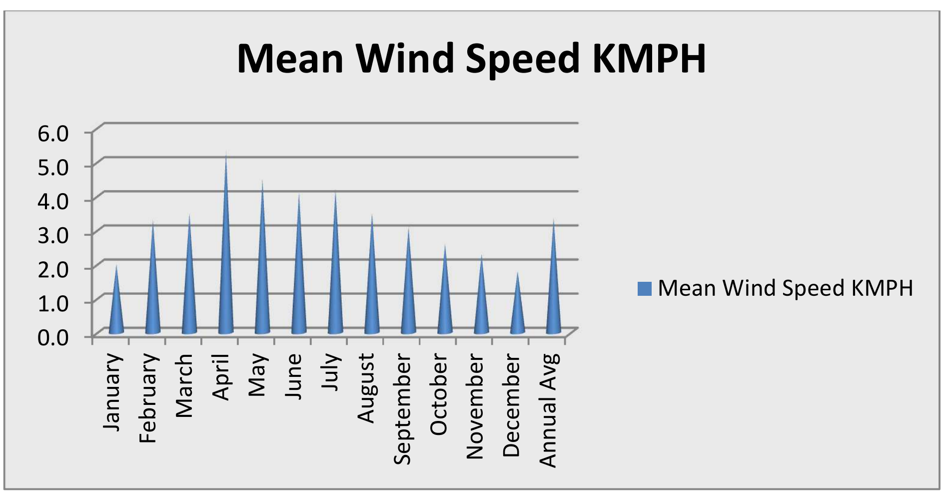
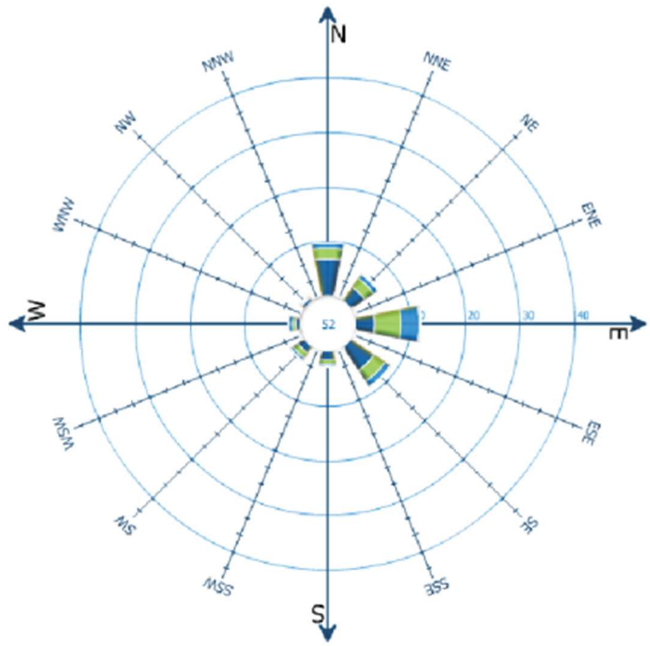


Table 3.3: Historical Meteorological Data at IMD Narsapur (1988-2000)

Month	Daily mean Temp. (^{0}C)		Relative Humidity (%)		Rainfall (mm)		Cloud cover (in Okta)		Station Level Pressure (hPa)		Mean Wind Speed (KMPH)
	Max	Min	08:30	17:30	Monthly Total	No. of Rainy days	08:30	17:30	08:30	17:30	
January	24.1	10.1	87	71	8.4	0.7	1.6	0.7	1007.7	1004.5	2.0
February	26.3	11.9	80	66	19.9	1.2	1.6	0.8	1005.3	1001.8	3.3
March	30.3	15.7	69	59	26.8	1.8	1.8	0.8	1002.9	999.2	3.5
April	32	20.4	74	69	127.7	7.1	3.6	2.2	999.7	995.8	5.3
May	32	22.7	80	77	314.8	12.0	4.9	3.3	997.2	993.7	4.5
June	32.1	24.1	86	81	624.1	18.0	6.3	4.5	992.7	989.6	4.1
July	31.7	24.3	89	82	923.5	22.1	7.1	5.2	992.4	989.4	4.2
August	32.3	24.8	87	82	653.6	17.6	6.5	4.4	993.9	990.8	3.5
September	31.6	23.8	87	83	530.6	14.8	6.0	4.1	997.8	994.5	3.1
October	31.4	21.4	82	79	168.7	5.7	3.3	2.2	1002.5	999.0	2.6
November	29.1	16.7	79	74	9.6	0.9	1.5	0.7	1006.3	1002.5	2.3
December	26.1	12.3	84	74	4.4	0.6	1.2	0.6	1008.2	1004.8	1.8
Annual or Mean	**29.9**	**19.0**	**82.0**	**74.8**	**3412.1**	**102.5**	**3.8**	**2.5**	**1000.6**	**997.1**	**3.4**

Source: India Meteorological Department (IMD)



Source: India Meteorological Department (IMD)

Figure 3.1: Annual Windrose Diagramme (Ref. IMD station, IMD Jalpaiguri)

3.4.3 Site Specific Meteorology

The continuous weather monitoring station was installed at Bagdogra. Onsite monitoring was undertaken for various meteorological parameters in order to generate the site-specific data. The Central Monitoring Station (CMS), equipped with continuous monitoring equipment to record wind speed, wind direction, temperature, humidity and rain fall was set up at the top of the building at a height of ~5.0 m above the ground level. The methodology adopted for monitoring surface observations was as per the Standard norms laid down by the Bureau of Indian Standards (IS: 8829:1978) and IMD. Data was collected at every hour continuously from **1st March 2023 to 30th May 2023** for 12 weeks.

Table 3.5: Site specific Weather Report for the Study period

Sl. No.	Parameters	Observations (1st March 2023 to 30th May 2023)
1	**Dry Bulb Temperature (ºC)**	
	Maximum	39.00
	Minimum	15.00
	Average	25.80
2	**Relative Humidity (%)**	
	Maximum	99.00
	Minimum	23.00
	Average	79.00
3	**Wind Speed (km/hr.)**	
	Maximum	39.00

Sl. No.	Parameters	Observations (1st March 2023 to 30th May 2023)
	Minimum	0.00
	Average	25.8
	Predominant Wind Direction (From)	East
4	**Rainfall (in mm)**	
	Total (mm)	2.5

Source: ABC Techno Labs India Pvt. Ltd.

Temperature

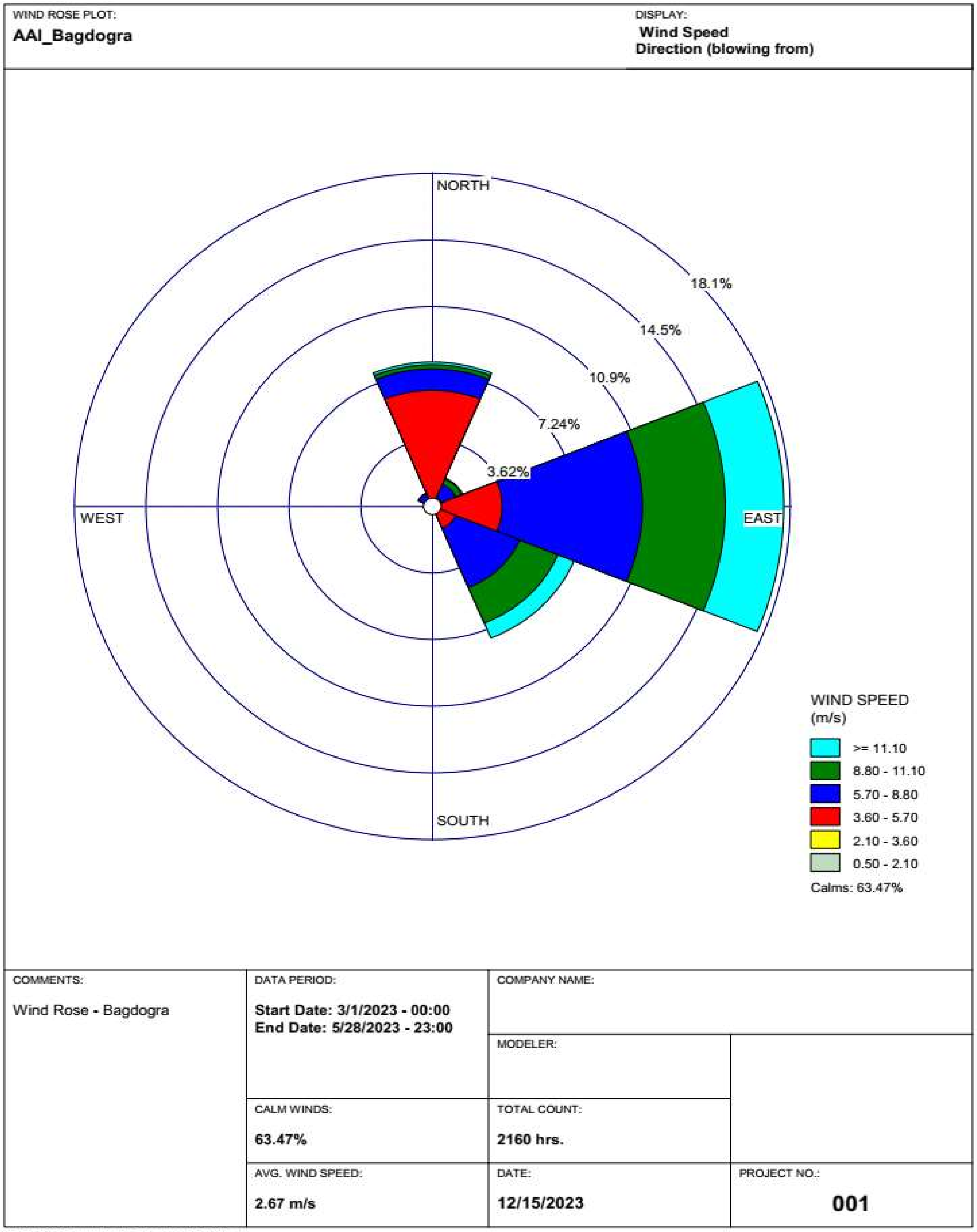
The average temperature during study period in the site locations at project site varied from 15°C to 39°C.

Relative Humidity

The average relative humidity during study period in the site locations at project site varied from 23% to 99%.

Wind Speed

The monthly wind speed in and around project site during the study period (3 months) are found to be varied from 0 KMPH to 39 KMPH. The rose diagram showing overall wind direction and wide speed for the study period is given in Figure 3.2.



Source: ABC Techno Labs India Pvt. Ltd.

Figure 3.2: Wind rose at project site for the Study Period

3.5 PHYSIOGRAPHY OF THE REGION

Physiographically the Darjeeling Himalaya is highly complex with innumerable variety of micro and macro relief forms. The hills rise abruptly from the plains, that is, approximately from about 150 m and the elevation increases north-westwards upto Sandakphu (3636 m). Two transverse ranges running north-south enclose the Singalila in the west and the Dongkya in the east. Ravines, deep valleys, innumerable springs and jhoras dissect these landscapes, interspersed with a mosaic of micro-topographic units. This complex physical environment is due to different geomorphic processes, each of which has developed its own characteristic assemblage of landforms. The geomorphic configuration of this hilly tract is the joint product of geologic foundation and fluvial processes; although slope-wash, in particular mass-movements and related phenomena play a significant role in the final shaping of the landform. The region is characterized by a myriad of ridges and valleys because of the spurs ramifying into lateral spurs which give off lesser ones and these in turn cut the terrain into ridges and valleys, creating a mosaic of micro-topographical units.

The Darjeeling hills (formally Darjeeling Himalayan hill region) comprise parts of Darjeeling district and all of Kalimpong district; specifically, they contain: Darjeeling Sadar subdivision, Kalimpong subdivision and Kurseong subdivision. Darjeeling town lies in the Sadar subdivision. It is located at an average elevation of 2,045 m on the Darjeeling–Jalapahar range which runs south to north starting at Ghum. The range is Y-shaped with its base resting at Katapahar and Jalapahar and two arms diverging north of the Observatory Hill. The north-eastern arm dips swiftly and ends in the Lebong spur, while the north-western arm slopes gently, passing through North Point, and ends in the valley near the Tukver Tea Estate. Kangchenjunga, the world's third-highest peak at 8,598 m, which lies 74.4 kilometres to the north. The region is divided into two parts by the River Tista. The area east to the River Tista is known as the Chola range and Kalimpong is one of the main towns here. The western part is divided into two ranges, the Singalila range and the Darjeeling-Kurseong range. Darjeeling town along with Kurseong and Ghoom, falls in the Darjeeling-Kurseong range.

The soil in these hills is mostly composed of sandstone and other conglomerate formations. However, in most areas the soil is not properly consolidated and hence the area is not only unsuitable for agriculture, but it is also prone to landslides. Although heavy rainfall during the monsoon is held responsible for such disasters geolithology of the area is indeed an important aspect. Elevation as well as degree of the hill slope and lack of green coverage too can also be held responsible for such rampant landslides.

3.6 REGIONAL GEOLOGY

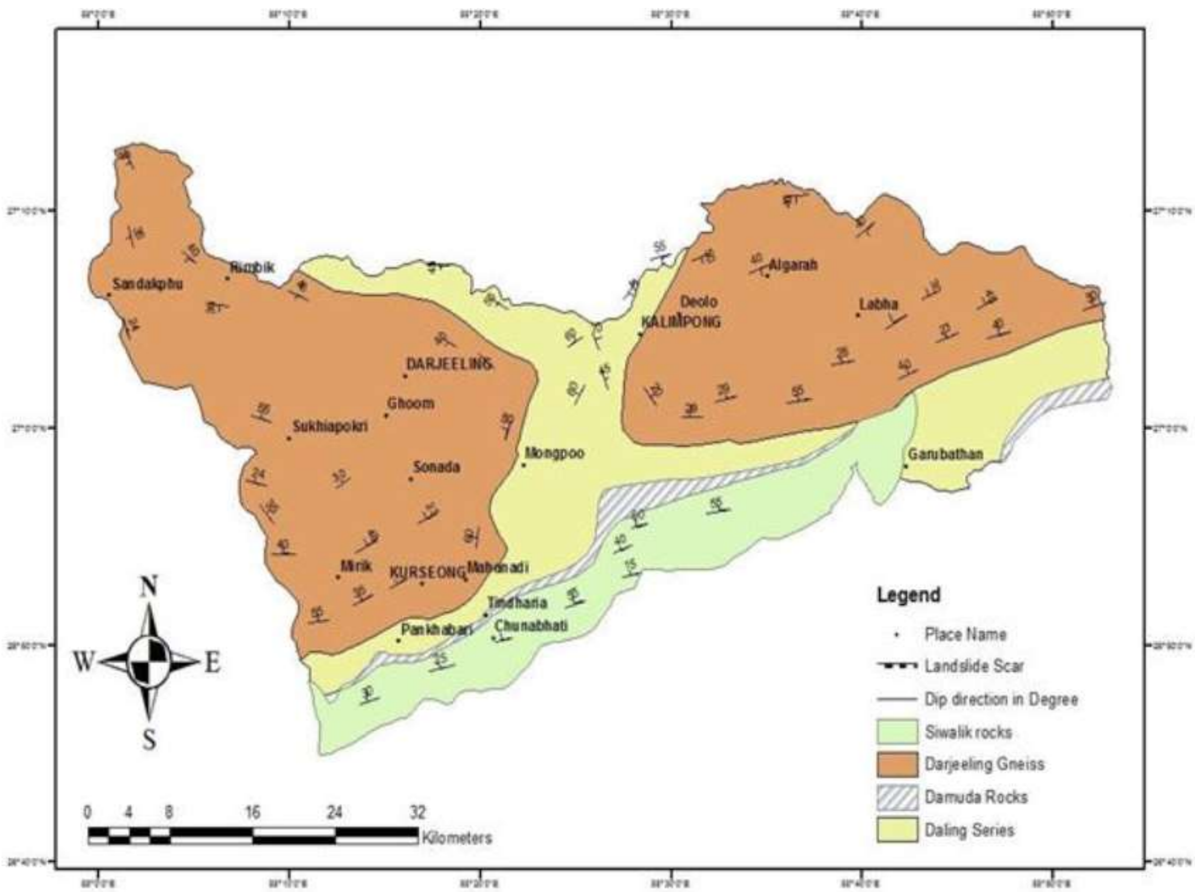
The Darjeeling hills have been formed by accumulations of folds, faults and tangential thrusts caused by a compression in the north–south direction as the Indian tectonic plate has subducted under the Eurasian plate. Their physical composition varies from unaltered sedimentary rocks in the southern regions to several types of metamorphic rock and some intrusive rocks in the middle and northern, suggesting upward intrusion of the Earth's mantle. The collective process has sheared, folded, crushed together, fractured and jointed the rocks, reducing their strength and making them vulnerable to water percolating down their crevices and causing pore water pressure to build up. Phyllites and schists are found in the hills around Kalimpong, which lies to the east, and gneiss predominates the western regions in which Darjeeling lies. The continual tectonic activity of Darjeeling's ancient past can be inferred from the surrounding landscape in such features as terraces that dip in their middle as a result of earlier horizontal pressure. Eroded fault scarps, or steps, observed in the landscape were caused by vertical slips in the faults below. Alluvial fans at different heights signify a succession of previous rivers that dried up and spread their silt outwards as their beds were raised by the uplift.

The geological formations of the Darjeeling Himalaya consist essentially of unaltered sedimentary rocks. The Sub-Himalaya is made up of Siwalik deposits of the Tertiary age. North of the Siwaliks is the coal-bearing lower Gondwana formations. The Daling series (Pre-Cambrian) follows and is succeeded by the Darjeeling gneiss further north.

Table 3.2: Geological Succession of the Study Area

Age	Formation	Lithology
Recent to Sub Recent	Alluvium	Younger flood plain deposits of rivers consisting of sands, pebbles, gravels, boulders etc
Pleistocene to Lower Pleistocene (Lower Tertiary)	Siwalik	Micaceous sandstone with siltstone, clay, lignite lenticles, etc.
Thrust (Main Boundary Fault)		
Permian	Damuda (Lower Gondwana)	Quartzitic sandstone with slaty bands, seams of graphitic coal, lampophyre silt and minor bands of limestone
Thrust (Fault Of Nappe Qutlier)		
Pre-Cambrian	Daling Series	Slate, chlorite-sericite schist, chlorite- quartz schist
	Darjeeling Gneiss	Golden silvery mica-schist, carboniferous mica-schist, coarse grained gneiss

Source: CGWA



Source: CGWA

Figure 3.4: Geological formation in Darjeeling District

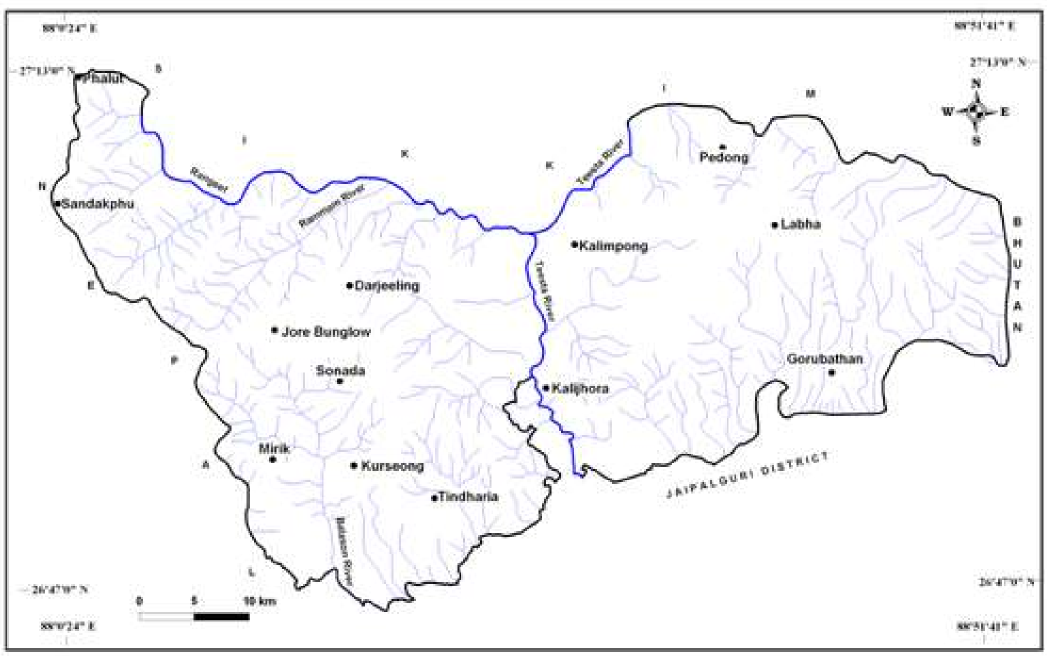
3.7 GEOMORPHOLOGY AND SOIL CHARACTERISTICS

The soil of upland is usually red and gritty while that of the plains are dark and more fertile. Along the banks of the Teesta, silty or silty loam predominates. Red and yellow soils are developed on the gneisses and schists formations in the higher slopes of the Darjeeling Himalaya. The greater portion of the hill area lies on the Darjeeling gneiss, which most commonly decomposes into a stiff reddish loam but may also produce almost pure sand or stiff red clay. The colour of the red soil is derived from weathering of gneisses and schists due to wide diffusion rather than to high proportion of iron content in the rocks. This type of soil is mainly siliceous and aluminous with free quartz as sand. It is usually poor in lime, magnesia, iron oxide, phosphorus and nitrogen, but fairly rich in potash, some areas being quite rich in potassium derived from the muscovite and feldspar of the gneiss. River alluvium is found in the southernmost part of the district.The podzolic soils in the hilly area are suitable for cultivation of tea. Parent material variations exert a stronger influence on soil characteristics of Darjeeling Himalayas than climate or vegetation. Very broadly the soil on Siwaliks is pale yellow and coarse in texture, on the Dalings, dark grey and porous; on the gneisses a brown clay, sometimes plastic, shallow and sticky. The soil on the Gondwana is generally sandy. Almost everywhere the soil is residual i.e., derived by the weathering of the underlying rocks. Weathering is selective in Darjeeling gneiss and proceeds along some susceptible bands, i.e., mica rich bands in preference to quartzose bands also along joints and shear planes. As a result, blocks of fresh rocks are generally found encircled on all sides by highly weathered rocks of the nature of clay. The impervious clay is found mixed with grains of quartz, feldspar and flakes of mica. This has got an important bearing on the massive landslips.

3.8 HYDROGEOLOGY & DRAINAGE

The rivers of the tract drain ultimately to the south but as the west to east ridges cross the tract at certain regions it causes a series of rivers and streams to flow northwards or eastwards direction before joining the main river system. The two most important rivers of Darjeeling are the river Teesta and the river Great Rangeet. Both these glacier fed rivers originate from Sikkim. While the Teesta originates from the Zemu glacier located in north Sikkim the Rangeet arises from the Rothong glacier in West Sikkim. The Teesta is a broad mountainous river with numerous shallows and rapids. It traverses a large part of the state of Sikkim and enters the district of Darjeeling at the point it meets with the Great Rangeet. The major tributaries in Sikkim include the Lachung chhu, the Zemu chhu, the Dhakung chhu, in the north district the Talung chhu and Tangpo chhu in the west district and Sethikhola Rangpo khola, Jolly khola in the east district, while the Reyang, originating from Mahaldiram Reserve Forest (2438m), Peshok and Geile khola constitute its main tributaries on the right bank after its entry into the District of Darjeeling.The main tributary of Teesta is the Great Rangeet, which arises from the Pathong glacier and confluences with Teesta at the Teesta Bazar. It enters the district of Darjeeling at the point on the northern boundary where it receives the Rammam river arising from Singalila and Rangu arising from Senchal in Darjeeling on its right bank. The Rammam demarcates the northern boundary between Sikkim and Darjeeling district. The Rammam originates at an altitude of 3600 m at Phalut in the Singalila range. The entire course of the river is interspersed with deep gorges. A very prominent gorge is found at the confluence of the Rammam with its main tributary; the Lodhoma Khola.The Little Rangeet arises at Chitre Pokhri (2380 m) and flows north, almost parallel to the Lodhoma Khola. The Little Rangeet winds sinuously within a maze of interlocking spurs and valleys. Below the Triveni confluence, the Teesta flows eastwards, where it receives the Little Rangeet from Darjeeling and enters the plains of North Bengal and finally joins the river Brahmaputra in Bangladesh.The Balason, which arises from Lepchajagat in the Ghum saddle, flows towards the south, scooping out deep gorges in the catchment area, till it reaches the plains and thereby turns southeast, where its valley is larger than that of the Mahanadi.The other important rivers of Darjeeling include the Balason, arising from the Ghoom saddle and running south till it reaches the plains at an altitude of 304 m and then turns south east and divides into two channels the New Balason and the Old Balason and subsequently joins the Mahanadi further south. It receives tributaries like

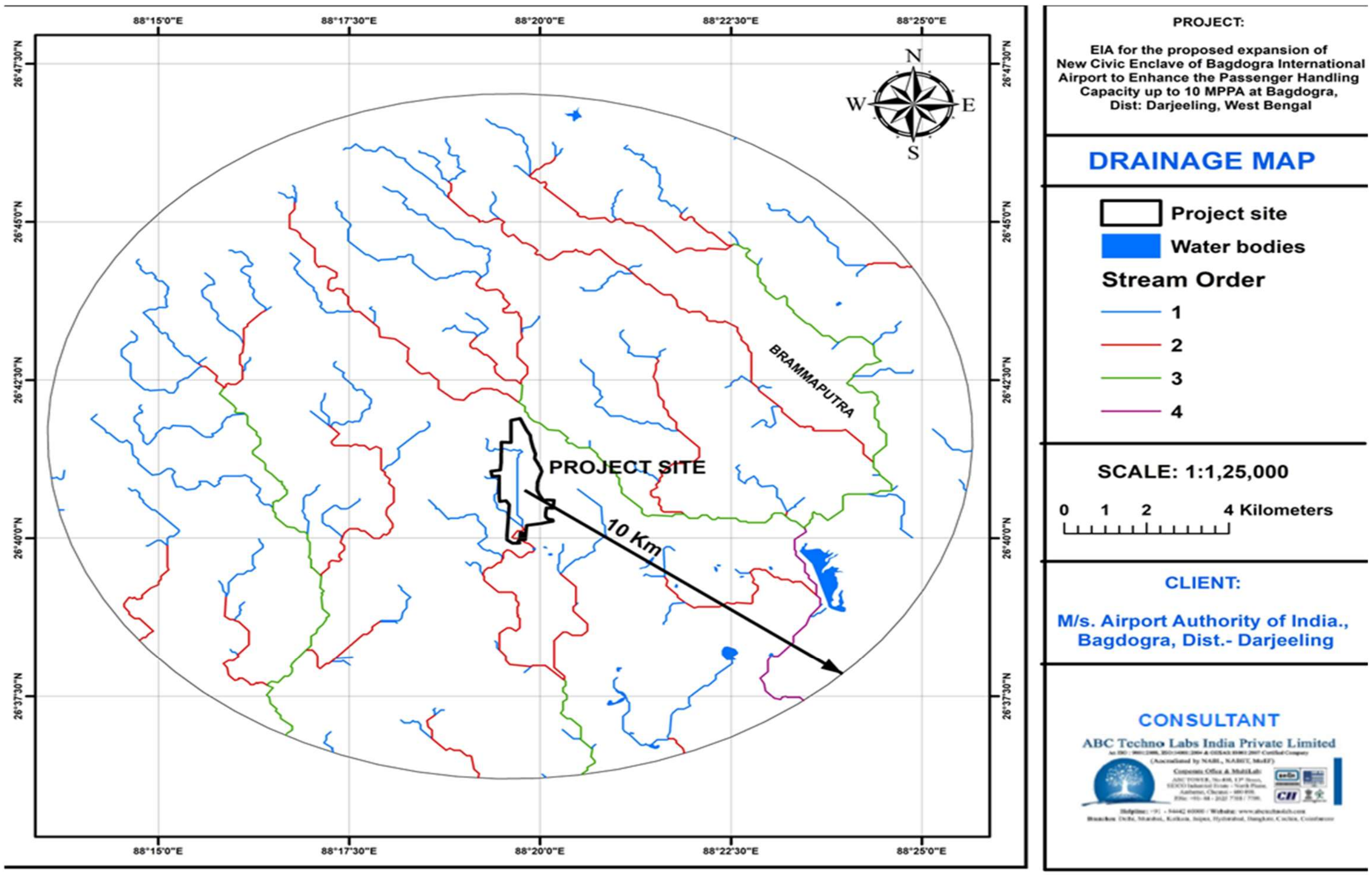
Pulungdung khola, Rangbang khola he Marma khola, Dudhia khola on the right bank and Rinchingtong khola, Rakti khola, Rohini khola, Jor khola etc on the left. The Mahanadi has its source near the Mahaldiram dome, east of Kurseong and flows southeast receiving a few sizable right side tributaries the Siva khola being the most important one. Its left bank tributaries include the Jholi khola, the Jogi khola, Gulma khola Babu khola and Ghoramara khola. The Mechi River, which is the western boundary of the study area, forms the Indo-Nepal boundary. The source of the river is the Rangbang spur of the Singalila range at an altitude of 1905 m. It flows through deep gorges in the hilly tracts and widens suddenly when it enters the Terai and the plains. The Mechi eventually joins the Mahananda.The Teesta and Jaldhakha form the western and eastern boundaries of the sub-division of Kalimpong. A number of rivers and tributaries that originate in this sub-division include the Lish which originates at the ridge of Pabringtar village and flows downwards receiving the Amlkhola on the western side and Turungkhola on the east further southwards it is joined by the Phangkhola and Chunkhola near the Bagrakote colliery and eventually joins the Teesta at the Kalagaiti Tea estate.



Source: CGWA

Figure 3.5: Hydrogeological map of Darjeeling District

The Drainage Map of the entire study area is given as Figure 3.6.



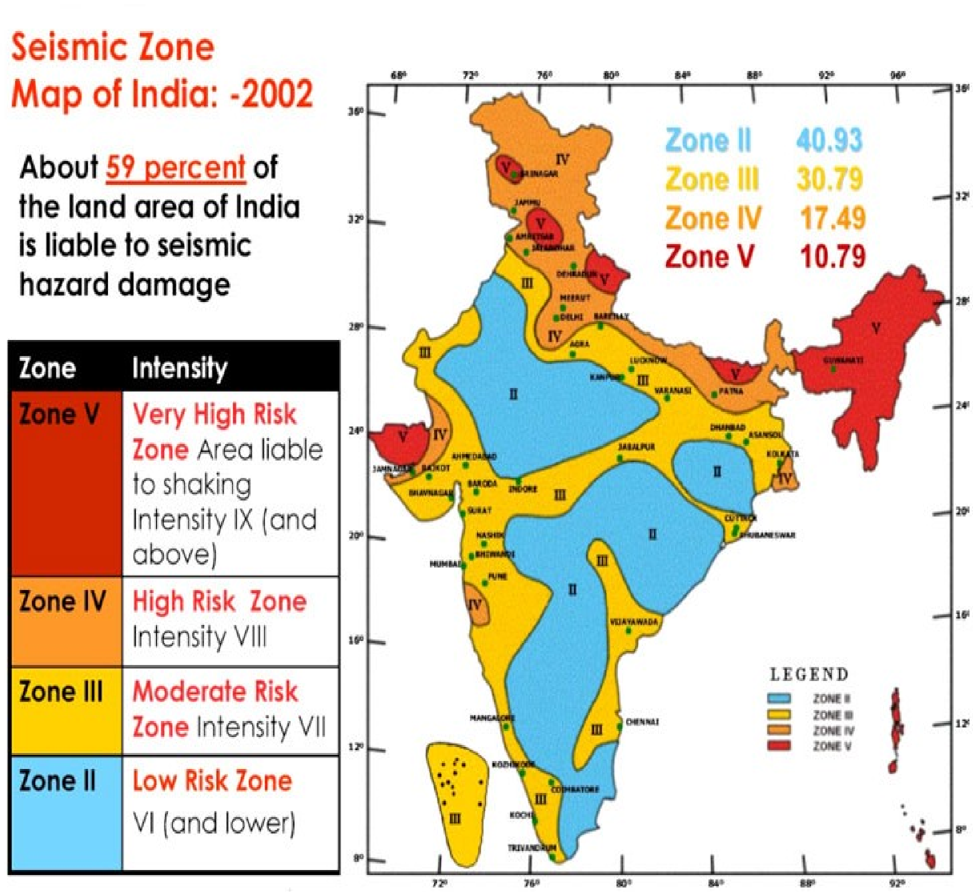
Source: ABC Techno Labs India Pvt. Ltd.

Figure 3.6: Drainage Map of the study area

3.9 NATURAL HAZARDS

3.9.1 SEISMICITY

The Bureau of Indian Standards has categorized the entire India into zones depending upon the degree of proneness to earthquakes. The Zone I signify lesser degree while Zone V signifies highest order. As per the Figure 3.4, the blocks are located in project site falls under earthquake Zone V (Very High Risk Zone).



Source: Maps of India

Figure 3.7: Map showing seismic tectonic zone

3.10 LAND USE PATTERN

As per requirement of study on areas of critical concern for environmental control such as flood plains and wetlands, energy resource development areas, wildlife habitat, recreational lands and areas such as major residential and industrial development sites, we require the analysis of Land use Land Cover for expansion of airport. The survey and studies of past several years conclude that the Remote Sensing data play a vital role in the field of land use and land cover mapping. Land use maps are presently being developed from local to National and to Global

Scales. The knowledge of Land Use/Land Cover is important for many planning and management activities as it is considered as an essential element for modeling and understanding the earth system. The term Land Use relates to the human activity or economic function associated with a specific piece of Land, while the term Land Cover relates to the type of feature present on the surface of the earth *(Lillesand and Kiefer, 2000).*

The basic purpose of land use pattern and classification in an EIA study is to identify the manner in which different parts of land area is utilized or not utilized. Remote sensing data provides reliable accurate baseline information for land use mapping as it is a rapid method of acquiring up-to-date information of over a large geological area.

Studies on land use aspects of eco-system play an imperative role in identifying susceptible issues and to take appropriate action to uphold ecological equilibrium in the region. The main objective of this section is to provide a baseline status of the study area covering 10 Km radius of project site, so that temporal changes due to the proposed expansion on the surroundings can be assessed in future. The objectives of Land use pattern are to:

- Determine the present Land use pattern.
- Analyze the impacts on Land use due to the Project activities within the study area.
- Study area comprises of 10 km radius of project site.

❑ **Data Acquisition**

Topographical Data: Topographical maps of Survey of India (SOI) were obtained for land use study as well to develop contour and drainages pattern of area.

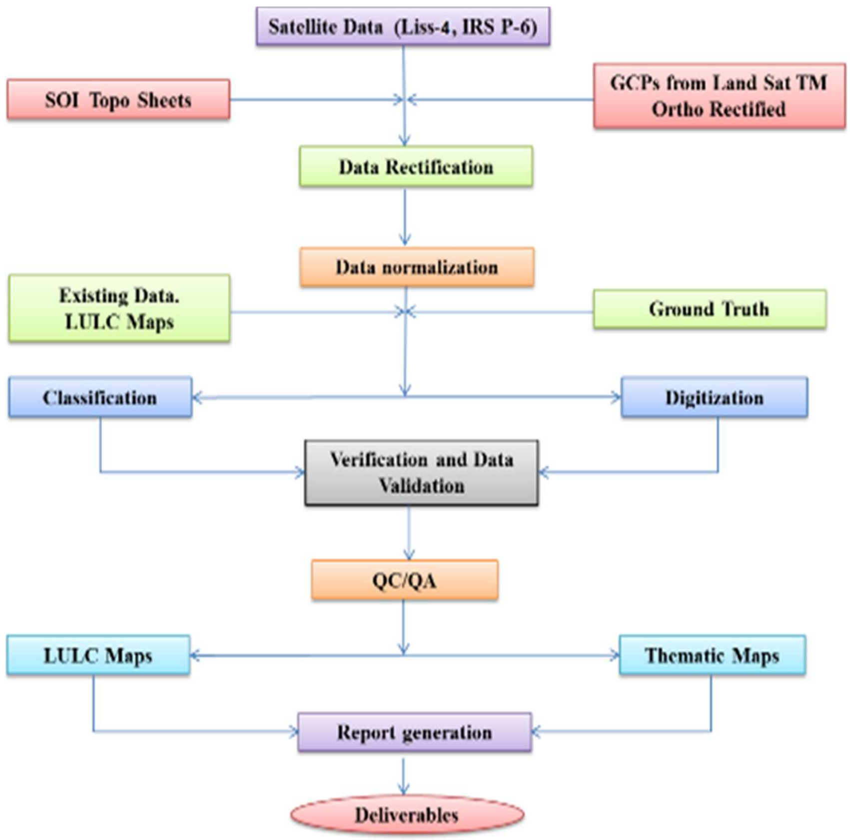
❑ **Methodology**

The overall methodology adopted and followed to achieve the objectives of the present study involves the following steps:

- ✓ Collection of source data of Survey of India (SOI) toposheets. These are the main inputs for the preparation of essential layers.
- ✓ Satellite data of IRS P-6 LISS III sensor is geometrically corrected and enhanced using principal component method and nearest neighborhood resampling technique.
- ✓ Preparation of basic themes like layout map, transport & settlement map and contour map from the source data. Then updating of layout map, transport map and drainage map from the satellite image by visual interpretation.
- ✓ Essential maps (related to natural resources) like Land use/Land cover map are prepared by visual interpretation of the satellite imagery. Visual interpretation is carried out based on the image characteristics like tone, size, shape, pattern, texture, location, association, background etc. in conjunction with existing maps/ literature
- ✓ Preliminary quality check and necessary corrections are carried out for all the maps prepared

- ✓ All the maps prepared are converted into soft copy by digitization of contours and drainages. In that process editing, labelling, mosaicking, quality checking, data integration etc. are done, finally Land use areas are measured in Sq.km.

Flow Chart of Methodology



❑ Land use Map Analysis

Land use Map Analysis done based on the image color, texture, tone etc. Following steps are used to analyze the Land use pattern of project site:

- ✓ Collection of scanned toposheets and Geo-reference the scanned image using the available coordinates;
- ✓ Collection of IRS LISS III images and made fused and blended the images for colour combinations using Image interpreter-Utilities and Layer stack option available in ERDAS;
- ✓ Identification Area of interest (AOI) and made a buffer of 10 km radius of the project site;
- ✓ Enhance the Fused and blended LISS III image using the Spatial, Radiometric and Temporal options in ERDAS;

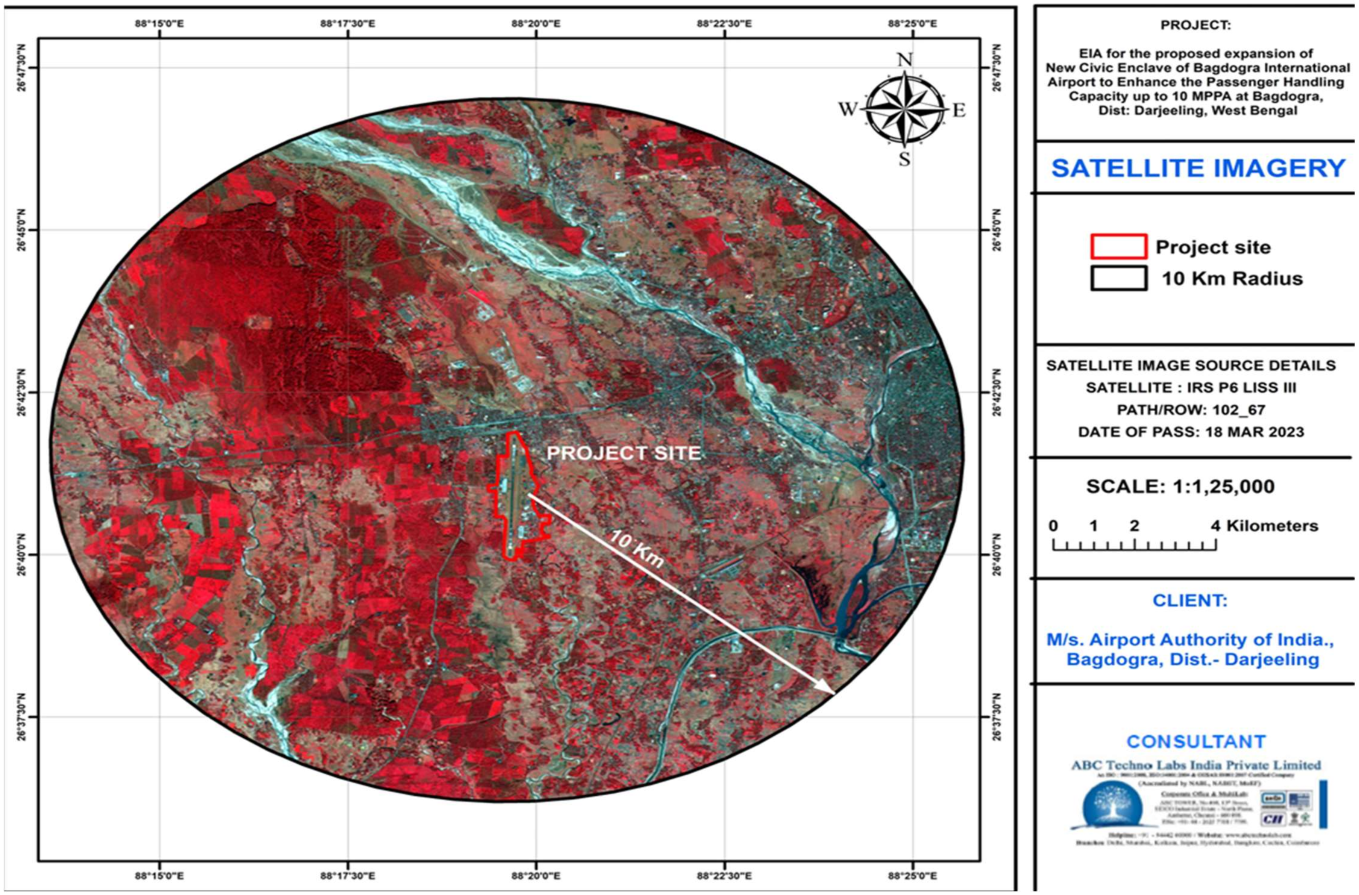
- ✓ Rectified the LISS III image using Geo-referencing technique, Toposheet to get UTM coordinate system;
- ✓ Subset the LISS images and Toposheet using 10 km buffer AOI;
- ✓ Automatic classifications done for LISS III images using maximum iterations and number of options in unsupervised classification options;
- ✓ Created the signature file by selecting the more samples of different features with AOI on Unsupervised classification image;
- ✓ Visual interpretation and supervised classification mixed with recoding practice;
- ✓ Verified through the QC/QA and finalized the data.

Spatial Data from SOI Topographical Sheets

Creating a GIS spatial database is a complex operation, and is the heart of the entire work; it involves data capture, verification and structuring processes because raw geographical data are available in many different analogue and digital form such as toposheets, aerial photographs, satellite imageries and tables. Out of all these sources, the source of toposheets is of much concern to natural resource scientist and an environmentalist.

In the present study, the essential maps generated from SOI topographical maps and satellite image. Using the topographical maps, the drainage map and contour map were also developed. The maps are prepared to a certain scale and with attributes complying with the requirement of TOR. The location of entities on the earth's surface is then specified by means of an agreed co-ordinate system. For most GIS, the common frame of co-ordinate system used for the study is UTM co-ordinates system. All the maps are first Geo-referenced. The same procedure is also applied on remote sensing data before it is used to prepare the essential maps.

Satellite Data: The Satellite IRS P-6 LISS III (Bhuvan -NRSC, Govt. of India) images are obtained from National Remote Sensing Centre (NRSC) Hyderabad.

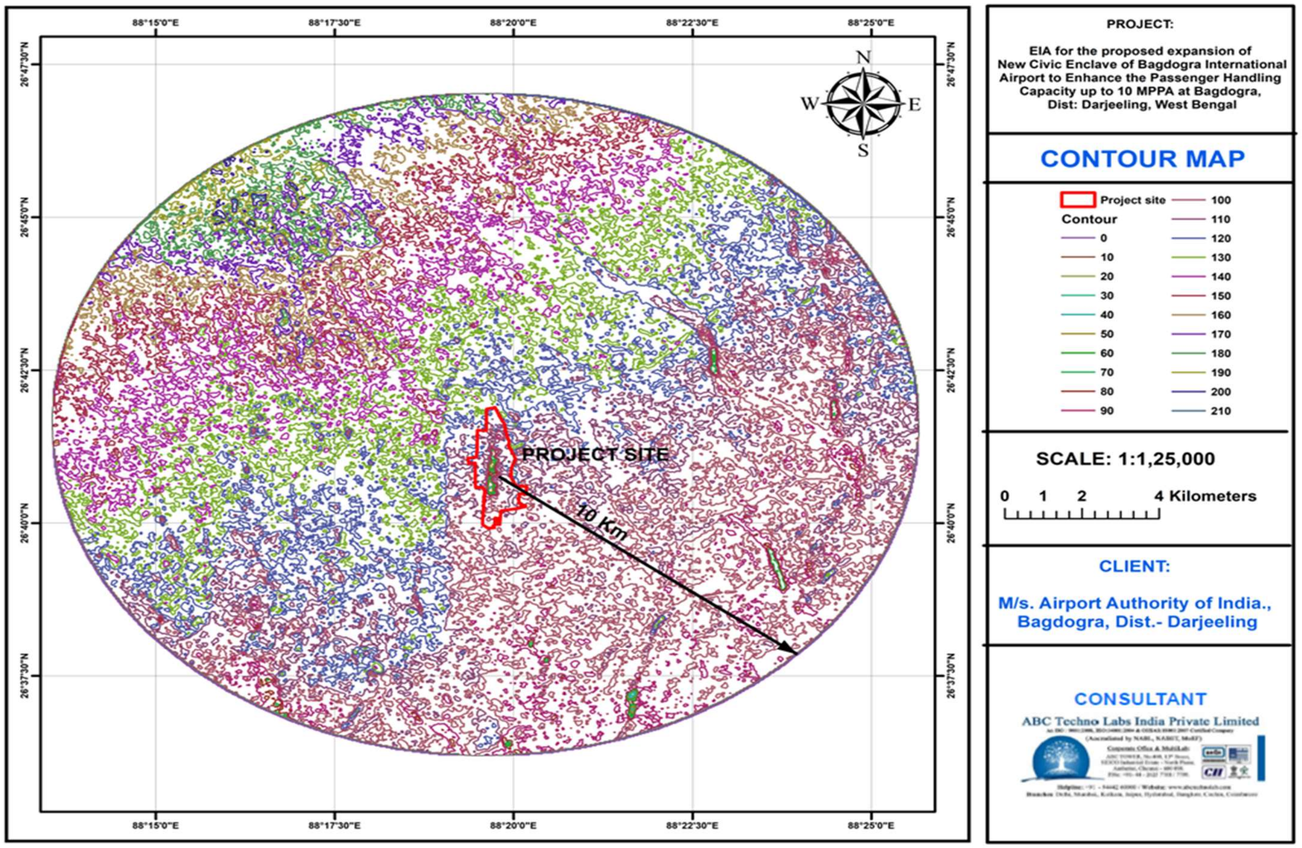


Source: ABC Techno Labs India Pvt. Ltd.

Figure 3.8: Satellite Image of the study area

3.10.1 CONTOUR MAP AND ELEVATIONS OF STUDY AREA

The contours in Toposheet have been digitized in the GIS environment and assigned the respective elevation values in meters with reference to the mean sea level. Using the SRTM (Shuttle Radar Topography Mission) data, the elevation values has been verified. Thereafter, final contour map has been prepared with combination of Toposheet and SRTM with contour interval of 10 m. The elevation varies from 0m to 210 m above MSL within the study area. There are high land/hills outside the the study area towards southern side. The area with lowest contours is located in eastern direction of the site. While the remaining areas showed minor variations with respect to contours (ground elevation). Contour Map of the Study Area is presented in Fig 3.10.

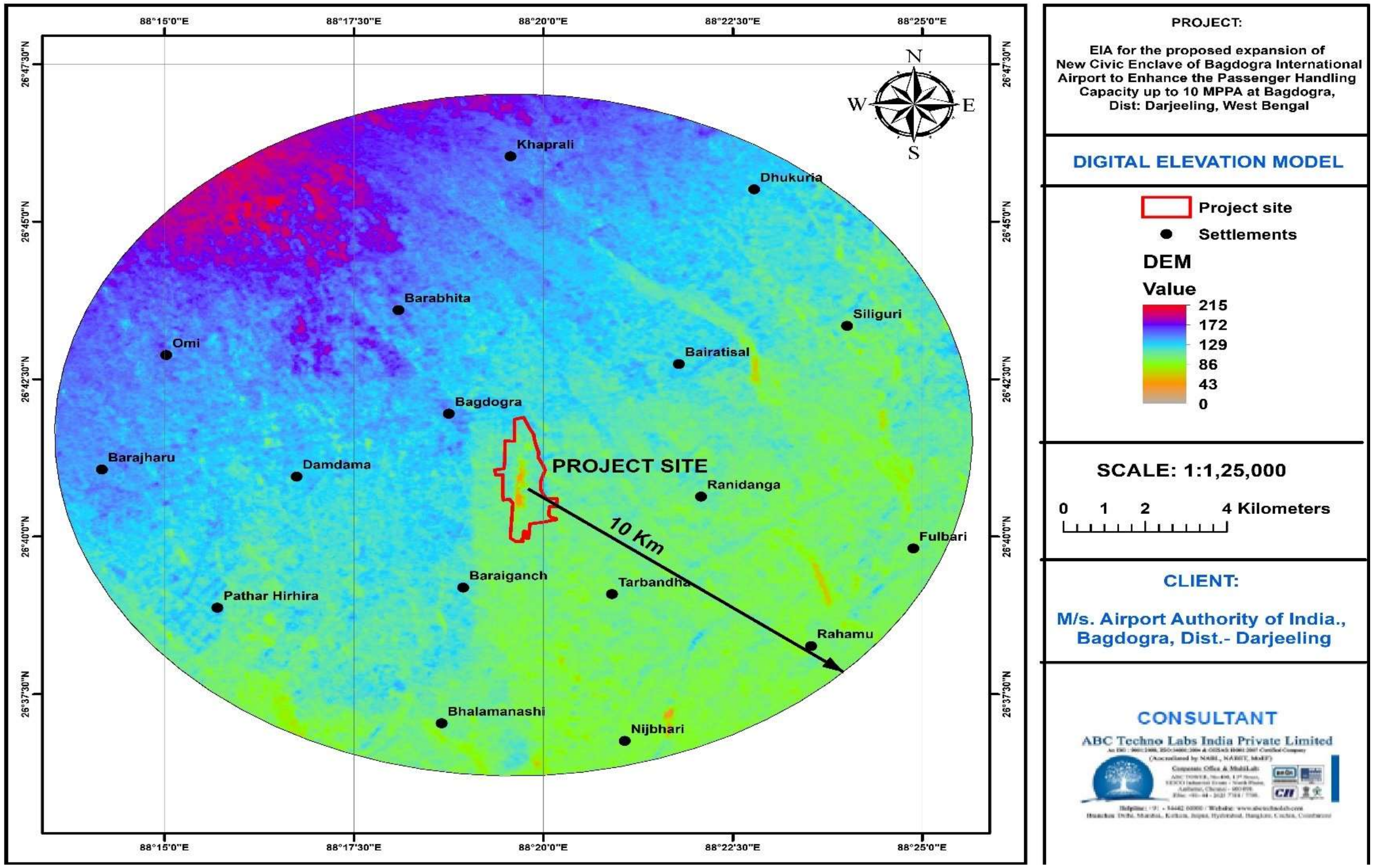


Source: ABC Techno Labs India Pvt. Ltd.

Figure 3.10: Surface Elevation map of study area

3.10.2 TOPOGRAPHY (DIGITAL ELEVATION MODEL)

A digital elevation model (DEM) is a digital representation of ground surface topography or terrain (Fig. 3.11). It is also widely known as a digital terrain model (DTM). A DEM can be represented as a raster (a grid of squares, also known as a height map when representing elevation) or as a triangular irregular network. The proposed block & well locations shown in that Relief map. For the relief study of the area very higher quality SRTM (Shuttle Radar Topography Mission) and DEM is downloaded. These DEMs represents elevation at a 30 m resolution.



Source: ABC Techno Labs India Pvt. Ltd.

Figure 3.11: DEM of the Study Area

3.10.3 MAP FOR THE LAND USE LAND COVER

Supervisory & unsupervisory classification techniques is being used to prepare the of landuse map using remote sensing data and also sampling techniques used for better results. Land use map as shown in Figure 3.13 is prepared with types of classifications of the landuse as shown by different colors.

From the map, it can be observed that Agricultural land/fallow land is around 49.36% of the total area. Settlement (Built-up area) is located and occupies around 29.62% of the total study area. The proposed Project activities will not have any significant impact on the surrounding villages and habitation. The water bodies (Tank/pond/lake/reservoir) cover 0.32% of the total area and River/stream/canal covers 10.19% of the total area. Wetland area covers 1.27% of the total area and forest area covers about 8.6% of the total study area.

- **National Park/Wild life sanctuary/Reserve Forest within 10 km radius of the project:**
  - ✓ No National parks located in the study area.
  - ✓ Mahananda WLS is about 9.6 Km towards northern direction

The statistical break-up of the land use classes of buffer zone are presented in Table 3.7 and depicted in Fig 3.12.

Table 3.7: Land use land cover statistics of buffer zone

Sl.No.	Classification	Area (in Sq. Km)	Percentage (%)
1	Mixed builtup	93	29.62
2	Agricultural land/Plantation/Fallow land	155	49.36
3	Forest land	27	8.60
4	Pond/Tank/Lake/Reservoir	1	0.32
5	River/Stream/canal	32	10.19
6	Wetland	4	1.27
7	Existing Feature (Airport)	2	0.64
	Total	**314**	**100**

Source: ABC Techno Labs India Pvt. Ltd.

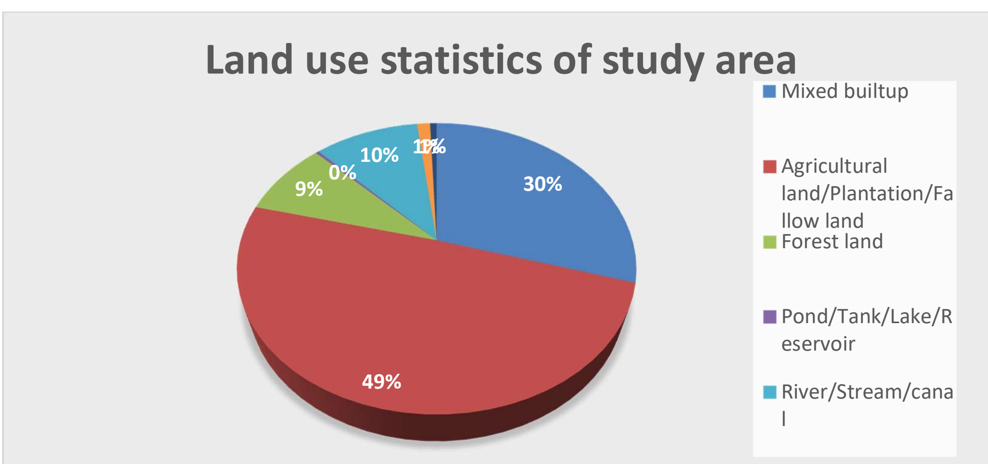
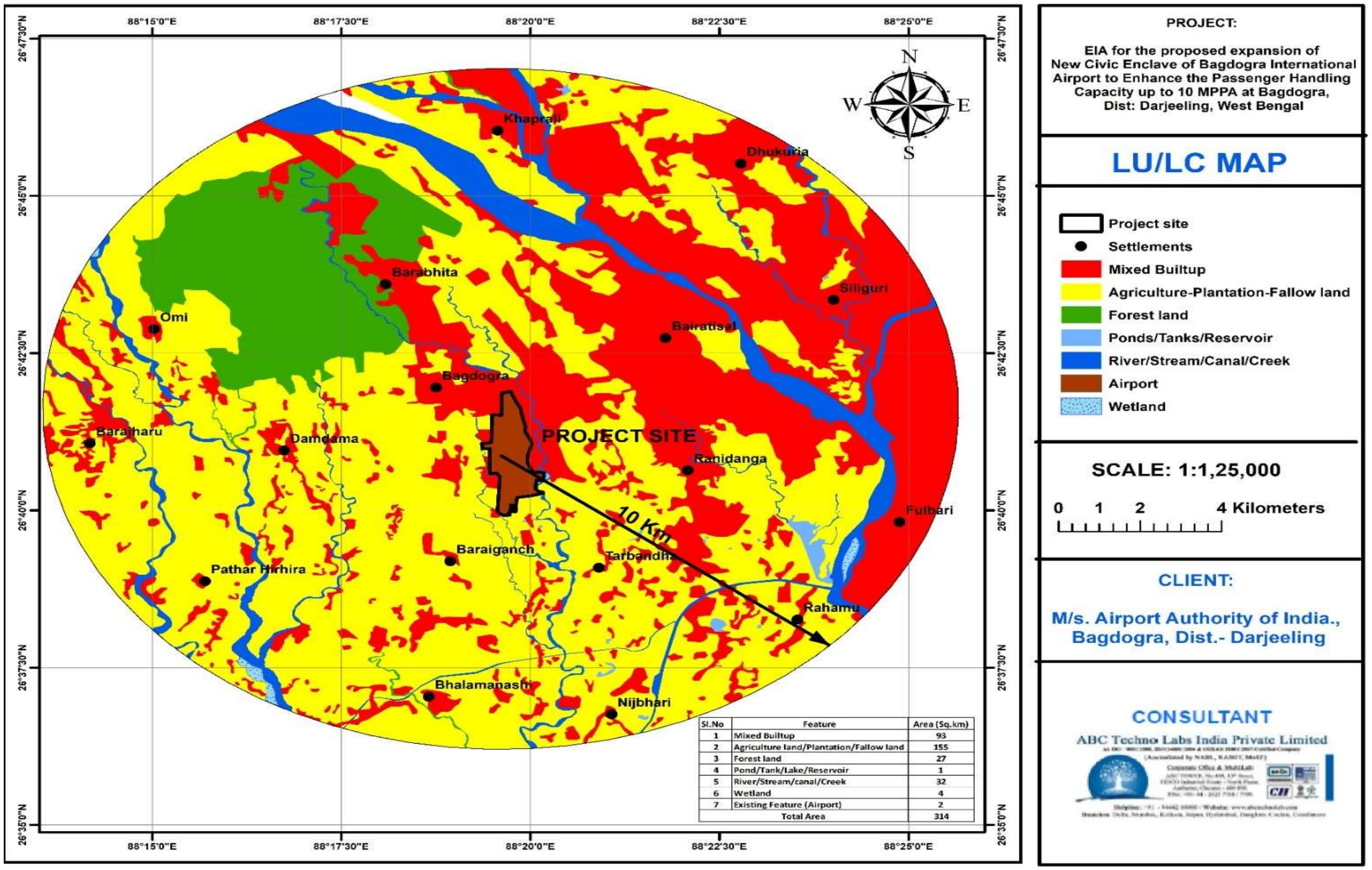


Figure 3.12: Graphical Presentation of Land use Land Cover statistics



Sl.No	Feature	Area (Sq.km)
1	Mixed Builtup	93
2	Agriculture land/Plantation/Fallow land	155
3	Forest land	27
4	Pond/Tank/Lake/Reservoir	1
5	River/Stream/canal/Creek	32
6	Wetland	4
7	Existing Feature (Airport)	2
	Total Area	314

Source: ABC Techno Labs India Pvt. Ltd.

Figure 3.13: Land Use/ Land Cover Map within 10 km Study Area

3.11 AIR ENVIRONMENT

The prime objective of baseline air monitoring is to evaluate the existing air quality of the study area. This will also be useful for assessing the conformity to standards of the ambient air quality during the execution of the Proposed Project Activities. This section describes the selection of sampling locations, the methodology adopted for sampling, analysis techniques and frequency of sampling. Ambient air monitoring was carried out during **1st March 2023 to 30th May 2023** for 12 weeks.

Ambient air quality of the study area has been assessed through a network of 8 ambient air quality stations designed keeping in view the meteorological conditions of the study region and others such as major habitation, environment sensitivity etc. It was observed that no habitats present near the well locations and all the proposed well locations fall within the open land area. The AAQ locations selected based on the predominant wind directions and major habitation area. The methodology adopted for the air quality survey is given below:

3.11.1 SELECTION OF SAMPLING LOCATIONS

The locations for air quality monitoring were scientifically selected based on the following considerations using climatological data.

- ✓ Topography/Terrain of the study area
- ✓ Human Settlements
- ✓ Health status
- ✓ Accessibility of monitoring site
- ✓ Resource Availability
- ✓ Representativeness of the region for establishing baseline status
- ✓ Representativeness with respect to likely impact areas.

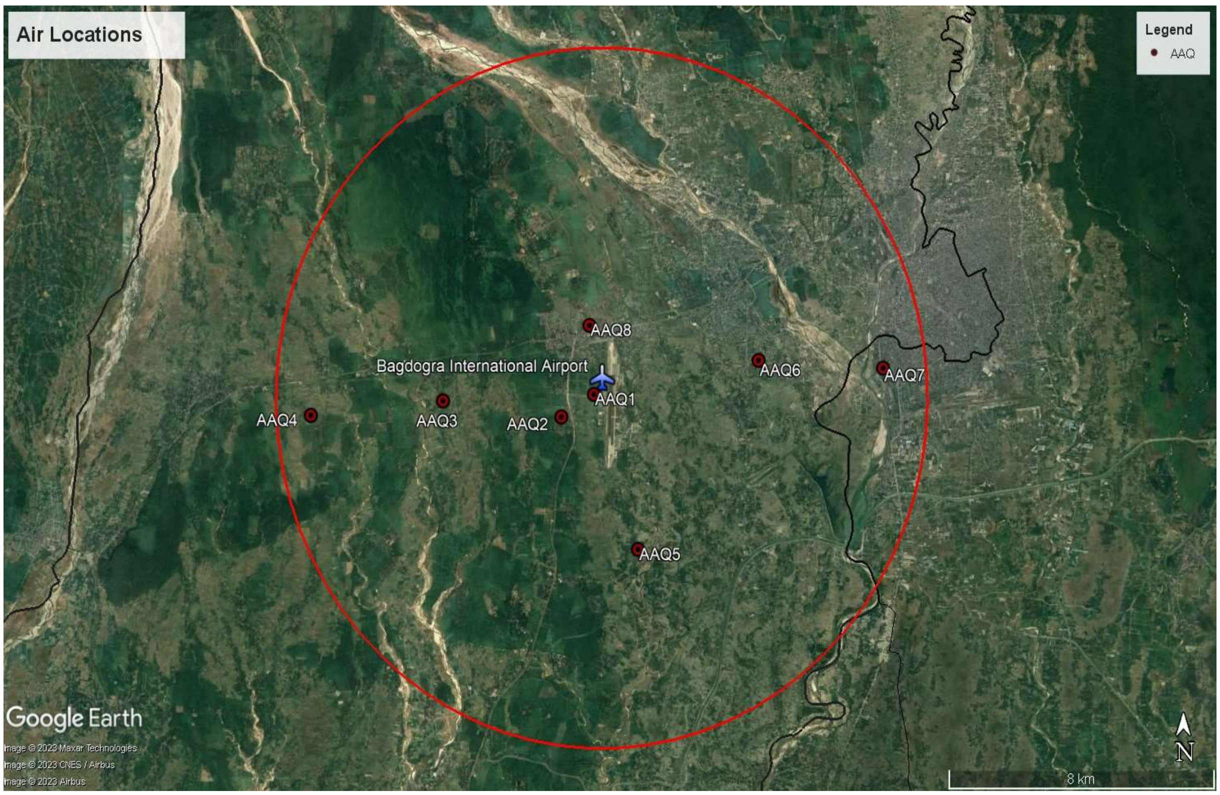
The coordinates of the Ambient Air Quality monitoring locations are given in Table 3.8.

Table 3.8: Ambient Air Quality Monitoring Locations

Air sampling location code	Location	Coordinates		Distance with respect to project site (km)	Direction with respect to project site	Direction with respect to Wind
AAQ1	Project Site	26°41'3.56"N	88°19'24.08"E	--	--	
AAQ2	Dakshin Bagdogra	26°40'42.85"N	88°18'47.95"E	1.52	ENE	DW
AAQ3	Chaupukuria	26°40'57.58"N	88°16'36.94"E	4.89	NNE	DW
AAQ4	Barajharu	26°40'44.26"N	88°14'10.83"E	8.92	NNW	DW
AAQ5	Tarbandha	26°38'42.10"N	88°20'12.61"E	4.6	N	CW
AAQ6	Kawakhari	26°41'34.80"N	88°22'26.68"E	4.86	WNW	UW

Air sampling location code	Location	Coordinates		Distance with respect to project site (km)	Direction with respect to project site	Direction with respect to Wind
AAQ7	Babupara, Siliguri	26°41'27.64"N	88°24'44.72"E	8.67	WSW	UW
AAQ8	Uttar Bagdogra	26°42'7.27"N	88°19'18.96"E	1.85	SW	CW

Source: ABC Techno Labs India Pvt. Ltd.



Source: ABC Technolabs India Pvt. Ltd.

Figure 3.14: Ambient Air quality monitoring locations

3.11.2 PARAMETERS FOR SAMPLING

Ambient air quality monitoring was carried out at a frequency of two days per week at each location for continuous three months. The baseline data of air environment was generated for the parameters namely Particulate Matter size less than 10 µm (PM10), Particulate Matter size less than 2.5 µm (PM2.5), Sulphur dioxide (SO_2), Nitrogen dioxide (NO_X), Carbon Monoxide (CO), Ammonia (NH_3), Ozone (O_3), Lead (Pb), Benzene (C_6H_6), Benzo alpha pyrene (BaP), Arsenic (As), Nickel (Ni). Concentrations of pollutant parameter monitored have been compared with National Ambient Air Quality standards.

3.11.3 INSTRUMENTS USED FOR SAMPLING

Respirable Dust Samplers APM 460 BL of Envirotech, Fine Particulate Samplers APM 550 of Envirotech & Combo PM10 & PM 2.5 sampler and AAS 271 of Envirotech were used for monitoring the Particulate matter PM10 & PM 2.5. The Gaseous pollutant samplers AAS 109 of Ecotech & APM 411 along with APM 460 Envirotech were used for sampling of gaseous pollutant like SO_2, NO_X, O_3, NH_3, Benzene. Carbon Monoxide was measured by Non-Dispersive Infrared (NDIR) method. The instruments used for monitoring are periodically calibrated every year or after in case of any repair.

3.11.4 SAMPLING AND ANALYTICAL TECHNIQUES

The sampling and analytical techniques used for the monitoring of Ambient Air quality is given in Table 3.9. The power supply for operation of AAQ instruments were utilized from nearest available sources like Panchayat office, Schools or residential buildings at each AAQ station.

Table 3.9: Techniques used for Ambient Air Quality Monitoring

Sl. No	Parameters	Instruments/Apparatus used	Method followed	Reference
1	Particulate Matter (PM10), µg/m³	Respirable Dust Sampler (RDS), balance	Gravimetric (High-Volume with Cyclone)	NAAQS Monitoring & Analysis Guidelines
2	Particulate Matter (PM2.5), µg/m³	PM2.5 Sampler (Fine dust sampler), balance	Gravimetric (Fine particulate Sampler)	NAAQS Monitoring & Analysis Guidelines
3	Oxides of Sulphur (SO_2), µg/m³	RDS with Impinger tubes, spectrophotometer	Improved West & Gaecke Method	NAAQS Monitoring & Analysis Guidelines
4	Oxides of Nitrogen (NOx), µg/m³	RDS with Impinger tubes, spectrophotometer	Jacobs & Hochheiser Modified (Sodium Arsenite) Method	NAAQS Monitoring & Analysis Guidelines
5	Carbon Monoxide (CO), mg/m³	CO Analyzer	NDIR Method	NAAQS Monitoring & Analysis Guidelines
6	Ozone (O_3), µg/m³	Ozone analyzer	UV photometric	IS 5182 part 9, 1974
7	Nickel, Arsenic, ng/m³ Lead, µg/m³	AAS	AAS Method after sampling on EPM 2000 F.P.	IS 5182 part 10, 1999
10	Ammonia (NH_3), µg/m³	Spectrophotometer	Indophenol Method	AAFA Edition 21st
11	Benzo-a-Pyrine (BaP), µg/m³	HPLC	Solvent extraction followed by HPLC	IS 5182 part 12, 2004
12	Benzene, µg/m³	Gas Chromatograph	Chromatography	Methods of Air Sampling & analysis; 3rd Edition 1998; Edited: J.P. Lodge Jr; Lewis Publishers

Source: ABC Techno Labs India Pvt. Ltd.

3.11.5 RESULTS

Various parameters like maximum, minimum and average have been computed from the monitored data for all the locations within the study area and summary of Ambient Air Quality test results are presented in Tables 3.10

Table 3.10: Summary of Ambient Air Quality Result

Location	Statistics	PM10 µg/m³	PM2.5 µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	NH_3 µg/m³	O_3 µg/m³	Lead µg/m³	Benzene µg/m³	BaP µg/m³	As ng/m³	Ni ng/m³
AAQ1	Minimum	61.0	28.0	9.6	18.3	0.3	BDL (<5.0)	14.8	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	Maximum	41.0	20.0	6.9	14.6	0.1	BDL (<5.0)	11.7	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	Average	51.9	24.3	8.4	16.2	0.2	BDL (<5.0)	13.1	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	98th Percentile	60.1	28.0	9.6	18.3	0.3	BDL (<5.0)	14.8	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
AAQ2	Minimum	54.0	25.0	7.4	17.8	0.2	BDL (<5.0)	14.2	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	Maximum	38.0	18.0	5.1	12.4	0.1	BDL (<5.0)	9.9	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	Average	45.6	21.4	6.3	14.8	0.2	BDL (<5.0)	11.7	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	98th Percentile	52.6	24.5	7.4	17.6	0.2	BDL (<5.0)	14.1	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
AAQ3	Minimum	50.0	24.0	7.4	16.6	0.2	BDL (<5.0)	13.1	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	Maximum	37.0	18.0	0.0	12.5	0.0	BDL (<5.0)	9.6	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	Average	43.6	20.5	6.4	14.2	0.1	BDL (<5.0)	11.3	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	98th Percentile	50.0	24.0	7.4	16.3	0.2	BDL (<5.0)	13.0	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
AAQ4	Minimum	52.0	25.0	7.7	16.7	0.5	BDL (<5.0)	13.1	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	Maximum	41.0	19.0	5.2	12.8	0.1	BDL (<5.0)	9.5	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	Average	46.4	21.9	6.5	14.5	0.2	BDL (<5.0)	11.5	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	98th Percentile	52.0	25.0	7.6	16.4	0.4	BDL (<5.0)	13.1	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
AAQ5	Minimum	57.0	27.0	8.6	17.0	0.3	BDL (<5.0)	14.2	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	Maximum	41.0	19.0	6.8	12.6	0.1	BDL (<5.0)	9.9	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	Average	48.9	23.3	7.9	15.0	0.2	BDL (<5.0)	12.1	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	98th Percentile	57.0	27.0	8.5	16.8	0.3	BDL (<5.0)	14.0	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
AAQ6	Minimum	63.0	30.0	10.6	20.5	0.3	BDL (<5.0)	16.2	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	Maximum	47.0	22.0	7.1	14.9	0.2	BDL (<5.0)	12.3	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	Average	54.8	25.8	8.9	17.8	0.3	BDL (<5.0)	14.0	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	98th Percentile	63.0	30.0	10.6	20.5	0.3	BDL (<5.0)	15.9	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
AAQ7	Minimum	67	33	12.2	22.4	0.44	BDL (<5.0)	16.6	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	Maximum	50	24	8.9	14.9	0.18	BDL (<5.0)	12.2	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	Average	58.9	28.3	10.4	19.1	0.3	BDL (<5.0)	14.6125	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	98th Percentile	67.0	33.0	12.0	22.3	0.4	BDL (<5.0)	16.6	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
AAQ8	Minimum	66.0	30.0	11.7	21.7	0.4	BDL (<5.0)	15.9	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	Maximum	47.0	22.0	8.1	13.9	0.2	BDL (<5.0)	12.1	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)

Location	Statistics	PM10 µg/m³	PM2.5 µg/m³	SO_2 µg/m³	NO_2 µg/m³	CO mg/m³	NH_3 µg/m³	O_3 µg/m³	Lead µg/m³	Benzene µg/m³	BaP µg/m³	As ng/m³	Ni ng/m³
	Average	54.7	25.8	10.0	18.3	0.3	BDL (<5.0)	14.2625	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
	98th Percentile	64.2	29.5	11.6	21.4	0.4	BDL (<5.0)	15.9	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<1)	BDL(<1)
NAAQS Standard		**100**	**100.0**	**60.0**	**80.0**	**80.0**	**2.0**	**100**	**100.0**	**5**	**1**	**6**	**20**

Source: ABC Techno Labs India Pvt. Ltd.

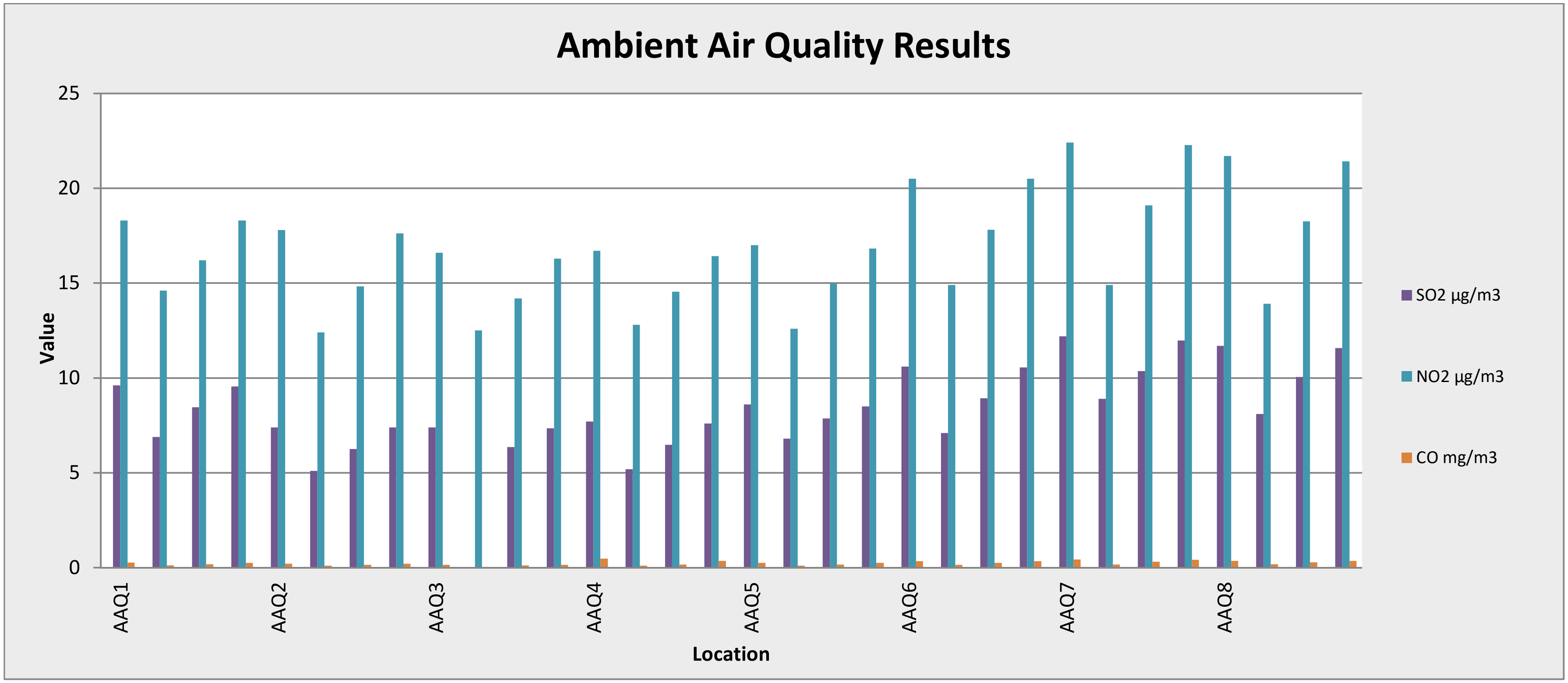


Figure 3.15: Statistical analysis of results of Ambient Air quality

3.11.6 OBSERVATIONS ON AMBIENT AIR QUALITY

PM10: The maximum and minimum concentrations of PM10 were recorded as 67 μg/m³ and 37 μg/m³ respectively. The maximum concentration was recorded at Babupara, Siliguri (AAQ7) and the minimum concentration was recorded at Chaupukuria (AAQ3).

PM2.5: The maximum and minimum concentrations for PM2.5 were recorded as 33.0 μg/m³ and 18.0 μg/m³ respectively. The maximum concentration was recorded at the Babupara, Siliguri (AAQ7) and the minimum concentration was recorded at Chaupukuria (AAQ3).

SO_2: The maximum and minimum SO_2 concentrations were recorded as 12.2 μg/m³ and BDL (<5 μg/m³). The maximum concentration was recorded at Babupara, Siliguri (AAQ7) and the minimum concentration was recorded at Chaupukuria (AAQ3).

NOx: The maximum and minimum NOx concentrations were recorded as 22.4 μg/m³ and 12.4 μg/m³. The maximum concentration was recorded at Babupara, Siliguri (AAQ7) and the minimum concentration was recorded at Dakshin Bagdogra (AAQ2).

CO: The maximum and minimum CO concentrations were recorded as 0.5 mg/m³ and BDL(<0.1 mg/m³).

O_3: The maximum and minimum O_3 concentrations were recorded as 16.6 μg/m³ and 9.5 μg/m³.

HC (methane and non-methane) and Volatile Organic Compounds (VOCs): It has been observed that the concentrations of Benzene (C_6H_6), BaP, Lead, Arsenic, Nickel and Ammonia are also below detectable limits at all locations and O_3 present in locations are well within the standards prescribed by the Central Pollution Control Board (CPCB) for Industrial, Rural, Residential and Other area.

3.12 NOISE ENVIRONMENT

The main objective of monitoring of ambient noise levels was to establish the baseline noise levels in the surrounding areas and to assess prevailing total noise level in the environment of the study area. The measurements were carried out using Type 1 noise level integrated sound level meter. Monitoring was done at each location during the study period for 24 hrs. on hourly basis to obtain hourly equivalent sound pressure level. A digital noise level meter was used to record the noise levels. From these values, day time and night time and 24-hrs Equivalent Continuous Sound Pressure Level (Leq) values were calculated. Day time is considered from 0600 hrs to 2200 hrs and night from 2200 hrs to 0600 hrs.

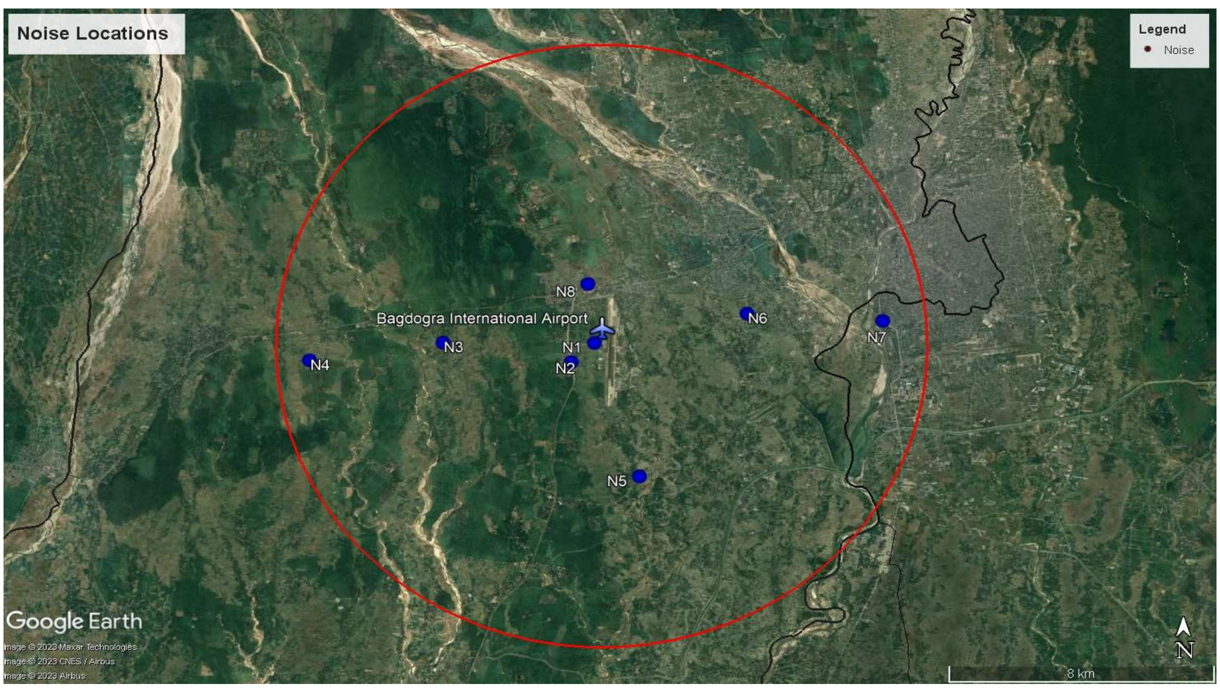
3.12.1 IDENTIFICATION OF SAMPLING LOCATION

A preliminary reconnaissance survey was undertaken to identify the major noise sources in the area. The noise monitoring has been conducted at 8 locations. The location coordinates of these eight locations are given in Table 3.12.

Table 3.12: Noise Quality Monitoring Locations

Sampling Location Code & Name	Location	Zone	Coordinates		Dist. (Km) from project site	Direction
			Latitude	Longitude		
N1	Project Site	Commercial	26°41'3.02"N	88°19'24.01"E	--	--
N2	Dakshin Bagdogra	Residential	26°40'42.54"N	88°18'58.38"E	1.5	ENE
N3	Chaupukuria	Residential	26°41'3.42"N	88°16'36.43"E	4.88	NNE
N4	Barajharu	Residential	26°40'44.28"N	88°14'8.90"E	8.94	NNW
N5	Tarbandha	Residential	26°38'41.32"N	88°20'13.67"E	4.5	N
N6	Kawakhari	Commercial	26°41'34.29"N	88°22'13.50"E	4.81	WNW
N7	Babupara, Siliguri	Commercial	26°41'26.48"N	88°24'43.80"E	8.66	WSW
N8	Uttar Bagdogra	Commercial	26°42'6.29"N	88°19'16.69"E	1.84	SW

Source: ABC Techno Labs India Pvt. Ltd.



Source: ABC Technolabs India Pvt. Ltd.

Figure 3.16: Ambient Air quality monitoring locations

3.12.2 INSTRUMENTS USED FOR SAMPLING

Noise levels were measured using a sound level meter. A typical meter consists of a microphone for picking up the sound and converting it into an electrical signal, followed by electronic circuitry for operating on this signal so that the desired characteristics can be measured.

3.12.3 METHOD OF MONITORING

Noise, in general, is sound which is composed of many frequency components of various types of loudness distributed over the audible frequency range. Equivalent sound pressure levels of day time i.e. Leq (day) and night time Leq (night) are calculated from the hourly measured noise level and compared to Ambient Noise Level Standards as per the "Noise Pollution (Regulation and Control) Rules, 2000" stipulated for daytime and night time for residential land use.

Various noise scales have been introduced to describe, in a single number, the response of an average human to a complex sound made up of various frequencies at different loudness levels. The most common and universally accepted scale is the 'A' weighted Scale which is measured in dB scale (A). This is more suitable for an audible range of 20 to 20,000 Hz. The scale has been designed to weigh various components of noise, according to the response of a human ear.

Sound Pressure Level (SPL) measurements were measured at all locations. The readings were taken for every hour for 24 hours. The day noise levels have been monitored during 6 am to 10 pm and night levels during 10 pm to 6 am at all the locations covered in a 10 Km radius of project site. The noise levels were measured once during the study period. These readings were later tabulated and the frequency distribution table was prepared. Finally, hourly and 24-hourly values for various noise parameters viz. L_{day} and L_{night} were calculated.

For noise levels measured over a given period of time, it is possible to describe different levels of noise using statistical quantities. This is calculated using the percent of the time certain noise levels exceed the time interval. The notations for the statistical quantities of noise levels are described below:

L10 is the noise level exceeded 10 percent of the time

L50 is the noise level exceeded 50 percent of the time and

L90 is the noise level exceeded 90 percent of the time

Equivalent Sound Pressure Level (Leq)

The Leq is the equivalent continuous sound level, which is equivalent to the same sound energy as the actual fluctuating sound measured in the same period. This is necessary because the sound from a noise source often fluctuates widely during a given period of time. This is calculated from the following equation:

$$\mathbf{Leq = L50 + (L10 - L90)2/60}$$

Parameters Measured During Monitoring

For noise levels measured over a given period of the time interval, it is possible to describe important features of noise using statistical quantities. This is calculated using the percent of the time, certain noise levels are exceeded during the time interval. The notation for the statistical quantities of noise levels id described below:

Hourly Leq day: Equivalent noise levels between 6.00 hours to 22.00 hours.

Leq night: Equivalent noise levels between 22.00 hours to 6.00 hours.

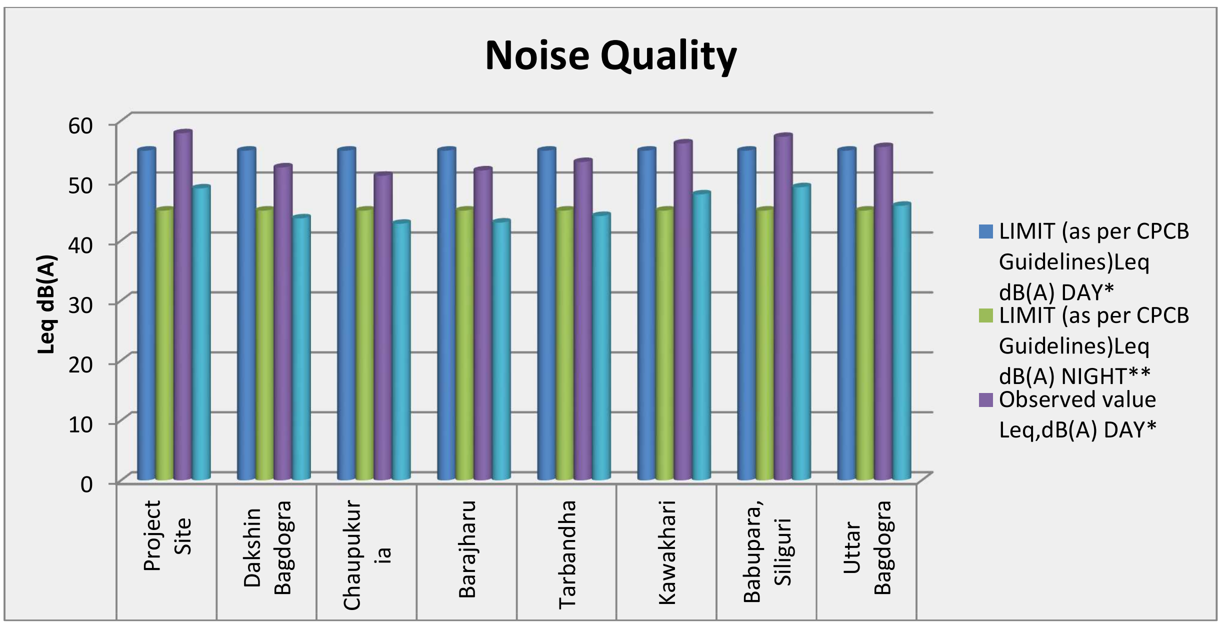
3.12.4 RESULTS

The summary of computed ambient noise level parameters like L_{day} and L_{night} are presented in Table 3.13 and compared to the standards specified by CPCB mentioned.

Table 3.13: Ambient Noise Level

S. No.	Location code	Location	Zone	LIMIT (as per CPCB Guidelines) Leq dB(A)		Observed value Leq, dB(A)	
				DAY*	NIGHT**	DAY*	NIGHT**
1	N1	Project Site	Commercial	55	45	**57.9**	**48.7**
2	N2	Dakshin Bagdogra	Residential	55	45	**52.2**	**43.7**
3	N3	Chaupukuria	Residential	55	45	**50.8**	**42.8**
4	N4	Barajharu	Residential	55	45	**51.7**	**43**
5	N5	Tarbandha	Residential	55	45	**53.1**	**44.1**
6	N6	Kawakhari	Commercial	55	45	**56.2**	**47.7**
7	N7	Babupara, Siliguri	Commercial	55	45	**57.3**	**48.9**
8	N8	Uttar Bagdogra	Commercial	55	45	**55.6**	**45.8**

*Note: *Daytime shall mean from 6.00 a.m. to 10.00 p.m.*
***Night time shall mean from 10.00 p.m. to 6.00 a.m.*



Source: ABC Techno Labs India Pvt. Ltd.

Figure 3.17: Statistical analysis of results of Ambient Noise quality

3.12.5 OBSERVATIONS

Day time Noise Levels

Noise levels during daytime in the study area are found to be in the range 50.8 to 57.9 dB(A). The maximum noise level was observed to be 57.9 dB(A) at Project Site (N2) and a minimum of 50.8 dB(A) was observed at Chaupukuria (N3).

Night time Noise Levels

Noise levels observed to fall in the range 42.8 to 48.9 dB (A) during the night time in the study area. A maximum of 48.9 dB (A) was observed at Babupara, Siliguri (N7) and a minimum of 42.8 dB (A) was observed at Chaupukuria (N3). Measured noise levels in Kavitam Block are found to be in compliance with prescribed standards for ambient noise for the respective applicable categories.

3.13 TRAFFIC STUDY

The traffic studies have been conducted to know the prevailing traffic volumes on the existing roads. It is essential to consider these details for assessing the anticipated future traffic volumes as a part of overall impacts assessment for the proposed project activities. The variations of traffic densities depend upon the working days and time and also vary in day and night times. In order to assess the prevailing traffic volumes on the roads, the survey was conducted during normal working days of the week by avoiding local holidays or abnormal situations to reflect the true picture of the traffic densities.

Vehicle Count

The vehicles passing through the road (in both ways) were counted separately for 24 hours at the two (2) selected locations from 0600 hrs to 0600 hrs next day continuously. Category-wise vehicle counting has been done continuously and recorded in the traffic volume count on daily basis under respective categories.

Categorization of Traffic

The engine driven vehicles were categorized into various heads viz. Cycles, Two Wheelers, Auto Rickshows, Cars/ Vans, LCV, Trucks/ Bus, Multiaxle, Cart.

3.13.1 OBSERVATIONS AND RESULTS

Traffic study was conducted at 2 locations for 1 day during March 2023 at T1- NH27 (Bagdogra Airport Road) and T2- NH2 (Bihar More, Bagdogra) to cover all possible traffic variations and to assess the peak traffic flow.

T1- NH27 (Bagdogra Airport Road) is one of the busiest highways in the region.

1. T1- NH27 (Bagdogra Airport Road)

Traffic flow patterns

The traffic study was conducted for NH27 (Bagdogra Airport Road) which is a main access to the project site. The average traffic on NH27 (Bagdogra Airport Road) is observed as 1280 PCUs/day. The peak traffic on NH27 is observed from 10:00 AM – 7:00 PM of 6334 PCUs.

V = Worst Case Volume in PCU/hr	*802*
Total Width of Road in Meters	*10*
C = carrying capacity of road (2 lane 1 way road with frontage access, parked vehicles and heavy cross traffic as per IRC: 106-1990 (PCUs per Hour)	*1400*
Existing V/C ratio	*0.573*
Level of Servicing Existing = LOS =	*C*

2. T2- NH2 (Bihar More, Bagdogra)

Traffic flow patterns

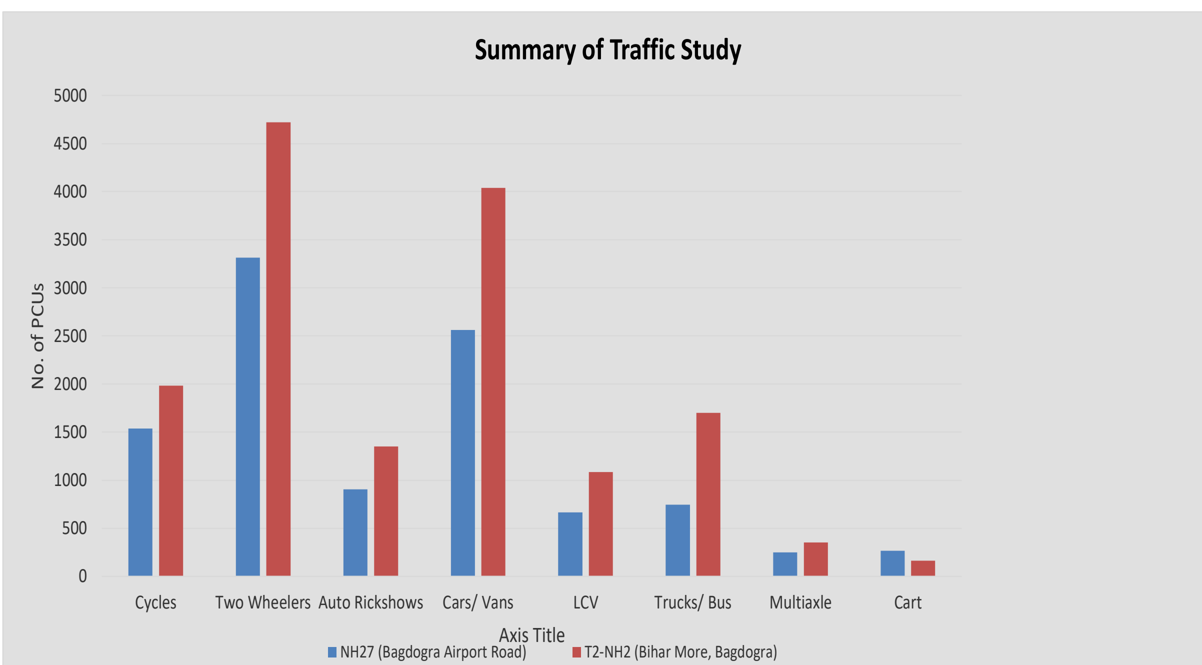
The traffic study was conducted for T2- NH2 (Bihar More, Bagdogra) which is a another access to the project site. The average traffic on NH2 is observed as 1925 PCUs/day. The peak traffic is observed from 9:00 AM – 7:00 PM of 10404 PCUs.

V = Worst Case Volume in PCU/hr	*1176*
Total Width of Road in Meters	*22*
C = carrying capacity of road (2 lane 1 way road with frontage access, parked vehicles and heavy cross traffic as per IRC: 106-1990 (PCUs per Hour)	*1400*
Existing V/C ratio	*0.840*
Level of Servicing Existing = LOS =	*E*

Table 3.18: Summary of Traffic Study

Vehicle Type	NH27 (Bagdogra Airport Road)	T2-NH2 (Bihar More, Bagdogra)
Cycles	1536	1984
Two Wheelers	3313	4720
Auto Rickshows	903	1353
Cars/ Vans	2564	4041
LCV	665	1086
Trucks/ Bus	745	1700
Multiaxle	249	350
Cart	266	163
Average	**1280**	**1925**

Source: ABC Techno Labs India Pvt. Ltd.



Source: ABC Techno Labs India Pvt. Ltd.

3.14 WATER ENVIRONMENT

The quality of ground and surface water is influenced by surface and sub-surface environmental conditions. The quantity and quality of water entering the underground regime is another important parameter which influences underground water quality.

Water sampling has been conducted to establish baseline water quality in the area. Water analysis was carried out for physical and chemical parameters as per the methods prescribed in IS and *"Standard Methods for the Examination of Water and Wastewater (American Public Health Association)"*. The water samples were collected as grab samples and were analyzed for physical, chemical and biological characteristics. A grab sample is any individual sample collected without compositing or adding other samples. Equivalent to a snap shot, a grab sample is generally appropriate for sampling from smaller facilities.

3.14.1 SAMPLING LOCATIONS

The sampling locations were selected based on reconnaissance survey with the following consideration:

- ✓ Location of water courses/ water bodies; and
- ✓ Location of residential areas representing different activities

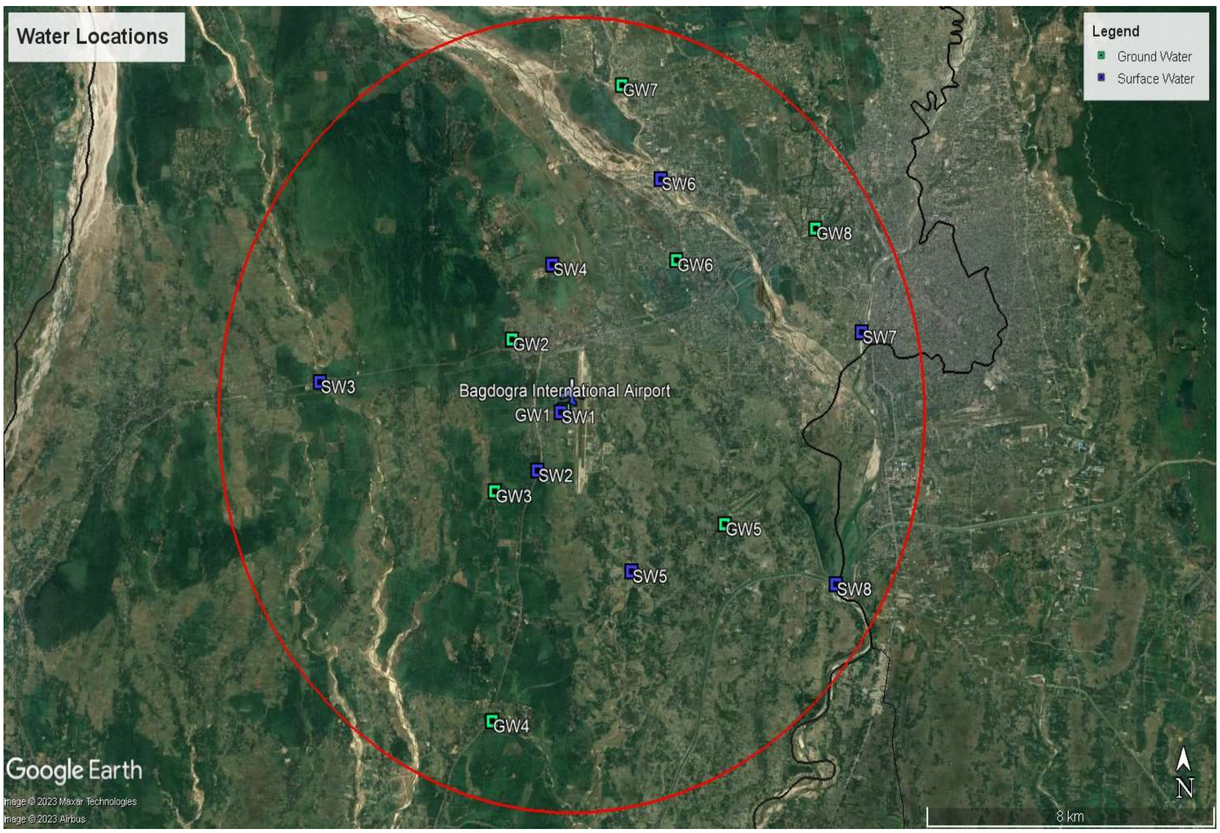
The coordinates of the water sampling stations are presented in the Table 3.14.

Table 3.14: Water quality monitoring locations

Location Code	Location	Geographical location		Distance with respect to project site (Km)	Direction with respect to project site	Type of water
		Latitude	Longitude			
GW1	Near Project Site(Airport Campus)	26°41'3.63"N	88°19'24.85"E	0.36	W	Handpump
GW2	Uttar Bagdogra	26°42'1.09"N	88°18'31.40"E	2.42	NW	Handpump
GW3	Rangali	26°39'58.16"N	88°18'14.52"E	3.1	SW	Handpump
GW4	Gayaganga (Amdangi)	26°36'55.66"N	88°18'13.32"E	7.79	SSW	Handpump
GW5	Rangapani,	26°39'31.69"N	88°22'8.20"E	5.14	SE	Handpump
GW6	Bairatisal	26°43'6.02"N	88°21'20.24"E	4.49	NE	Handpump
GW7	Khaprail	26°45'31.30"N	88°20'24.25"E	8.21	NNE	Handpump
GW8	Siliguri	26°43'31.96"N	88°23'43.80"E	8.1	ENE	Handpump
SW1	Canal Western side of Airport	26°41'1.98"N	88°19'21.47"E	0.31	WSW	Canal
SW2	Canal Near Bagdogra Electric SubStation	26°40'14.86"N	88°18'57.83"E	1.79	SSW	Canal
SW3	Canal Near Atal	26°41'26.43"N	88°15'14.95"E	7.13	W	Canal
SW4	Canal Near Mayaram	26°43'2.34"N	88°19'12.45"E	3.62	N	Canal

Location Code	Location	Geographical location		Distance with respect to project site (Km)	Direction with respect to project site	Type of water
		Latitude	Longitude			
SW5	Canal Near Tarbandha	26°38'54.09"N	88°20'33.61"E	4.38	SSE	Canal
SW6	Balason River (New Rangia)	26°44'12.98"N	88°21'4.36"E	6.19	NNE	River
SW7	Mahananda Up Stream River	26°42'6.87"N	88°24'30.10"E	8.25	E	River
SW8	Mahananda Down Stream River	26°38'43.76"N	88°24'0.51"E	8.56	ESE	River

Source: ABC Techno Labs India Pvt. Ltd.



Source: ABC Technolabs India Pvt. Ltd.

Figure 3.17: Water quality monitoring locations

Water samples for chemical analysis were collected in polyethylene carboys. Water samples collected for metal content were acidified with 1 ml HNO_3. Presence of selected physico-chemical and heavy metal have been analysed for ground water quality status in the study area.

3.14.2 RESULTS

A. Ground Water

The physicochemical characteristics of ground water (8 no.s) in the study area are presented in the Tables 3.15 and is compared with the standards (IS 10500: Indian Standards/Specifications for Drinking Water) reference values.

1. Physical Parameters

Colour: The colour of ground water samples was <1 Hazen unit and meets the permissible limit of drinking water standards.

Odour: Ground water samples were found Agreeable.

Turbidity: The turbidity of water samples ranges from BDL (<0.5 NTU) to 0.5 NTU and meets permissible limit at all the ground water sampling locations.

pH: The pH value of all ground water samples ranges from 6.74 to 7.41 and meets the Acceptable limit of drinking water standards.

Total Dissolved Solids (TDS): The TDS in ground water samples range from 109 to 241 mg/l meets the Acceptable limit of 500 mg/l in the ground water sampling locations.

2. Chemical Parameters

Total Alkalinity: Total alkalinity in ground water samples ranges from 58 mg/l to 114 mg/l and meets Acceptable limit of 200 mg/l at all the ground water sampling locations.

Total Hardness: The total hardness of ground water samples range between 64 mg/l to 130 mg/l, meets Acceptable limit of 200 mg/l at the ground water sampling locations.

Chloride: The chloride content in ground water samples range from 24 mg/l to 66 mg/l, meets Acceptable limit of 250 mg/l at all the ground water sampling locations.

Sulphate: Sulphate content in ground water sample ranges from 4 mg/l to 17 mg/l, meets Acceptable limit of 200 mg/l at all the ground water sampling locations.

Fluoride: Fluoride content in ground water samples ranges from 0.11 mg/l to 0.29 mg/l, meets the Acceptable limit of drinking water standards.

Nitrate: Nitrate content in ground water samples ranges from 1.0 to 9.0 mg/l, meets the acceptable limit of 45 mg/l at all the ground water sampling locations.

Calcium: The Calcium content in ground water samples range from 19 mg/l to 44 mg/l, meets permissible limit of 200 mg/l at all the ground water sampling locations.

Magnesium: The Magnesium content in ground water samples range from 4 mg/l to 8.3 mg/l, meets permissible limit of 100 mg/l at all the ground water sampling locations.

Iron: The iron content in all ground water sample ranges from 0.05 mg/l to 0.07 mg/l and meets acceptable limit of 1 mg/l.

Manganese: Manganese content in ground water samples found to be Below Detection Level (<0.02 mg/l).

Sodium: Sodium content in ground water samples ranges from 17 mg/l to 41 mg/l.

Potassium: Potassium content in ground water samples ranges from 1 mg/l to 3 mg/l.

Zinc: Zinc content in ground water samples ranges from 0.03 mg/l to 0.09 mg/l, meets the acceptable limit 5 mg/l at all the ground water sampling locations.

Lead: Lead content in ground water samples found to be Below Detection Level (<0.01 mg/l) at all the ground water sampling locations.

3. Biological Parameters

Total Coliform: Total coliform content in ground water samples ranges from <2 MPN/100ml in sampling locations.

4. Other Parameters

Aluminum, Selenium, Phenolic Compounds, Copper, Cadmium, Mercury, Nickel, Total Arsenic, Total Chromium and Cyanide in all ground water samples were found below detection limit (BDL).

Observation

The results of ground water samples were compared to Indian Standard Specification of drinking water IS: 10500:2012 and it has been observed that all the analysed parameters of the ground water in the study area meet the permissible limits for drinking standards except for iron and total coliform. Ground water samples needs filtration and other treatment before usage for drinking.

Table 3.15: Results for Ground Water Analysis

S. No	Parameters	Unit	Acceptable limit as per IS 10500:2012	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8
1	Colour	Hazen	5	<1	<1	<1	<1	<1	<1	<1	<1
2	Odour	-	Agreeable	No Odour Observed	No Odour Observed	No Odour Observed	No Odour Observed	No Odour Observed	No Odour Observed	No Odour Observed	No Odour Observed
3	Turbidity	NTU	1	BDL(<0.5)	0.5	BDL(<0.5)	BDL(<0.5)	BDL(<0.5)	BDL(<0.5)	BDL(<0.5)	BDL(<0.5)
4	pH at 25 °C	-	6.5-8.5	7.16	6.74	6.87	7.22	7.08	7.22	6.78	7.41
5	Conductivity at 25 °C	µS/cm	Not Specified	303	248	208	254	327	361	197	432
6	Total dissolved solids	mg/l	500	160	131	115	142	170	198	109	241
7	Total Suspended solids	mg/l	Not Specified	<2	<2	<2	<2	<2	<2	<2	<2
8	Total Alkalinity as CaCO3	mg /l	200	94	80	66	86	98	114	58	108
9	Total Hardness as CaCO3	mg/l	200	102	78	72	90	102	120	64	130
10	Calcium as Ca	mg/l	75	27	22	20	25	35	37	19	44
11	Magnesium as Mg	mg/l	30	8.3	5.6	5	6.7	4	6.7	4	5
12	Chloride as Cl-	mg/l	250	39	27	24	29	38	44	24	66
13	Sulphate as SO4	mg/l	200	4	6	7	5	8	13	5	17
14	Nitrate as NO3	mg/l	45	3	1	1	2	6	5	2	9
15	Iron as Fe	mg/l	1	BDL(<0.05)	BDL(<0.05)	0.07	BDL(<0.05)	0.05	BDL(<0.05)	0.05	0.06
16	Manganese as Mn	mg/l	0.1	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)	BDL(<0.02)
17	Fluoride as F	mg/l	1	0.11	0.12	0.14	0.13	0.19	0.22	0.11	0.29
18	Sodium as Na	mg/l	Not Specified	21	19	17	19	25	32	17	41

S. No	Parameters	Unit	Acceptable limit as per IS 10500:2012	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8
19	Potassium as K	mg/l	Not Specified	2	2.6	1.3	1	1.4	2.3	1.1	3
20	Barium as Ba	mg/l	0.7	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)
21	Residual Free Chlorine	mg/l	0.2	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)
22	Aluminium as Al	mg/l	0.03	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)
23	Cadmium as Cd	mg/l	0.003	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)
24	Lead as Pb	mg/l	0.01	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
25	Copper as Cu	mg/l	0.05	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)
26	Zinc as Zn	mg/l	5	0.08	0.05	0.03	0.03	0.09	0.04	0.03	0.07
27	Total Chromium as Cr	mg/l	0.05	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)
28	Arsenic as As	mg/l	0.01	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
29	Cyanide as CN	mg/l	0.05	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)
30	Selenium as Se	mg/l	0.01	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
31	Mercury as Hg	mg/l	0.001	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)
32	Anionic Surfactants as MBAS	mg/l	0.2	BDL(<0.025)	BDL(<0.025)	BDL(<0.025)	BDL(<0.025)	BDL(<0.025)	BDL(<0.025)	BDL(<0.025)	BDL(<0.025)
33	Phenolic Compounds as Phenol	mg/l	0.001	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)
34	Pesticides	mg/l	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
35	Total Coliforms	MPN/100ml	Absent /100ml	<2	<2	<2	<2	<2	<2	<2	<2

S. No	Parameters	Unit	Acceptable limit as per IS 10500:2012	GW1	GW2	GW3	GW4	GW5	GW6	GW7	GW8
36	E.coli	MPN/100ml	Absent /100ml	<2	<2	<2	<2	<2	<2	<2	<2

Source: ABC Techno Labs India Pvt. Ltd.

Date of sampling: 24th May 2023

B. Surface Water

The collected surface water samples (8 no.s) were analyzed and results of surface water analysis are given in Table 3.16.

1. Physical Parameters

Colour: The colour of surface water samples was found to be 5 to 25 Hazen units.

Odour: Surface water samples were found Agreeable for all the samples.

Turbidity: The turbidity of surface water samples was found in the range 2.2 to 6.8 NTU which doesn't meet the tolerance limit.

pH: The pH value of all surface water samples ranges from 7.17 to 7.95.

Electrical Conductivity: Electrical conductivity in surface water samples ranges from 258 µS/cm to 556 µS/cm.

Total Dissolved Solids (TDS): The TDS in surface water samples range from 142 to 309 mg/l which is below tolerance limit for all surface water samples.

2. Chemical Parameters

Total Hardness: The total hardness of surface water samples range between 62 mg/l to 120 mg/l.

Chloride: The chloride content in surface water samples range from 39 mg/l to 84 mg/l which is below tolerance limit for all surface water samples.

Sulphate: Sulphate content in surface water sample ranges from 8 to 28 mg/l which is below tolerance limit for all surface water samples.

Fluoride: Fluoride content in surface water samples ranges from 0.1 mg/l to 0.21 mg/l which is below tolerance limit for all surface water samples.

Nitrate: Nitrate content in surface water samples ranges from 2 mg/l to 21 mg/l which is below tolerance limit for all surface water samples.

Iron: The iron content in all surface water sample ranges from 0.14 mg/l to 0.54 mg/l which is below tolerance limit for all surface water samples.

Calcium: The Calcium content in surface water samples range from 21 mg/l to 36 mg/l.

Magnesium: The Magnesium content in surface water samples range from 2.3 mg/l to 7.7 mg/l.

Sodium: Sodium content in surface water samples ranges from 26 mg/l to 60 mg/l.

Potassium: Potassium content in surface water samples ranges from 1.3 mg/l to 7.8 mg/l.

Zinc: Zinc content in all surface water samples found to be 0.06 mg/l to 0.19 mg/l which is below tolerance limit for all surface water samples.

Bio-chemical Oxygen Demand (BOD): The BOD level of the SW samples found to be in the range between 2 mg/l to 4.2 mg/l which is below tolerance limit for all surface water samples.

Chemical Oxygen Demand (COD): The COD level of the SW samples found to be in the range between 12 mg/l to 28 mg/l.

Dissolved Oxygen (DO): The DO level of the SW samples found to be in the range between 4.9 mg/l to 6.9 mg/l.

3. Biological Parameters

Total Coliform Count: Total Coliform Count in surface water samples was found to be >1600 MPN/100ml.

Fecal coliform: Fecal Coliform in surface water samples found to be 40 to 1100 MPN/ 100ml.

4. Other Parameters

Aluminum, Selenium, Phenolic Compounds, PCBs, PAH, Mineral oil, Pesticides and Cadmium, Mercury, Nickel, Total Arsenic, Total Chromium, Selenium, Cyanide in all surface water samples were found below detection limit (BDL).

Observation

The results of surface water samples were compared to CLASS – C category and it has been observed that the analysed parameters of water meet permissible limits for all the surface water locations.

Table 3.16: Results for Surface Water Analysis

S.No	Parameters	Unit	Class C	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
1	Temperature	°C		26	25.8	24.7	25.7	26.5	25.1	27.3	25.8
2	Colour	Hazen	300	25	15	5	15	8	6	7	5
3	Odour	-	-	No Odour Observed	No Odour Observed	No Odour Observed	No Odour Observed	No Odour Observed	No Odour Observed	No Odour Observed	No Odour Observed
4	pH at 25°C	-	-	7.78	7.95	7.35	7.48	7.34	7.17	7.69	7.53
5	Electrical Conductivity,	µS/cm	-	556	481	307	408	499	258	465	411
6	Turbidity	NTU	-	6.8	5.5	2.8	4.7	3.8	2.2	3.6	2.9
7	Total Dissolved Solids	mg/l	1500	309	262	166	224	274	142	255	228
8	Total Hardness as $CaCO_3$	mg/l	-	120	100	72	98	114	62	112	96
9	Total Alkalinity as $CaCO_3$	mg/l	-	108	90	66	84	102	56	110	100
10	Chloride as Cl	mg/l	600	84	71	50	72	81	39	71	66
11	Sulphate as SO_4	mg/l	400	28	20	8	12	15	8	12	10
12	Fluoride as F	mg/l	1.5	0.21	0.19	0.1	0.12	0.13	0.1	0.13	0.1
13	Nitrate as NO_3	mg/l	50	15	21	2	7	11	2	7	5
14	Ammonia as NH_3	mg/l	-	1.33	1.02	0.05	0.37	0.68	0.05	0.14	0.05
15	Phosphate as PO_4	mg/l	-	0.98	1.11	0.26	0.28	0.41	0.16	0.18	0.14
16	Sodium as Na	mg/l	-	60	51	35	45	50	26	54	46
17	Potassium as K	mg/l	-	7.8	6.7	1.8	2.4	3.9	1.3	3.3	2.8
18	Calcium as Ca	mg/l	-	36	30	23	29	33	21	34	31
19	Magnesium as Mg	mg/l	-	7.3	6	3.5	6.2	7.7	2.3	6.5	5.5
20	Iron as Fe	mg/l	50	0.54	0.29	0.18	0.33	0.31	0.14	0.25	0.19
21	Manganese as Mn	mg/l	-	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
22	Anionic Surfactants as MBAS	mg/l	-	BDL(<0.025)	BDL(<0.025)	BDL(<0.025)	BDL(<0.025)	BDL(<0.025)	BDL(<0.025)	BDL(<0.025)	BDL(<0.025)
23	Total Suspended Solids	mg/l	-	10	7	3	7	8	3	7	5
24	Dissolved Oxygen as O_2	mg/l	4	4.9	5.2	6.6	6.1	5.8	6.9	6.1	6.3
25	Chemical Oxygen Demand	mg/l	-	28	20	12	22	20	14	22	18
26	Bio-Chemical Oxygen Demandand 27°C for 3 days	mg/l	3	4.2	3.6	BDL(<2)	2.7	2.6	BDL(<2)	2.7	2
27	Phenolic compounds as C6H5OH	mg/l	-	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)
28	Copper as Cu	mg/l	-	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)	BDL(<0.03)
29	Mercury as Hg	mg/l	-	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)	BDL(<0.001)
30	Cadmium as Cd	mg/l	-	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)	BDL(<0.003)
31	Selenium as Se	mg/l	-	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)

S.No	Parameters	Unit	Class C	SW1	SW2	SW3	SW4	SW5	SW6	SW7	SW8
32	Total Arsenic as As	mg/l	-	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
33	Cyanide as CN	mg/l	-	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)	BDL(<0.05)
34	Lead as Pb	mg/l	-	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
35	Zinc as Zn	mg/l	-	0.18	0.14	0.06	0.19	0.14	0.06	0.17	0.12
36	Total Chromium as Cr	mg/l	-	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
37	Nickel as Ni	mg/l	-	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)
39	Oil & Grease	mg/l	-	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)	BDL(<0.1)
	Mineral oil	mg/l		BDL(<0.5)	BDL(<0.5)	BDL(<0.5)	BDL(<0.5)	BDL(<0.5)	BDL(<0.5)	BDL(<0.5)	BDL(<0.5)
	Poly Chlorinated Biphenyls (PCBs)	mg/l		BDL (<0.0001)	BDL (<0.0001)	BDL (<0.0001)	BDL (<0.0001)	BDL (<0.0001)	BDL (<0.0001)	BDL (<0.0001)	BDL (<0.0001)
	Poly Nuclear Aromatic Hydrocarbon as PAH	mg/l		BDL (<0.0001)	BDL (<0.0001)	BDL (<0.0001)	BDL (<0.0001)	BDL (<0.0001)	BDL (<0.0001)	BDL (<0.0001)	BDL (<0.0001)
40	Total Coliform	MPN/100ml	5000	>1600	>1600	>1600	>1600	>1600	1600	>1600	>1600
41	E coli	MPN/100ml	-	>1600	>1600	110	>1600	>1600	40	>1600	1100

Source: ABC Techno Labs India Pvt. Ltd.

Date of sampling: 24th May 2023

3.15 Soil Environment

3.15.1 Soil analysis

The present study of the soil quality establishes the baseline characteristics and this will help in future in identifying the incremental concentrations if any, due to the operation of the proposed Project Activities. The sampling locations have been identified with the following objectives;

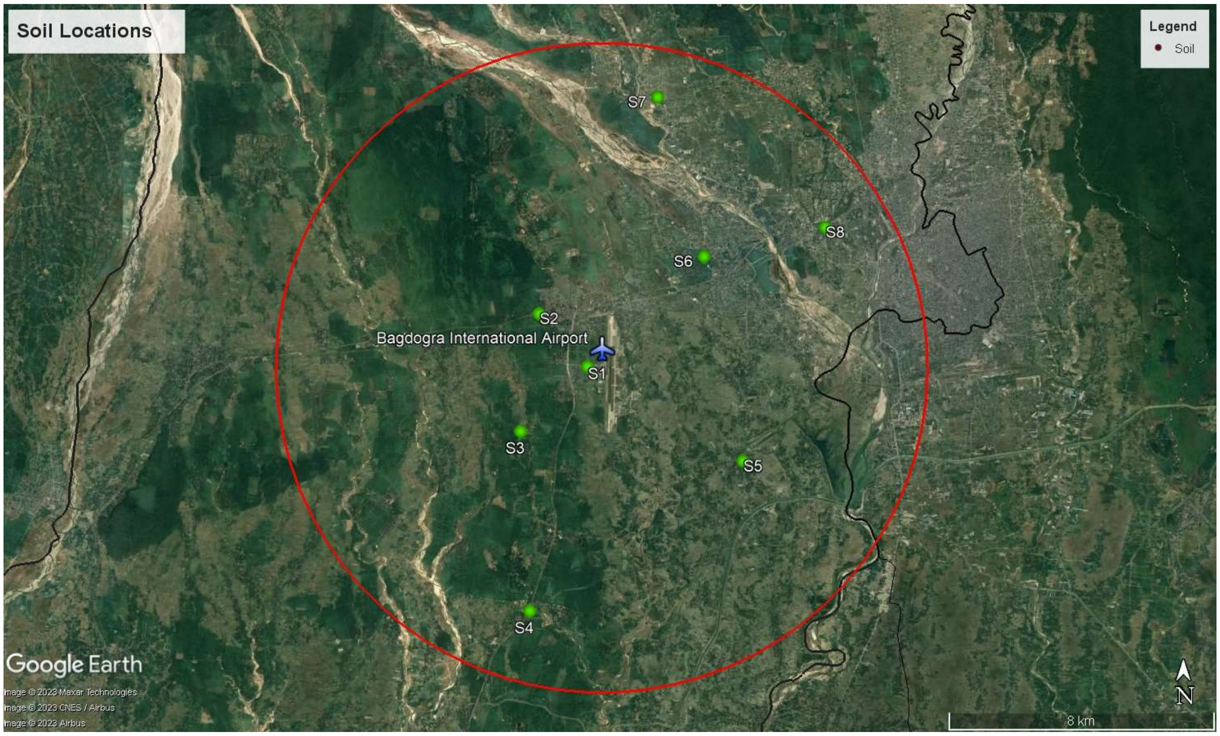
- ✓ To determine the baseline soil characteristics of the study area and
- ✓ To determine the impact of the proposed Project Activities on soil characteristics in study area

Eight (8) locations within the study area were selected for soil sampling. At each location, soil samples were collected from three different depths viz., 30 cm, 60 cm and 100 cm below the surface. The samples were analyzed for physical and chemical characteristics. The coordinates of the soil sampling location are presented in Table 3.17. The results are presented in Table 3.18.

Table 3.17: Soil Sampling Locations

Location Code	Sample location	Geographical location		Distance with respect to project site (km)	Direction with the respect to project site
		Latitude	Longitude		
S1	Near Project Site(Airport Campus)	26°41'0.99"N	88°19'16.17"E	0.44	W
S2	Uttar Bagdogra	26°41'53.54"N	88°18'22.34"E	2.42	NW
S3	Rangali	26°39'56.96"N	88°18'2.49"E	3.19	SW
S4	Gayaganga (Amdangi)	26°37'1.83"N	88°18'13.57"E	7.73	SSW
S5	Rangapani,	26°39'27.70"N	88°22'7.49"E	5.1	SE
S6	Bairatisal	26°42'50.81"N	88°21'25.97"E	4.45	NE
S7	Khaprail	26°45'32.47"N	88°20'34.97"E	8.22	NNE
S8	Siliguri	26°43'20.10"N	88°23'41.56"E	7.9	ENE

Source: ABC Techno Labs India Pvt. Ltd.



Source: ABC Technolabs India Pvt. Ltd.

Figure 3.18: Soil quality monitoring locations

3.15.2 RESULTS

The results of the soil analysis are tabulated in Table 3.18. Standard soil classification is given in Table 3.19.

Table 3.18: Results of Soil Sample Analysis

Sl.No	Parameters	S1	S2	S3	S4	S5	S6	S7	S8
1	pH	6.74	6.69	7.05	6.89	6.57	7.08	6.68	6.91
2	Bulk Density, g/cc	1.48	1.45	1.44	1.38	1.36	1.37	1.47	1.45
3	Electrical Conductivity, mS/cm	0.098	0.114	0.081	0.144	0.096	0.157	0.069	0.108
4	Total Nitrogen as N, kg/ha	49	67	56	83	63	55	91	44
5	Available Phosphorous as P, kg/ha	32.8	27.9	21.3	36.6	40.5	32.5	24.7	19.6
6	Available Potassium as K, kg/ha	312	264	308	358	216	278	244	310
7	Exchangeable Calcium as Ca,m.eq/100g	12.2	14.1	13.7	16.4	15.5	14.7	11.9	13.2
8	Exchangeable Magnesium as Mg, m.eq/100g	3.98	4.98	4.11	5.26	4.52	3.78	5.61	4.93
9	Exchangeable Sodium as Na, m.eq/100g	0.89	1.04	1.21	1.35	1.15	1.41	1.24	0.98
10	Organic matter (%)	0.77	0.68	1.02	1.13	0.82	0.64	1.05	0.97
11	Sodium Absorption Ratio	0.99	1.06	1.28	1.3	1.15	1.47	1.33	1.03
12	Boron as B, mg/kg	2.74	2.05	3.71	1.94	2.87	4.15	3.62	2.57
13	Iron as Fe, mg/kg	678	933	1071	874	1074	639	841	702
14	Copper as Cu, mg/kg	10.7	21.2	8.79	18.9	12.5	18.4	7.6	20.9
15	Manganese as Mn, mg/kg	23.6	41.7	26.6	52.3	48.3	35.7	28.9	30.8
16	Zinc as Zn, mg/kg	13.6	27.1	19.9	20.7	12.2	18.9	15.7	10.4
17	Molybdenum as Mo , mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
18	Lead as Pb, mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
19	Nickel as Ni, mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
20	Chromium as Cr, mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)

Sl.No	Parameters	S1	S2	S3	S4	S5	S6	S7	S8
21	Cadmium as Cd, mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
22	Arsenic as As, mg/kg	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)	BDL(<2)
23	Mercury as Hg, mg/kg	BDL(<0.5)	BDL(<0.5)	BDL(<0.5)	BDL(<0.5)	BDL(<0.5)	BDL(<0.5)	BDL(<0.5)	BDL(<0.5)
24	Water Holding Capacity,%	31.1	29.7	31.9	35.6	36.2	34.5	28.9	30.2
25	Texture Classification	Sandy Loam	Sandy Loam	Sandy Loam	Loam	Loam	Loam	Sandy Loam	Sandy Loam
26	Sand (%)	61.2	58.4	63.9	41.1	38.9	39.7	62.2	59.1
27	Clay (%)	8.9	10.2	11.7	25.6	26.1	27.3	8.74	9.71
28	Silt (%)	29.9	31.4	24.4	33.3	35	33	29.06	31.19

Source: ABC Techno Labs India Pvt. Ltd.

Date of sampling: 25th May 2023

The physic-chemical concentrations in the soil samples are determined in laboratory analysis and compared with the standard soil classification provided by the Indian Council of Agricultural Research (ICAR) (Table 3.19).

Table 3.19: Standard Soil Classification

Sl.No.	Parameters	Classification
1	pH	<4.5 Extremely acidic 4.51- 5.00 Very strongly acidic 5.01-6.00 moderately acidic 6.01-6.50 slightly acidic 6.51-7.30 Neutral 7.31-7.80 slightly alkaline 7.81-8.50 moderately alkaline 8.51-9.0 strongly alkaline >9.01 very strongly alkaline
2	Salinity Electrical Conductivity (µS/cm) (1ppm = 640 µS/cm)	Up to 1.00 Average 1.01-2.00 harmful to germination 2.01-3.00 harmful to crops (sensitive to salts)
3	Organic Carbon (%)	Up to 0.2: very less 0.21-0.4: less 0.41-0.5 medium, 0.51-0.8: on an average sufficient 0.81-1.00: sufficient >1.0 more than sufficient
4	Nitrogen (kg/Ha)	Up to 50 very less 51-100 less 101-150 good 151-300 Better >300 sufficient
5	Potassium (kg/ha)	0 -120 very less 120-180 less 181-240 medium 241-300 average 301-360 better >360 more than sufficient
6	Phosphorus (kg/ha)	Up to 15 very less 16-30 less 31-50 medium, 51-65 on an average sufficient 66-80 sufficient >80 more than sufficient

Source: ICAR

3.15.3 OBSERVATION

- The pH values ranging from 6.57 to 7.08 indicating the slightly alkaline. The conductivity of the soil ranges from 0.069 to 0.157 mS/cm.
- The bulk density in the study locations ranged from 1.36 g/cc to 1.48 g/cc.

- The Available Nitrogen Content ranges between 44 kg/Ha to 91 kg/Ha in the locality and the value of Phosphorus content varies between 19.6 kg/Ha to 40.5 kg/Ha. This indicates that the soil has medium quantities of Nitrogen and Phosphorus.
- The Potassium content varies from 216 kg/Ha to 358 kg/Ha, which indicates that the soils have high levels of potassium.
- The Texture of the soil sample is predominantly Sandy loam and loam in most of the places. The sand, silt and clay properties were found to be in the range of 38.9% to 63.9%, 24.4% to 35% and 8.74% to 27.3%.
- The Organic matter properties of the soil was found to be in the range of 0.64% to 1.13%

From the above observations, it was found that the soil quality in the Study area is found to be of moderate fertility and ideal for plant growth.

3.16 ECOLOGICAL ENVIRONMENT

An ecosystem is composed of plant and animal populations, and it differs from natural community designation in that it involves the total nutrient and energy economics of the system as well as the organisms involved. Ecosystems are self-maintained and self-contained. Natural ecosystems are invariably richer in species and more stable than those of artificially developed, due to their many inter-dependencies and inter-relationships.

The plant and animal populations in an area from recognizable associations called Natural communities. These are characterized by a few species called dominants. Natural communities have structure based on the life forms (e.g. grass) of the species that make them up. The species composition refers to the kinds of species making up to the community. The variety of species and their relative numbers are referred to as species diversity. A community composed of few species is called simple or one of Low diversity. A community composed of many species is called complex or one of high diversity. The greater the biotic diversity, the greater the number and kind of habitats for the inhabitants of the community. Based on the physical setting and the kind of distribution of flora and fauna, the study area can be classified into crop, terrestrial and aquatic ecosystems.

The studies on the biological aspects of the ecosystem are important in Environment Impact Assessment studies for the suitability of natural flora and fauna. Information on the impact of environment stress on the community structure serves as an inexpensive and efficient early warning system to check the damage on a particular ecosystem.

A change in the composition of biotic communities under stress is reflected through a change in the distribution pattern, density, diversity, frequency, dominance and abundance of natural species of fauna and flora existing in the ecosystem. These changes over a span of times can be quantified and related to the existing environment.

3.16.1 OBJECTIVES OF ECOLOGICAL STUDIES

The detailed ecological assessment of the study area has been carried out with the following objectives:

- To establish the present status of ecological conditions surrounding the project site;
- To study the existing anthropogenic stresses on the prevailing ecosystem.
- To identify and predict the likely impacts on the local ecosystem from the proposed Project Activities;
- To list out floral species, terrestrial vertebrate and aquatic flora and fauna present within the study area, and significance status under The Wildlife (Protection) Act, 1972;
- To define ecological/conservation status of each species as per IUCN categories (Red Data List).
- To formulate mitigatory measures and a sustainable Environmental Management Plan (EMP) basing upon the likely impacts.

During survey, following aspects were considered for ecological studies:

- Assessment of present status of flora and fauna;
- Identification of rare and endangered species of plants and animals (if any);
- Identification of ecologically sensitive areas within the study area;
- Assessment of migratory route of wildlife (if any); and
- Assessment of Aquatic Ecology with specific reference to aquatic birds and fishery resources.

3.16.2 BIOGEOGRAPHIC ZONE AND PROVINCE

This study has been carried out during the winter season during April 2023 of study period for the purpose of providing an independent and comprehensive baseline assessment of the flora, terrestrial vertebrate, aquatic fauna and associated habitat values present in and around of Laxmijan Block area and a subsequent assessment of potential ecological impacts. The study area falls under semi-arid category as far as the Indian biogeographical zones (*Rodger, Panwar, Mathur 2000)* are concerned. Under the biogeographical provinces, the study area falls under the category of **7B-Lower Gantetic Plain**. The field investigation and satellite imagery data show that the study area includes water bodies such as Teesta River at eastern side.

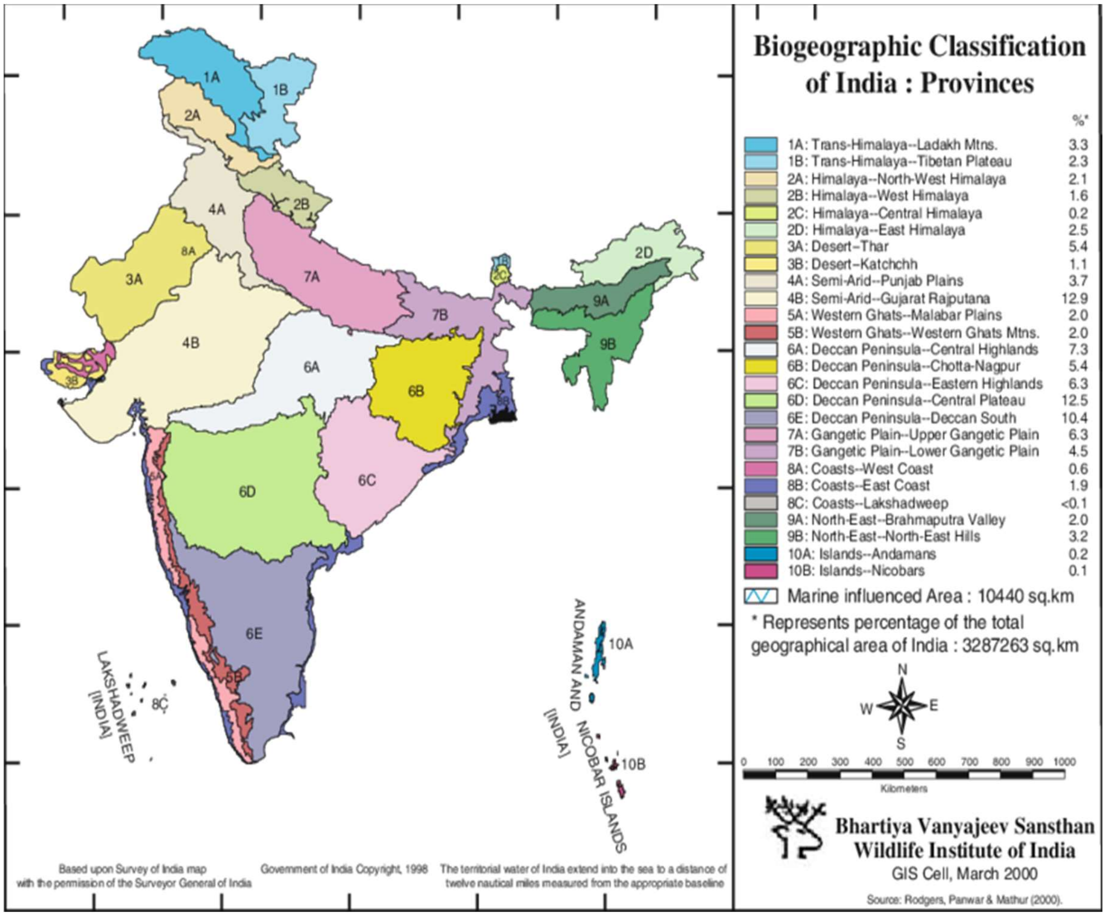


Figure 3.19: Map showing the Bio-geographic Provinces of India

3.16.3 METHODOLOGY ADOPTED FOR THE STUDY

Terrestrial investigations for flora and fauna records were collected by random field survey and a checklist was prepared. During field survey, discussions with the local people were carried-out to collect information related to local biodiversity in and around the villages. The ecological status of the study area has been assessed based on the following methodology:

- Primary field surveys to establish primary baseline of the study area;
- Compilation of secondary information available in published literatures/ working plan was referred from State Forest Department.
- Site Verification and finalization in consultation with local inhabitants.
- Vegetation analysis through quadrate method using sampling plots of 30m x 30m.
  - ✓ 30m X 30m for tree species;
  - ✓ 5m X 5m [four plots] was laid along diagonals wherein all the shrubs recorded.
  - ✓ 1m X 1m [five plots], one at the centre and four at one per quadrate] was laid and herbs, grasses in five plots to be noted.

Protocol for Sampling through Quadrate Method

The standard method chosen for the assessment of plant diversity involves the use of square vegetation quadrates ('plots'). These quadrates were used to measure most vegetation attributes in most vegetation types. Quadrate locations marked by pegs or sometimes by grid system.

The study area is demarcated as 10 Km radius of study area based on the MoEF&CC guidelines. After demarcation, the areas which are approximately true representative of the whole area, and were sampled for the identification of plant and animal species.

A. Floral Study

The assessment of the flora of the study area is done by an extensive field survey of the area.

- Plants species were identified based on their specific diagnostics characters of family, genus and species using available floral, other related literature.
- Besides the identification of plant species, information was collected on the vernacular names and uses of plants made by local inhabitants.
- Qualitative analysis of vegetation is made by two different methods such as floristic (by simple studying various genera and species of various plant groups i.e., herbs, shrubs, trees etc).

B. Phyto-sociology

A nested quadrates technique was used for sampling the vegetation. All the plots sampled were representative of most common types, sampling 30m x 30m for trees and 5m x 5m for shrubs, 1m x 1m for herbs square meter quadrates were laid. Selection of sites for sampling of vegetation is done by random sampling procedure. However, in general to study the phytosociological attributes, quadrates of 30m × 30m size for tree species are randomly laid out at each site at different elevations. Then the observation on the following parameters is recorded:

1. Name of the species.
2. Number of the occurrence of each species in each quadrate.
3. Vegetation data was quantitatively analyzed for frequency, density and dominance using standard methodologies.
4. The relative values of frequency, density, and dominance of all the recorded species was summed up to represent Importance Value Index (IVI).

IVI = Relative frequency + Relative density + Relative dominance

C. Faunal Study

Ground surveys are carried out by trekking the study area for identification of important animal groups such as birds, mammals and reptiles for sampling of animals through the following methods.

- For sampling birds/avifauna 'point sampling' along the fixed transects (foot trails) were done to record all the species of birds with the help of binoculars; field guides and photography for more than 1 hour on each transect (n=4).

- For sampling mammals, 'direct count on open width (20 m) transect' were used on the same transects. Besides, information on recent sightings/records of mammals by the locals was also collected from the study areas.
- 'Reptiles' mainly lizards were sampled by 'direct count on open width transects'.
- Secondary information collected from local villagers, published government data etc.

List of the endangered and endemic species as per the schedule of The Wildlife Protection Act, 1972

- Emphasis is given to identify avifauna and mammals to determine the presence and absence of Schedule-1 species, listed in The Wildlife Protection Act 1972, as well as in Red List of IUCN. Various methods used for study animals are as follows:

1. Point Survey Method: Observations were made at each site for 15-20 min duration.
2. Road Side Counts: The observer travelled by motor vehicles from site to site and all sightings were recorded.

3.16.4 SAMPLING LOCATIONS

The ecology and diversity survey were conducted in 6 sampling locations within the study area. It is observed that human settlements present within the study area and many of villages have water bodies harboring moderate diversity of water birds. During site assessment several floral species encountered within the study area. The following locations were surveyed within the study area during the field visits as given in Table 3.20.

Table 3.20: Details of locations for plot survey

Sl.No.	Name of village	Plot No.	Latitude	Longitude
1	Near Putimari	EB1	26°41'34.01"N	88°20'12.57"E
2	Near Kamalpur	EB2	26°42'42.47"N	88°18'23.33"E
3	Near Liohakaichi	EB3	26°40'28.63"N	88°18'9.48"E
4	Near Antigach	EB4	26°38'10.36"N	88°19'27.64"E
5	Near Kalaram	EB5	26°39'57.74"N	88°21'54.85"E
6	Near Ranidanga	EB6	26°40'54.64"N	88°21'59.21"E

Source: ABC Techno Labs India Pvt. Ltd.

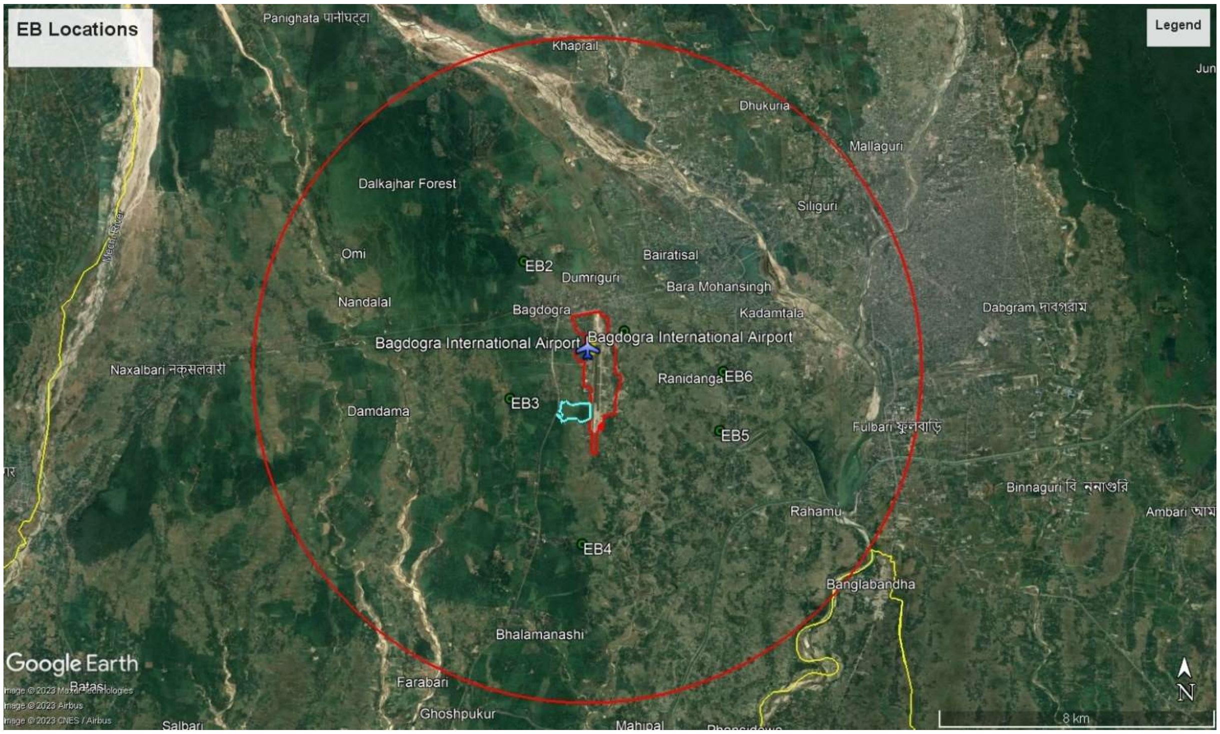


Figure 3.20: Locations of sampling for plot survey

3.16.5 FLORA IN THE STUDY AREA

During the primary survey, about 96 floral species observed. The most dominant tree species in the entire study area was dominated *Acacia auriculiformis, Shorea robusta, Ziziphus jujuba, Borassus flabellifer, Lannea coromandelica, Cordia pinnata, Azadirachta indica* etc. Most dominant shrubs in the study area were *Calotropis procera, Hibiscus rosa-sinensis, Leea asiatica, Woodfordia fruticosa, Caesalpina pulcherrima, Nerium odorum, Ziziphus xylopyrus* etc. Among the herb species observed are *Cynodon dactylon, Datura metel, Amaranthus spinosus, Cyperus rotundus, Oplismenus burmannii, Imperata cylindrica* etc. The list of flora observed in the entire study area is given below.

The list of flora observed in the buffer zone is given below:

Table 3.21: List of Flora observed in the study area

Sl. No	Scientific Name	Local name/ Common name	Family	IUCN Conservation Status
Tree				
1	*Albizia lebbeck*	Sirish	Fabaceae	Least Concern
2	*Acacia auriculiformis*	Setbabul	Fabaceae	Least Concern
3	*Tectona grandis*	Segun	Lamiaceae	Endangered
4	*Terminalia arjuna*	Arjun	Combretaceae	Least Concern
5	*Acacia nilotica*	Babla	Fabaceae	Least Concern

Sl. No	Scientific Name	Local name/ Common name	Family	IUCN Conservation Status
6	*Mangifera indica*	Aam	Anacardiaceae	Data Deficient
7	*Shorea robusta*	Sal	Dipterocarpaceae	Least Concern
8	*Ziziphus jujuba*	Kul	Rhamnaceae	Least Concern
9	*Aegle marmelos*	Bel	Rutaceae	Near Threatened
10	*Borassus flabellifer*	Taal	Arecaceae	Not assessed
11	*saurauia napaulensis*	Gogun	Actinidaceae	Least Concern
12	*Emblica officinalis*	Amlokhi	Phyllanthaceae	Least Concern
13	*Alangium salvifolium*	Akol	Alanginaceae	Not assessed
14	*Buchanania lanzan*	Charoli	Anacardiaceae	Not assessed
15	*Lannea coromandelica*	Indian Ash Tree	Anacardiaceae	Least Concern
16	*mangifera sylvatica*	Chuche Anp	Anacardiaceae	Least Concern
17	*Semecarpur anacardium*	Bhillava	Anacardiaceae	Least Concern
18	*Holarrhena pubescens*	Kurchi	Apocynaceae	Least Concern
19	*Azadirachta indica*	Neem	Meliaceae	Least Concern
20	*Nephelium litchi*	Litchi	Anacardiaceae	Not assessed
21	*Wrightia arborea*	Dharauli	Apocynaceae	Least Concern
22	*Heteropanax fragrans*	Fragrant Aralia	Araliaceae	Not assessed
23	*Trevesia Palmata*	Snowflake Tree	Araliaceae	Least Concern
24	*Caryota urens*	Rangbhang	Arecaceae	Least Concern
25	*Phoenix rupicola*	cliff date palm	Arecaceae	Near Threatened
26	*Alnus nepalensis*	Utis	Betulaceae	Least Concern
27	*Betula alnoides*	Himalayan Birch	Betulaceae	Least Concern
28	*Oroxylum indicum*	Sona pata	Bignoniaceae	Not assessed
29	*Cordia pinnata*	korobi	Burseraceae	Not assessed
30	*Tamarindus indica*	Tetul	Fabaceae	Least Concern
31	*Spondias pinnata*	Amra	Anacardiaceae	Not assessed
32	*Areca catechu*	Supari	Arecaceae	Data Deficient
33	*Dalbergia sissoo*	Shishoo	Fabaceae	Least Concern
34	*Cocos nucifera*	Coconut	Arecaceae	Not assessed
35	*Syzygium cumini*	Jamun	Myrtaceae	Least Concern
36	*Ficus benghalensis*	Bot	Moraceae	Not assessed
37	*Bombax malabaricum*	Katseori Roktosimul	Bombacaceae	Least Concern
38	*Eriodendron anfractuosum*	White Silk Cotton Tree	Bombacaceae	Least Concern
39	*Cassia fistula*	Amaltas	Caesalpiniae	Least Concern
40	*Lagerstroemia speciosa*	Jarul	Lythraceae	Not assessed
41	*Melia azadiractha*	Ghora neem	Meliaceae	Not assessed
42	*Alstonia scholaris*	Chatim	Apocynaceae	Least Concern
43	*Mitragyna parviflora*	Dharakadam	Rubiaceae	Not assessed

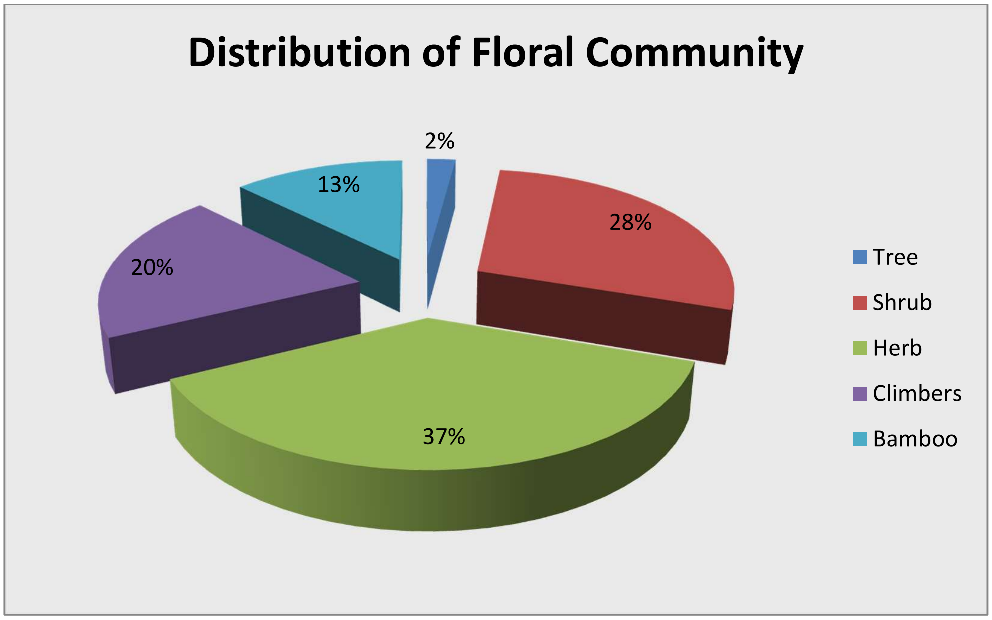
Sl. No	Scientific Name	Local name/ Common name	Family	IUCN Conservation Status
44	*Bauhinia accuminata*	Shwet Kanchan	Caesalpiniae	Not assessed
45	*Peltophorum inerme*	Radhachura	Caesalpiniae	Not assessed
46	*Casuarina equisetifolia*	Jhau	Caesalpiniae	Least Concern
47	*Ficus elastica*	Rabar Gach	Moraceae	Least Concern
48	*Psidium guajava*	Guava	Myrtaceae	Least Concern
49	*Excoecaria agallocha*	Geanoa	Euphorbiaceae	Least Concern
50	*Sesbania grandiflora*	Bakful	Fabaceae	Not assessed
51	*Butea monosperma*	Palas	Fabaceae	Least Concern
52	*Gliricidia sepium*	Saranga	Fabaceae	Least Concern
53	*Bauhinia variegata*	Rakta kanchan	Caesalpinaceae	Least Concern
54	*Cinnamomum tamala*	Tej patta	Lauraceae	Least Concern
55	*Bombax ceiba*	Shimlu	Malvaceae	Least Concern
56	*Madhuca longifolia*	Mahua	Sapotaceae	Not assessed
57	*Cassia siamea*	Minjiri	Caesalpiniaceae	Least Concern
58	*Albizia procera*	Safed Siris	Mimosaceae	Least Concern
59	*Cassia fistula*	Amaltas	Fabaceae	Least Concern
60	*Lyonia ovalifolia*	Angeri	Ericaceae	Least Concern
61	*Rhododendron arboreum*	Azalea	Ericaceae	Least Concern
62	*Lithocarpus pachphylla*	Thick Leaved Oak	Fagaceae	Not assessed
63	*Quercus glauca*	Ring-cupped oak	Fagaceae	Least Concern
64	*Exbucklandia populnea*	Pipli Tree	Hamamelidaceae	Least Concern
65	*Delonix regia*	Gulmohar	Fabaceae	Least Concern
66	*Achras zapota*	chikku	Sapotaceae	Least Concern
67	*Citrus sp*	Lembu	Rutaceae	Not assessed
68	*Erythrinia variegata*	Indian coral tree	Fabaceae	Not assessed
69	*Pongamia pinnata*	Karanj	Fabaceae	Least Concern
70	*Polyalthia longifolia*	Debdaru	Annonaceae	Not assessed
71	*Lagerstroemia parviflora*	Sida	Lythraceae	Least Concern
72	*Aphanamixis polystachya*	Pithraj	Meliaceae	Least Concern
73	*Chukrasia tabularis*	Chekrasi	Meliaceae	Least Concern
74	*Mesua ferrea*	Nageswar	Calophyllaceae	Not assessed
75	*Nyctanthes arbortristis*	Coral jasmine	Oleaceae	Not assessed
76	*Michelia champaca*	Chompa	Apocynaceae	Least Concern
77	*Anthocephalus cadamba*	Kadam	Rubiaceae	Not assessed
78	*Moringa oleifera*	Drum stick	Moringaceae	Least Concern
79	*Terminalia bellirica*	Baheda	Combretaceae	Least Concern
80	*Terminalia crenulata*	Asan	Combretaceae	Not assessed
81	*Terminalia myriocarpa*	Almond	Combretaceae	Not assessed
82	*Leucaena leucocephala*	Subabul	Fabaceae	Not assessed

Sl. No	Scientific Name	Local name/ Common name	Family	IUCN Conservation Status
83	*Ziziphus mauritiana*	Indian plum	Rhamnaceae	Least Concern
84	*Annona squamosa*	Ata	Annonaceae	Least Concern
85	*Ficus religiosa*	Asbattha	Moraceae	Least Concern
86	*Ceiba pentandra*	Boga-simalu	Malvaceae	Least Concern
87	*Eucalyptus globulus*	Eucalyptus	Myrtle	Least Concern
88	*Ficus hispida*	Dumur	Moraceae	Least Concern
89	*Terminalia chebula*	Haritoky	Combretaceae	Least Concern
90	*Bauhinia purpurea*	Kanchan	Fabaceae	Least Concern
91	*Artocarpus heterophyllus*	Kanthal	Moraceae	Not assessed
Shrub				
1	*Calotropis procera*	Aakanda	Apocynaceae	Least Concern
2	*Hibiscus rosa-sinensis*	Jaba Phool	Malvaceae	Not assessed
3	*Leea asiatica*	Galeni	Leeaceae	Not assessed
4	*Woodfordia fruticosa*	Fire flame Bush	Malvaceae	Least Concern
5	*Hypericum uralum*	Yurilo	Hypericaceae	Not assessed
6	*Lantana camara*	Putus	Verbenaceae	Not assessed
7	*Musa paradisiaca*	Kela	Musaceae	Not assessed
8	*Combertum indicum*	Madhu malati	Combertaceae	Not assessed
9	*Caesalpina pulcherrima*	Peacock flower	Caesalpinaceae	Not assessed
10	*Nyctanthes arbor-tristis*	Shiuli	Oleaceae	Least Concern
11	*Hydrangea aspera*	Phirephire Ghans	Hydrangeaceae	Least Concern
12	*Nerium odorum*	Karabi	Apocynaceae	Not assessed
13	*Ziziphus xylopyrus*	Katber	Rhamnaceae	Not assessed
14	*Phoenix acaulis*	Khejur	Arecaceae	Not assessed
15	*justicia adhatoda*	Basak	Acanthacea	Least Concern
16	*Jasminum elongatem*	Jesmin	Oleaceae	Not assessed
17	*Ipomoea carnea*	Dhol Kalmi	Convolvulaceae	Not assessed
18	*Morinda angustifolia*	Daruhoridra	Rubiaceae	Not assessed
19	*Cassia alata*	Candle bush	Fabaceae	Least Concern
20	*Clerodendrum indicum*	Akalbih	Lamiaceae	Not assessed
21	*Cassia tora*	Chakunda	Fabaceae	Not assessed
22	*Murraya paniculata*	Kamini	Rutaceae	Least Concern
23	*Jatropha curcas*	Bherenda	Euphorbiaceae	Least Concern
24	*Tabernaemontana divaricata*	Thoka Tagar	Apocynaceae	Least Concern
25	*Thuja occidentalis*	Thuja	Cupressaceae	Least Concern
26	*Hyptis suaveolens*	Buno tulsi	Lamiaceae	Not assessed
27	*Hymenodictyon excelsum*	Ban kadam	Rubiaceae	Not assessed
Herb & Grasses				
1	*Cynodon dactylon*	Durba ghas	Poaceae	Not assessed

Sl. No	Scientific Name	Local name/ Common name	Family	IUCN Conservation Status
2	*Datura metel*	Dhutra	Solanaceae	Not assessed
3	*Amaranthus spinosus*	Kantanotya	Amaranthaceae	Not assessed
4	*Rauwolfia serpentina*	Nagbeli	Apocynaceae	Not assessed
5	*Saccharum spontaneum*	Khasful	Poaceae	Least Concern
6	*Lagenaria siceraria*	Lauki	Cucurbitaceae	Not assessed
7	*Tinospora sinensis*	Padma Gulancha	Menipermaceae	Not assessed
8	*Momordica dioica*	Jangli karela	Cucurbitaceae	Not assessed
9	*Ocimum sanctum*	Tulsi	Lamiaceae	Not assessed
10	*Xanthium strumarium*	Gokru	Asteraceae	Not assessed
11	*Ageratum conyzoides*	Nakful	Asteraceae	Not assessed
12	*Andropogon contortus*	Spear grass	Poaceae	Not assessed
13	*Oplismenus burmannii*	Burmanns basket grass	Poaceae	Not assessed
14	*Cyperus rotundus*	Nut Grass	Cyperaceae	Least Concern
15	*Commelina diffusa*	Jalpari	Commelinaceae	Least Concern
16	*Abutilon indicum*	Potari	Malvaceae	Not assessed
17	*Boerhavia diffusa*	Punarnava	Nyctaginaceae	Not assessed
18	*Amaranthus viridis*	Note shak	Amaranthaceae	Not assessed
19	*Acalypha indica*	Muktajhuri	Euphorbiaceae	Not assessed
20	*Parthenium hysterophorus*	Gajar Ghas	Asteraceae	Not assessed
21	*Cassia occidentalis*	Kalkashunda	Fabaceae	Least Concern
22	*Cannabis sativa*	Cannabis sativa	Cannabaceae	Not assessed
23	*Desmodium triflorum*	Kudaliya	Fabaceae	Least Concern
24	*Microlepia speluncae*	Lace Fern	Dennstaedtiaceae	Not assessed
25	*Zingiber offcinale*	Ada	Zingiberaceae	Not assessed
26	*Nephrolepis auriculata*	Boston fern	Nephrolepidaceae	Least Concern
27	*Cyperus rotundus*	Bada	Cyperaceae	Least Concern
28	*Imperata cylindrica*	Bady grass	Poaceae	Least Concern
29	*Cymbopogon citratus*	Lemon grass	Poaceae	Least Concern
30	*Dactyloctenium aegyptium*	Makorjali	Poaceae	Not assessed
31	*Eleusine indica*	Indian goosegrass	Poaceae	Least Concern
32	*Sesamum indicum*	Til	Pedaliaceae	Not assessed
33	*Curcuma zedoaria*	Kochura	Zingiberaceae	Not assessed
34	*Catharanthus roseus*	Nayantara	Apocynaceae	Not assessed
35	*Curcuma longa*	Halud	Zingiberaceae	Not assessed
36	*Mimosa rubicaulis*	Lojjaboti	Fabaceae	Not assessed
Climbers				
1	*Basella rubra*	Pui shak	Basellaceae	Not assessed

Sl. No	Scientific Name	Local name/ Common name	Family	IUCN Conservation Status
2	*Clitoria ternatea*	Aparajita	Fabaceae	Not assessed
3	*Hoya parasitica*	Wax plant	Asclepiadaceae	Not assessed
4	*Herpetospermum pedunculosum*	Pumpkin	Cucurbitaceae	Not assessed
5	*Abrus precatorius*	Kunchmoni	Fabaceae	Not assessed
6	*Ipomea mauritiana*	Bhumikumra	Convolvulaceae	Not assessed
7	*Tinosporia cordifolia*	Gulancha	Menispermiaceae	Not assessed
8	*Solena amplexicaulis*	Kudri	Cucurbitaceae	Not assessed
9	*Coccinia grandis*	Telakucha	Cucurbitaceae	Not assessed
10	*Cuscuta reflexa*	Swarna Lata	Convolvulaceae	Least Concern
11	*Ipomoea quamoclit*	Kunja Lota	Convolvulaceae	Not assessed
12	*Ipomoea reptans*	Kalmi Shak	Convolvulaceae	Not assessed
13	*Ipomoea obscura*	Charulata	Convolvulaceae	Not assessed
14	*Asparagus racemosus*	Shatavari	Asparagaceae	Not assessed
15	*Acacia sinuata*	Shikakai	Mimosaceae	Not assessed
16	*Ipomoea nil*	Kaladana	Convolvulaceae	Not assessed
17	*Allamanda cathartica*	Harkakra	Apocynaceae	Not assessed
18	*Cucurbita moschata*	Mitha Lau	Cucurbitaceae	Not assessed
19	*Passiflora foetida*	Jhumka Lota	Passifloraceae	Not assessed
20	*Actinidia Callosa*	Theki Phal	Actinidaceae	Not assessed
Bamboos				
1	*Himalayacalamus hookerianus*	Pareng Bans	Poaceae	Not assessed
2	*Bombusa vulgaris*	Common bamboo	Poaceae	Not assessed
3	*Arundinaria intermediate*	Malingo	Poaceae	Not assessed
4	*Arundinaria maling*	Bhaluka bamboo	Poaceae	Not assessed
5	*Cephalostachyum capitatium*	Dallo Bans	Poaceae	Not assessed
6	*Cynadon dactylon*	Duboo	Poaceae	Not assessed
7	*Capillipedium assimile*	Scented-tops	Poaceae	Not assessed
8	*Oplismenus Burmanii*	Wavy-Leaf Basketgrass	Poaceae	Not assessed
9	*Oplismenus compositus*	Running Mountain Grass	Poaceae	Not assessed
10	*Setaria palmifolia*	Palmgrass	Poaceae	Not assessed
11	*Isachne globosa*	Marsh Milet	Poaceae	Not assessed
12	*Melocana baccifera*	Philing Bans	Poaceae	Not assessed

Source: ABC Techno Labs India Pvt. Ltd.



- **Economically Important Flora of the study area**

Medicinal plant species: The nearby area is also endowed with the several medicinal plants which are commonly available in the shrub forest. The common medicinal plant of the region is *Azadirachta indica* (Neem).

Fuel wood plant species: Local villagers use to collect dry leaves, stems and log to fulfil their daily need for fuel wood requirement. *Azadirachta indica* (Neem), *Mangifera indica* etc. are the species used for fuel wood collection from the surrounding forest area.

Rare and endangered floral species: As per IUCN red list *Tectona grandis* (Teku) categorized as endangered species. During the vegetation survey in the study area did not encounter any such species which are endangered or threatened under IUCN (International Union for Conservation of Nature and Natural resources) guidelines.

- **Phytosociological Analysis**

Regeneration of trees in the study area is better than herbs and shrubs. The density and composition of vegetation is more near the forest area whereas low in the agricultural and village areas. Grasses mainly cover open degraded land. Herbs and shrubs are abundant mostly during monsoon whereas during the summer land turns dry.

Phytosociological parameters, such as, density, frequency and importance value index of individual species were determined in randomly placed quadrats of different sizes in the study area. Relative frequency, relative basal area and relative density were calculated and the sum of these three represented Importance Value Index (IVI) for various species. For shrubs, herbs and seedlings, the IVI was calculated by summing up relative frequency, relative density and relative abundance.

Sample plots were selected in such a way to get maximum representation of different types of vegetation and plots were laid out in different part of the study area. Analysis of the vegetation will help in determining the relative importance of each species in the study area and to reveal if any economically valuable species is threatened in the process. Phytosociological analysis of tree species is shown in Table 3.22.

Table 3.22: Phytosociological Analysis of Plant Species

Sl.No.	Scientific name	Local name	Total No.	Total no. of quad with sp.	Total No. of quad	Density	Relative Density	Frequency %	Relative Frequency	Abundance	Relative Abundance	IVI
Tree Species												
1	*Albizia lebbeck*	Sirish	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
2	*Acacia auriculiformis*	Setbabul	6	6	6	1.00	**1.71**	100.0	**1.8**	1.00	**0.02**	**3.50**
3	*Tectona grandis*	Segun	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
4	*Terminalia arjuna*	Arjun	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
5	*Acacia nilotica*	Babla	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
6	*Mangifera indica*	Aam	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
7	*Shorea robusta*	Sal	8	6	6	1.33	2.29	100.0	1.8	1.33	0.02	4.07
8	*Ziziphus jujuba*	Kul	8	6	6	1.33	2.29	100.0	1.8	1.33	0.02	4.07
9	*Aegle marmelos*	Bel	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
10	*Borassus flabellifer*	Taal	7	6	6	1.17	2.00	100.0	1.8	1.17	0.02	3.78
11	*saurauia napaulensis*	Gogun	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
12	*Emblica officinalis*	Amlokhi	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
13	*Alangium salvifolium*	Akol	6	6	6	1.00	1.71	100.0	1.8	1.00	0.02	3.50
14	*Buchanania lanzan*	Charoli	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
15	*Lannea coromandelica*	Indian Ash Tree	7	6	6	1.17	2.00	100.0	1.8	1.17	0.02	3.78
16	*Mangifera sylvatica*	Chuche Anp	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
17	*Semecarpur anacardium*	Bhillava	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
18	*Holarrhena pubescens*	Kurchi	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
19	*Azadirachta indica*	Neem	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
20	*Nephelium litchi*	Litchi	2	2	6	0.33	0.57	33.3	0.6	1.00	0.01	1.17
21	*Wrightia arborea*	Dharauli	2	2	6	0.33	0.57	33.3	0.6	1.00	0.01	1.17
22	*Heteropanax fragrans*	Fragrant Aralia	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33

Sl.No.	Scientific name	Local name	Total No.	Total no. of quad with sp.	Total No. of quad	Density	Relative Density	Frequency %	Relative Frequency	Abundance	Relative Abundance	IVI
23	*Trevesia Palmata*	Snowflake Tree	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
24	*Caryota urens*	Rangbhang	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
25	*Phoenix rupicola*	cliff date palm	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
26	*Alnus nepalensis*	Utis	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
27	*Betula alnoides*	Himalayan Birch	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
28	*Oroxylum indicum*	Sona pata	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
29	*Cordia pinnata*	korobi	6	5	6	1.00	1.71	83.3	1.5	1.20	0.02	3.20
30	*Tamarindus indica*	Tetul	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
31	*Spondias pinnata*	Amra	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
32	*Areca catechu*	Supari	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
33	*Dalbergia sissoo*	Shishoo	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
34	*Cocos nucifera*	Coconut	2	2	6	0.33	0.57	33.3	0.6	1.00	0.01	1.17
35	*Syzygium cumini*	Jamun	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
36	*Ficus benghalensis*	Bot	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
37	*Bombax malabaricum*	Katseori Roktosimul	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
38	*Eriodendron anfractuosum*	White Silk Cotton Tree	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
39	*Cassia fistula*	Amaltas	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
40	*Lagerstroemia speciosa*	Jarul	2	2	6	0.33	0.57	33.3	0.6	1.00	0.01	1.17
41	*Melia azadiractha*	Ghora neem	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
42	*Alstonia scholaris*	Chatim	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
43	*Mitragyna parviflora*	Dharakadam	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
44	*Bauhinia accuminata*	Shwet Kanchan	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
45	*Peltophorum inerme*	Radhachura	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33

Sl.No.	Scientific name	Local name	Total No.	Total no. of quad with sp.	Total No. of quad	Density	Relative Density	Frequency %	Relative Frequency	Abundance	Relative Abundance	IVI
46	*Casuarina equisetifolia*	Jhau	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
47	*Ficus elastica*	Rabar Gach	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
48	*Psidium guajava*	Guava	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
49	*Excoecaria agallocha*	Geanoa	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
50	*Sesbania grandiflora*	Bakful	3	2	6	0.50	0.86	33.3	0.6	1.50	0.01	1.45
51	*Butea monosperma*	Palas	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
52	*Gliricidia sepium*	Saranga	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
53	*Bauhinia variegata*	Rakta kanchan	1	1	6	0.17	0.29	16.7	0.3	1.00	0.00	0.58
54	*Cinnamomum tamala*	Tej patta	2	2	6	0.33	0.57	33.3	0.6	1.00	0.01	1.17
55	*Bombax ceiba*	Shimlu	2	2	6	0.33	0.57	33.3	0.6	1.00	0.01	1.17
56	*Madhuca longifolia*	Mahua	2	2	6	0.33	0.57	33.3	0.6	1.00	0.01	1.17
57	*Cassia siamea*	Minjiri	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
58	*Albizia procera*	Safed Siris	6	6	6	1.00	1.71	100.0	1.8	1.00	0.02	3.50
59	*Cassia fistula*	Amaltas	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
60	*Lyonia ovalifolia*	Angeri	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
61	*Rhododendron arboreum*	Azalea	1	1	6	0.17	0.29	16.7	0.3	1.00	0.00	0.58
62	*Lithocarpus pachphylla*	Thick Leaved Oak	2	2	6	0.33	0.57	33.3	0.6	1.00	0.01	1.17
63	*Quercus glauca*	Ring-cupped oak	1	1	6	0.17	0.29	16.7	0.3	1.00	0.00	0.58
64	*Exbucklandia populnea*	Pipli Tree	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
65	*Delonix regia*	Gulmohar	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
66	*Achras zapota*	chikku	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
67	*Citrus sp*	Lembu	1	1	6	0.17	0.29	16.7	0.3	1.00	0.00	0.58
68	*Erythrinia variegata*	Indian coral tree	2	2	6	0.33	0.57	33.3	0.6	1.00	0.01	1.17
69	*Pongamia pinnata*	Karanj	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91

Sl.No.	Scientific name	Local name	Total No.	Total no. of quad with sp.	Total No. of quad	Density	Relative Density	Frequency %	Relative Frequency	Abundance	Relative Abundance	IVI
70	*Polyalthia longifolia*	Debdaru	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
71	*Lagerstroemia parviflora*	Sida	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
72	*Aphanamixis polystachya*	Pithraj	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
73	*Chukrasia tabularis*	Chekrasi	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
74	*Mesua ferrea*	Nageswar	2	2	6	0.33	0.57	33.3	0.6	1.00	0.01	1.17
75	*Nyctanthes arbortristis*	Coral jasmine	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
76	*Michelia champaca*	Chompa	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
77	*Anthocephalus cadamba*	Kadam	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
78	*Moringa oleifera*	Drum stick	5	4	6	0.83	1.43	66.7	1.2	1.25	0.01	2.62
79	*Terminalia bellirica*	Baheda	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
80	*Terminalia crenulata*	Asan	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
81	*Terminalia myriocarpa*	Almond	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
82	*Leucaena leucocephala*	Subabul	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
83	*Ziziphus mauritiana*	Indian plum	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
84	*Annona squamosa*	Ata	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
85	*Ficus religiosa*	Asbattha	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
86	*Ceiba pentandra*	Boga-simalu	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
87	*Eucalyptus globulus*	Eucalyptus	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
88	*Ficus hispida*	Dumur	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
89	*Terminalia chebula*	Haritoky	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
90	*Bauhinia purpurea*	Kanchan	7	6	6	1.17	2.00	100.0	1.8	1.17	0.02	3.78
91	*Artocarpus heterophyllus*	Kanthal	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
	Total		**350**	**340**	**546**							
Shrub Species												

Sl.No.	Scientific name	Local name	Total No.	Total no. of quad with sp.	Total No. of quad	Density	Relative Density	Frequency %	Relative Frequency	Abundance	Relative Abundance	IVI
1	*Calotropis procera*	Aakanda	10	6	6	1.67	**2.86**	100.0	**1.8**	1.67	**0.03**	**4.65**
2	*Hibiscus rosa-sinensis*	Jaba Phool	7	6	6	1.17	2.00	100.0	1.8	1.17	0.02	3.78
3	*Leea asiatica*	Galeni	6	5	6	1.00	1.71	83.3	1.5	1.20	0.02	3.20
4	*Woodfordia fruticosa*	Fire flame Bush	7	6	6	1.17	2.00	100.0	1.8	1.17	0.02	3.78
5	*Hypericum uralum*	Yurilo	8	5	6	1.33	2.29	83.3	1.5	1.60	0.02	3.78
6	*Lantana camara*	Putus	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
7	*Musa paradisiaca*	Kela	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
8	*Combertum indicum*	Madhu malati	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
9	*Caesalpina pulcherrima*	Peacock flower	7	6	6	1.17	2.00	100.0	1.8	1.17	0.02	3.78
10	*Nyctanthes arbor-tristis*	Shiuli	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
11	*Hydrangea aspera*	Phirephire Ghans	6	6	6	1.00	1.71	100.0	1.8	1.00	0.02	3.50
12	*Nerium odorum*	Karabi	8	6	6	1.33	2.29	100.0	1.8	1.33	0.02	4.07
13	*Ziziphus xylopyrus*	Katber	7	6	6	1.17	2.00	100.0	1.8	1.17	0.02	3.78
14	*Phoenix acaulis*	Khejur	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
15	*justicia adhatoda*	Basak	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
16	*Jasminum elongatem*	Jesmin	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
17	*Ipomoea carnea*	Dhol Kalmi	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
18	*Morinda angustifolia*	Daruhoridra	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
19	*Cassia alata*	Candle bush	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
20	*Clerodendrum indicum*	Akalbih	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
21	*Cassia tora*	Chakunda	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
22	*Murraya paniculata*	Kamini	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
23	*Jatropha curcas*	Bherenda	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33

Sl.No.	Scientific name	Local name	Total No.	Total no. of quad with sp.	Total No. of quad	Density	Relative Density	Frequency %	Relative Frequency	Abundance	Relative Abundance	IVI
24	*Tabernaemontana divaricata*	Thoka Tagar	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
25	*Thuja occidentalis*	Thuja	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
26	*Hyptis suaveolens*	Buno tulsi	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
27	*Hymenodictyon excelsum*	Ban kadam	5	4	6	0.83	1.43	66.7	1.2	1.25	0.01	2.62
	Total		**142**	**127**	**162**						**0.41**	
	Herb Species											
1	*Cynodon dactylon*	Durba ghas	20	6	6	3.33	5.71	100.0	1.8	3.33	0.06	7.54
2	*Datura metel*	Dhutra	15	6	6	2.50	4.29	100.0	1.8	2.50	0.04	6.09
3	*Amaranthus spinosus*	Kantanotya	12	6	6	2.00	3.43	100.0	1.8	2.00	0.03	5.23
4	*Rauwolfia serpentina*	Nagbeli	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
5	*Saccharum spontaneum*	Khasful	8	6	6	1.33	2.29	100.0	1.8	1.33	0.02	4.07
6	*Lagenaria siceraria*	Lauki	6	6	6	1.00	1.71	100.0	1.8	1.00	0.02	3.50
7	*Tinospora sinensis*	Padma Gulancha	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
8	*Momordica dioica*	Jangli karela	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
9	*Ocimum sanctum*	Tulsi	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
10	*Xanthium strumarium*	Gokru	6	5	6	1.00	1.71	83.3	1.5	1.20	0.02	3.20
11	*Ageratum conyzoides*	Nakful	6	5	6	1.00	1.71	83.3	1.5	1.20	0.02	3.20
12	*Andropogon contortus*	Spear grass	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
13	*Oplismenus burmannii*	Burmanns basket grass	9	6	6	1.50	2.57	100.0	1.8	1.50	0.03	4.36
14	*Cyperus rotundus*	Nut Grass	10	6	6	1.67	2.86	100.0	1.8	1.67	0.03	4.65
15	*Commelina diffusa*	Jalpari	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
16	*Abutilon indicum*	Potari	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
17	*Boerhavia diffusa*	Punarnava	3	2	6	0.50	0.86	33.3	0.6	1.50	0.01	1.45

Sl.No.	Scientific name	Local name	Total No.	Total no. of quad with sp.	Total No. of quad	Density	Relative Density	Frequency %	Relative Frequency	Abundance	Relative Abundance	IVI
18	*Amaranthus viridis*	Note shak	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
19	*Acalypha indica*	Muktajhuri	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
20	*Parthenium hysterophorus*	Gajar Ghas	8	6	6	1.33	2.29	100.0	1.8	1.33	0.02	4.07
21	*Cassia occidentalis*	Kalkashunda	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
22	*Cannabis sativa*	Cannabis sativa	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
23	*Desmodium triflorum*	Kudaliya	6	6	6	1.00	1.71	100.0	1.8	1.00	0.02	3.50
24	*Microlepia speluncae*	Lace Fern	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
25	*Zingiber offcinale*	Ada	3	3	6	0.50	0.86	50.0	0.9	1.00	0.01	1.75
26	*Nephrolepis auriculata*	Boston fern	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
27	*Cyperus rotundus*	Bada	2	2	6	0.33	0.57	33.3	0.6	1.00	0.01	1.17
28	*Imperata cylindrica*	Bady grass	9	6	6	1.50	2.57	100.0	1.8	1.50	0.03	4.36
29	*Cymbopogon citratus*	Lemon grass	6	4	6	1.00	1.71	66.7	1.2	1.50	0.02	2.91
30	*Dactyloctenium aegyptium*	Makorjali	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
31	*Eleusine indica*	Indian goosegrass	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
32	*Sesamum indicum*	Til	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
33	*Curcuma zedoaria*	Kochura	8	6	6	1.33	2.29	100.0	1.8	1.33	0.02	4.07
34	*Catharanthus roseus*	Nayantara	4	4	6	0.67	1.14	66.7	1.2	1.00	0.01	2.33
35	*Curcuma longa*	Halud	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
36	*Mimosa rubicaulis*	Lojjaboti	5	5	6	0.83	1.43	83.3	1.5	1.00	0.01	2.91
	Total		**221**	**171**	**216**						**0.63**	

Source: ABC Techno Labs India Pvt. Ltd.

The interpretation vegetation study results of the study area are presented in the following Table 3.23.

Table 3.23: Interpretation of Vegetation Results in the Study Area

Relative density	Relative density is found to be maximum for *Shorea robusta*– 2.29	Density of primary species is found to be much higher in comparison with the other species.
Relative frequency	Maximum RF found to be 1.8 in case of *Shorea robusta*	Vegetation community is heterogenous in nature
Relative Abundance	Maximum value observed in case of *Shorea robusta* is about 0.02.	*Shorea robusta* is the most common species found in the area.
Importance Value Index (IVI	The maximum IVI value observed in case of *Shorea robusta* is about 4.07.	The dominant species are *Shorea robusta*.

Source: ABC Techno Labs India Pvt. Ltd.

- **Biodiversity Indices**

Biodiversity index is a quantitative measure that reflects how many different types species, there are in a dataset, and simultaneously takes into account how evenly the basic entities (such as individuals) are distributed among those types of species. The value of biodiversity index increases both when the number of types increases and when evenness increases. For a given number of type of species, the value of a biodiversity index is maximized when all type of species are equally abundant. Interpretation of Vegetation results in the study area is given in Table 3.24.

Table 3.24: Biodiversity Indices in the Study Area

Community	Biodiversity indices		
	Shannon-Wiener Index (H)	Simpson Diversity Index (1/D)	Species Evenness
Tree	4.44	0.99	0.15
Shrub	1.68	0.97	0.20
Herbs	2.47	0.97	0.22

Source: ABC Techno Labs India Pvt. Ltd.

From Table 3.26, it can be interpreted that tree community has highest diversity. While the shrub community shows less diversity. It is also observed that most of the quadrates have controlled generation of plant species with older strands. Higher tree species diversity can be interpreted as a greater number of successful species and a more stable ecosystem where more ecological niches are available and the environment is less likely to be hostile, environmental change is less likely to be damaging to the ecosystem as a whole.

3.16.6 FAUNA IN THE STUDY AREA

To prepare a detailed report on the status of faunal diversity within study area of 10 Km radius of study area, field studies were conducted. Both direct (sighting) and indirect (evidences) observations methods were used to survey the faunal species around the study area. Additionally, reference of relevant literatures (published/ unpublished) and dialogues with local villagers were also carried out to consolidate the presence of faunal distribution in the area *(Smith 1933-43, Ali and Ripley 1983, Daniel 1983, Prater 1993, Murthy and Chandrasekhar 1988).*

Mammals: No wild mammalian species was directly sighted during the field survey. Dialogue with local villagers located within the study area also could not confirm presence of any wild animal in that area. Rhesus Monkey, Common Grey Langur, Common Indian Mongoose, Palm squirrel, Banberal Katas, Five striped squirrel, Indian flying Fox, Three stripped Palm Squirrel, Indian Field Mouse, Indian Hare, Indian Crested Porcupine, Small India civet, House Shrew, Common otter were observed during primary survey.

Avifauna: Since birds are considered to be the indicators for monitoring and understanding human impacts on ecological systems *(Lawton, 1996)* attempt was made to gather quantitative data on the avifauna by walk through survey within the entire block area and surrounding area. From the primary survey, a total of 78 species of avifauna were identified and recorded from the entire block area and surrounding area. The diversity of avifauna from this region was found to be quite high and encouraging. List of animals present in the study area are given below:

Table 3.25: List of Fauna observed in the study area

Sl.No	Scientific name	English Name	Schedule of Wildlife Protection Act	Status as per IUCN Red Data List	Method
Mammals					
1	*Macaca mulatta*	Rhesus Monkey	II (Part I)	Least Concern	DS
2	*Semnopithecus entellus*	Common Grey Langur	II (Part I)	Least Concern	DS
3	*Cannomys badius*	Bay bamboo rat	V	Least Concern	DS
4	*Bandicota indica*	Large bandicoot Rat	V	Least Concern	DS
5	*Herpestes edwardsii*	Common Indian Mongoose	II	Least Concern	DS
6	*Funambulus palmarum*	Palm squirrel	IV	Least Concern	DS
7	*Felis chaus*	Banberal Katas	II (Part I)	Least Concern	NS
8	*Funambulus pennantii*	Five striped squirrel	IV	Least Concern	DS
9	*Pteropus giganteus*	Indian flying Fox	V	Least Concern	DS
10	*Funambulus palmarum*	Three stripped Palm Squirrel	IV	Least Concern	DS
11	*Mus booduga*	Indian Field Mouse	IV	Least Concern	DS

Sl.No	Scientific name	English Name	Schedule of Wildlife Protection Act	Status as per IUCN Red Data List	Method
12	*Lepus nigricollis*	Indian Hare	IV	Least Concern	DS
13	*Axis axis*	Chital	II	Least Concern	NS
14	*Rattus rattus*	Common house Rat	V	Least Concern	DS
15	*Hystrix indica*	Indian Crested Porcupine	IV	Least Concern	NS
16	*Viverricula indica*	Small India civet	II (Part I)	Least Concern	DS
17	*Tamiops mcclellandii*	Himalayan Striped Squirrel	IV	Least Concern	NS
18	*Suncus murinus*	House Shrew	IV	Least Concern	DS
19	*Lutra lutra*	Common otter	II (Part I)	Near threatened	DS
20	*Mus musculus*	Home mouse	V	Least Concern	DS
21	*Vulpes bengalensis*	Indian Fox	II (Part I)	Least Concern	NS
22	*Sus scrofa*	Wild Boar	III	Least Concern	NS
23	*Bandicota bengalensis*	Mole rat	V	Least Concern	DS
Birds					
1	*Acridotheres tristis*	Common myna	IV	Least Concern	DS
2	*Ceryle rudis*	Pied Kingfisher	IV	Least Concern	DS
3	*Anas poecilorhyncha*	Eastern Spot billed duck	IV	Least Concern	DS
4	*Ardea alba*	Great Egret	IV	Least Concern	DS
5	*Phalacrocorax niger*	Little cormorant	IV	Least Concern	DS
6	*Anas strepera*	Gadwall	IV	Least Concern	DS
7	*Spilopelia chinensis*	Spotted dove	IV	Least Concern	NS
8	*Acridotheres ginginianus*	Bank myna	IV	Least Concern	NS
9	*Dicrurus macrocercus*	Finge	IV	Least Concern	DS
10	*Eudynamys scolopceae*	Koel	IV	Not assessed	DS
11	*Grus grus*	Common crane	IV	Least Concern	DS
12	*Dicrurus leucophaeus*	Ashy Drongo	IV	Least Concern	DS
13	*Centropus sinensis*	Crow pheasant	IV	Least Concern	DS
14	*gracula religiosa*	Hill Myna	IV	Least Concern	NS
15	*Glareola lactea*	Small Indian pranticole	IV	Least Concern	DS
16	*Turdoides caudatus*	Common Babbler	IV	Least Concern	DS
17	*Psittacula alexandri*	Indian Red breasted Parakeet	IV	Near Threatened	DS
18	*Anas creaca*	Common Teal	IV	Not assessed	DS
19	*Ciconia epsioopus*	White necked stork	IV	Not assessed	DS
20	*Turdoides striata*	Jungle babbler	IV	Least Concern	DS
21	*Gallus gallus*	Red jungle fowl	IV	Least Concern	DS
22	*Turdus ruficollis*	Dark throated thrush	IV	Least Concern	DS
23	*Athene brama*	Spotted owlet	IV	Least Concern	DS

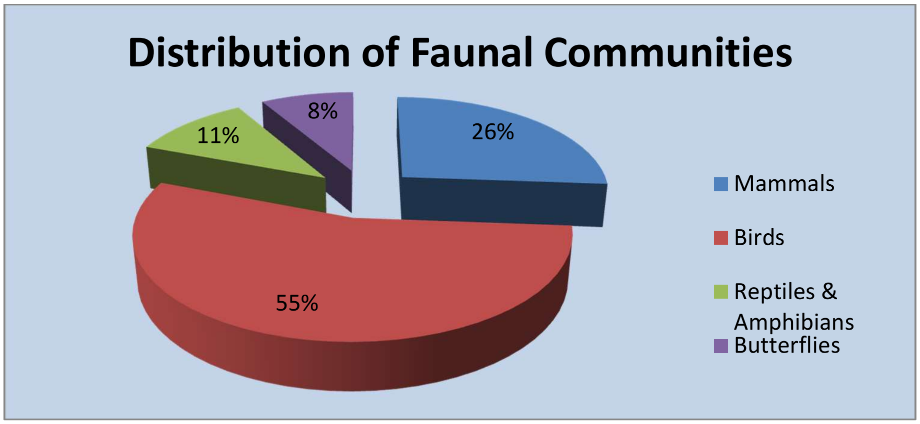
Sl.No	Scientific name	English Name	Schedule of Wildlife Protection Act	Status as per IUCN Red Data List	Method
24	*Centropus cinensis*	Crow pheasant	IV	Not assessed	NS
25	*Acridotheres fuscus*	Jungle myna	IV	Least Concern	NS
26	*Columbia livia*	Rock pigeon	IV	Not assessed	NS
27	*Eudynamys scolopacea*	Koel	IV	Least Concern	DS
29	*Bubulcus ibis*	Cattle egret	IV	Least Concern	DS
30	*Halcyon smyrnensis*	White-breasted kingfisher	IV	Least Concern	DS
31	*Alcedo atthis*	Small blue kingfisher	IV	Least Concern	DS
32	*Dendocitta vagabunda*	Indian tree pie	IV	Not assessed	DS
33	*Dicrurus adsimilis*	Black drongo	IV	Least Concern	DS
34	*Amaurornis phoenicurus*	White-breasted waterhen	IV	Least Concern	DS
35	*Anastomus oscitans*	Asian open billed stork	IV	Least Concern	DS
36	*Ciconia nigra*	Black stork	IV	Least Concern	DS
37	*Copsychus saularis*	Magpie robin	IV	Least Concern	DS
38	*Coracias benghalensis*	Indian roller	IV	Least Concern	DS
39	*Corvus macrorhynchos*	Indian jungle crow	V	Least Concern	DS
40	*Tyto alba*	Burn owl	IV	Least Concern	DS
41	*Upupa epops*	Common hoopoe	IV	Least Concern	DS
42	*Vanellus indicus*	Red-wattled lapwing	IV	Least Concern	DS
43	*Corvus splendens*	House crow	V	Least Concern	DS
44	*Cuculus micropterus*	Indian cuckoo	IV	Least Concern	DS
45	*Dendrocitta vagabunda*	Harichacha	IV	Least Concern	DS
46	*Dinopium benghalensis*	Golden backed woodpecker	IV	Not assessed	DS
47	*Oriolus xanthornus*	Black hooded oriole	IV	Least Concern	DS
48	*Streptopelia decaocto*	Eurasia collard dove	IV	Least Concern	DS
49	*Clamator jacobinus*	Pied cuckoo	IV	Least Concern	DS
50	*Turdoides striatus*	Jungle babbler	IV	Least Concern	DS
51	*Cisticola juncidis*	Streaked fantail warbler	IV	Least Concern	DS
52	*Columba livia*	Blue rock pigeon	IV	Least Concern	DS
53	*Aethopyga siparaja*	Indian yellow backed sunbird	IV	Least Concern	DS
54	*Egretta garzetta*	Little egret	IV	Least Concern	DS
55	*Accipiter badius*	Shikra	IV	Least Concern	DS
56	*Pericrocotus flammeus*	Scarlet minivet	IV	Least Concern	DS
57	*Hirundo rustica*	Common eastern swallow	IV	Least Concern	DS

Sl.No	Scientific name	English Name	Schedule of Wildlife Protection Act	Status as per IUCN Red Data List	Method
58	*Hydrophasianus chirurgus*	Pheasant-tailed Jacana	IV	Least Concern	DS
59	*Ixobrychus sinensis*	Yellow bittern	IV	Least Concern	DS
60	*Merops orientalis*	Small green bee-eater	IV	Least Concern	DS
61	*Lanius cristatus*	Brown shrike	IV	Least Concern	DS
62	*Lonchura malabarica*	White throated munia	IV	Least Concern	DS
63	*Oriolus oriolus*	Golden oriole	IV	Least Concern	DS
64	*Milvus migrans*	Common pariah kite	IV	Least Concern	DS
65	*Motacilla alba*	White wagtail	IV	Least Concern	DS
66	*Motacilla flava*	Yellow wagtail	IV	Least Concern	DS
67	*Nectarinia asiatica*	Purple sunbird	IV	Least Concern	DS
68	*Nectarinia zeylonica*	Indian Purple rumped sunbird	IV	Least Concern	DS
69	*Nycticorax nycticorax*	Night heron	IV	Least Concern	DS
70	*Anhinga melanogaster*	Indian Darter	IV	Near Threatened	DS
71	*Sterna aurantia*	River Tern	IV	Vulnerable	DS
72	*Orthotomus sutorius*	Common tailorbird	IV	Least Concern	DS
73	*Tephrodornis pondicerianus*	Common wood shrike	IV	Least Concern	DS
74	*Psittacula cyanocephala*	Blossom headed parakeet	IV	Least Concern	DS
75	*Psittacula krameri*	Rose-ringed parakeet	IV	Least Concern	DS
76	*Pycnonotus cafer*	Red-vented bulbul	IV	Least Concern	DS
77	*Saxicoloides fulicata*	Indian robin	IV	Least Concern	DS
78	*Streptopelia chinensis*	Spotted dove	IV	Least Concern	DS
Reptiles & Amphibians					
1	*Ptyas mucosus*	Yellow Rat Snake	II (Part II)	Not assessed	NS
2	*Bungarus caeruleus*	Common Indian Krait	IV	Not assessed	NS
3	*Bungarus fasciatus*	Banded krait	II	Least Concern	NS
4	*Naja kaouthia*	Monocled Cobra	II (Part II)	Least Concern	NS
5	*Sitana ponticerana*	Fan throated lizard	IV	Not assessed	NS
7	*Bufo melanostictus*	Common toad	IV	Not assessed	NS
8	*Bufo stomaticus*	India marbled toad	IV	Least Concern	NS
9	*Rana limnocharis*	Rice field frog	IV	Least Concern	NS
10	*Tomopterna breviceps*	Indian burrowing frog	IV	Not assessed	NS
11	*Hemidactylus gleadoviimaculatus*	Common house gecko	IV	Not assessed	NS
12	*Calotes versicolor*	Common garden lizard	IV	Not assessed	NS
13	*Hemidactylus flaviviridis*	House lizard	IV	Not assessed	NS

Sl.No	Scientific name	English Name	Schedule of Wildlife Protection Act	Status as per IUCN Red Data List	Method
14	*Varanus varanus*	Tree lizard	II	Not assessed	NS
15	*Burngarus caeruleus*	Common Indian krait	II	Not assessed	NS
16	*Mabuya macularia*	Little skink	-	Not assessed	NS
17	*Naja naja*	Indian Cobra	II (Part II)	Least Concern	NS
18	*Daboia russelii*	Russell's Viper	II (Part II)	Least Concern	NS
19	*Xenochrophis piscator*	Checkered Keelback	II (Part II)	Least Concern	NS
20	*Euphlyctis cyanophlyctis*	Skipper frog	IV	Least Concern	NS
21	*Duttaphrynus melanostictus*	Common Indian Toad	IV	Least Concern	NS
22	*Bufo melanostictus*	Asian Common Toad	IV	Least Concern	NS
23	*Polypedates maculatus*	Common Tree Frog	IV	Least Concern	NS
Butterflies					
1	*Azanus ubaldus*	Bright babul blue	-	Not assessed	DS
2	*Danaus chrysippus*	Plain tiger	-	Least Concern	DS
3	*Danaus genutia*	Common tiger	-	Not assessed	DS
4	*Spialia galba*	Indian Skipper	-	Not assessed	NS
5	*Junonia iphita*	Chocolate pansy	-	Not assessed	NS
6	*Euthalia garuda*	Common baron	-	Not assessed	NS
7	*Phalanta phalantha*	Common Leopard	-	Least Concern	NS
8	*Neptis hylas*	Common sailor	-	Not assessed	DS
9	*Eurema hecabe*	Common Grass Yellow	-	Not assessed	DS
10	*Parantica algae*	Glassy Tiger	-	Not assessed	DS
11	*Hypolimnas bolina*	great Egg fly	-	Not assessed	NS
12	*Junonia almana*	Peacock Pansy	-	Not assessed	NS
13	*Porantica melaneus*	chcolate Tiger	-	Not assessed	DS
14	*Papilio polytes*	Common Mormon	-	Not assessed	DS
15	*Euploea core*	Common crow	-	Least Concern	NS
16	*Eurema brigitta*	Small Grass Yellow	-	Not assessed	NS
17	*Junonia atlites*	Grey pansy	-	Not assessed	DS
18	*Junonia lemonias*	Lemon pansy	-	Not assessed	DS
19	*Papilio deneoleus*	Lime Butterfly	-	Not assessed	DS
20	*Tirumala hamate*	Blue Tiger	-	Not assessed	DS

N.B: NS= Not sighted but included as per the information provided by villagers, DS = Direct Sighting

Source: ABC Techno Labs India Pvt. Ltd.



From the above diagramme, it is evident that avifauna found to be abundant (55%) within the study area and less number of mammals (26%) and reptiles/amphibians (11%) observed during field study.

Apart from agriculture locals of the all the villages were involved in livestock keeping and each of the individual had a substantial number of cattle. Livestock like cattle, goat, poultry, duck, and pig are reared for dairy products, meat, egg and for agriculture purpose. Majority of cattle are of local variety. Backyard poultry farms are mostly common in this area; however, some commercial poultry farms are also recorded in the study area.

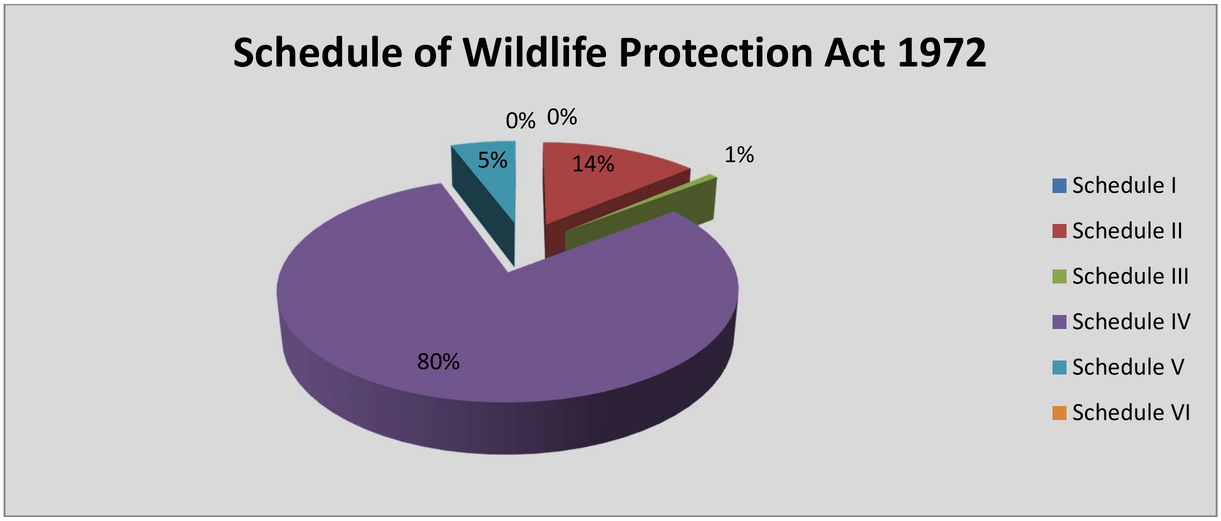
Study has been done in order to do biological survey of the study area. The area was found human dominated and associated surround habitats i.e., near agricultural fields, tea gardens and water bodies.

There is no rare or endangered fauna observed within the study area. The study area is marked with moderate population of flora and fauna. With reference to the Wildlife Protection Act 1972 total number of wildlife tabulated in this study can be characterized as given in the Table 3.26.

Table 3.26: Characterization of Fauna in the Study Area (As Per W.P Act, 1972)

Sl.No.	Schedule of Wildlife Protection Act 1972	No. of species	Remark
1	Schedule I	0	-
2	Schedule II	17	-
3	Schedule III	1	-
4	Schedule IV	99	-
5	Schedule V	7	-
6	Schedule VI	0	-

Source: ABC Techno Labs India Pvt. Ltd.



The detailed interpretation of flora and fauna identified within Laxmijan block area are tabulated In Table 3.27.

Table 3.27: Description of Flora & Fauna

Sl.No.	Type of Species	Scientific Name	Common Name
Flora			
1	Endangered species	*Tectona grandis*	Segun
2	Threatened species	None	-
3	Near Threatened species	*Aegle marmelos*	Bel
		Quercus lamellosa	Oal Banj
4	Vulnerable species	None	-
Fauna			
1	Endangered species	None	-
2	Threatened species	None	-
3	Near Threatened species	*Lutra lutra*	Common otter
		Psittacula alexandri	Indian Red breasted Parakeet
		Anhinga melanogaster	Indian Darter
4	Vulnerable species	*Sterna aurantia*	River Tern
5	Migratory Corridors & Flight Paths	None	-
6	Breeding & Spawning grounds	None	-

Source: ABC Techno Labs India Pvt. Ltd.

3.17 SOCIOECONOMIC ENVIRONMENT

Major developmental activities in industrial sector are required for economic development as well as creation of employment opportunities (direct/indirect) and to meet the basic/modern needs of the society, which ultimately results in overall improvement of quality of life through economical, health, education nutrition status in project region, state as well as the country. In this manner all developmental projects have direct as well as indirect relationship with socioeconomic aspect, which also include public acceptability for new developmental projects.

Thus, the study of socio-economic component incorporating various facets related to prevailing social and cultural conditions and economic status of the project region is an important part of EIA study. The study of socio-economic component incorporating various facts related to socio-economic condition in the area is an integral part of EIA process. This includes demographic structure, population dynamics, infrastructure resources, health status of the community and economic attributes refers to employment, industrial development and sustainability of the project in view of financial terms.

3.17.1 DISTRICT PROFILE

Darjeeling

Darjeeling began to be an "administrative" town in independent India after being made the headquarters of Darjeeling district in 1947. During the period 1961–2011, the town's population increased at an accelerated rate. An "aspirational middle class" arose, comprising families of professionals in the administration, and retail and service industries. As of 2016, the population of Darjeeling was predominantly Indian Gorkha. There were also smaller numbers of Lepchas, Bhutias, Tibetans, Bengalis, Marwaris and Biharis. The Indian decennial census of 2011 (the last for which there is processed data) recorded the population of the Darjeeling municipality to be 118,805 individuals. Of these, 59,618 were females and 59,187 were males, yielding a gender ratio of 1007 females for every 1000 males. The population density of the municipality was 15,990 individuals per km2. The literacy rate was 93.9%—the female literacy rate was 91.3% and the male was 96.4%. Among groups whose historical disadvantages have been recognized by the Constitution of India and designated for amelioration in subsequent commissions and programmes, the scheduled tribes of Darjeeling town constituted approximately 22.4% of the population, and the scheduled castes 7.7%. The work participation rate was 34.4%. The number of people living in slums was 25,026 individuals (which was 21.1% of the population).

3.17.2 METHODOLOGY

In order to assess and evaluate the likely impacts arising out of any proposed projects on socio-economic environment, it is necessary to gauge the apprehensions of the people in the project area. For the process of data collection through primary and secondary sources certain methods are used are given below:

Field Survey and Observations

Field survey and observations is made at each sampling villages and the quality of life of that region is studied. Visits are made at hospitals, primary health centers and sub-centers to know the health status of the region. Various governmental organizations such as statistical department, department of census operations are visited to collect the population details of that region.

Interview Method

Structured interview method is used to collect data regarding the awareness and opinion from the sample selected of the various socio-economic sections of the community. Structured interviews involve the use of a set of predetermined questions that includes fixed and alternative questions. The questionnaire mainly highlights the parameters such as income, employment and working conditions, housing, food, clothing, water supply, sanitation, health, energy, transportation and communication, education, environment and pollution to assess the quality of life of that particular region and general awareness and opinion of the respondents about the project. Interview method helps to collect more correct and accurate information as the interviewer is presented during the field survey. The respondents were asked for their awareness/opinion about the project and also the impacts of the project which is an important aspect of socio-economic environment, viz. job opportunities, education, health care, transportation facility and economic status.

Review of Secondary sources

As per the scope of this study, the information on socio-economic aspects has been gathered and compiled from several secondary sources.

3.17.3 SOURCES OF INFORMATION

As per the scope of this study, the information on socio-economic aspects has been gathered and compiled from several secondary sources. These include Taluka Office, Collectorate, Agriculture Department, Irrigation Department, Central Ground Water Board, Directorate of Census Operation, West Bengal etc. The socio-economic details are briefly described in the following sections. This section includes the present status of the Socio-Economic Environment in the study area. To determine the baseline socio-economic pattern, at and around the project site, the required data have been obtained from the published data. Socio-economic baseline data were collected for the following indicators:

- ✓ Demographic Structure
- ✓ Economic Structure
- ✓ Availability of Basic Amenities

The major demographic and economic structure of the study area are classified into the population, literacy rate and workers details.

3.17.4 DEMOGRAPHIC STRUCTURE OF STUDY AREA

The demographic structure of the study area was derived primarily from data of Census record of Darjeeling covering one district and 5 talukas of West Bengal state. The Demographic structures of each village in the study area as per Census 2011 are presented in Table 3.33.

Table 3.33: Summary of Demographic Structure in Study Area

Sl. No	Demographic Parameters (Within Block boundary)	Name of District
		Darjeeling
1	Name of Taluka	**Matigara, Naxalbari, Phansidewa, Kharibari, Siliguri**
2	No. of Total Villages	140
3	Total No. of Households	78171
4	Total Population	364367
5	Sex ratio (No. of female/1000 males)	942.1
6	Scheduled castes	113275 (31.08%)
7	Scheduled Tribes	58330 (16%)
8	Literate	239727 (65.79%)
9	Total Illiterate	124640 (34.21%)
10	Total Worker	137262 (37.67%)
11	Non-Worker	227105 (62.33%)

Source: Census, 2011

The salient features of Socio-economic Profile are as follows:

Demographic Structure

- The study area located inside Darjeeling district in West Bengal State which includes total 140 villages within study area.
- Total population in the study area is 364367 with 187616 male and 176751 female populations. Overall sex ratio is 942 females per 1000 male, indicating male population is marginally higher in the region as compared with the female.
- Total Scheduled Caste population is 113275 (31.08%) and total Scheduled Tribe population is 58330 (16%).

3.17.5 SOCIO ECONOMIC STRUCTURE

The socio-economic details are briefly described in the following sections. To determine the baseline socio-economic pattern, in and around the project site, the required data have been collected from the published data based on the following indicators:

- Economic Structure
- Availability of Basic Amenities

The major economic structure of the study area is classified into the population, literacy rate and workers details, economic and industry details, etc.

Educational Structure

The literacy rate of the total population is worked out to 239727 (65.79%). Male literacy 135159 (56.38%) and female literacy is 104568 (43.62%).

The illiteracy rate of the total population is worked out to 124640 (34.21%).

Occupational Pattern

The total population of Total Worker 137262 (37.67%) and non-worker population is 227105 (62.32%).

During survey it was reported monthly family income are Rs. 8000/- to Rs. 30000/-

Economy and Industry Profile

The main industries in Darjeeling are Tea, agriculture and tourism. Majority of the population are agrarian.

3.17.6 AVAILABILITY OF INFRASTRUCTURE

Based on the field surveys it is found that, the infrastructure resources in the study area with reference to education, medical facility, water supply, postal, transportation, communication and power supply are available however, which needs to be strengthened.

- ***Education Facilities***

All villages in the study area have education facilities such as primary school with reasonably good facilities. Due to better transport from villages to taluka place Bagdogra and district place Darjeeling, students have opportunity to travel for better education. The survey reported that most of the villages have primary and secondary school facility (10th Standard) and for further education student have to go about 5 to 25 km away. For higher & technical education people have to go to taluka place and district place.

- ***Health Facilities***

Very few villages in the study area have medical facilities. While conducting surveys in this area, observed some villages have Health facilities like sub-center, Primary Health Center [PHC] and some villages have private clinic for better medical treatment, the people move to nearby town and district and taluka where better medical facilities are available. No major diseases were reported by local people in the study area except routine cough, cold and fever etc.

- ***Sanitation and Drinking water facilities***

One of the most important factors responsible for the emergence of a settlement is availability of water. In surveyed all villages, it was found that people are using Tap water, tank, well, tube well water for drinking purposes; however, pond water also used of other purpose.

During the field study and interaction with local people, it is observed that sanitation is very good in nearby villages. Government has launched the scheme for sanitation and gives subsidy for toilet construction, but still, they are not ready to build toilets at home. From the primary survey, it can be observed that there is good facility of the drinking water in all the study villages. Awareness level about sanitation is very low.

- ***Power Supply***

Electricity is available in all the surveyed villages and is provided by the WB State Electricity Board a state-owned power distribution utility.

- ***Communication and Transportation***

Majority of the villages have moderate road facility in the study area i.e., villages are having Kutcha roads. It was observed that bus services are available but limited; however other transportation facilities are available on state and national highway. Regular local transport facilities are available within the villages. Observed that, some villages have sub post office facilities.

Bagdogra is well connected by airway, national highway and railway.

NH 27 crosses through the heart of the city which is now a part of AH2 project. Siliguri originates the century-old Hill Cart Road that is NH 110 which connects Siliguri and Darjeeling (77 km) made in British period. Siliguri also originates NH 10 which connects Gangtok, NH 12 which connects Pankhabari-Mirik. Tenzing Norgay Bus Terminus is the main bus terminus serves as bus depot for both Government & private bus service which operated by NBSTC. It connects to all other districts and cities in West Bengal like Darjeeling, Kalimpong, Jalpaiguri, Cooch Behar, Malda, Balurghat, Raiganj, Berhampore, Kolkata, Asansol, Suri etc. Lots of private buses connect short as well as long distance routes including some cities of Bihar too.Sikkim National Transport bus terminus & P.C. Mittal Memorial bus terminus another two bus terminus which connects Sikkim and many other cities of West Bengal. City buses, cabs auto's are available to cover the whole city. Erickshaws also available for covering short distance inside city.

- ***Livelihood in the Local Villages***

During survey and interaction with local people it was revealed that majority of people are engaged in agricultural works, small business etc. as a source of livelihood. Most of the farmers are cultivating Paddy, banana, sugarcane, and coconut. Proposed study area does not involve any major place with religious, archaeological and historical importance.

3.17.7 MAJOR FINDINGS BY FIELD SURVEYS

Field surveys and observations are made at each sampling villages and the quality of life of that region was studied. Visits are made to hospitals, primary health centers and sub- centers to know the health status of the region. During field survey, visited various governmental organizations such as statistical department, department of census operations to collect the population details of that region.

- Almost villages having Gram panchayat and some villages having group gram panchayat.
- All villages have Anganwadi facilities.
- The survey reported that most of the villages have primary and middle school facility, for further education student have to go about 5 to 25 Km away. For higher & technical education people have to go to nearest town/city.
- Communication facilities are satisfactory; Most of the people use mobile phone. Dish TV are also available in the study area.
- Approach road to most of the villages are Kutcha Road. Each and every village connects to the pakka (main) road.

- Tap water, bore well, tank water, tube wells are the main source of drinking water supply in the region.
- Health condition of villagers is good in this area; villagers are not satisfied with the health centers because they are getting proper treatment from Government Hospitals. Private clinics are also available in study area.
- Electricity is available in almost all the villages. Most of the villages having irrigation facility through electricity.
- LPG gas and Wood is major fuel for cooking purpose; kerosene is also used in some villagers.
- Most of the people are engaged in agricultural and livestock activities. Farming is the main occupation; 80% farmer are busy in livestock activity. A few respondents have service in government sector and most of respondent are farmer, labor. Some other is trying to migrate in other places. In the study area villagers are engaged in agriculture work, livestock small business-like shop. Rice, Tea, Spices, Potato, Ginger, Mustard, Wheat, Maize, Til are the main agriculture crop in the study area.
- Self Help Group (SHG) is actively strong in maximum villages.
- Bengali is the official language but people known Nepali, hindi. Few people know English, because day by day increasing English medium educational facility.

3.17.8 Awareness of People about the Project

An attempt has been made to know the awareness of the people about project activities. The respondents were asked for their opinion about the impacts of the project on the overall development of the project siteand surround area in relation to viz. job opportunities, education, health care, housing, transportation facility and economic status.In general, the people are satisfied with job opportunities and business opportunities that are prevailing in study area However, advent of proposed projects would create more employment opportunities (Construction phase and operation phase) and improve existing in and around infrastructure facilities.

3.17.9 Quality of Life

Standard indicators of the quality of life include not only wealth and employment but also the built environment, physical and mental health, education, recreation and leisure time, and social belonging. Quality of life is an important concept in the field of international development, since it allows development to be analyzed on a measure broader than standard of living.

In this area living standard of life is good, all are the facilities is good and satisfactory level due to good economic status like income, employment, educational facilities and also availability of basic needs, viz. food, clothing, and housing. Main indicator of quality of life is given below:

Socio-economic Indictors					
01	Income	07	Water Supply and Sanitation	13	Environment and Pollution
02	Employment	08	Clothing	14	Recreation

03	Working Condition	09	Energy	15	Social Security
04	Housing	10	Transportation	16	Human Rights
05	Food	11	Communication		
06	Health	12	Education		

Details of Demographc structure, employment patter etc provided in Annexure 8.

CHAPTER 4: ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

4.1 INTRODUCTION

The assessment of potential environmental impact consists of comparing the expected changes in the environment with or without the development activities at Bagdogra International Airport. The main aim of assessment of environment impacts is to identify the nature and significance of anticipated environmental impacts.

This chapter assesses the nature, type and magnitude of the potential impacts likely on the various relevant physical, biological, social and cultural components due to relocation, improvement, modification/up-gradation/augmentation and modernization of existing Airside/Landside facilities and infrastructure at Bagdogra International Airport. The environmental, biological, ecological and social impacts can be direct as well as indirect. The direct area of influence includes the construction sites for the project and surrounding area. The impacts on various environmental components can occur at any of the following stages of the project planning and implementation:

1. Planning and design stage;
2. Construction stage; and
3. Operation stage.

This chapter presents identification of impacts and appraisal of various impacts due to the proposed expansion project on the surroundings and mitigation measures proposed to minimize the adverse impacts. The impacts have been studied for the proposed expansion project, taking into account that the pollution due to the activities has already been covered under baseline environmental monitoring and will continue to remain same during the operation of the project.

Impact assessment describes identification and appraisal of various impacts due to the proposed expansion project. "Environmental Impact" is defined as any alteration of environmental conditions or creation of a new set of environmental conditions, adverse or beneficial, caused or induced by the action or set of actions under consideration.

Generally, the environmental impacts are categorized as either primary or secondary.

- Primary impacts are those, which are attributed directly by the project,
- Secondary impacts are those, which are indirectly induced and typically include the associated investment and changed patterns of social and economic activities by the proposed action.

Mitigation is the implementation of measures designed to reduce the undesirable effects of the proposed expansion project on the environment. For mitigation to be effective, the following factors should be taken care of,

- The measure proposed must be achievable within time, resources and capabilities
- The mitigation measures must correspond to impacts
- Funding must be adequate over the life of the activity
- Preventive mitigation is usually cheapest and most effective. It must be done at design stage.

Methodology for Qualitatively Assessment of Environmental Impacts

The anticipated environmental impacts due to the proposed expansion project at Bagdogra International Airport may be beneficial or adverse, short or long term (acute or chronic), temporary or permanent, direct or indirect and local or regional. Adverse environmental impacts include such impacts which can lead harm to living resources, atmosphere, damage to human health, birds & animal, vegetation, land & water resources, hindrance to activities in place, harm of quality for use, reduction of amenities, damage to physical structures, etc. Environmental risk is also evaluated based on its likelihood and significance for each identified potential environmental impact due to proposed activities in the area. For proposed project, the impact assessment has been carried out in the following three steps:

Step 1 : Identification of interface between project activities & environmental receptors
Step 2 : Identification of potential environmental impacts
Step 3 : Evaluation of significant environmental impacts

In Step 1, based on the project description and environmental baseline conditions, a detailed matrix of activities and environmental receptors has been prepared. Based on project activities and baseline environment conditions at and around Bagdogra International Airport, it is determined whether an interface exists between project activity and an environmental receptor.

In Step 2, based on interface identified in Step 1, potential environmental impacts due to the proposed expansion project at Bagdogra International Airport, activities are identified. The environmental impacts may be beneficial or adverse, direct or indirect, reversible or irreversible and short-term or long-term as given, as per criteria given in Table 4.1

The main procedural stepsof environmental impact assessment can be summarized as follows:

4.2 IDENTIFICATION

This involves identification of the major project activities, environmental attributes, the impacts of the activities on the environmental attributes and formulation of 'activity-impact' matrix. The impact rating assessment matrix is presented below in Table 4.1.

Table 4.1: Impact Rating Assessment Matrix

Impact		Criteria
Nature of impact	Beneficial	Positive
	Adverse	Negative
Duration of impact	Short term	Impacts shall be confined to a stipulated time
	Long term	Impacts shall be continued till the end of life of proposal
Impacted Area	Localized	Impacts shall be confined within study area

Impact		Criteria
	Regional	Impacts shall be continued beyond study area

Source: ABC Techno Labs India Pvt. Ltd.

4.3 PREDICTION

This involves prediction of the nature, magnitude and significance of the impacts. It also includes analysis of the possibilities and/or probabilities of occurrences of the impacts. The matrix establishes 'Cause-effect' relationship between the activities and the environmental factors responsible for them as shown in Table 4.2 with respect to activities during proposed execution of proposed Project Activities for expansion of existing airport at Bagdogra.

In Step 3, all the potential environmental impacts are evaluated and a qualitative evaluation is carried out. An impact level is rated as "low", "medium" or "high". The impact rating is based on two parameters, i.e. "severity of environmental impacts" and "likelihood of occurrence of the environmental impacts".

Severity of Environmental Impact: The severity of an environmental impact is a function of a range of considerations including impact magnitude, impact duration, impact extent, compliance of prescribed legal framework and the characteristics of the receptors/ resources; and

Likelihood of Occurrence of Environmental Impact: How likely is the impact (this is particularly an important consideration in the evaluation of unplanned/ accidental events).

4.4 EVALUATION

The significance of each impact is determined by assessing the impact severity against the likelihood of the impact occurring as summarized in the impact significance assessment matrix provided below in Table 4.3.

Table 4.3: Impact Rating Assessment Matrix

Impact Severity	Impact Likelihood			
	Unlikely (e.g., Not expected to occur during project lifetime)	**Low Likelihood (e.g., may occur once or twice during project lifetime)**	**Medium Likelihood (e.g., may occur every few year)**	**High Likelihood (e.g., Routine, happens several times a year)**
Slight	Negligible Impact	Negligible Impact	Negligible Impact	Negligible Impact
Low	Negligible Impact	Negligible Impact	Negligible to Minor Impact	Minor Impact
Medium	Negligible Impact	Minor Impact	Minor–Moderate Impact	Moderate Impact
High	Minor Impact	Moderate Impact	Major Impact	Major Impact

Notes:

Negligible Impact : Defined as magnitude of change comparable to natural variation
Minor Impact : Defined as detectable but not significant
Moderate Impact : Defined as insignificant; amenable to mitigation; should be mitigated where practicable
Major Impact : Defined as significant; amenable to mitigation; must be mitigated

All the potentially significant environmental impacts are evaluated and a qualitative assessment is made. An impact level is rated as “Slight”, “Low”, “Medium” or “High”. The impact rating is based on two parameters i.e., the “severity of impact” and the “likelihood of occurrence of impact”.

- *Severity of Impact: The severity of an impact is a function of a range of considerations including impact magnitude, impact duration, impact extent, compliance of prescribed legal framework and the characteristics of the receptors/ resources; and*
- *Likelihood of Occurrence: How likely is the impact (this is particularly important consideration in the evaluation of unplanned/ accidental events)*

The mitigation measures for adverse environmental impacts have been suggested as applicable regulatory requirements on environmental and socio-economic issues and are intended to meet the following objectives:

Prevent air, water, soil and noise pollution during construction & operation phases;

- Adopt environmental and social enhancement measures;
- Encourage the socio-economic development in the region.

The anticipated environmental impacts of the proposed project and corresponding mitigation measures for construction and operation phases have been described in the following sub-sections.

4.5 IDENTIFICATION OF IMPACTS & MITIGATION MEASURES

The assessment of impacts in this section is confined within airport area only. The proposed site for civil enclave will contain all equipment, storage, workshops, etc. using distances between various components in line with existing rules and regulations for the area of operation and the hazardous area drawing of the civil enclave.

The pre-construction phase will involve completion of necessary legal formalities with respect to environmental clearances, site surveys / design and bidding of the proposed enhancement. The proposed expansion project will require equipment and machinery, requisite skilled, semi-skilled manpower & labour. Airport Authority of India will undertake the supervision and project management.

4.6 ANTICIPATED IMPACT AND MITIGATION MEASURES DURING CONSTRUCTION PHASE

For the proposed expansion project, the construction activity is temporary and the impact during the construction phase will be short term. This includes the activities related to relocation, improvement, modification/up-gradation/augmentation and modernization of existing Airside/Landside facilities and infrastructure, construction of additional buildings, machineries and installation of equipment during constructional phase will have varying impacts on the following attributes.

4.6.1 Impact on Topography

Potential impact on drainage and topography viz. alteration of drainage pattern and water logging are anticipated during well site preparation, widening/strengthening of access roads and restoration of well facilities.

❑ **Impacts**

The airport site is located at an altitude of range 143-150 m above MSL. The study area lies in the middle of the vast fertile plains (Tarai) south of the Himalayas. Minimal levelling would be required for the proposed construction. During construction of foundation, excavated top soil will be conserved and reutilized for gardening/landscape. Thus, the impact during the construction is reversible, short term and insignificant.

Mitigation Measure

- ✓ Land clearing at the site will be kept to the absolute minimum practicable; and
- ✓ Construction site would be designed to minimize filling of the earths.

Hence, the impact on the Topography & Drainage pattern of the project activities are as per given below.

Impact Rating	Topography & Drainage pattern
Significance and Nature of impact	Negligible and Adverse
Duration of impact	Long term
Impacted Area	Localized
Likelihood of Occurrence	Medium
Severity of Impact	Medium
Significance of Impact	Low

4.6.2 Land Use Pattern

❑ **Impacts**

M/s. Airport Authority of India is going to expand the Bagdogra International Airport with the development of Civil Enclave with infrastructure such as New Terminal Building, Car Parking, Apron, Link Taxiways etc. and associated city side / airside infrastructure on approx. 105 Acres of Land. Total 104.65 acres of land acquired/proposed for New Terminal Building out of which 98.72 acres has already been acquired and for 5.93 acres working permission given by IAF (Indian Air Force).

The present expansion is an improvement, modification/ up-gradation/ augmentation and modernization of existing Airside & Landside facilities and infrastructure to meet operational safety requirements and to increase the capacity of the existing airport. Few felling of timber yielding trees, some bushes and shrubs, which will be cleared for construction of proposed buildings and compensation will be met in 1:5 ratio. Thus, the overall impact on land use will be Low.

Mitigation Measures

- ✓ Land clearing at the site will be kept to the absolute minimum practicable; and

- ✓ The earthwork will be optimized to the maximum extent and gradual ground levels will be maintained based on specific unit requirement.
- ✓ As a part of overall master plan, a part of landside area ~24926 Sq.m of green area will be maintained
- ✓ Timber yielding trees will be prioritized for transplantation and landscaped for stabilization of the top soil.
- ✓ During construction of foundation, excavated top soil will be conserved and reutilized for gardening/landscape, as per the suitability.
- ✓ The filling and cutting of soil would be kept minimum; and
- ✓ Construction debris and waste generated during construction activities will be collected and disposed in environmental sound manner as per applicable rules depending upon type of wastes.
- ✓ Compensatory plantation will be executed as part of the felling of trees;

Hence, the impact on the land use pattern of the study area is as per given below.

Impact Rating	Land Use pattern
Significance and Nature of impact	Negligible and Adverse
Duration of impact	Short Term
Impacted Area	Localized
Likelihood of Occurrence	Low
Severity of Impact	Slight
Significance of Impact	Negligible

4.6.3 DRAINAGE PATTERN

The overall terrain of the project site will be changed by the construction of additional buildings and this will bring slight change in the existing pattern of surface drainage. The change of surface drainage will lead to increase the run-off water during monsoon season. Mainly, the impact will arise from the creation of impermeable surfaces (roofs, pavements, etc.) which results in reduction of percolation. Proper slope and storm water management system will be provided at the site to maintain natural drainage and runoff movement at the site and surrounding areas. The drains will be kept sufficiently away from the taxiway /runway.

Mitigation Measures

- ✓ Slope and storm water management shall be provided to maintain drainage and flow of runoff in the drain.
- ✓ Drainage at the site will be maintained as per drainage counter at the site; therefore, no flooding will be occurred in and around the Bagdogra International Airport during and after expansion of Civil Enclave building and allied works.
- ✓ The construction of the drainage network and the grading concept will be in line with the Storm water management plan discussed under section 2.10.2 in Chapter 2.

- ✓ The drainage system is designed by identifying distinct catchment zones, thereby discharging into the parallel drains and are supplemented by box / pipe culvert wherever required. The runoff will be properly drained through external outfalls at boundary wall.
- ✓ Rainwater from the airport premises will be collected from the identified catchment zones and stored in proposed rainwater recharge pits at suitable locations to store rainwater.
- ✓ Silt ponds are proposed near every outfall location to prevent the silt getting into the receiving water bodies.
- ✓ The existing drainage design of Bagdogra International Airport will be integrated with the proposed drainage master plan in order to reduce the impact of flooding;

Hence, the impact on the land use pattern of the study area is as per given below:

Impact Rating	Land Use pattern
Significance and Nature of impact	Negligible and Adverse
Duration of impact	Short Term
Impacted Area	Localized
Likelihood of Occurrence	Low
Severity of Impact	Low
Significance of Impact	Negligible

4.6.4 MATERIAL TRANSPORTATION

The various materials required for construction (e.g. Steel, Blocks, Cement, Stones, Asphalt, etc.) will be obtained from sources elsewhere and transported to the site. Transportation of these materials, typically in over-laden and sometimes uncovered trucks, usually results in undue road wear-and tear. In the case of fine earth materials, dusting and spillages occur on the roadways between source and site. Dusting degrades local air quality and material spillages worsen road-driving conditions and increase the risk of road accidents. These occurrences represent indirect, short-term, reversible, negative impacts on public health and safety related to the project.

Mitigation Measures

- ✓ All fine earth materials will be covered during transportation to the site to prevent spillage and dusting.
- ✓ Trucks used for that purpose on the project will be fitted with tailgates that close properly and with tarpaulins to cover the materials.
- ✓ The cleanup of spilled earth and construction material on the main roads will be the responsibility of the contractor and will be done in a timely manner (say within 4 hours) so as not to inconvenience or endanger other road users.
- ✓ Transportation of lubricants and fuel to the site will be done only in the appropriate vehicles and containers, i.e. fuel tankers and sealed drums.
- ✓ As far as possible, transportation of construction materials will be scheduled for off-peak traffic hours. This will reduce the risk of traffic congestion and of road accidents on the access roads to the site.

Impact Rating	Land Use pattern
Significance and Nature of impact	Negligible and Adverse
Duration of impact	Short Term
Impacted Area	Localized
Likelihood of Occurrence	Low
Severity of Impact	Low
Significance of Impact	Negligible

4.6.5 Soil Quality

From construction of the proposed facilities at the Bagdogra International Airport, minimal quantity of excavated earth from the site will be used for filling and leveling within the Airport. At the time of construction, some amount of debris, cuttings of construction materials, etc, may be generated at the construction site. Wastes and debris generated at the site will be collected time-to-time and disposed suitability to avoid contamination of earth.

During the construction phase, hydraulic lube oil, fuels and lubricating oils would be used near proposed construction site. There is possibility of spills of such oils during loading, unloading, storing and handing. During construction phase, waste oil shall be generated as and when lubricating oil will be changed from engines of DG sets and construction machineries. Used oil shall be collected and stored in leak proof drums and sent to be used oil recyclers. The used oil drums shall be properly identified with a label in regional language.

Used Oil generated shall be handed over to authorized recyclers for treatment and reuse. Other solid wastes, like debris, metal pieces, cotton wastes, electrical wires cuttings, etc so generated will be collected & segregated and will be disposed of as per standard practices.

Mitigation Measures

- ✓ Compaction and stabilization will be ensured during filling to ensure that no loose soil is washed away with runoff during rains,
- ✓ Wastes, fuel, oil drums, used oil, etc. stored and handled according to the guidelines specified under Manufacture, Storage, and Import of Hazardous Chemical Rules (MSHIC) and Hazardous Wastes Storage, Handling and Transportation Rules of MoEF&CC.
- ✓ Transportation of lubricants and fuel to the site will be done only in the appropriate vehicles and containers, i.e. fuel tankers and sealed drums.
- ✓ Dustbins will be placed at requisite locations at construction site and there will be segregation of wastes before disposal.
- ✓ The construction material/ chemicals shall be managed as per SOPs/SDS protocols to avoid spillage.
- ✓ Minimize the use of asbestos based material and appropriate collection and segregation of asbestos waste to be practiced as per HWM rules.
- ✓ Use an identified area for undertaking any repair and maintenance of vehicles/equipment.
- ✓ Separate storage of waste paints and thinners, contaminated rags, and brushes to facilitate recycling and reuse. Rags could be laundered for reuse.

- ✓ Vehicle maintenance area will be designed to prevent contamination of ground water by accidental spillage of oil; and
- ✓ Maintaining appropriate inventory control

The overall impact on soil quality during construction phase is summarized as hereunder

Impact Rating	Land Use pattern
Significance and Nature of impact	Negligible and Adverse
Duration of impact	Short Term
Impacted Area	Localized
Likelihood of Occurrence	Low
Severity of Impact	Low
Significance of Impact	Negligible

4.6.6 Impact on Air Environment

The potential sources of air emissions during construction phase at Bagdogra International Airport will be as follows:

- Dust from earth works (during site preparation & excavation),
- Emissions from the operation of construction equipment and machines for compaction,
- Fugitive emissions from vehicles running to the construction site,
- Fugitive emissions during the unloading of cement bags,
- Fugitive emissions during mixing of cement with other building materials,
- Emission for DG sets to be used temporarily during construction phase,
- Air emissions other than dust arise from combustion of hydrocarbons. The pollutants of concerns are NOx, SO2, CO, un-burnt hydrocarbons and particulate matter (PM10 & PM2.5).

The impact of construction activity on ambient air quality is a cause for concern mainly in the dry months due to settling of dust particles. The main sources of dust emissions during the construction period are the movement of equipment at the site and dust emitted during the levelling, grading, earthworks, and other construction related activities. The dust emitted during the above-mentioned activities will depend upon the type of soil being excavated and the humidity levels. The impact is likely to be for short duration and confined to vicinity of the construction site. The composition of dust in this kind of operation is however mostly coarse particles, inorganic and non-toxic in nature and these are not expected to travel long distance before settling.

Exhaust emissions from vehicles and equipment deployed during the construction phase also result in marginal increase in the levels of SO2, NO2, unburnt hydrocarbons and particulate matter (PM10 & PM2.5). The impact will however, be reversible, marginal, and temporary in nature.

The impact of construction activities on ambient air would be temporary and restricted to the construction phase. The impact will be confined within the project boundary and is expected to be negligible outside the project boundaries. Proper up-keep and maintenance of vehicles, sprinkling of water at construction site, etc. are some of the proposed measures that would greatly reduce the impact on the air quality during the construction phase of the project.

During the filling of earth, unloading of cement bags and mixing of cement with other building materials, fugitive dust emissions may be emitted at the construction site. It may be noted that these emissions would be in the form of coarse particulate matter and will be settled down ultimately in the closed vicinity of the construction site.

Emissions from the DG sets may cause localized impact on ambient air quality for short duration, as these will be operated during grid power failure. DG sets will be operated only in case of grid power failure. Adequate height of stacks will be provided to the DG sets as per guidelines of CPCB to facilitate the dispersion of flue gases in the atmosphere.

Mitigation Measures

- ✓ Dust suppression systems (water spray) will be used as per requirement at the construction site;
- ✓ Dust emissions from crushers can be controlled with implementation of dust control measures in the crushers like use of dust containment enclosure and water spraying for reduction of fly dust. In addition, the crusher areas should be paved to reduce re-entrainment of settled dust on the unpaved road, reducing the drop height near the crushing area and covering the potential dust emissions sources to reduce transportation of dust material.
- ✓ Construction materials and earth will be fully covered during transportation to the construction site by road;
- ✓ The welding activities will be limited and thus emissions thereof will be insignificant, although personnel involved in welding shall use appropriate PPE to abet the impact due to emissions during the welding activity.
- ✓ Standard prescribed by the CPCB/ West Bengal Pollution Control Board (WBPCB) for stack height and emissions from DG sets will be complied with;
- ✓ Preventive maintenance will be carried out for vehicles and pollution check (PUC certified) will be mandatory on periodic basis for all the vehicles approaching to the construction site.
- ✓ Earth moving equipment, typically a bulldozer with a grader blade and ripper, will be used for excavation work;
- ✓ Trucks used for that purpose on the project will be fitted with tailgates that close properly and with tarpaulins to cover the materials.
- ✓ Monitoring of ambient air quality/source emission will be carried out as per details given in Chapter 6 or as stipulated by the MoEF&CC/ WBPCB

As construction activities will be mainly confined to the project site only for a short duration, hence the impact on the ambient air quality during construction phase is rated as given below.

Impact Rating	Land Use pattern
Significance and Nature of impact	Negligible and Adverse
Duration of impact	Short Term

Impacted Area	Localized
Likelihood of Occurrence	High
Severity of Impact	Low
Significance of Impact	Negligible

4.6.7 Noise Environment

During the construction phase, noise will be generated from various sources. Some major sources of noise generation during construction phase are listed below:

- Generation of noise during movement of vehicles carrying materials and loading & unloading activities,
- Generation of noise from construction machines, pavers, concrete mixer, compactor, rollers and other construction machines,
- Generation of noise from vehicle movement.
- Generation of noise during concreting, and pavement, etc.
- Noise from the mechanical operations at the site.
- Generation of noise from DG sets at works site.

All the above-mentioned sources at the proposed construction activities will be intermittent and would be experienced occasionally. It may also be noted that, most of the construction activities will be carried out only during the daytime.

The expected noise levels from these activities are given hereunder in Table 4.3:

Table 4.3 : Typical Noise Levels of Construction Equipment

Particulars	Noise Levels dB(A)
Earth Movers	
Front End Loaders	72-84
Tractors	76-96
Scrapers, Graders	80-93
Pavers	86-88
Trucks	82-94
Material Handlers	
Concrete mixers	75-88
Concrete pumps	81-88
Stationary Equipment	
Pumps	69-71
Generators	70-80

The noise produced during construction phase will have temporary impacts on the existing ambient noise levels at the project site but restricted to small distance and only during daytime within the airport. Therefore, the impact of noise levels on surrounding area will be insignificant during the construction phase.

The general noise level due to construction activities, such as working of heavy earth moving equipment and machinery installation, may sometimes go up to 85 dB(A) at the work site during day time. The workers in general are likely to be exposed to an equivalent noise level of 70-75 dB (A) in an eight (8) hour shift for which all statutory precautions as per law will be implemented. Use of proper Personal Protective Equipments (PPEs) will further mitigate adverse impacts of noise on the workers, if any. The impacts can be further minimized and made insignificant by using standard practice of construction. The present noise level, monitored in the study area, is well within the standards of noise level. The present noise level, monitored in the study area, is well within the standards of noise level.

Mitigation Measures

- ✓ Provision of rubber padding / noise isolators to DG sets, along with acoustic enclosures and construction machines
- ✓ Preventive maintenance of the machine / Equipment will be carried out;
- ✓ Provision of silencers to modulate the noise generated by machines;
- ✓ Restriction of horns in residential area;
- ✓ Vehicles and construction equipment with internal combustion engines without proper silencer will not be allowed to operate at the construction site;
- ✓ Detailed traffic management and decongestion plan will be implemented;
- ✓ Provision of protective devices like ear muff / plugs to the workers; and
- ✓ Monitoring of ambient noise level / source emission will be carried out as per details given in Chapter 6 or as stipulated by the CPCB/ WBPCB

Hence, the impact on the noise level during construction phase is rated as given in the table below:

Impact Rating	Land Use pattern
Significance and Nature of impact	Negligible and Adverse
Duration of impact	Short Term
Impacted Area	Localized
Likelihood of Occurrence	High
Severity of Impact	Low
Significance of Impact	Negligible

4.6.8 WATER RESOURCES & WATER QUALITY

The development phase would involve water requirements for the following activities:

- Site preparation: Involves levelling for infrastructure development.
- Water is required for dust settlement, consolidation, compaction, and curing.
- Construction of building infrastructure involves water for construction activities and domestic and other water requirements for labour and staff onsite.

During the construction phase, water will be required for construction purposes. It is also proposed to adopt the techniques and equipment's, which will further help in reduction of water demand during construction. The construction water requirement would be temporary in depending nature of construction activities. The construction water requirement will be sourced from the existing bore-wells or sourced through authorized tankers. Therefore, the impact on the water resources during the construction phase would be temporary and variable in nature.

Anticipated impacts on water quality during construction phase may be due to sewage and wastes generated from the construction site. The wastewater (sewage) generated during construction phase will be mainly from domestic activities. The construction site sanitation facilities will be linked to the well designed soakpit / mobile STPs for treatment and disposal of sanitary sewage generated by the workforce.

During construction activity in rainy season, the water quality is likely to be affected due to the construction work and loosening of topsoil. This is likely to increase the suspended solids in the run-off during heavy precipitation. To reduce the impact of runoff on the water quality of nearby water streams, temporary sedimentation pond will be constructed for the settlement of the suspended matter.

Mitigation Measures

- ✓ Explore possibility of usage of Surface water.
- ✓ Monitoring of water usage at construction camps to prevent wastage.
- ✓ No chemical or fuel spills at water body crossings.
- ✓ STP at construction camps/ sites and the proposed facilities shall be properly designed to handle peak wastewater load and properly maintained.
- ✓ Tracking of consumption and installing water meter at any new water abstraction source.
- ✓ Contaminated oil from wash water from workshops/maintenance yards shall be separated out and decanted water will be reused.
- ✓ Domestic sewage from labour colony is treated in Sewage Treatment Plant and recycled for water sprinkling to suppress the dust.

Therefore, the impact on the water resources during the construction phase would be temporary and variable in nature. The overall impact on water resource during construction phase is rated as:

Impact Rating	Land Use pattern
Significance and Nature of impact	Negligible and Adverse
Duration of impact	Short Term
Impacted Area	Localized
Likelihood of Occurrence	Low
Severity of Impact	Low
Significance of Impact	Negligible

4.6.9 Solid Waste Generation

The construction phase waste will comprise of excavated and demolition material. The different types of wastes will be handled as per their needs and regulatory requirements. It is not possible to dispose-off all type of wastes onto the land and has to be dealt with depending upon their type and characteristics. Building construction leads to generation of sand, gravel, concrete, stone, bricks, wood, metal, glass, polythene sheets plastic, paper etc. as waste.

The solid waste generated in the project site may be broadly classified as hazardous and non-hazardous wastes. In the absence of appropriate waste management practices, the impacts are anticipated as below:

- Inappropriate waste management will lead to the loss of site aesthetics and may cause freak accidents.
- Hazardous waste if not segregated and handled properly will lead to pollution load and serious health impacts in construction workers.
- Municipal waste if not handled properly may lead to air-borne or water borne diseases; etc.

Mitigation Measures

- ✓ Hazardous and flammable materials such as diesel, fuel oil, lubricating oil during development phase should be stored properly as per the safety regulations and applicable rules. Combustible wastes shall be burnt in a controlled manner and other category of wastes should be disposed of at identified dumpsite.
- ✓ Major solid waste generation from the premises is mostly municipal solid waste. Municipal solid waste from labour camp and office area are required to dispose on daily basis and to be handed over to authorized agency.
- ✓ The sludge generated from the sewage treatment plant will be used as manure for greenbelt development.
- ✓ To avoid any solid waste disposal problems, an effective solid waste management system by means of collection of wastes in different types of dustbins and transporting the same to the municipal dumping grounds by the contractors is proposed.
- ✓ Hazardous waste shall be handled as per the Hazardous Waste Handling Rule, 2016. Strict adherence to the established solid waste collection and disposal system will ensure clean environment during development period.

Hence, the impact on the Solid waste during construction phase is rated as given in the table below:

Impact Rating	Land Use pattern
Significance and Nature of impact	Negligible and Adverse
Duration of impact	Short Term
Impacted Area	Localized
Likelihood of Occurrence	High
Severity of Impact	Low
Significance of Impact	Negligible

Construction and Demolition Waste

Construction and demolition waste generated during development phase will be handled as per The Construction and Demolition (C&D) Waste Management Rules, 2016 notified vide G.S.R. 317(E) 29th March 2016 by the Ministry of Environment, Forest, and Climate Change (MoEF&CC).

Contractor / Subcontractor will be informed to comply with all the applicable rules of C&D Waste Rules 2016. Waste shall be segregated into four streams such as concrete, soil, steel, wood and plastics, bricks and mortar and waste management plan will be developed and appropriate approvals will be obtained and the concerned authorities will be informed regarding the relevant activities from the planning stage to the implementation stage and this should be on project to project basis.

Mitigation Measures

It is important during any demolition project to follow the right protocols and take waste to the proper areas, such as recycling centers. This will reduce the risk to the environment and reduce the impact in a positive manner. The impacts due to demolition can be mitigated by following the protocols listed below

- ✓ Following proper protocol as mentioned in the Construction and Demolition Waste Rules, 2016
- ✓ To minimise the dust, water spraying should be done within the project site
- ✓ The demolition work should be strictly carried out during day time and by latest process to reduce the noise pollution.
- ✓ The impacts due to transportation of demolition waste can be mitigated by using vehicles which are properly maintained.
- ✓ The Contractor should be responsible for preparing a demolition quality control (QC) plan
- ✓ Required WBPCB and local administration approval to be obtained for handling and disposal of Demolition waste, inline to C&D Waste rules 2016
- ✓ Debris net curtain and barricade should be provided around the demolition structure to prevent any accidents.
- ✓ Well trained person should be equipped to carry out the demolition work
- ✓ Spotters should be utilized to prevent workers from entering the area where the excavator is working
- ✓ Steel, tin, copper and aluminum should be separated from the debris and hauled separately for recycling
- ✓ Demolition debris should not be stored long-term on the site. All debris should be hauled-off the site as soon as possible. All construction debris should be taken to a construction debris recycling facility
- ✓ Concrete should be separated mechanically from demolition debris by using Excavators.
- ✓ All wires may be pulled out by using excavators and laborers. Wire and other metal, both ferrous and non-ferrous, will be cut in pieces on site and hauled to metal recyclers.

4.6.10 TERRESTRIAL ECOLOGY

The proposed expansion of Bagdogra International Airport entails clearance of the site from any encumbrances and levelling of the site for commencement of the project development. Existing green area will be realigned inline to the Master plan. In case, tree cutting is required, it will be carried out inline to State Govt. Prevalent rules. The construction activities lead to inward migration of a labour force in the area and thus there would be pressure on trees in the area due to increase in fuel demand. The area being an aviation zone, impact on terrestrial fauna will be negligible.

Mitigation Measures

- ✓ As a part of overall master plan, green area of ~2.49 Ha. in landside will be developed.
- ✓ Timber yielding trees will be prioritized for transplantation and landscaped for stabilization of the top soil.
- ✓ Indigenous species will be selected which will be suitable for local climacteric conditions.
- ✓ Care will be taken that the labours do not cut small tress or branches as fuel wood, for their requirement in cooking and other purposes.

The overall impact on the terrestrial ecology due to construction activities is rated as:

Impact Rating	Land Use pattern
Significance and Nature of impact	Negligible and Adverse
Duration of impact	Short Term
Impacted Area	Localized
Likelihood of Occurrence	Low
Severity of Impact	Minor
Significance of Impact	Significant

4.6.11 OCCUPATIONAL SAFETY AND HEALTH

During construction phase of proposed expansion project, the personnel working at the site may be exposed to physical hazards, like, dust, noise, fugitive dust emissions, welding fumes, working at height, handling of heavy loads, falling objects underneath of temporary structures, working on unguarded moving machine, hammering and cutting without PPEs, etc. These are most occupational hazards at the airport construction site and may have potential adverse impacts on the Occupational Safety and Health.

Mitigation Measures

General Occupational Health and Safety Measures

- ✓ Provide effective dust suppression measures during earthwork.
- ✓ Dust-proof masks will be provided to personnel working in areas with high dust levels;
- ✓ Standard Operating Procedures (SOPs) for machinery will be used;
- ✓ Mandatory use of relevant Personal Protective Equipments (PPEs) for all workers. Employees will be provided with helmets, safety boots, eye and ear protection and snug fitting gloves, safety belt, goggles, as appropriate;
- ✓ Procedures shall be strictly enforced for the storage, handling and transport of explosives, flammable and hazardous materials;
- ✓ Sanitary facilities like toilets and bath rooms will be provided and workers will be instructed to use them;
- ✓ Housekeeping at the work site will be maintained well.

- ✓ Ensuring preventive health check-up by the contractors.
- ✓ Solid waste generated at the site will be collected and disposed as per standard practices.
- ✓ Motivational, warning and informatory signage and poster related occupational health and safety will be displayed at strategic locations
- ✓ Do and Don'ts will be provided at critical equipment and machinery.
- ✓ Pre-employment and periodic medical examinations will be conducted for all personnel and specific surveillance programs will be initiated for personnel potentially exposed to health hazards.

Hence, overall impact is rated as follows:

Impact Rating	Land Use pattern
Significance and Nature of impact	Negligible and Adverse
Duration of impact	Short Term
Impacted Area	Localized
Likelihood of Occurrence	High
Severity of Impact	Low
Significance of Impact	Low

4.6.12 SOCIO ECONOMIC CONDITION

The construction phase of the proposed expansion project will have beneficial impacts on social environment, as land acquisition is not involved as required land.

During construction, phase significant increase in income of local people is expected as local unskilled, semiskilled and skilled persons will gain direct or indirect employment during construction phase. Since the immigration of work force during construction phase is likely to be very small, the social impacts on demography, literacy, health care, transport facilities and cultural aspect are expected to be insignificant.

Economic Impacts

The relatively short-lived economic impacts of the construction stage are likely to be experienced in local area for the duration of construction phase as workers make everyday purchases from local traders in nearby areas. This is likely to give a short-lived stimulus to the shopkeepers / traders that will disappear as soon as the construction is complete. Noticeable, flow-on economic impacts will be experienced in other sectors of economy as a result of purchase of construction materials and the payment of wages and salaries to the personnel engaged in the construction of New Terminal Building and other associated work.

Hence, impact on economic impacts is rated as follows:

Impact Rating	Land Use pattern
Significance and Nature of impact	Beneficial
Duration of impact	Short term
Impacted Area	Regional
Likelihood of Occurrence	High
Severity of Impact	High
Significance of Impact	Major

Employment

During the expansion of the existing integrated terminal building and other associated work, skilled, semi-skilled, and unskilled workers will get direct employment opportunity for about one year, which will have beneficial impact on the socio-economic conditions of the area. Therefore, overall positive impacts are anticipated on socio-economic environment during construction phase. Furthermore, local skilled, semi-skilled and unskilled laborers will get indirect employment also during the construction phase. It is expected about 500 (permanent and temporary) direct & indirect employment will be generated during construction phase. This may also result in a steep rise in wages of workers in the surrounding villages. Several other opportunities for locals will be available in terms of supply of construction materials & machinery, vehicles and other essential commodities, petty contracts, etc.

Hence, overall impact on employment is rated as follows:

Impact Rating	Land Use pattern
Significance and Nature of impact	Beneficial
Duration of impact	Short term
Impacted Area	Localized
Likelihood of Occurrence	High
Severity of Impact	Medium
Significance of Impact	Low

Influx of Construction Workers

Although the construction contractors are likely to use unskilled labour drawn from local communities, use of specialized road construction equipment will require trained personnel not likely to be found locally. Sudden and relatively short-lived influxes of construction skilled workers to communities near the airport may have the potential to 'skew' certain demographic variables and the traditional social coherence.

Hence, overall impact influx of construction workers is rated as follows:

Impact Rating	Land Use pattern
Significance and Nature of impact	Adverse
Duration of impact	Short term
Impacted Area	Localized
Likelihood of Occurrence	Low
Severity of Impact	Low
Significance of Impact	Negligible

Mitigation Measures

- ✓ Preference will be given to locals for direct and indirect employment opportunity;
- ✓ Local suppliers for machineries and construction materials will be given preference;
- ✓ Local transporters will be preferred for transportation of machinery / earth / materials;
- ✓ To train unskilled local work, short-term skill development course will be organized in the area.

4.6.13 IMPACTS DUE TO TRAFFIC

The project development will lead to increased movement of HEMMS like cranes, excavators, dozers, dumpers, etc., mass transport vehicles, trucks, motor cars, etc. Adequate road infrastructure is essential for reduction of traffic congestion and air and noise pollution to the extent possible.

A detailed traffic management and decongestion plan has been prepared to improve the traffic management and ease the traffic congestion to the required level. Several road infrastructure improvement project is proposed to be implemented by the local urban bodies in the influence area of the project. Airport development identifies several transportation activities during the construction as:

- Transportation of construction workers.
- Transportation of construction aggregates/excavated material.
- Transportation of solid and liquid hazardous and non-hazardous wastes.

Mitigation Measures

A traffic circulation and management plan for construction vehicles inside Bagdogra International Airport will be intended to provide adequate proactive measures against identified possible traffic congestion and safety issues. To achieve this objective of safe, smooth, congestion free as well as minimum impact of construction vehicles on air and noise, following traffic movement requirements shall be fulfilled at Bagdogra International Airport site.

- ✓ Route of vehicles inside Bagdogra International Airport worksite shall be shorter as far as possible.
- ✓ Riding surface of roads shall be smoother.
- ✓ Signage plan shall be demarcated throughout the road for guidance of the driver.
- ✓ Speed limits shall be imposed throughout site.
- ✓ Pedestrian access at worksite and route shall be marked throughout the site for ensuring safety.
- ✓ Road users shall accommodate through and around the construction zones safely with minimum of delays.
- ✓ As far as possible, transportation of construction materials will be scheduled for off-peak traffic hours. This will reduce the risk of traffic congestion and of road accidents on the access roads to the site.
- ✓ Traffic control and construction activities shall co-ordinate to provide for safe and efficient flow of traffic together with efficient, safe, and rapid progress of the construction activity.
- ✓ All site roads, parking areas, pedestrian crossings, and other areas accessed by vehicles and pedestrians, shall be appropriately lit and designed to avoid extremes of light variation (i.e., moving from a brightly lit area to a dark one). Parking area, pedestrian walkways and Roads will have a minimum level of lighting as per National Lighting Code 2010.

- ✓ Contractors shall implement physical safeguards whenever reasonably practicable wherever pedestrians are required to cross vehicle routes. Measures may include the use of gates, barriers, and traffic lights. Safety barriers, in accordance with Indian Standard Codes, shall be constructed where required as determined by site risk-based assessment.
- ✓ Multi-level car parking area (MLCP) is proposed for 1010 vehicles ~ 2.07 Ha. It shall have the capacity to handle 10% more PCU.

4.7 IMPACTS DURING OPERATIONAL PHASE

The proposed project will have varying impact on environment during the operation phase. Both beneficial as well as potential adverse impacts may be expected on environment due to its various activities associated with the operation of the airport. The impact causing activities related to the operational phase on the environment are considered for impact assessment:

- Land use & Topography.
- Ambient Air Quality.
- Traffic Densities.
- Noise Levels.
- Water Resources & Water Quality.
- Soil Quality.
- Ecology; and
- Demography and Socioeconomics.

During operation phase after the proposed expansion of Bagdogra International Airport will comprise mainly following activities,

- Operation of existing Integrated Terminal Building in the western side & New Terminal Building in the eastern side.
- Passengers / visitors / staff movement at departure and arrival of terminal building
- Vehicle movement at airport for drop and pick up
- Operation of DG sets (only in case of emergency)
- Operation of HVAC etc.

During the operation after development of Bagdogra International Airport, the following sources of pollution are anticipated.

- Exhaust emissions in the form of particulate matters, NOx, SO2, CO and unburnt hydrocarbons will be emitted from aircrafts movement (take-off, landing and taxing), vehicular movement and operation of DG sets
- Wastewater from domestic usages, which include within Airside and Landside areas - dine outlets, washing hands, toilets and urinals, etc.
- Energy consumption for HVAC and lightings.
- Solid waste from aircrafts, passengers, visitors, staff, cargo handling, sewage treatment plant (STP), waste lubricating oil from machinery / equipment, etc.

- Accidental spillage of fuel oil, if any.

The anticipated environmental impacts of during operation of Bagdogra International Airport after proposed development and corresponding mitigation measures for operation phase have been described in the following sub-sections.

4.7.1 Topography and Physiography

During operation phase of the Bagdogra International Airport after expansion and other allied work, no major impacts is anticipated on the topography and physiography of the area. The major envisaged visual topographical changes would be due to the rise of terminal building. Thus, the present topography will be altered, and the site area will be maintained to aesthetically pleasant conditions. This will invite positive benefits in the form of land leveling and plantations in the airport vicinity areas. Landscaping and green covering activities will be further improved. No other major adverse impact on topography of the site is envisaged during the operation phase.

4.7.2 Water Resources and Water Quality

The entire water demand for the airport is met through ground water (bore-wells)/municipal water supply & State Govt. Supply. The Present Water Requirement Quantity of water is approved under issued existing EC and consents.

The daily consumption of water during operation phase after proposed expansion will be about 2540 KLD out of which 1153 KLD will be fresh water and 1387 KLD will be recycled water. The water requirement for plantation, HVAC & flushing will be met through STP Treated water.

To reduce the load on fresh water demand AAI is committed in implementing the Zero discharge concept for sewage system. The entire sewage that is generated from the campus will be recycled and reused for non-potable purposes. 1622.67 KLD of wastewater will be generated from airport operations, which will be treated through STP (ASBR,MBR, MBBR, SBR etc.) total capacity of 1800 KLD, will be developed on modular basis. Treated wastewater will be used for Landscaping or other purposes.

Mitigation Measures

- ✓ Use of low flow fixtures and appliances for reduced water consumption such as low flush water closets and cisterns;
- ✓ Water saving shower head flow controls, spray taps and faucet aerators and photo-sensitive taps;
- ✓ 1622.67 KLD of Sewage and domestic wastewater will be treated in Sewage Treatment Plant and reused for HVAC make-up, toilet flushing, greenery and landscaping development to reduce fresh water requirement.
- ✓ Based on the topography, water shed catchment zones & external outfalls are considered to channelize the stormwater from the airport premises.

- ✓ Open Rainwater Harvestings pits of are proposed to harness and manage storm water runoff, thereby reducing the load of external outfall drains.
- ✓ Silt ponds are proposed near every outfall location to prevent the silt getting into the receiving water bodies.
- ✓ During monsoon period, regular aquatic monitoring will be carried out to ascertain that there is no impact on surface water bodies.
- ✓ The existing drainage design of Bagdogra International Airport will be integrated with the proposed drainage master plan in order to reduce the impact of flooding.
- ✓ Regular testing and analysis of treated waste water from STP to ensure effectiveness of STP and compliance of discharge standards.
- ✓ Dry cleaning process in workshop and maintenance area to clean the oil spillages;
- ✓ Smart irrigation system that uses daily, weather data, slope, soil types, planting coefficients, and precipitation and infiltration rates to calculate actual water requirements on a daily basis;
- ✓ Flow restrictors have been installed in all the taps and health faucets in the restrooms;

The overall impact on water resources during operation phase is rated as follows:

Impact Rating	Land Use pattern
Significance and Nature of impact	Adverse
Duration of impact	Long term
Impacted Area	Localized
Likelihood of Occurrence	High
Severity of Impact	Medium
Significance of Impact	Medium

4.7.3 Ambient Air Quality

During the operational phase of the airport, the continuous air emissions are expected from aircraft engines during approach, landing, taxiing, take-off and initial climb or collectively called as reference Landing and Take-off cycle (LTO cycle). The air pollutants of concern from the aircraft emissions will be unburnt Carbon Monoxide (CO) and Oxides of Nitrogen (NOX) as per ICAO guidelines. The emission height of 3.5 m is assumed for aircraft emissions, during normal taxiing condition of the aircraft.

The projected total annual passenger demand will be 10 MPPA for the upcoming phase. The impact on ambient air quality is assessed hereunder considering the following:

- The air quality impacts have been predicted for the proposed expansion project assuming that the pollution due to the existing activities has already been captured under baseline environmental monitoring; and
- Site-specific meteorological parameters have been recorded by using continuous recorders. Short-term 24 hourly incremental values (GLCs) were estimated using the site-specific meteorological data.

❑ **Air Pollution Modeling**

For prediction of maximum Ground Level Concentrations (GLC's), the air dispersion modeling software (AERMOD version 10.2.1) with SRTM DEM Model of 90m resolution has been used to consider the Topography. AERMOD is steady state advanced Gaussian plume model that simulates air quality and deposition fields up to 50 km radius. AERMOD is approved by USEPA and is widely used software. It is an advanced version of Industrial Source Complex (ISCST3) model, utilizes similar input and output structure to ISCST3 sharing many of the same features, as well as offering additional features. The model is applicable to rural and urban areas, flat and complex terrain, surface and elevated releases and multiple sources including point, area, flare, line and volume sources.

Dispersion modeling using AERMOD requires hourly site-specific meteorological data like wind direction, wind speed, temperature etc. Site specific data recorded during (1st March 2023 to 30th May 2023) at site is used for executing modeling studies. The site-specific meteorological data is processed using AERMET meteorological Pre-processor.

❑ **Dispersion Model Input Data**

The specific types of emission sources considered during the operational phase of the airport are given in Table 4.4.

Table 4.4: Types of Emission Sources at Airport Premises

S. No.	Emission Source	Emission Calculation Basis	Dispersion Modeling Basis
A	Aircraft Activity	ICAO	AERMOD
B	Auxiliary Power Units (APUs)		
C	Ground Support Equipment (GSE)		

The calculations for the emissions generated by the aircrafts and allied activities have been done using ICAO Airport Air Quality Manual, second edition, 2020 developed by International Civil Aviation Organization approved by and published under the authority of the Secretary General, ICAO, Canada. The input data for the considered sources has been described in following section:

A. Aircraft Activity

Aircraft activity is expressed in LTO cycles. Each LTO cycle consists of approach, landing, and taxiing, queuing, takeoff, climb out. The Times in Mode (TIMs), [i.e., the durations per LTO cycle that an aircraft spends in each of the three modes of aircraft operation: takeoff, climbs out and approach are considered, based on the ICAO and Environmental Protection Agency (EPA) defaults. SO2, NOx, CO are the major pollutants that will be emitted during the LTO cycle.

The emission factor data is based on the ICAO Aircraft Engine Exhaust Databank and supplemented by engine emissions data provided directly from the manufacturer and, for older aircraft, the data provided and methodology in the EPA's AP-42, Part II, Section-1.

B. Auxiliary Power Units (APU)

Emissions are generated by Ground Support Vehicles (GSV) and Auxiliary Power Units (APUs) while the aircraft is parked at the gate. The LTO based study setup has been selected, in which

Ground Service Equipment (GSE) are assigned to aircraft and their operations depend on aircraft activity. Since the APU's are onboard aircraft, they are only modeled on an aircraft LTO basis.

APU's are most often on-board generators that provide electrical power to the aircraft while its engines are shut down. Some pilots start the on-board APU while taxiing to the gate but, for the most part, it is started when the aircraft reaches the gate. The on-board APU is, in effect, a small jet engine and the calculations for the emissions generated by it are similar to that of an aircraft engine operating in one power setting only.

C. GSE Assigned to Aircraft

Upon arrival at a gate, aircrafts are met by GSE to unload baggage and service the lavatory and cabin. While an aircraft is parked at a gate, mobile generators and air conditioning units may be in operation to provide electricity and conditioned air. Prior to aircraft departure, GSE are present to load baggage, food and fuel. When an aircraft departs from a gate, a tug may be used to push or tow the aircraft away from the gate and to the taxiway. Each GSE carries a default operational time in minutes associated with one complete LTO cycle of the aircraft.

❑ **Emissions Inventory**

An emissions inventory giving summary of the total pollutants generated by all active sources under study is prepared using ICAO. Both narrow-bodied and wide-bodied air craft emissions have been considered during modelling. On the basis of peak hour input data and hourly, daily and monthly averages of aircraft operations for each of the identified sources. The Model setup is given in Table 4.5.

Table 4.5: Model Setup

S. No.	Parameter	Details
1	Model Name	AERMOD (Version 10.2.1)
2	Model Type	Steady State Gaussian Plume Air Dispersion Model
3	Topography	Vast Fertile Plains
4	Terrain data	SRTM 90m DEM (Digital Elevation Model)
5	Averaging Time	24 hours
6	Source Type	Point and Line
7	Boundary Limits	7 km X 7 km
8	Co-ordinate System	Universal Transverse Mercator (UTM)
9	Receptor type	Uniform Cartesian Grid / Discrete
10	Receptor Height	0 (Ground Level)
11	Anemometer	10 m
12	Surface meteorological data	Site Specific data processed by AERMET
13	Upper air Data	Upper Air Estimator using AERMET Pre-Processor

❑ **Presentation of Results**

Cumulative Impact due to Proposed Airport Activity

The modeling has been carried out to determine the cumulative impact due to the operation of Aircraft, GSE movement, activity of DG sets and Landside traffic to predict the peak concentration under worst case scenario. The incremental GLC's due to the cumulative impact of airport operations are provided in Table-4.6 and the resultant GLC's due to the cumulative impact of airport operations are provided in Table-4.7.

Table 4.6: Predicted Incremental GLC's due to Cumulative Impact within Airport Premises

S.No	Parameter	Incremental Concentration µg/m3
1	NOx	2.38
2	CO	108
3	SO2	7.64
4	PM	0.96

Table 4.7: Resultant GLC's due to Cumulative Impact within Airport Premises

S.No	Parameter	Baseline Concentration µg/m³	Incremental Concentration µg/m³	Resultant Concentration µg/m³	NAAQ Standards (µg/m³)
1	NO_x	18.3	2.38	20.68	80
2	CO	300	108	408	2000
3	SO_2	9.6	7.64	17.24	80
4	PM	61	0.96	61.96	100

The predicted incremental concentration for Airport due to cumulative impact of airport operations for parameter NOx, CO, SO2 & PM are 20.68 µg/m3, 408 µg/m3, 17.24 µg/m3, 61.96 µg/m3 respectively.

The predicted incremental GLC's when superimposed over the Baseline concentration, the resultant concentration is well within the NAAQS limits. Further AAI is planning to implement carbon neutrality program at AAI, which further will reduce the emission from the airport operation to a greater extent.

The isopleths of NOx, CO, SO2 & PM are given from Figure 4-2 to Figure 4-5.

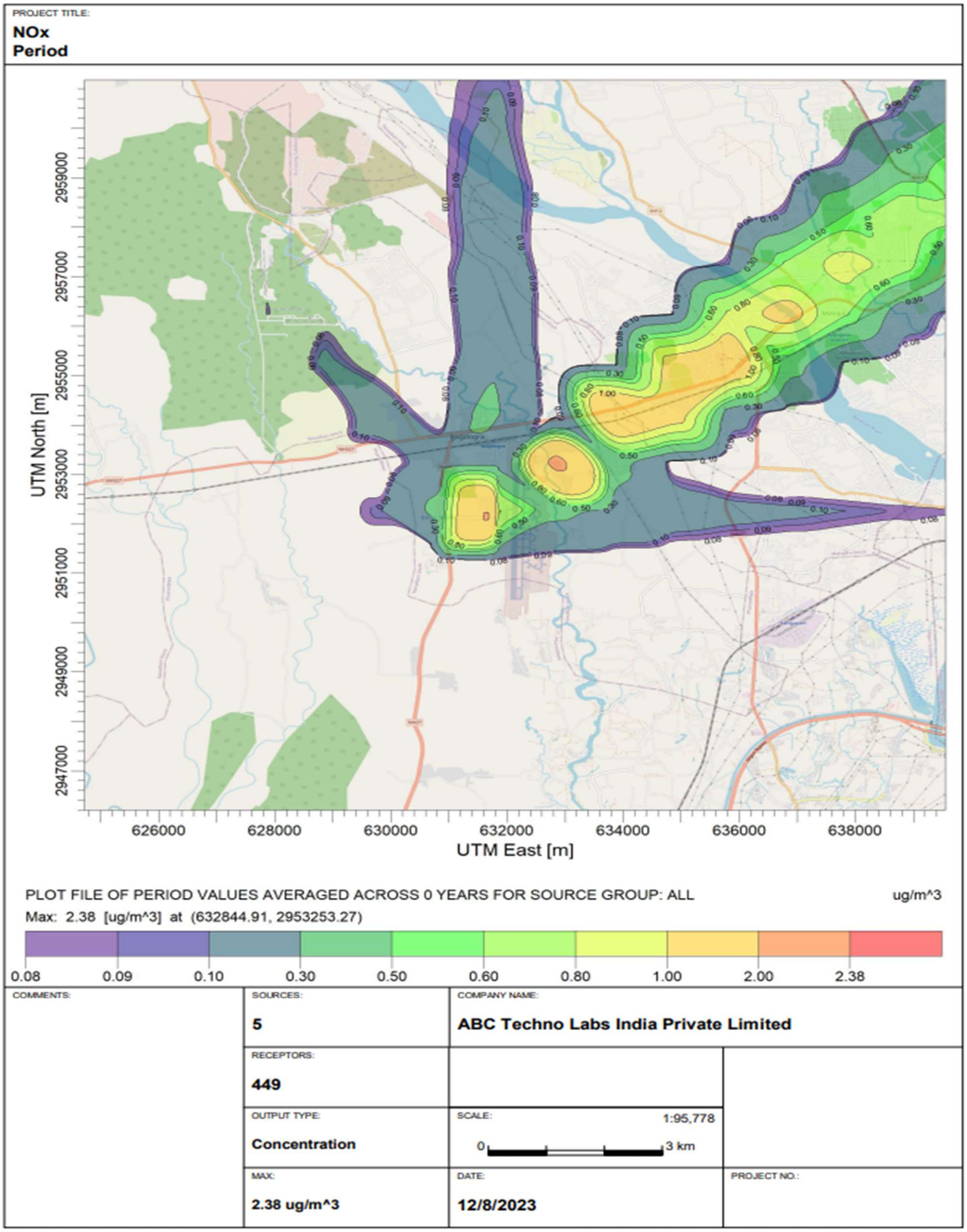


Figure 0-1 : Predicted Incremental GLC's – NO_x (Cumulative)

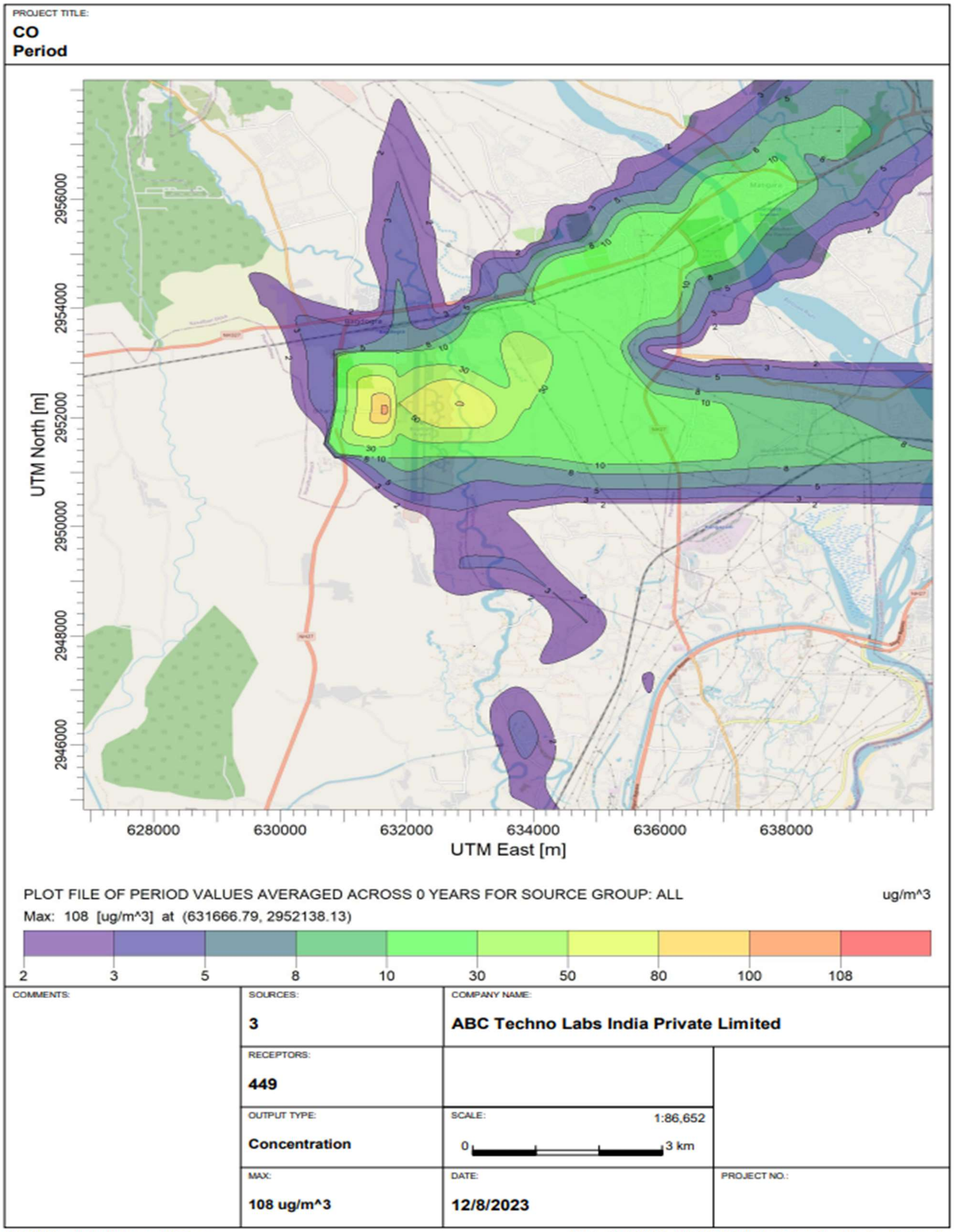


Figure 0-2 Predicted Incremental GLC's – CO (Cumulative)

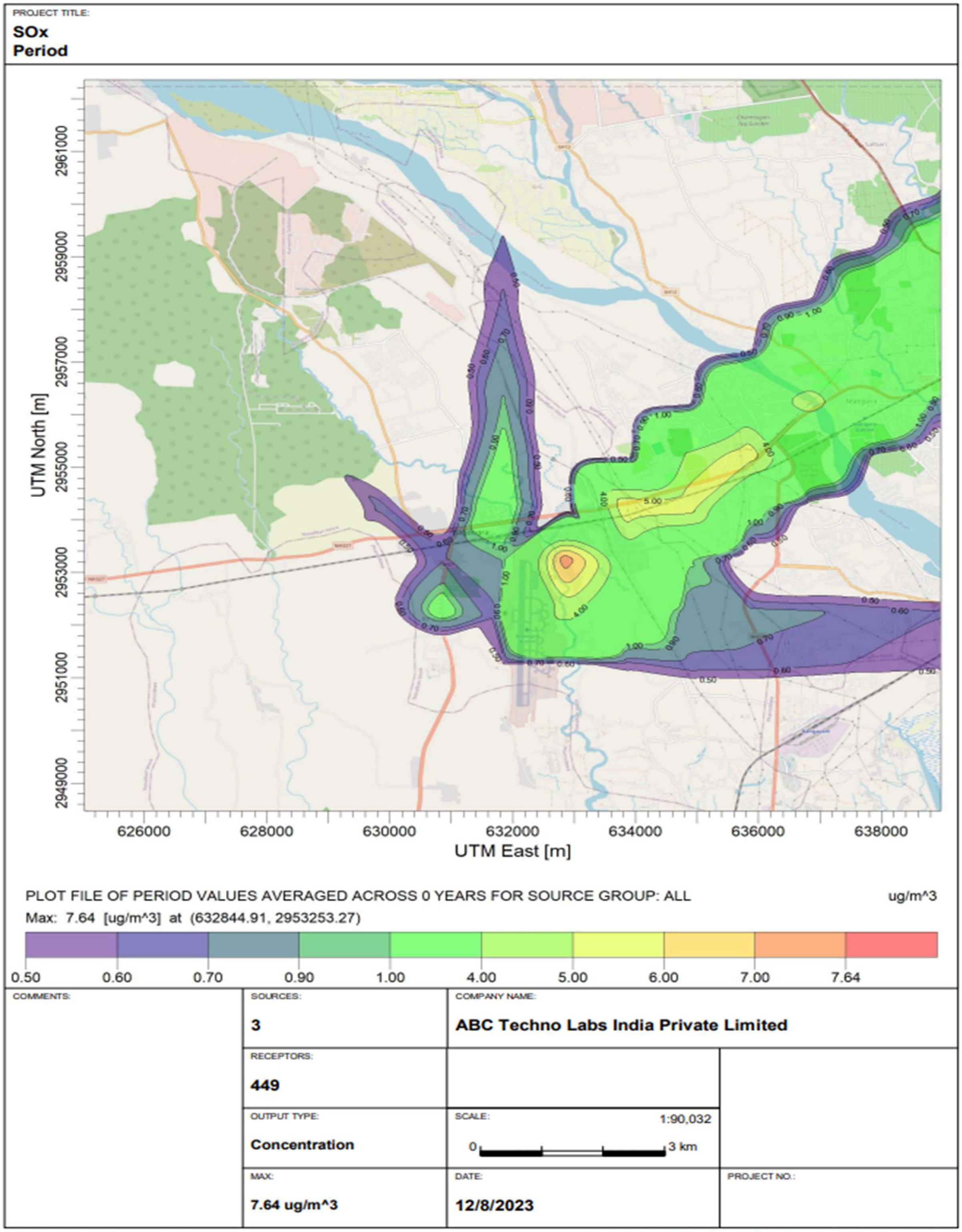


Figure 0-3 Predicted Incremental GLC's – SO_2 (Cumulative)

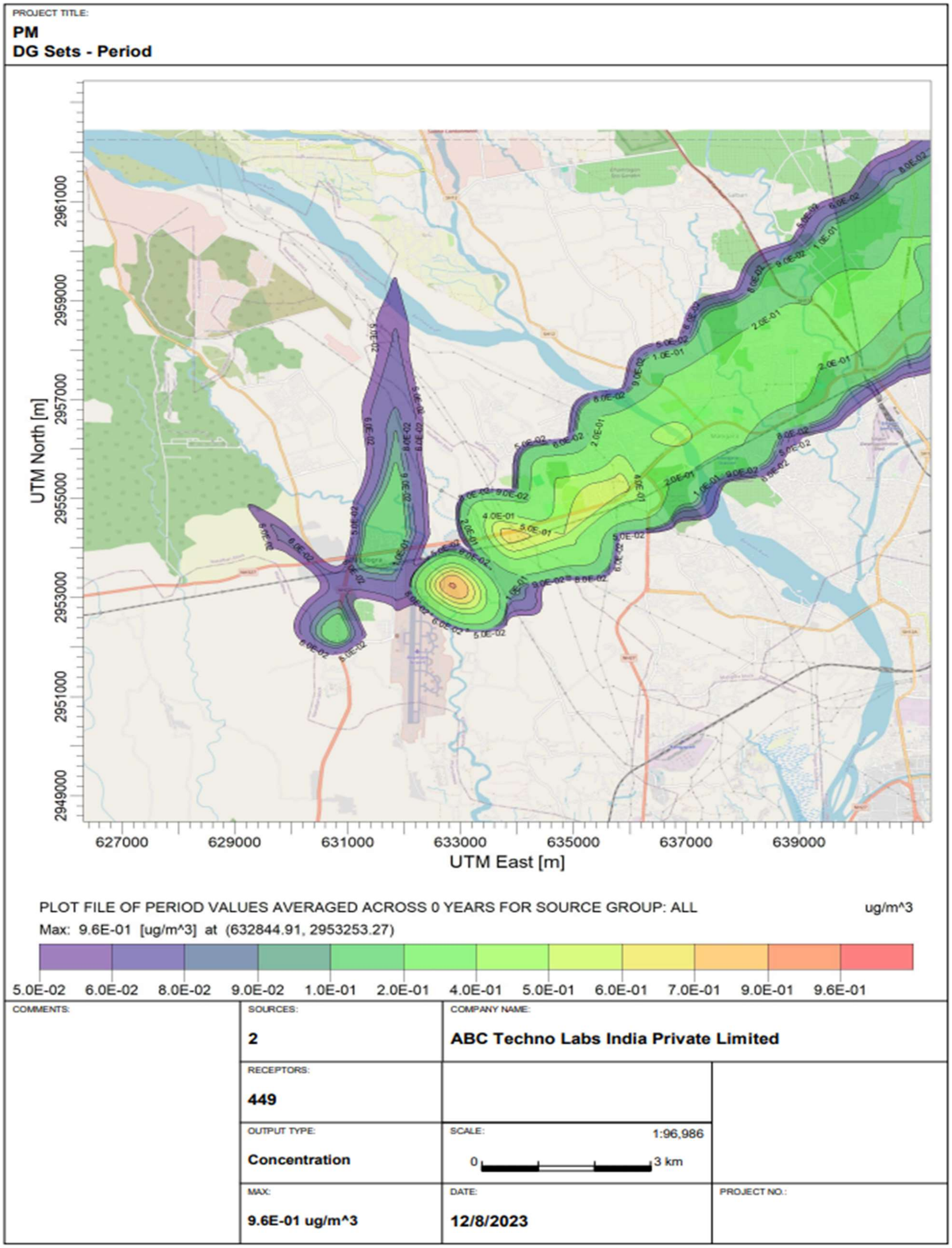


Figure 0.5:4 Predicted Incremental GLC's – PM (cumulative)

- **Air Quality Management:**

The following methods of abatement will be employed for the air pollution control at the source level.

- ✓ Aircrafts will be operated in accordance with ICAO/USEPA standards to ensure aircraft emissions are within specified standards;
- ✓ Allowing aircrafts with certified engines only to land and take-off, as far as possible;
- ✓ Shut down as many engines as possible during idling and taxing;
- ✓ Single engine taxiing and reduced taxiing to reduce emissions of CO from aircrafts;
- ✓ Encouraging to use larger aircrafts and increasing occupancy rate on aircrafts will reduce the number of landings and takeoffs;
- ✓ Converting ground service equipment to use alternative fuels;
- ✓ The Double Annular Combustor (DAC) burns the fuel at lower temperature in two stages to radically reduce NOx levels;
- ✓ Height of the stack for DG sets will be kept as per CPCB guidelines;
- ✓ Measures for vehicles and equipment with internal combustion engines will be taken in the operational phase also;
- ✓ Providing adequate buffer zones where pollution concentrations is highest to reduce the impact of emissions;
- ✓ Appropriate design of access roads to avoid traffic jams to reduce air pollution;
- ✓ Fixed Electric Ground Power (FEGP) for aircraft in place of auxiliary power units;
- ✓ Providing suitable green belt / green cover to reduce the impact of air pollution; and
- ✓ Battery operated ground support vehicles/equipment.
- ✓ In addition to the above, any additional control measures suggested by SPCB/CPCB/MoEF&CC will be implemented.
- ✓ The main air pollution in the region is particulate matter originating from traffic and natural windblown dust (background level).
- ✓ Monitoring of the gaseous concentrations of NO2 and CO around the airport has been performed for the present situation and for future developments. The results indicate that the contribution from AAI on local and regional air quality will be within the permissible norms.
- ✓ Close to the roads and in the terminal areas, maximum concentrations of NO2 and CO may reach levels close to or less than the NAAQS 2009 limit values. The emissions from the airport activities alone will only, in very limited areas and for some specific peak hour, approach adverse levels.
- ✓ AAI may lead to impacts that will affect the population's exposure and wellbeing. This gives rise to undesired effects that are caused by the increase of dust levels. The increased dust levels are likely to cause health impacts and also impact the growth of vegetation.

- ✓ The best form of mitigation from the point of view of AAI would be to offer alternative forms of transportation to and from the airport to reduce the dependency on private car usage, and enforce short term parking time zones outside to reduce idling time to a minimum.
- ✓ Steps have been taken by the AAI to improve public transport service and has successfully operated a shuttle bus service connecting airport to city.
- ✓ Baseline data has been collected, allowing informed decisions to be made in the future regarding airport developments, road construction, residential development, and any unforeseen developments in the future.

Hence impact on ambient air quality is rated as shown below:

Impact Rating	Ambient Air
Significance and Nature of impact	Negligible and Adverse
Duration of impact	Short term
Impacted Area	Localized
Likelihood of occurrence	Low
Severity of impact	Slight

4.7.4 Traffic Management

- ✓ All vehicles and equipments in use will be maintained for effective combustion to reduce carbon particles, CO and HC emission. Vehicles entering the airport will be restricted by emission controlled certification and efficient engine conditions. The Air Traffic Control personnel at air strips/runways shall be provided with Safety gadgets like ear muffs, Respiratory protection, Retroreflective vest and retrorespective hand bands.
- ✓ All the transport corridors leading to airport and the proposed approach roads should have sufficient right of way for expansion to absorb the increase in traffic.
- ✓ Multi-level car park (MLCP) is proposed with 1010 parking spaces is planned in total area of 2.08 Ha.
- ✓ Roads and utilities falling within the premises will be developed by AAI, however for outside area, required support/facilitation to the respective authorities will be provided for the execution, inline to the requirements.
- ✓ Background air quality will be maintained by reducing idling time and control on emissions.
- ✓ Well-developed green area all around the airport except the landing funnels.
- ✓ Bagdogra International Airport is committed towards achieving carbon neutrality status by adoption of renewable energy sources.
- ✓ Bagdogra International Airport enable transition to Electric Vehicles (EVs) for ground service equipment and cargo and explore Green Hydrogen/ lower power consuming technology.
- ✓ A detailed traffic management and a traffic decongestion plan was carried out. Details has been attached as Annexure XII.

4.7.5 Impact on Noise Environment

During operation phase of the proposed development of Bagdogra International Airport, landing, take-off and taxing of various types of aircrafts and apron will be major sources of noise emissions. The effects of aircraft noise to receptors at the point of interest on the ground fundamentally depend on the following factors:

- Effective Perceived Noise Level (EPNL) at the point of interest on the ground during every aircraft movement;
- Type of aircrafts;
- Flight paths of aircraft during take-off and landing; and
- Number of LTO during the given period of time.

Local topography and weather also affect sound propagation generated during take-off and landing of aircrafts. To predict the impact on the existing noise levels in the study area due to the operation of Bagdogra International Airport after proposed development, Custic 3.2 (Lakes Environmental - USEPA approved) scientific model.

❑ **Aircraft Noise Modeling Source**

The most important noise sources in airport are aircrafts, ground supporting equipments and parking vehicles, which are the part of airport are also the sources of noise. All these different sound sources, which contribute overall noise in and around the airport, are identified and categorized it as a point source, line source. The choice of source type whether the particular heavy machine is of point, line. DG sets were considered as point sources and aircrafts, ground supporting equipment and other vehicles were represented as line source Table 4.8.

Table 4.8: Noise sources in the study area

Sources	Equipment	Total Nos.
Point Source	DG Sets	6
Line Source	Aircrafts	A-321 (critical aircraft)
	GSE	630 (1260 to and fro)
	Other Vehicles	30

In addition, meteorological parameters like temperature, wind speed, wind angle and humidity were collected.

❑ **Noise due to Air Craft Traffic:**

In Noise Propagation Model, the sound pressure level generated by noise sources decreases with increasing distance from the source due to wave divergence. An additional decrease in sound pressure level from the source is expected due to atmospheric effect or its interaction with object in the transmission path. For hemispherical sound wave propagation through homogenous loss free medium, noise levels at various locations can be calculated due to different sources using the inverse square law.

Simulation of noise levels from the aircrafts has been considered as a stationary point source at the following major positions:

- Take off
- Taxiing along the runway (at the central point)
- Landing on the run-way

In the prediction of noise levels due to the expansion project, operation of the primary runway has been considered. For the noise modeling exercise, it is assumed that the aircraft will follow standard procedures of flying for approaches and departures as defined in the model. The following input is given to the model:

- Runway orientation;
- Aircraft fleet mix; and
- Terrain features.

❑ **Noise Due to Surface Traffic:**

The combined effect of all categories of vehicle at the receptor has been determined by adding the individual values using the following equation:

$$L_{eq}(h, total) = 10 \; Log_{10} \sum_{h=1}^{i} 10^{L_{eq}(hi)/10}$$

Generation of noise significantly vary with vehicle speed. Hence speed dependency of noise emissions for various categories of vehicles is taken into account while using the model for noise predictions due to roadways.

❑ **Noise due to DG set and GSE movement**

In addition to noise generated from aircraft, noise pollution poses a major health risk to the Ground staff as they are continuously exposed from the operation of GSE movement and intermittent activity of backup DG sets.

❑ **Model Results**

Impact due to aircraft

Considering the maximum certified noise of 100 dB (A) measured at a reference distance of 5 m during ground operation (Reference: ICAO Manual on Air Craft Noise) the noise levels have been predicted using the Inverse Square Law. The predicted noise levels at different contour intervals due to the proposed activity are given in Table 4.9

Table 4.9: Predicted noise levels due to Air Craft Traffic

Distance (m)	Predicted Noise Levels, dB(A)
50	80
100	74
200	68
300	64.4
400	61.9
500	60
1000	54
2000	48
3000	44.4
4000	42

Distance (m)	Predicted Noise Levels, dB(A)
5000	40
6000	38.4
7000	37
8000	36
9000	34.9
10000	34

Noise abatement measures - Due to Aircraft Operations:

The International Civil Aviation Organization (ICAO) has defined a four-point "balanced approach" that includes:

- **Reduction of noise at source:**

The new and latest aircrafts which are designed with minimum source noise levels shall be allowed at the airports.

- **Land-use-planning**

Proper land use planning with super-imposition of probable noise contours will help reduce the noise induced health impacts.

- **Noise abatement operational procedures**

Of all the activities that take place in an airport, the main sources of noise are aircraft take-off and landing operations. In this regard, the measures put into practice aimed at reducing the inconvenience, the noise causes for the surrounding population are set out in the framework of the "balanced approach" adopted by the International Civil Aviation Organization (ICAO) in the resolution of Assembly A33-7 of October 2001 and ratified by resolution A36-2 of September 2007.

The balanced approach provides ICAO contracting States with an internationally agreed approach to dealing with the problem of noise in airports. The approach comprises four main elements: reduction of noise at the source, land-use planning and management, noise-reduction procedures and operations and restrictions on aircraft operations. This line of work is complemented by adopting other measures that are equally important, such as ongoing impact assessments carried out by control and monitoring systems, information provided to local authorities, stakeholders and the general public on aspects of the environment, the collaboration of various sector agents which allow to identify areas of improvement, and the implementation of corrective measures through noise abatement plans which guarantee the fulfilment of noise quality objectives inside buildings.

The noise levels of the airport will be around 60 dB (A) near the boundaries and about 85-90 dB(A) near the runway during aircraft movement. The specifications for procuring major noise generating machines/ equipment will include built in design requirements to have minimum noise levels meeting Occupational Safety & Health Association (OSHA) requirement. Appropriate noise barriers/shields, silencers will be provided, wherever feasible

Impact due to DG set and GSE movement

In addition to noise generated from aircraft, noise pollution poses a major health risk to the Ground staff as they are continuously exposed from the operation of GSE movement and intermittent activity of backup DG sets. When noise in the form of waves impinges the eardrum, it begins to vibrate, stimulating other delicate tissues and organs in the ear. If the magnitude of noise exceeds the tolerance limits, it is manifested in the form of discomfort leading to annoyance and in extreme cases to loss of hearing. Detrimental effects of noise pollution are not only related to sound pressure level and frequency, but also on the total duration of exposure and the age of the person. The incremental noise levels due to the proposed operations is given.

Table 4.10: Noise Exposure Levels & Its Effects

Noise Levels dB(A)	Exposure Time	Effects
85	Continuous	Safe
85-90	Continuous	Annoyance and irritation
90-100	Short term	Temporary shift in hearing threshold, generally with complete recovery
Above 100	Continuous	Permanent loss of hearing
	Short term	Permanent hearing loss can be avoided
100-110	Several years	Permanent deafness
110-120	Few months	Permanent deafness
120	Short term	Extreme discomfort
140	Short term	Discomfort with actual pain
150 and above	Single exposure	Mechanical damage to the ear

It is a well-accepted fact that noise pollution causes fatigue to operating personnel. Provision will be made to keep down the noise level to the extent it is feasible.

For the purpose of noise dispersion, it is assumed that all the noise generating sources from the DG sets are considered as Point source and Aircraft movement is considered as Line source. The dispersion of this noise is computed by using the Custic 3.2 Noise Dispersion Model.

From the isopleth, it is observed that the noise levels at the airport boundary ranges from 18.1 dB(A) to 7.8 dB(A) for only DG sets. And the noise levels at the airport boundary ranges from 87.2 dB(A) to 51.7 dB(A) for cumulative of Aircraft, GSE & Traffic.

High noise levels will be confined to work zone areas only within 15 m to 20 m. It can be seen that noise levels get diffused rapidly with distance.

Day and night sound pressure levels Ldn is often used to describe the community noise exposure, which includes 10 dB (A) night time penalty. From the noise modelling, it can be stated that the impact on the present noise levels due to proposed airport operations of DG set and GSE movement will be restricted to the work zone environment only. The noise contour is shown in Figure 4-6 & Figure 4-7 given below:

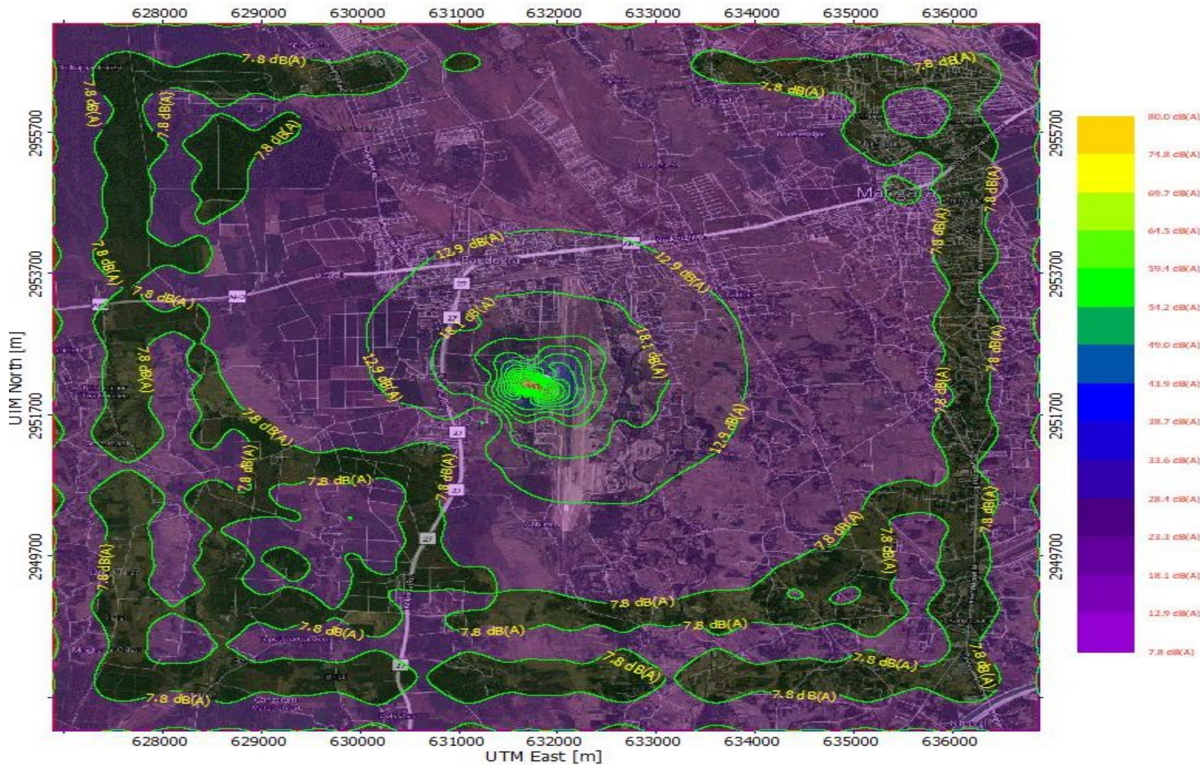


Figure 4.6: Noise Contours-Impact due to Activity of DG Set

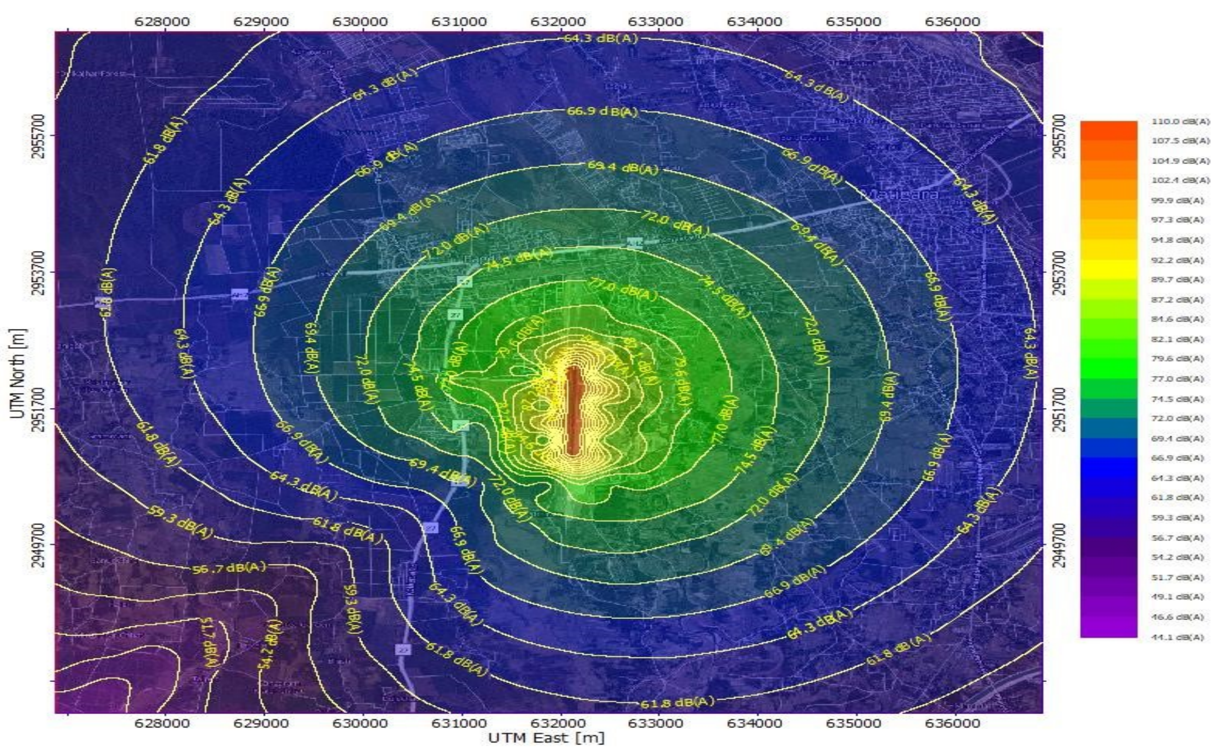


Figure 4.7: Noise Contours-Impact due to Activity of DG Set

Noise Attenuation Measures

- ✓ Strict adherence to DGCA/ICAO prescribed environmental guidelines & circulars on airport operations.
- ✓ Restricted usage of ground engine run-ups to reduce noise.
- ✓ Restricted use of thrust reversal while landing of aircraft to minimize noise in lateral direction.
- ✓ Aircrafts with certified engines only shall be allowed to land and take-off to the extent possible to reduce the noise impacts on the surroundings.
- ✓ Dual nozzle in the aircraft will reduce the noise levels.
- ✓ Proper scheduling of the aircrafts to minimize the noise levels.
- ✓ Switching off as many engines as possible during idling and taxing.
- ✓ Proper maintenance of ground servicing equipment.
- ✓ Use of damping materials such as thin rubber/ lead sheet for wrapping the workplaces like compressor room, DG room etc.;
- ✓ Maintenance of vehicles to reduce noise levels.
- ✓ Personnel working in noisy areas shall be provided with ear plugs/mufflers to reduce the noise impacts;
- ✓ The DG sets shall be provided with acoustic enclosures and exhaust mufflers for effective noise reduction of 25 dB(A) each;
- ✓ Sources of intermittent noise generating equipment such as compressors will be provided with appropriate acoustic barriers so that the noise level within 100 m of these facilities when in operation will be less than 70 dBA; and
- ✓ Noise attenuating green belt / green cover shall be developed for effective reduction in noise wherever feasible taking local meteorology into consideration.

Hence the impact on the noise level during operation is rated as per given below:

Impact Rating	Noise Level
Significance and Nature of impact	Negligible and Adverse
Duration of impact	Short term
Impacted Area	Localized
Likelihood of occurrence	Low
Severity of impact	Slight

4.7.6 Impact of Solid Waste

Total quantity of 5.12 Tonnes/day of Solid Waste will be generated at site, through Airside and Landside Operation. Hazardous waste of 0.6 Ton/Day, including Used Oil, Contaminated filters, Oily cotton waste, discarded drums etc. will be generated during operation phase.

The major solid waste contributing facilities include terminals, hospitality, cargo and other airport related buildings. The characteristics of the solid waste generated is of typical municipal waste along with hazardous wastes from specific facilities, consisting of plastic, metal, paper, cardboard, pet bottles, used oils and bio-medical waste. Non-hazardous construction and demolition waste from proposed infrastructure development include metals, wood, food, asphalt and debris.

Mitigation Measures

- ✓ The solid waste generated during operation phase will be collected, segregated, dried, transported, disposed and treated in a scientific manner, based on the integrated approach;
- ✓ Wastes will be segregated into bio-degradable and recyclable wastes at the source of generation and stored separately in appropriately designed wastes storage facilities;
- ✓ Adequate quantity and sizing of dustbins will be maintained throughout the airport area during the operation stage to receive solid wastes as and when generated;
- ✓ The collection bins will be regularly sprayed with disinfectants;
- ✓ The solid waste transporting vehicles will be adequately covered to prevent any spillages during transportation;
- ✓ The biodegradable/ organic portion of the solid waste will be treated by bio-composting process and is converted to Compost using Organic Waste Convertor (OWC). The manure thus generated will be used for horticulture within the site;
- ✓ Sewage sludge to be generated from the STPs will be dried and used as manure for horticulture purpose;
- ✓ Paper and cardboard wastes, plastic wastes, metal wastes and other recyclable wastes from the cargo handling areas will be disposed through authorized recyclers;
- ✓ The e-waste will be stored separately in the complex and disposed through authorized recyclers approved by the State/Central Pollution Control Boards or will be disposed back to the manufacturer through buy-back system;
- ✓ Hazardous wastes generated in the complex will be stored in secured place with adequate secondary containment and labelling as per the requirements of HWM Rules;
- ✓ Records of hazardous wastes generation and disposal will be maintained as per the requirements of HWM Rules;
- ✓ Fire extinguishers near storage of hazardous wastes will be installed;
- ✓ The used oil and oil-contaminated wastes, spent fuels and lubricants will be disposed of through authorized recyclers/re-refiners;
- ✓ All the waste will be handled inline to 5R principles of waste management (Reduce, Reuse-Recycle-Recover-Reprocess) to avoid the disposal of waste back to the environment, and to be aligned to the vision of Zero Waste to Landfill.
- ✓ A notified by the Union Environment Ministry on August 2021, the use of single-use plastics is banned in the Airport.
- ✓ All stipulated procedures as per the Solid Waste Rules and the Hazardous waste Handling and management Rules would be adhered to.
- ✓ Dedicated Solid Waste Yard Facilities are proposed and the following tasks are accounted as part of Solid waste management methodology.
- ✓ Identification of Waste Generation Sources

- ✓ Waste collection, storage & transportation
- ✓ Waste segregation, handling and processing
- ✓ Waste Quantification and Characterization
- ✓ Treatment & Disposal of wastes

The overall impact of solid wate during operation phase of Bagdogra International Airport after proposed development is rated as follows:

Impact Rating	Waste Management
Significance and Nature of impact	Negligible and Adverse
Duration of impact	Long term
Impacted Area	Localized
Likelihood of occurrence	High
Severity of impact	Low

4.7.7 Terrestrial Ecology

For proposed development of Bagdogra International Airport, tree felling will be required. It is proposed that landscaping and green belt will be developed around open space at the Bagdogra International Airport. For irrigation of green belt, treated wastewater from STP is available and same shall be used. This has positive and long-term beneficial impact on terrestrial ecology of the area.

The baseline flora and fauna has been depicted in Chapter-3. As per the forest department records, there are 2 Nos. endangered or rare species of flora and fauna are reported or observed in the study area. The impact on terrestrial ecology will be due to emission of pollutants like PM, NO2 and SO2. However, the incremental concentrations of these pollutants are very less and the impacts on the terrestrial ecology will be insignificant. No treated effluent / sewage will be discharged into any surface water streams. Hence, no impact is envisaged from the proposed project on aquatic bodies.

Mitigation Measures

- ✓ Landscaping / plantation / greenery will be developed at Bagdogra International Airport with adequate area with no of trees, shrubs and bushes.
- ✓ Indigenous species of trees will be planted at Bagdogra International Airport
- ✓ The fugitive emissions from different sources will be suppressed by spraying water.
- ✓ Vehicles emissions will also be minimized by proper maintenance and by avoiding use of adulterant fuels and will be maintained below the standard limits prescribed by competent authority.
- ✓ Development of a thick green belt will reduce the pollution loads in the surroundings areas and contain the negative impact on forests and terrestrial ecology.

Hence, overall impact on terrestrial ecology during operation phase is rated as follows:

Impact Rating	Terrestrial Ecology
Significance and Nature of impact	Negligible and Adverse
Duration of impact	Short term
Impacted Area	Localized

Impact Rating	Terrestrial Ecology
Likelihood of occurrence	High
Severity of impact	Low
Significance of Impact	Minor

4.7.8 Road & Traffic

During various phases of projects like operation of new civil enclave, various types of vehicle/equipment movement will be involved. The vehicular movement is expected to be more in airport operation due to movement of visitors.

The impacts will be for limited duration. Thus, the impacts are temporary in nature and limited mostly within the airport area.

Mitigation Measures

- ✓ Entry of vehicles into the airport area will be maintained.
- ✓ Regular supervision will be done to control vehicular traffic movement along defined traffic routes particularly near identified sensitive receptors.
- ✓ Speed limits will be maintained by vehicles involved in transportation.
- ✓ Adequate parking will be provided at allotted parking area.

Hence, the impact on the roads and traffic due to the proposed activities are given below:

Impact Rating	Roads & Traffic
Significance and Nature of impact	Negligible and Adverse
Duration of impact	Short term
Impacted Area	Localized
Likelihood of occurrence	Low
Severity of impact	Slight

4.7.9 Heritage Structures

There is no heritage, historical or archaeological structure in the area around the airport. Therefore, no impact is anticipated due to development at Bagdogra International Airport. Hence, no mitigation measure is required

4.7.10 Impact on Occupational Health and Safety

The most significant occupational hazards from the airport operation at the existing and after proposed facilities may include; collisions with moving ground service vehicles, or taxing aircraft, high noise levels near aircraft, jet engine hazards, sucking of person in to aircraft jet engine, fire in terminal building, etc.

Mitigation Measures

- ✓ Operators and workers will be certified with access to airfield operations;
- ✓ Workers involved in the operation of aircraft support equipment will be familiar with safety procedures applicable to apron and taxiway traffic, including communications with the air control tower;

- ✓ Operators will be provided safety signs and pavement markings for ground support vehicle circulation and parking areas in ramps, taxiways and any other areas with a risk of collision between ground vehicles and aircraft;
- ✓ Delineated safety areas include high risk locations, such as jet engine suction areas to protect aircraft service workers;
- ✓ All workers involved in luggage and cargo handling, whether as a regular or incidental aspect of their work function, will be trained in the use of proper lifting, bending and turning techniques to avoid back injury or extremities;
- ✓ Particular attention is placed on the handling of luggage and cargo in aircraft holds which often do not have adequate standing height (requiring special lifting or pushing techniques) and which may present tripping and slipping hazards;
- ✓ Workers will be provided with appropriate Personal Protective Equipments (PPEs), such as knee pads, when accessing cargo holds;
- ✓ Safety features of ground support vehicles will be maintained, including back-up alarms, moving part guards and emergency stop switches;
- ✓ The frequency and duration of worker assignments to heavy lifting activities will be mitigated through rotations and rest periods;
- ✓ Operators have facility for mechanizing luggage handling activities, such as the use of conveyors that extend into the cargo holds;
- ✓ Operators will be trained on the prevention of heat stress, including the identification of early symptoms and management techniques (e.g. hydration, rest). Workers will be provided with the necessary clothing and fluids to prevent weather related stress; and
- ✓ Adequate Firefighting facilities will be provided in the extension area of the terminal building.

General Safety Measures

- ✓ Shield guards or guard railings will be installed at all belts, pulleys, gears and other moving parts;
- ✓ Conveyors and similar machinery will be provided with a means for stopping them at any point;
- ✓ Elevated platforms & walkways, and stairways & ramps will be equipped with handrails, toe-boards and non-slip surfaces;
- ✓ Electrical equipment will be grounded, well insulated and conform to applicable codes;
- ✓ Employees will be provided with hard hats, safety boots, eye and ear protection and snug fitting gloves, as appropriate;
- ✓ Procedures will be strictly enforced for the storage, handling and transport of explosives, flammable and hazardous materials.

General Health Measures

- ✓ Necessary control measures like earmuff and earplug, high visible vest with refractive tape will be provided to ground staffs at the Bagdogra International Airport.

- ✓ Personnel required to work in areas of high temperature and/or high humidity will be allowed to take frequent breaks away from these areas; and
- ✓ Pre-employment and periodic audiometric medical examinations will be conducted for personnel potentially exposed to high noise areas.

The overall impact on occupational hazards and safety during operation phase is rated as follows:

Impact Rating	Occupational health & safety
Significance and Nature of impact	Negligible and Adverse
Duration of impact	Long term
Impacted Area	Localized
Likelihood of occurrence	Low
Severity of impact	Slight
Significance of Impact	Negligible

4.7.11 IMPACTS TO SOCIO-ECONOMIC ENVIRONMENT

During operation phase, proposed development at Bagdogra International Airport will open additional direct and indirect job opportunities in the area and region. Further, it will attract more and more tourist, commercial and developmental activities in the area. Therefore, positive impacts are anticipated on socio-economic environment during operation phase after extension.

Employment and Economic Growth

The proposed development at Bagdogra International Airport will result in a boost commercial activities and tourism in the region. This will improve direct and indirect employment opportunities, revenue generation, commercial and industrial activities; therefore, resulting in positive impact on the employment and economic growth of the region. It is expected about 2000 direct and indirect employment during operational phase of the project after expansion. City side development will lead to financial growth & promotes travel, tourism, hospitality, trade, cargo, etc. leading to employment and revenue generation for local / regional economy.

Hence, overall impact during operation phase is rated as:

Impact Rating	Employment & Economic Growth
Significance and Nature of impact	Beneficial
Duration of impact	Long term
Impacted Area	Regional
Likelihood of occurrence	High
Severity of impact	Medium
Significance of Impact	Moderate

4.8 IMPACT EVALUATION

The evaluation of the impacts of the proposed Project Activities on the environment, both in terms of quality & quantity have been made. For quantification of impacts, matrix system as modified to some extent has been used as per given below:

For quantifying impacts on the environment, the guidelines and standards prescribed by national and international agencies are being considered. 1000 numbers are distributed as per the weightage to each parameter considered based on its importance as per given below in Table 4.7.

Table 4.7: Evaluation of Impact Prediction

Parameters	Importance Value
Air Quality	100
Water quality	200
Water resources	200
Noise and vibration	200
Soil & Solid waste	100
Land Use Pattern	100
Forest &Vegetation and wild life	50
Socio – economic	50
Employment	100
Total	**1000**

The severity has been divided in impact scores from 0-5 for calculating the severity of impacts on the environmental parameters due to various project activities as given below in Table 4.8.

Table 4.8: Impact Assessment Score

Severity criteria	Impact score
No impact	0
Significant impact-slight and short term	1
Significant impact-slight and long term	2
Moderate impact- short term	3
Moderate impact- long term	4
Major Impact - Permanent	5

The impact score can be negative or positive depending on whether the impact is adverse or beneficial. Based on the above importance values and impact scores, the impact value (impact score x importance value) for each environmental parameters are calculated. The impact value for individual parameter is added to arrive at the total impacts value. The criterion used to make conclusive statement is based on the total impacts value without control measures is defined as given below in Table 4.9.

Table 4.9: Impact Assessment Criterion

Total impact value	Conclusions
Up to (-)1000	No appreciable impact on environment
(-) 1000 to (-) 2000	Appreciable but reversible impact. Mitigation measures important.
(-) 2000 to (-) 3000	Significant impact which is mostly irreversible. Mitigation measures crucial.
(-) 3000 to (-) 4000	Major impact which is mostly Irreversible. Selection of process and raw material to be crucial.

Total impact value	Conclusions
Above (-) 4000	Permanent irreversible impact, alternative sites to be considered.

The environmental impact matrix based on the above principles has been attempted for the proposed Project Activities and are given in Table 4.10.

Table 4.10: Impact Evaluations – expansion of Airport

Environmental parameters	Importance value	Impact Score		Overall Value	
		Without EMP	With EMP	Without EMP	With EMP
Air Quality	100	-1	-1	-100	-100
Water quality	200	-2	-1	-400	-200
Water resources	200	-2	-1	-400	-200
Noise and vibration	200	-1	-1	-200	-200
Soil & Solid waste	100	-2	-1	-200	-100
Land Use Pattern	100	-2	-1	-200	-100
Forest & Vegetation and wild life	50	-2	-1	-100	-50
Socio – economic	50	-2	1	-100	50
Total	**1000**			**-1700**	**-900**

Source: ABC Techno Labs India Pvt. Ltd.

Thus, it can be evaluated that there will be No appreciable impact on environment is envisaged with proper mitigation measures.

CHAPTER 5: ANALYSIS OF ALTERNATIVES

5.1 GENERAL

The consideration of alternatives for the developmental activities through improvement, modification/upgradation/augmentation and modernization of existing Airside/Landside facilities and infrastructure at Bagdogra International Airport is one of the more proactive sides of environmental assessment - enhancing the project design through examining options instead of only focusing on the more defensive task of reducing adverse impacts of a single design. This calls for the systematic comparison of feasible alternatives for the developmental works at Bagdogra International Airport, technology and operational alternatives. Feasible alternatives are compared in terms of their potential environmental impacts, capital and recurrent costs, suitability under local conditions and institutional, training and monitoring requirements.

5.2 ALTERNATIVES IN PROJECT SITE

In view of the future traffic growth, there is an urgent requirement of proposed capacity enhancement activities for Bagdogra International Airport. Due to the fast and previously unforeseen growth of air traffic at Bagdogra International Airport in the last few years it was necessary to review the air traffic forecast. Their view concluded that the actual growth was even higher than anticipated in the most optimistic forecasts from previous efforts. This growth will be met through improvement, modification/up gradation/augmentation and modernization of existing Airside/Landside facilities and infrastructure. The Proposed project falls within the Airport Zone as classified under Master plan/Zoning Plan by the State Government. Hence, there is no consideration of Alternative sites.

5.3 ALTERNATIVE FOR DESIGN PROCESS

Design process for the proposed expansion/modernization of the airport has been examined to maintain the positive environment impacts during the construction phase (like utilization of fly ash) and operational phase (socio-economic benefit) and efforts will be made while designing to minimize the temporary adverse impacts.

There is no displacement of people or loss of agricultural land involved for the proposed expansion project. Project planning and the design process need is designed which will be flexible enough to adopt the basic project alternatives includes the below steps:

- **Source:** Taking the measures in design aspects at source level to mitigation the environmental impacts such as ICAO measures on design of storage tanks, landscape design and flight safety measures to counter risks due to birds etc.
- **Process:** Implementing management measures in the operational procedures like ICAO measures for Air traffic system procedures for surface traffic, sewage treatment plants, waste disposal procedures and rain water harvesting structures for conservation of water etc. which are under implementation in the operating airport and the same will be strengthened.

- **Receptors:** Implementing defensive measures in the location of receptors like safety and health of population and flora and fauna and by implementing risk mitigation measures.
- **Multi Modal Transportation:** Analysed the possibility of meeting the alternative modes of transport such as road/rail. MLCP is proposed for 1100 vehicles ~ 2.08 Ha inline to business needs. Multi-level car park (MLCP), city side check-in and self-bag drop (SBD) facility, Airport Plaza area for passengers / visitors arriving early at the airport from surrounding villages, towns and cities, staff and stakeholder facilities – all connected seamlessly to the main levels of the New Terminal Building setting a new benchmark for the state and the country offering world class passenger and user experience.

5.4 Alternative for Energy Conservation Measures

The resource optimization is always pre-requisite for any development project. In quest towards resource optimization in proposed project, the tradition practices are substituted by modern practices involving water reduction, rainwater harvesting, energy Conservation, etc.

Bagdogra International Airport is planned to be developed as Green Airport, with key objective of Environmental Sustainability to be achieved through, optimization in resource consumption through following measures:

- ✓ Energy Optimization
- ✓ Utilization of Solar Energy
- ✓ Natural Day Lighting
- ✓ Re-Cycling of Waste
- ✓ Water Balance
- ✓ Water Transport
- ✓ Water Harvesting
- ✓ Plantation & Landscape
- ✓ Environment Management

The approaches have planned to be adopted from planning & design stage, and hence demand for resources shall be optimized more efficiently.

5.5 Alternative Project Scenario

Siliguri is the densely populated city in the state and one of the important and fast-growing cities. Bagdogra International Airport is located at "Bagdogra", 9 Km from Siliguri, the capital city of Darjeeling district. Rapid urbanization and intense commercial developments in the recent past have resulted in steep rise in travel. Siliguri is both agriculturally and industrially active. However, increase in capacity of the transport system has not been compatible with transport demand. With ever increasing demand for road space – both for vehicular movement and parking, it is difficult to depend only on road-based transport solutions. AAI has thus planned to develop existing Bagdogra Airport for the city. It will accentuate the industrialization status, multi-model-connectivity and real estate development in the region and surrounding areas that will eventually support in the growth of the state as well as country. Analysis is carried out to assess the impacts of project in both with & without project considering physical and social environment component and is given in Table 5.1.

Table 5.1: With & Without Project Scenario

Sl. No.	Environment	Without project Scenario	With Project scenario
1	Physical Environment	✓ Climate of the area may get affected due to increased GHG emissions due to increased nos. of vehicle & increased congestion in the area. Increased GHG emissions may affect the temperature profile and rainfall pattern of the area ✓ Air environment will continue to affect, and air quality will continue to degrade due to addition of nos. of private vehicle & their exhaust emissions. Congestion will increase due to addition of the vehicle on roads that will add the additional exhaust on the roads. ✓ Further for expansion of roads, tree will be required to be cut which have impact on the air quality. During construction of roads, emission of pollutants will result which may affect the air quality of the area. ✓ Noise environment will continue to get affected due to increased vehicular noise during movement and due to jams. ✓ Land use will not be affected as the road development is as per the master plan designed for the area. But due to increased requirement of the roads, more area may be required to be diverted for construction of roads. ✓ Soil environment will continue to affect due to the project. Soil quality may get affected due to inflow of the contaminated run-off from roads into the nearby agricultural fields. Also large quantity of	✓ Vehicle reduction will reduce the fuel requirement. This will reduce the vehicular emissions including HC, NOx, Particulate Matter, CO & CO2. Due to this overall quality of the life in city will be improved. Air will be cleaner, traffic jams will be lesser, time of travelling will be reduced ✓ However, air quality may get impacted during construction of the Airport and also during operation phase, air quality near the stations may get impacted due to increased vehicular movement near the stations. But overall, air quality of the cities will be improved. ✓ Water environment may get affected as water will be required for curing, construction and to meet the domestic water requirement of staff and construction workers. But since there is minimal chance of leakage of fuel/lubricant in Airport project when compared to road vehicles, chances of contamination of run-off is minimal. Further to manage storm water, it is proposed to have dedicated storm water management system in the premises and RWH recharge pits is proposed to recharge the collected storm water. This will improve the ground water aquifers of the cities. To prevent contamination, desilting chambers and oil traps will be provided with RWH pit. ✓ Noise environment will be improved in the area due to reduction of traffic overall in the area. Noise will be generated both during construction and operation ✓ Phase of the project. Construction noise is one time and will be localized. However, during operation, source of noise will be aircraft, operation of equipment, motors, and compressors.

Sl. No.	Environment	Without project Scenario	With Project scenario
		soil is required for construction of roads & highways. Construction of roads & highway or the expansion of existing roads & highways will be required to accommodate the increasing vehicles in the area.	But when compared to noise levels due to road traffic, the noise levels will be lower. ✓ Land required for the development of this Airport belongs to the AAI. Thus requirement of land is minimal and very less when compared to road/highway projects. Cautiously land involving non-R&R and other social impacts are considered. Impact on land use due to Airport projects is anticipated to be comparatively lesser than that of road projects ✓ Soil environment will not be significantly affected due to project. There could be impact on soil quality during construction phase & Operation phase due to erosion and contamination of soil. During construction phase soil is required to be excavated for construction and same shall be used for levelling of the site. No major soil from outside the premises shall be required for levelling.
2.	Biological environment.	✓ Biological environment may get affected due to increased dust generation and other pollutants generated due to vehicular movement. Further tree cutting will required to be carried out for expansion of existing or construction of new road/highways. Forest land may also be required to be diverted for purpose of expansion of old alignment and construction of green field projects	✓ For Airport construction project, tree cutting will be required but tree cutting is comparatively lesser for airport projects as compared to new road projects.
3.	Social Environment	✓ Social environment will continue to get affected due to development of proposed project due to various reasons ✓ Increased traffic and vehicular emissions ✓ Increased noise level due to increased traffic ✓ Increased land acquisition and R & R for expansion of old and construction of new highway/roads	✓ Social environment will be highly benefited due to the project due to following reasons ✓ Reliable, fast and safe transportation system ✓ Less exposure to pollutants thus cost saving due to reduction in expenditure on health. ✓ Reduced fuel consumption & associated GHG & exhaust emissions ✓ Comparatively lesser land acquisition

Sl. No.	Environment	Without project Scenario	With Project scenario
		✓ Increased traffic jams and increased time loss in traffic jams due to travelling ✓ Reduced right of pedestrian on the roads ✓ Increased road accidents ✓ High cost of travelling using private vehicles ✓ High fuel consumption ✓ Increased road infrastructure development and infrastructure development along the new constructed roads	✓ Reduced traffic congestion and associated exhaust emissions & GHGs due to congestion ✓ Reduction in travelling time ✓ Improved quality of life ✓ Well-developed transportation infrastructure ✓ Generation of employment during construction & operation phase ✓ 10. Development of commercial activities near airport thus development of area, facility for public and generation of indirect employment

5.6 CONCLUSION

No alternative site was analyzed for development of proposed project as the project involves expansion of existing airport. Alternatives were analyzed in terms of technology. Alternative energy options, building material options, fixtures etc. were analyzed. Options having low cost (both capital & maintenance), low environmental impacts and high life are tried to be selected. Some of the chosen alternatives have high capital cost but low O&M cost. With respect to the "Without" project scenario environment will continue to get affected whereas in "With" project scenario there is expected reduction in traffic, congestion on roads, development of safe, reliable, fast & cost-effective public transportation system, reduced air & noise pollution and increased employment generation.

CHAPTER 6: ENVIRONMENTAL MONITORING PROGRAMME

6.1 INTRODUCTION

Environmental Monitoring is an essential tool for sustainable development and ensuring effective implementation of Environmental Management Plan and mitigation measures. The monitoring and evaluation of the management measures envisaged are critical in implementation of the Project. Monitoring involves periodic checking to ascertain whether activities are going according to the plans. The purpose of the environmental monitoring plan is to ensure that the envisaged purpose of the project is achieved and results in desired benefits. An environmental monitoring programme is important as it provides useful information and helps to-

- Assist in detecting the development of any unwanted environmental situation and thus, provides opportunities for adopting appropriate control measures.
- Define the responsibilities of the project proponents, contractors and environmental monitors and provides means of effectively communicating environmental issues among them.
- Evaluate the performance and effectiveness of mitigation measures proposed in the Environment Management Plan (EMP) and suggest improvements, if required.
- Identify training requirement at various levels.

6.2 OBJECTIVES OF MONITORING PROGRAMME

The objective of carrying out environmental monitoring for the Expansion of Bagdogra international Airport to enhance the Passenger Handling Capacity up to 10 MPPA is given below:

- ✓ To implement the mitigative measures defined in EMP.
- ✓ To evaluate the performance of mitigation measures proposed in the EMP.
- ✓ To evaluate the adequacy of Environmental Management Plan.
- ✓ To suggest improvements in management plan, if required.
- ✓ To improve environmental quality.

A detailed monitoring of emissions and effluent from different sources for different environmental parameters will be carried out as per the permitted norms and any further notification/direction from West Bengal Pollution control Board (WBPCB), Central Pollution Control Board (CPCB) and MoEF&CC. Monitoring methodologies will follow standard methods prescribed by Central Pollution Control Board (CPCB), Bureau of Indian Standards (BIS), USEPA etc.

6.3 Environmental Monitoring Programme

To ensure the effective implementation of the mitigation measures and environmental management plan during construction and operation phases of proposed development activities in Bagdogra international Airport, it is essential that an effective Environmental Monitoring Plan shall be designed and followed during construction and operation phases. This may take the form of direct measurement and recording of quantitative information, such as amounts and concentrations of discharges, emissions, and wastes, for measurement against statutory standards, consent limits or targets. It may also require measurement of ambient environmental quality in the vicinity of a site using ecological/ biological, physical, and chemical indicators. Monitoring may include socio-economic interaction, through local liaison activities or even assessment of complaints. The objectives of environmental post-project monitoring are to:

- ✓ Verify effectiveness of planning decisions.
- ✓ Measure effectiveness of operational procedures.
- ✓ Confirm statutory and corporate compliance; and
- ✓ Identify unexpected changes (if any).

6.4 Environmental Monitoring Schedule

Environmental monitoring schedules are prepared, covering various phases of project advancement, such as construction phase and regular operational phase.

6.4.1 Monitoring Schedule during Development Phase

During the construction phase, the environmental monitoring at the site and in its vicinity are being regularly carried out to check non-compliance to environmental standards and appropriate mitigation measures are implemented towards abetment of environmental pollution. The generic environmental monitoring that will be undertaken during project construction phase is given in Table-6.1 and will be integrated with the current environmental monitoring programme being undertaken during the pre-development stage.

6.4.2 Monitoring Schedule during Operational Phase

During the operational stage, continuous air emissions are envisaged from aircrafts, GSE, ground traffic, DG powerhouse. Wastewater is envisaged from the sanitary units and other aircraft operational areas. Further, solid waste such as municipal solid waste, hazardous solid waste and non-hazardous solid waste are envisaged from passenger terminal buildings, ATF storage and handling areas. The noise generated during the flight landing and take-off cycles and its impact in the funnel zone and on nearby habitat areas is also one of the key aspects of noise monitoring to be considered.

As part of post project monitoring, Airport Authority of India (AAI) will collect and monitor following data regularly:

Environmental Management Cell (EMC) will be formulated by the management of AAI to ensure proper implementation of EMP.

A. Meteorological Station

An automatic continuous recording meteorological station will be installed within the existing airport premises for a proper measurement and record of meteorological parameters on hourly basis. In addition, minimum and maximum temperatures, atmospheric pressure and rainfall will also be measured daily.

B. Ambient Air Quality (AAQ) Monitoring

Ambient air quality shall be monitored quarterly basis for PM10, PM2.5, SO2, NOx, CO. A MoEF&CC or NABL accredited laboratory may be engaged to monitor ambient air quality at the plant and adjoining area.

Ambient air quality monitoring in and around the premises will be done as per direction by West Bengal Pollution control Board (WBPCB). The parameters monitored include the parameters as per National Ambient Air Quality Standard (NAAQS), 2009.

C. Work Zone Emission Monitoring

Work zone emissions shall be measured at four (4) locations at about 5-10 meters from the source of fugitive emissions, once in a quarter.

D. Noise Levels Monitoring

Noise monitoring shall be carried at near to the high noise generating areas once in a month. Monitoring of Ambient noise levels will be monitored once every quarter during day time (6 AM to 10 PM) and night time (10 PM to 6 AM) as per The Noise Pollution (Regulation and Control) Rules, 2000, Schedule III at Industrial, Commercial, Residential and Silence Zone.

E. Water Quality Monitoring

Ground water shall be sampled from up gradient and down gradient to check for possible contamination and to ascertain the trend of variation in the water quality, if any. In case any adverse trend is noticed, immediate remedial measures shall be taken.

A total of two samples shall be collected from nearby and will be compared with IS: 10500 drinking water standards.

F. Waste Water Quality Monitoring

There will be no effluent/sewage discharge as the proposed plant has adopted zero liquid discharge (ZLD). Domestic water generated will be treated in STP. Blowdown water from HVAC shall be used for re-used in flushing and gardening. Water quality shall be monitored at following locations after the treatment facilities to check their conformance with Effluent Discharge Quality norms under Schedule – VI of Environmental (Protection) Rules, 1986 for the relevant parameters and will be maintained to meet the requirements of WBPCB.

G. Soil quality

Soil Quality monitoring shall be carried out at two locations inside the project premises i.e. near to Solid waste storage yard & Fuel storage area and near to the greenspace area as per the IS: 2720 and shall be compared with Indian Council of Agricultural Research (ICAR) categorization.

H. Plantation

Plant growth, its maintenance and survival rate will be monitored.

I. Occupational Health Check-up

Occupational health and safety monitoring programs shall verify the effectiveness of prevention and control strategies. The selected indicators shall be representative of the most significant occupational, health and safety hazards and the implementation of prevention and control strategies. The performance and achievements of the OHSMS responsible for all management of all environments, Health & Safety aspects shall be reassessed on annual basis. The occupational health and safety monitoring program shall include:

- M/s Airport Authority of India (AAI) shall carryout inspection and testing of all safety features and hazard control measures for Airport operation. This shall include regular inspection and testing of all safety features and hazard control measures focusing on engineering and personal protective features, work procedures, places of work, installations, equipment, and tools used. The inspection shall verify that issued personal protective equipment (PPE) continues to provide adequate protection and is being worn as required.
- All instruments installed or used for monitoring and recording of working environment parameters shall be regularly tested and calibrated, and the respective records maintained; Surveillance of the working environment shall be carried out.
- Surveillance of workers health: When extraordinary protective measures are required, workers shall be provided appropriate and relevant health surveillance prior to first exposure and at regular intervals thereafter. M/s Airport Authority of India (AAI) shall provide appropriate and relevant health surveillance to workers.

J. Training

Training activities for employees shall be adequately monitored and documented (curriculum, duration, and participants). Emergency exercises, including fire drills shall be documented adequately. Service providers and contractors shall be contractually required to submit to the AAI adequate training documentation before start of their assignment.

K. House keeping

There shall be different stockyard for the raw materials, so that the shop floor area can be kept clean. Proper maintenance and cleaning of the equipment/devices would be done. Any solid waste generated will be kept in specific marked area and shall be reused in the process or sold.

L. Periodic Preventive Maintenance

A detailed maintenance schedule shall be drawn for all pollution control systems. The maintenance shall be done strictly as per schedule and guidelines furnished by manufacturer. All pollution control, monitoring and safety equipment shall be periodically checked and calibrated.

M. Socio-Economic Development

The setting up of the proposed project has improved the socio-economic conditions in the surrounding area. The expansion plan will further improve the infrastructure, economic conditions further. The communities, benefited by the airport, are the key stakeholders of the airport. It is suggested that AAI should have structured interactions with the community to disseminate the measures taken by the airport and to elicit suggestions for overall improvement for the development of the area.

N. Accidents and Diseases Monitoring

M/s Airport Authority of India (AAI) shall establish procedures and systems for reporting and recording of Occupational accidents and diseases and dangerous occurrences and incidents.

These systems shall enable workers to report immediately to their immediate supervisor any situation they believe presents a danger to life or health. The systems and the employer shall further enable and encourage workers to report to management all:

- ✓ Occupational injuries and near misses;
- ✓ Suspected cases of occupational disease; and
- ✓ Dangerous occurrences and incidents.

All reported occupational accidents, occupational diseases, dangerous occurrences and incidents together with near misses shall be investigated with the assistance of a person knowledgeable/competent in occupational safety. The investigation shall:

- ✓ Establish what happened;
- ✓ Determine the cause of what happened; and
- ✓ Identify measures necessary to prevent a recurrence.

The Environmental monitoring plan for operation phase is detailed in Table 6.2.

Table 6.1: Environmental Monitoring Program during Construction Phase

Sl. No	Environmental Component	Source	Parameter	Standard	Nos	Duration/ Frequency
1.	Ambient Air Quality Monitoring	Heavy Earth Moving Machinery/ Mass Transport Vehicles	Pollution Under Control (PUC)	Pollution Under Control (PUC) certificate as per the Central Motor Vehicles Rule, 1989	--	Periodic
		DG House or mobile DG stations as per the availability within the construction site.	PM, SO_2, NMHC, CO, and NOx	Emission Standards for Diesel Engines as notified by the Environment (Protection) Third Amendment Rules 2002, vide G.S.R. 489 (E), dated 9th July, 2002	As per actuals	Half-yearly
		Ambient Air Quality monitoring at construction site in tandem with construction activities	PM10, PM2.5, SO_2, NOx, CO	National Ambient Air Quality Standards (MoEF&CC Notification G.S.R 826 (E), dated 16.11.2009)	3 (1 near construct ion site)	Twice in a week in-line with CPCB guidelines for ambient air quality monitoring (NAAQS 2009)
2.	Ambient Noise Monitoring	Ambient noise levels monitoring at construction site in tandem with construction activities	Hourly noise level for 24 hours, Leq (day); and Leq (night)	Noise Pollution (Regulation and Control) Rules, 2000.	3 (1 near construct ion site)	Monthly.
		DG Set	Noise Level	Noise Pollution (Regulation and Control) Rules, 2000.	As per actuals	Once in a six month

Sl. No	Environmental Component	Source	Parameter	Standard	Nos	Duration/ Frequency
3.	Water Quality	Ground Water	Physical Parameters: pH, Temperature, Turbidity, EC, Salinity Chemical Parameters: DO, BOD, COD, Magnesium Hardness, Alkalinity, Chloride, Sulphate, Fluoride, Sodium, Potassium, total nitrogen, Total phosphorus, Phenol Heavy Metals: Fe, Zn, Mg, Mn, Cd, Cr, Hg Bacteriological parameters: Coliform Organism & E. Coli	All parameters as per IS:10500, 2012	As per actuals	Six Monthly
4.	Soil Quality	Composite sample from the construction site	Physical Parameters: pH, Classification of soil, Texture and Conductivity Chemical Parameters: TOC, Total Nitrogen, Phosphorus, Sulphate, Chloride, Ca, Na, Potassium Heavy Metals: Fe, Zn, Mg, Mn, Cd, Cr, Hg	IS: 2720 and Methods of Soil Analysis, Part-1, 2nd edition, 1986 of (American Society for Agronomy and Soil Science Society of America) for physical and Chemical characteristics	3	Once in six months
5.	Soil Erosion	Potential soil erosion areas	Topsoil stockpile where possible at edge of site.	--	--	At periodic intervals during construction activities
6.	Non-routine events and accidental releases	Mock drills and records of the same	--	--	--	Periodic during construction activities

Sl. No	Environmental Component	Source	Parameter	Standard	Nos	Duration/ Frequency
7.	Record Keeping	--	Equipment logs- List of all air/noise generating machinery onsite (including DG sets) along with age will be prepared. List of Vehicles including HEMMs accessing the construction area. Equipment to be maintained in good working order.	--	--	Once in a month

Source: ABC Techno Labs India Pvt. Ltd.

Table 6.2: Environmental Monitoring Program during Operation Phase

Sl.No	Environmental Component	Source	Parameter	Standard	Nos	Duration/ Frequency
1.	Meteorology	Met-Station	Wind speed & direction, Temperature, Relative humidity, Cloud cover and Rainfall	-	1	Hourly basis Throughout the life of the Project OR through nearby IMD data
2.	Ambient Air Quality Monitoring	Ambient Air Quality monitoring	PM10, PM2.5, SO_2, NOx, CO	National Ambient Air Quality Standards (MoEFCC Notification G.S.R 826 (E), dated 16.11.2009)	4	24 hourly samples Twice in a week in-line with CPCB guidelines for ambient air quality monitoring (NAAQS 2009)
		DG Set- Flue Gas Stack Emission	PM, SO_2, NMHC, CO, and NOx	Emission Standards for Diesel Engines as notified by the Environment (Protection) Third Amendment Rules 2002, vide G.S.R. 489 (E), dated 9th July, 2002	As per actuals	Once in Six Month
		Gaseous emissions	Parameters as per ICAO guidelines (HC, Pb, SO_2, CO, NOx and VOCs) and GHG Emissions	ICAO guidelines for Aircraft air emissions	--	GHG emission will be reported annually as per DGCA guidelines

Sl.No	Environmental Component	Source	Parameter	Standard	Nos	Duration/ Frequency
		from aircrafts engines				
		Indoor Air Quality Monitoring	CO, CO_2, VOCs	As per SPCB/ CPCB standards	2	Once in six month or as per the requirements
3.	Ambient Noise Monitoring	Ambient noise levels	Hourly noise level for 24 hours, Leq (day); and Leq (night)	Noise Pollution (Regulation and Control) Rules, 2000.	4	Monthly
		DG Set	Noise Level	Noise Pollution (Regulation and Control) Rules, 2000.	As per actuals	Once in a six month
		Noise generated due to aircraft operations	Noise level for 24 hours, Leq (day); and Leq (night)	Noise Limit for DG Sets run with Diesel as notified by Environment (Protection) second Amendment Rules vide GSR 371(E), dated 17th May 2002	4	Once in a quarter
4.	Water Quality	Ground Water	Physical Parameters: pH, Temperature, Turbidity, EC, Salinity Chemical Parameters: DO, BOD, COD, Magnesium, Hardness, Alkalinity, Chloride, Sulphate, Fluoride, Sodium, Potassium, total nitrogen, Total phosphorus, Phenol Heavy Metals: Fe, Zn, Mg, Mn, Cd, Cr, Hg Bacteriological parameters: Coliform Organism & E. Coli	All parameters as per IS:10500, 2012	As per actuals	Once in six months

Sl.No	Environmental Component	Source	Parameter	Standard	Nos	Duration/ Frequency
		Drinking Water	Physical Parameters: pH, Temperature, Turbidity, EC, Salinity Chemical Parameters: DO, BOD, COD, Magnesium, Hardness, Alkalinity, Chloride, Sulphate, Fluoride, Sodium, Potassium, total nitrogen, Total phosphorus, Phenol Heavy Metals: Fe, Zn, Mg, Mn, Cd, Cr, Hg Bacteriological parameters: Coliform Organism & E. Coli	All parameters as per IS:10500, 2012	4	Monthly
		Storm Water	Physical Parameters: pH, Temperature, Turbidity, EC, Salinity Chemical Parameters: DO, BOD, COD, Magnesium Hardness, Alkalinity, Chloride, Sulphate, Fluoride, Sodium, Potassium, total nitrogen, Total phosphorus, Phenol Heavy Metals: Fe, Zn, Mg, Mn, Cd, Cr, Hg Bacteriological parameters: Coliform Organism & E. Coli	All parameters as per IS:10500, 2012	2	During monsoon and/or once a year at least.

Sl.No	Environmental Component	Source	Parameter	Standard	Nos	Duration/ Frequency
		STP Inlet & Outlet	Physical Parameters: pH, Temperature, Turbidity, EC, Salinity Chemical Parameters: DO, BOD, COD, Magnesium, Hardness, Alkalinity, Chloride, Sulphate, Fluoride, Sodium, Potassium, total nitrogen, Total phosphorus, Phenol Heavy Metals: Fe, Zn, Mg, Mn, Cd, Cr, Hg Bacteriological parameters: Coliform Organism & E. Coli	Waste Water Quality as per CTE & CTO Conditions	2	Monthly
5.	Soil Quality	Composite sample from the construction site	Physical Parameters: pH, Classification of soil, Texture and Conductivity Chemical Parameters: TOC, Total Nitrogen, Phosphorus, Sulphate, Chloride, Ca, Na, Potassium Heavy Metals: Fe, Zn, Mg, Mn, Cd, Cr, Hg	IS: 2720 and Methods of Soil Analysis, Part-1, 2nd edition, 1986 of (American Society for Agronomy and Soil Science Society of America) for physical and Chemical characteristics	3	Once in six months

Sl.No	Environmental Component	Source	Parameter	Standard	Nos	Duration/ Frequency
6.	Waste Management	--	Comprehensive Waste Management (Solid Waste, Hazardous Waste, Biomedical Waste, E-Waste, Battery Waste)	Compliance with Solid Waste Management (SWM) Rules, 2016 and Hazardous Wastes (Management and Handling Rules), 2016 and its subsequent amendments E-Waste (Management) Rules, 2016 and its amendment. Bio-medical Waste Management Rules, 2016, Battery Waste Management Rules, 2020	--	Periodic check
7.	Health	Employees	Employees and migrant labour health check-ups	--	--	Regular checkups (pre-employment and six monthly for regular employees)
8.	Record Keeping	--	Equipment logs- List of all air/noise generating machinery onsite (including DG sets) along with age will be prepared.	--	--	Periodic

Source: ABC Techno Labs India Pvt. Ltd.

6.5 Health, Safety & Environmental Management Cell

M/s Airport Authority of India (AAI) is responsible for implementation Environmental Monitoring Programme. A separate department "Environmental Management Cell" (EMC) shall be established in the company to look after all environmental related matters of the plant. The EMC will supervise the activities from time to time for smooth implementation of Environmental Monitoring Program and will take necessary actions if required. The cell will act to ensure the suitability, adequacy and effectiveness of the Environment Management Program will also ensure to meet all the Statutory Requirements.

6.6 Audits and Inspection

The environmental monitoring Cell (EMC) of AAI will be responsible for environmental compliance, monitoring and environmental management programs. Regular audit and inspection shall be carried out by EMC.

EMC shall be in regular touch with WBPCB and shall send them environmental monitoring reports regularly in the prescribed format, as per the prevailing practice. Any new regulations considered by State/Central Pollution Control Board for the Industry shall be taken care of by EMC. AAI will have various reporting requirements. These include periodic reports and performance reviews. AAI will also require to record and report incidents and complaints.

A. Periodic Reports

As a part of the environmental monitoring program, the following compliance reports shall be submitted to WBPCB and Regional Office of MoEF&CC: Half yearly compliance report on 1st December and 1st June of each financial year to SEIAA, West Bengal.

- ✓ Environmental Statement for the financial year ending 31st March to WBPCB on or before 30th September every year - WBPCB
- ✓ Annual returns in Form 4 as per Hazardous & Other Waste (Management, Handling and Transboundary movement) Rules, 2016 on or before 30th June every year – WBPCB;
- ✓ Maintaining Records of Hazardous Waste, in Form 3 as per Hazardous & Other Waste (Management, Handling and Transboundary movement) Rules, 2016- WBPCB.

B. Compliance Monitoring

The record will be kept of any complaint received by the AAI Plant Management that nuisance or pollution has occurred because of operation of expansion of existing Airport related activities. The record will include the following details:

- ✓ The date and time of the complaint
- ✓ The name and address of the complainant, if known
- ✓ The nature of the complaint
- ✓ The likely source of the alleged pollution

Action taken in relation to the complaint, including any follow-up contact with the complainant.

- ✓ The records of complaints received from public or government will be retained for the operational lifetime of the plant,

- ✓ Total numbers of complaints received
- ✓ Actions taken by AAI's management to address the complaint;
- ✓ Actions taken to prevent recurrence;
- ✓ A description of any significant unresolved issues arising from the complaints.
- ✓ A dedicated email address will be created to receive generic complaints, while maintaining the anonymity of the complainant.

6.7 RECORD KEEPING AND REPORTING

Record keeping and reporting of environmental monitoring is an important management tool for ensuring sustainable operation of the plant. Environmental monitoring records should be maintained for regulatory, monitoring and operational issues. Typical record keeping requirements for the proposed expansion of existing Airport after commissioning is summarized in the following table.

Table 6.3: Record Keeping Requirements

Parameter	Particulars
Material Transportation	• Daily quantity of raw materials transported • No. of trips made to site per vehicle
Materials Handling	• Daily quantity of materials received • Daily quantity stored and utilized • Daily quantity production
Wastewater	• Daily quantity of sewage generated • Daily quantities of effluent disposed • Treated wastewater quality and recycled amount
Regulatory Licenses (Environmental)	• Consent to Operate and Hazardous Waste Authorization from West Bengal Pollution Control Board
Monitoring and Survey	• Records of all environmental monitoring carried out as per the finalized monitoring protocol.
Accident reporting	• Date and time of the accident • Sequence of events leading to accident • Chemical datasheet assessing effect of accident on health and environment • Emergency measure taken • Step to prevent recurrence of such events
Other	• Log book of compliance • Employee environmental, health and safety records • Equipment inspection and calibration records, where applicable • Vehicle maintenance and inspection records

Source: ABC Techno Labs India Pvt. Ltd.

6.8 ENVIRONMENTAL REPORTING SYSTEM

Monitoring and evaluation are critical activities in implementation of environmental management measures. The reporting system will operate linearly with well qualified environment person for implementation of Environment Management Plan. Site Environment Lead directly reports to the Top Management.

Responsibilities for overseeing will rest with the Airport Authority of India (AAI). Capacity to quantitatively monitor relevant environmental/ecological parameters would be an advantage but monitoring will primarily involve ensuring that actions taken are in accordance with contract and specification clauses, and specified mitigation measures as per the Environmental Management Plan (EMP).

Environment Monitoring will be carried out and submitted to all the concerned regulatory authorities, as per the specified period.

6.9 ENVIRONMENTAL MONITORING COST

The budget for environmental monitoring for the proposed expansion of Bagdogra international Airport has been estimated and submitted as a part of detailed Environmental Management Plan.

6.10 SUMMARY

The environment monitoring plan enables environmental management system with early sign of need for additional action and modification of ongoing actions for environment management, improvement and conservation. The environmental monitoring points will be decided considering the environmental impacts likely to occur due to the operation of proposed project as the main scope of monitoring program is to track, timely and regularly, the change in environmental conditions and to take timely action for protection of environment Monitoring of environmental samples will be done as per the guidelines provided by MoEF&CC/CPCB/WBPCB. Separate records for water, wastewater, solid wastes, air emission, soil and manure/ compost will be prepared and preserved regularly.

Along with other budgets, Budget for environmental management will be prepared and revised regularly as per requirement.

CHAPTER 7: ADDITIONAL STUDIES

Based on the TOR specified by the SEIAA, West Bengal issued vide letter no. 2807/EN/T-II-1/536/2023 dated 13th December 2023 for preparation of EIA/EMP Report for proposed project, several studies were conducted including the following. The studies and activities suggested in EIA Notification includes: -

- *Risk Assessment Study*
- *Disaster Management plan*

7.1 RISK ASSESSMENT

7.1.1 INTRODUCTION

The objective of the Risk Assessment study is to identify major risk contributing events, demarcate vulnerable zones and evaluate the nature of risk posed to nearby areas due to proposed project activity, in addition to ensure compliance to statutory rules and regulations. The scope of work for the study is described below:

- ✓ Identify potential risk scenarios that may arise from the proposed project and other associated activities
- ✓ Analyse the possible likelihood and frequency of such risk scenarios by reviewing historical accident related data.
- ✓ Predict the consequences of such potential risk scenarios and if consequences are high, establish the same by through application of quantitative simulations.
- ✓ Recommend feasible preventive and risk mitigation measures as well as provide inputs for drawing up of Emergency Response Plan (ERP) for the project.
- ✓ The assessments to be based on various existing documents including Emergency Response Plan (ERP), Disaster Management Plan (DMP).

The scope involves risk assessment of project activity including Diesel Day Tank located at project site that would have a detrimental impact to the personnel and properties.

7.1.2 METHODOLOGY & APPROACH

Risk analysis consists of hazard identification studies to provide an effective means to identify different types of hazards during the operation of the facility. This is followed by an assessment of the impacts of these hazards.

Hazard is present in any system, plant or unit that handles or stores flammable materials. The mere existence of hazards, however, does not automatically imply the existence of risk. Screening & ranking methodologies based on Preliminary Hazard Analysis (PHA) techniques have to be adopted for risk to be evaluated. The approach and methodology by ABC Techno Labs followed for the Risk Assessment study are described hereunder:

The study comprises of the following stages:

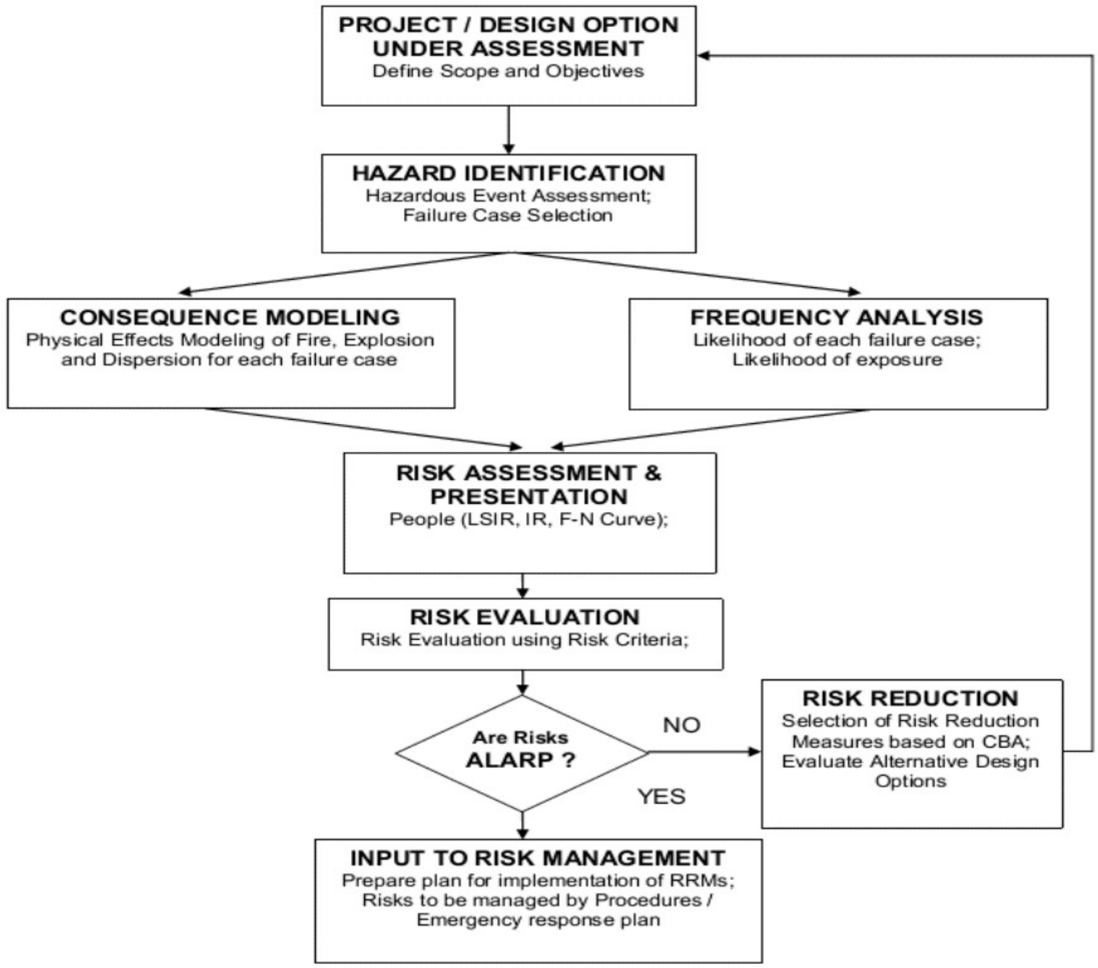
- ✓ Identification of potential major hazard scenarios;
- ✓ Assessment of the likelihood and consequences of identified hazards;

- ✓ Estimation of the impact of identified hazards on personnel; and
- ✓ Assessment of the risks against tolerance criteria.

The Risk Assessment (RA) uses conventional risk assessment techniques as shown in Figure 7.1 and described as follows:

- ✓ Identify the preliminary causes of major accidents associated with the process, and develop a list of representative potential events involving the release of hazardous materials or other events, which could lead to loss of life or damage to infrastructure.
- ✓ Model the possible scale of severity of the physical effects of each identified hazardous event. Predict the criticality of the damage that could be caused and the potential for escalation, developing rule sets and assumptions to form the basis of an analysis of the possible outcomes.
- ✓ For each identified hazard, use appropriate models and data to estimate its frequency, taking into account any site-specific features that may influence the likelihood of the scenarios. Compare the event frequency estimates with historical data to confirm the validity of the model.
- ✓ Combine the predicted consequences of each event with its frequency to estimate the risks to personnel. Assess the Individual Risk (IR) for the facilities.
- ✓ Compare the results of the study with Company Risk Tolerance Criteria to establish whether the operation of the project can be regarded as adequately safe. Consider the risk mitigation provided by other measures such as the gas detection and shutdown system.
- ✓ Propose additional Risk Reduction Measures (RRM).

The methodology is presented pictographically in the following section:



Source: ABC Techno Labs India Pvt. Ltd.

Figure 7.1: Risk Assessment Methodology

7.1.3 Hazard Identification

Hazard scenario development is carried out considering the activities at the facilities and the inherent hazardous properties of the material being handled.

The Hazard Identification looks into all incidents, which could result in possible fatalities. For project activity, such incidents typically include the following:

✓ Loss of containment of fuels and consequent pool fire on encountering an ignition source.

The HAZID would select the Scenarios for further modeling in the next sections. The HAZID is derived mainly from incidents in similar project activity based on worldwide experience and includes generic data sources.

Table 7.1: Accidents due to types of hazardous events

Type of Hazardous Event	*Specific Accident Events included in RA*
Hydrocarbon Release	• *Release from fuel tanks- Catastrophic failure, medium and small risks*

Type of Hazardous Event	*Specific Accident Events included in RA*
Occupational accidents	• *Single fatality accidents such as slips, trips, falls, dropped objectives etc.*

Source: M/s AAI

7.1.3.1 CONSEQUENCE ANALYSIS

Consequence analysis involves the calculation of the initial "release rate" and then predicting the consequence of the release through computer modeling- it forms an important ingredient in the Risk Assessment approach. Consequence analysis is a complex procedure involving numerous calculations. It must also be noted that a single starting incident could have numerous outcomes depending upon factors such as escalation, ignition and others. The various factors of importance in this airport study with respect to consequence analysis are described below.

Table 7.2: List of Isolatable Sections

IS	Scenario
IS 01	Hydrocarbon tank (200 KL)
IS 02	Hydrocarbon tank (200 KL)
IS 03	Hydrocarbon tank (200 KL)
IS 04	Hydrocarbon tank (200 KL)
IS 05	Hydrocarbon tank (70 KL)
IS 06	Hydrocarbon tank (70 KL)
IS 07	Hydrocarbon tank (70 KL)
IS 08	Transfer hose failure from Road Tanker filling
IS 09	Product Pumping from pump house

Source: ABC Techno Labs India Pvt. Ltd.

Depending on the type of liquid handled and process conditions, one or more of the following potential hazards/consequences could be encountered due to loss of containment of hydrocarbons:

- ✓ *Un-ignited release;*
- ✓ *Jet Fire;*
- ✓ *Pool Fire;*
- ✓ *Flash Fire;*
- ✓ *Vapour Cloud Explosion; and*
- ✓ *Toxic Impact (Not applicable for this project)*

7.1.3.2 UN-IGNITED GAS RELEASE/DISPERSION

A vapour cloud may be formed when a vaporizing liquid is released for an extended duration. If the gas cloud does not immediately ignite, it disperses based on the prevalent wind direction, speed and stability category (i.e., degree of turbulence).

The cloud dispersion simulation is carried out to provide the distance (from the leak) at which the concentration of flammable material falls below the Lower Flammability Limit (LFL).

7.1.3.3 JET FIRE

Jet fire causes damage due to the resulting heat radiation. The working level heat radiation impact will vary widely depending on the angle of the flame to the horizontal plane, which mainly depends on the location of the leak. The flame direction was considered horizontal for consequence analysis of leaks and ruptures from Piping and Tanks.

Upon accidental leakage, the pressurized fluid will disperse as a jet, initially moving forward in the spatial direction of the leak till the kinetic energy is lost and gravity slumping or lifting of the cloud occurs, dependent upon whether the fluid is heavier or lighter than air.

Source term modelling has been conducted for each identified study area at all the locations at the full stream operating pressure to determine the initial release rate. The release rates and material properties were used to calculate the flame length and distance to relevant heat radiation levels.

Two models are available for jet fire modelling in PHAST V8.2 – the cone model and the API-RP 521 model, of which the cone model is considered to be more conservative, and presents the jet fire as a tilted cone frustum, as opposed to a banana shaped plume in the API-RP 521 model, i.e., tapered at the end and bent by the wind. Thus, the cone model has been selected for jet-fire modelling.

The primary hazard associated with jet fires is thermal radiation and potential for flame impingement on adjacent pipelines/equipment, resulting in escalation. High pressure releases have the potential to cover large areas due to its relatively large flame length. However, the effects of escalation are minimized if the flame length reduces to less than the separation distance between other equipment and the jet fire source.

7.1.3.4 POOL FIRES

A liquid pool is formed during a prolonged leakage if the rate of leakage exceeds the rate of vaporization. On ignition, this would result in a pool fire whose size/radius would depend on the mass flow rate, ambient temperature, and heat of vaporization of material released, vapour pressure, duration of discharge and effects of containment or dykes.

The pool fire could cause damage to equipment or injury/fatality to personnel due to thermal radiation effects.

A pool fire is not envisaged for liquid systems which are highly pressurized. Any leak or rupture would result in a pressurized release leading to a liquid jet fire or flash fire.

7.1.3.5 FLASH FIRE

The vapour/gas release from a pool would disperse under the influence of the prevailing wind; with material concentration in air reducing with distance. At a particular location downwind, the concentration will drop below its lower flammable level (LFL) value. If ignited within the flammable envelope, the mass of the material available between the LFL and ½ LFL will be likely to burn as a flash fire; rapidly spreading through the cloud from the point of ignition back to the source of release.

Although flash fires are generally low intensity transitory events, the burning velocity is quite high and escape following ignition is not possible. Flash fires often remain close to the ground, where most ignition sources are present. It is assumed that personnel caught inside a flash fire will not survive while those outside suffer no significant harm. If other combustible material is present within the flash fire it is also likely to ignite and a secondary fire could result.

7.1.3.6 VAPOUR CLOUD EXPLOSION

The magnitude of the vapour cloud explosion is dependent on the size of the gas cloud that has formed and the degree of congestion in the area, as these determine the acceleration of the flame front. The TNO GAMES model is used for modeling of vapour cloud explosions, as the model incorporates the characteristics of the explosion, such as the type of fuel, its reactivity, the effect of obstacles in the congested region.

7.1.3.7 TOXIC EFFECTS

There is no toxic impact in this project as there are no toxic materials handled.

7.1.3.8 CONSEQUENCE IMPACT CRITERIA

The damage potential associated with the various hazardous outcomes described above is assessed based on pre-defined impairment criteria for losses.

Estimate of damage or impact caused due to thermal radiation, explosion overpressure and toxic effects is generally based on the published literature on the subject. Probit relations are used for these calculations. The actual potential consequences from these likely impacts can then be visualized by superimposing the damage effect zones on the proposed layouts and identifying the elements within the project which might be adversely affected, should one or more hazards materialize in practice. The damage criteria used in the present study is described in the following sections.

7.1.3.9 THERMAL DAMAGE/RADIATION DAMAGE

As per OGP-14;

4.73 kW/m2	*Maximum radiant heat intensity in areas where emergency actions lasting 2 min to 3 min can be required by personnel without shielding but with appropriate clothing. Corresponds to of painful burns and blistering after 20 second exposure (0% lethality)*
6.31 kW/m2	*Indicative of second degree burns after 20 second exposure (1% fatality)*
12.5 kW/m2	*Indicative of piloted ignition for susceptible structures (50% fatality)*
37.5 kW/m2	*Indicative of total asset loss (100% fatality)*

Hence, following heat radiation levels are considered to determine physical effects of hazard events:

4.73 kW/m²;
6.31 kW/m²,
12.5 kW/m²,
37.5 kW/m²

7.1.3.10 Flash Fire

The consequence distances should be identified for the following Lower Explosive Limit:

- ✓ 50 % Lower Explosive Limit
- ✓ 100 % Lower Explosive Limit

7.1.3.11 Explosion

Blast peak overpressure from explosion for buildings should not exceed the following levels provided in Table below. Internationally recognized and globally accepted TNO Multi energy model was used for the explosion modeling for this proposed project

Table 7.3: Overpressure level criteria

Level of Concern	Type of Damage
0.02068 bar	"Safe distance" (probability 0.95 of no serious damage1 below this value); projectile limit; some damage to house ceilings; 10% window glass broken.
0.07 bar	General buildings, offices
0.2068 bar	Partial collapse of wells, concrete Block wells, not reinforced, shattered
1 bar	Range for 1-99% fatalities among exposed population due to direct blast effects

Hence, following over pressure levels are considered to determine physical effects of hazard events:

- 0.02068 bar
- 0.07 bar
- 0.1379 bar
- 0.2068 bar
- 1 bar

7.1.3.12 Toxic Gas

No toxic gas dispersion envisaged in this project.

7.1.3.13 Consequence Analysis and Calculations

❑ **Hole Size Distribution**

For each isolatable section and its study areas, a range of leaks have been considered for the assessment of hydrocarbon hazards arising from facility is described in section, these leaks are defined on the basis of hole sizes.

❑ **Meteorological Data**

The consequences of material released being toxic and flammable are largely dependent on the prevailing weather conditions. For the assessment of various scenarios involving release of toxic or flammable materials, the most important meteorological parameters are those that affect the atmospheric dispersion of the leaking material. The crucial variables are wind direction, wind speed, atmospheric stability and temperature. Rainfall does not have any direct bearing on the results of the risk analysis; however, it can have beneficial effects by absorption/washout of released materials. Actual behavior of any release would largely depend on prevailing weather condition at the time of release.

- **Atmospheric Stability Classes**

The tendency of the atmosphere to resist or enhance vertical motion and thus turbulence is termed as stability. Stability is related to both the change of temperature with height (the lapse rate) driven by the boundary layer energy budget, and wind speed together with surface characteristics (roughness).

A neutral atmosphere neither enhances nor inhibits mechanical turbulence. An unstable atmosphere enhances turbulence, whereas a stable atmosphere inhibits mechanical turbulence. Stability classes are defined for different meteorological situations, characterized by wind speed and solar radiation (during the day) and cloud cover during the night. The so called Pasquill-Turner stability classes' dispersion estimates include six (6) stability classes as below:

A – Very Unstable B – Unstable C – Slightly Unstable

D – Neutral E – Stable F–Very Stable

For the study purpose, following weather conditions are taken forward for modeling purposes:

- ✓ 2F - F stability class and wind speed of 2m/sec
- ✓ 5D - D stability class and wind speed of 5m/sec

- **Release Rates**

The release rates were determined based on the release size and the process conditions i.e., temperature and pressure. Depending on the operating conditions, the release state of the fluid could be liquid, gas or two-phase. The release rates were estimated using the software. The release rates and the phase would give an indication of severity of the leak and influence the flammable and toxic impacts.

A. Jet Fire Radiation Distances

The Jet Fire Radiation distances are not generated for the scenarios considered in this project.

Table 7.4: Jet Fire Radiation Distances

Path	Scenario	Weather	Flame length [m]	Distance downwind to intensity level 1 (4 kW/m2) [m]	Distance downwind to intensity level 2 (12.5 kW/m2) [m]	Distance downwind to intensity level 3 (37.5 kW/m2) [m]
IS 01	10 mm	Category 2/F	0.60737	n/a	n/a	n/a
		Category 5/D	0.477475	n/a	n/a	n/a
IS 02	10 mm	Category 2/F	0.659009	n/a	n/a	n/a
		Category 5/D	0.517147	n/a	n/a	n/a
IS 03	10 mm	Category 2/F	0.60737	n/a	n/a	n/a
		Category 5/D	0.477475	n/a	n/a	n/a
IS 04	10 mm	Category 2/F	0.60737	n/a	n/a	n/a

Path	Scenario	Weather	Flame length [m]	Distance downwind to intensity level 1 (4 kW/m2) [m]	Distance downwind to intensity level 2 (12.5 kW/m2) [m]	Distance downwind to intensity level 3 (37.5 kW/m2) [m]
		Category 5/D	0.477475	n/a	n/a	n/a
IS 05	10 mm	Category 2/F	0.500419	n/a	n/a	n/a
		Category 5/D	0.394771	n/a	n/a	n/a
IS 06	10 mm	Category 2/F	0.500419	n/a	n/a	n/a
		Category 5/D	0.394771	n/a	n/a	n/a
IS 07	10 mm	Category 2/F	0.500419	n/a	n/a	n/a
		Category 5/D	0.394771	n/a	n/a	n/a
IS 08	5 mm	Category 2/F	4.12523	7.50365	5.61064	4.10803
		Category 5/D	3.60789	7.63533	5.56738	4.05647
	FBR	Category 2/F	23.7371	48.7157	36.3594	28.0599
		Category 5/D	19.7008	47.487	34.4787	26.3368
IS 09	5 mm	Category 2/F	4.12523	7.50365	5.61064	4.10803
		Category 5/D	3.60789	7.63533	5.56738	4.05647
	FBR	Category 2/F	23.7371	48.7157	36.3594	28.0599
		Category 5/D	19.7008	47.487	34.4787	26.3368

Source: ABC Techno Labs India Pvt. Ltd.

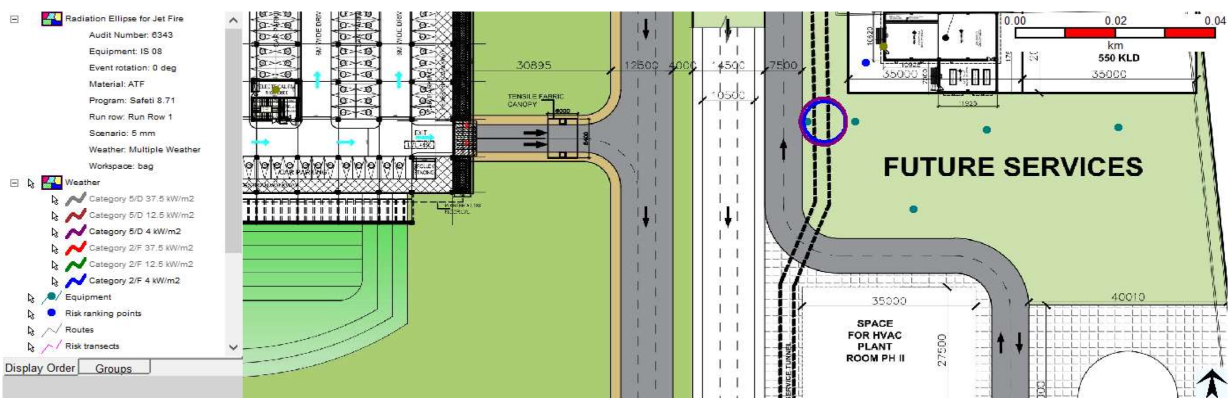


Figure 7.2: Jet Fire (5 mm) Consequence Contour for Blowout Scenario (IS 08)

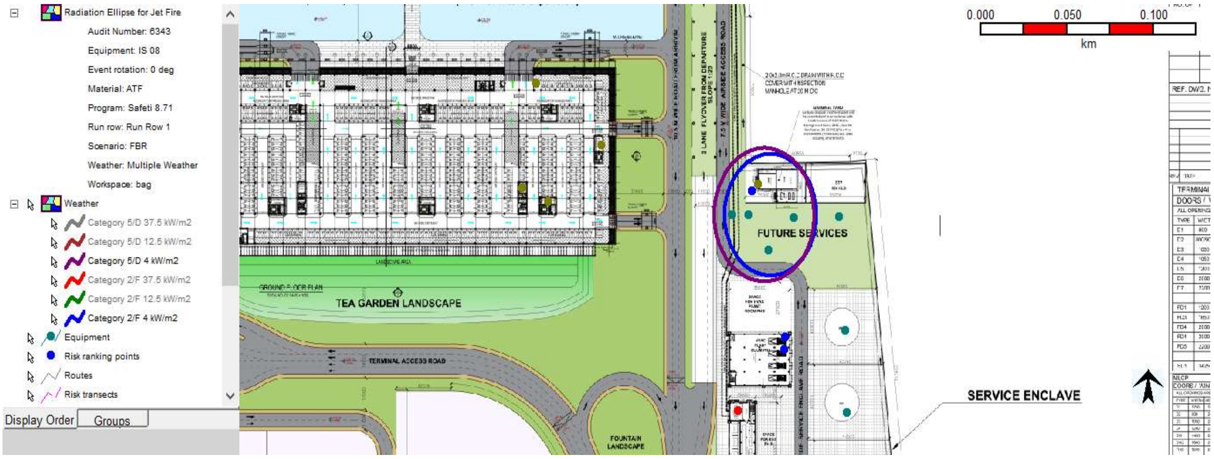


Figure 7.3: Jet Fire (FBR) Consequence Contour for Blowout Scenario (IS 08)

B. Pool Fire Radiation Distances

The Pool Fire Radiation Distances is provided below;

Table 7.5: Pool Fire Radiation Distances

Path	Scenario	Weather	Pool diameter [m]	Distance downwind to intensity level 1 (4 kW/m2) [m]	Distance downwind to intensity level 2 (12.5 kW/m2) [m]	Distance downwind to intensity level 3 (37.5 kW/m2) [m]
IS 01	10 mm	Category 2/F	14.9199	36.4283	20.5393	12.9811
		Category 5/D	14.5315	37.8964	21.7708	13.6626
	CR	Category 2/F	225.888	237.49	153.177	126.054
		Category 5/D	225.515	254.562	158.586	130.809
IS 02	10 mm	Category 2/F	15.6248	37.158	21.0126	13.5596
		Category 5/D	15.2077	38.6696	22.0261	14.2199
	CR	Category 2/F	225.888	237.49	153.177	126.054
		Category 5/D	225.515	254.562	158.586	130.809
IS 03	10 mm	Category 2/F	14.9199	36.4283	20.5393	12.9811
		Category 5/D	14.5315	37.8964	21.7708	13.6626
	CR	Category 2/F	225.888	237.49	153.177	126.054
		Category 5/D	225.515	254.562	158.586	130.809
IS 04	10 mm	Category 2/F	14.9199	36.4283	20.5393	12.9811
		Category 5/D	14.5315	37.8964	21.7708	13.6626
	CR	Category 2/F	225.888	237.49	153.177	126.054
		Category 5/D	225.515	254.562	158.586	130.809
IS 05	10 mm	Category 2/F	11.8632	32.9519	18.6657	10.4212
		Category 5/D	11.5466	34.4181	21.3278	11.2224
	CR	Category 2/F	133.59	154.363	97.8467	77.9516
		Category 5/D	133.545	164.593	101.138	81.6748
IS 06	10 mm	Category 2/F	11.8632	32.9519	18.6657	10.4212
		Category 5/D	11.5466	34.4181	21.3278	11.2224

Path	Scenario	Weather	Pool diameter [m]	Distance downwind to intensity level 1 (4 kW/m2) [m]	Distance downwind to intensity level 2 (12.5 kW/m2) [m]	Distance downwind to intensity level 3 (37.5 kW/m2) [m]
	CR	Category 2/F	133.59	154.363	97.8467	77.9516
		Category 5/D	133.545	164.593	101.138	81.6748
IS 07	10 mm	Category 2/F	11.8632	32.9519	18.6657	10.4212
		Category 5/D	11.5466	34.4181	21.3278	11.2224
	CR	Category 2/F	133.59	154.363	97.8467	77.9516
		Category 5/D	133.545	164.593	101.138	81.6748
IS 08	5 mm	Category 2/F	17.4262	42.125	25.505	18.2036
		Category 5/D	16.7871	44.9914	27.3811	20.1478
	FBR	Category 2/F	79.316	116.977	79.4682	65.1796
		Category 5/D	79.2392	121.617	80.5834	67.2441
IS 09	5 mm	Category 2/F	17.4262	42.125	25.505	18.2036
		Category 5/D	16.7871	44.9914	27.3811	20.1478
	FBR	Category 2/F	79.316	116.977	79.4682	65.1796
		Category 5/D	79.2392	121.617	80.5834	67.2441

Source: ABC Techno Labs India Pvt. Ltd.

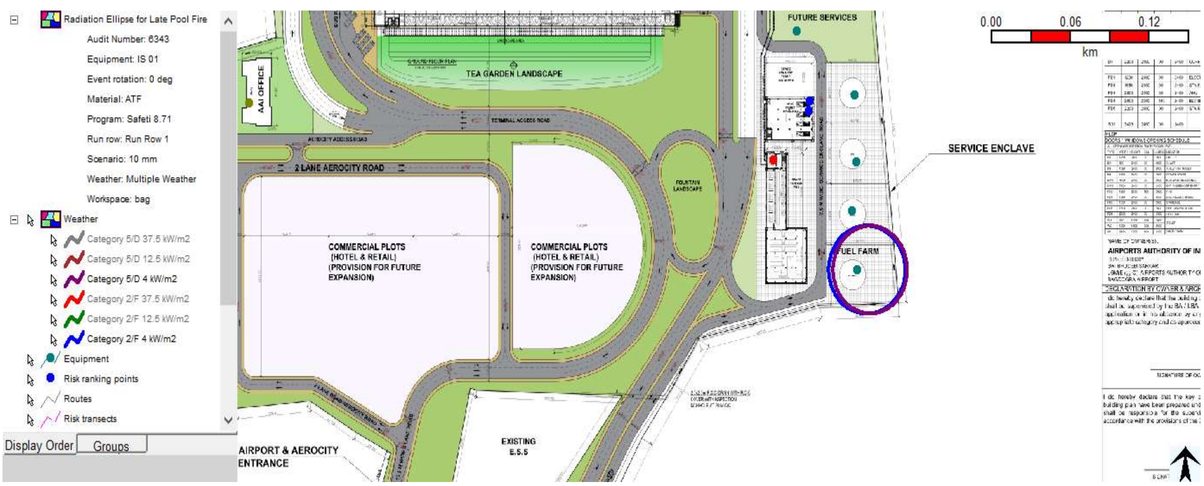


Figure 7.15: Pool Fire (10 mm) Consequence Contour for Blowout Scenario (IS 01)

Figure 7.16: Pool Fire (CR) Consequence Contour for Blowout Scenario (IS 01)

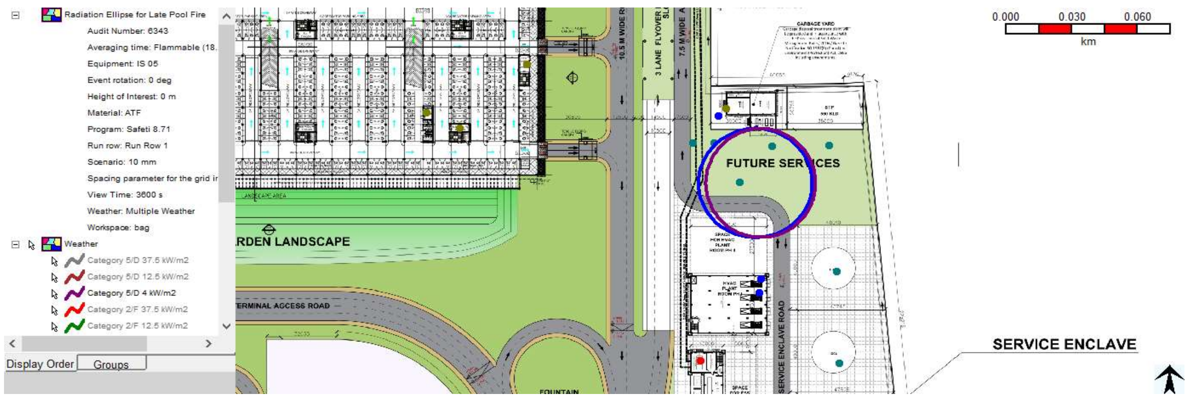


Figure 7.16: Pool Fire (10 mm) Consequence Contour for Blowout Scenario (IS 05)

Figure 7.16: Pool Fire (CR) Consequence Contour for Blowout Scenario (IS 05)

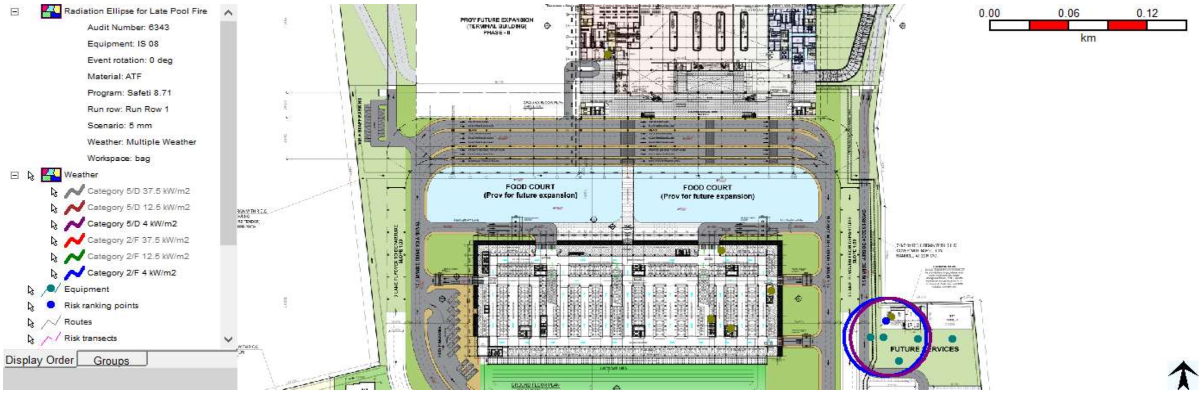


Figure 7.16: Pool Fire (5 mm) Consequence Contour for Blowout Scenario (IS 08)

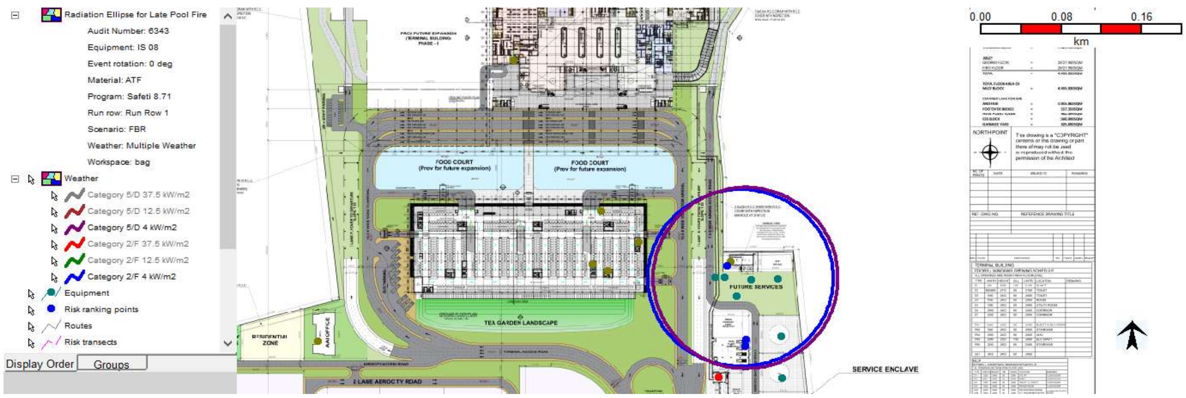


Figure 7.16: Pool Fire (FBR) Consequence Contour for Blowout Scenario (IS 08)

C. Flash Fire Radiation Distances

Flammable Dispersion Distances are provided below;

Table 7.6: Flammable Dispersion Distances

Path	Scenario	Weather	Distance downwind to LFL [m]	Distance downwind to LFL Fraction [m]
IS 01	10 mm	Category 2/F	NR	NR
		Category 5/D	NR	NR
	CR	Category 2/F	8.85348	8.85353
		Category 5/D	10.8518	10.8519
IS 02	10 mm	Category 2/F	NR	NR
		Category 5/D	NR	NR
	CR	Category 2/F	8.85348	8.85353
		Category 5/D	10.8518	10.8519
IS 03	10 mm	Category 2/F	NR	NR
		Category 5/D	NR	NR
	CR	Category 2/F	8.85348	8.85353
		Category 5/D	10.8518	10.8519
IS 04	10 mm	Category 2/F	NR	NR

Path	Scenario	Weather	Distance downwind to LFL [m]	Distance downwind to LFL Fraction [m]
		Category 5/D	NR	NR
	CR	Category 2/F	8.85348	8.85353
		Category 5/D	10.8518	10.8519
IS 05	10 mm	Category 2/F	NR	NR
		Category 5/D	NR	NR
	CR	Category 2/F	7.23449	7.23453
		Category 5/D	8.28928	8.28931
IS 06	10 mm	Category 2/F	NR	NR
		Category 5/D	NR	NR
	CR	Category 2/F	7.23449	7.23453
		Category 5/D	8.28928	8.28931
IS 07	10 mm	Category 2/F	NR	NR
		Category 5/D	NR	NR
	CR	Category 2/F	7.23449	7.23453
		Category 5/D	8.28928	8.28931
IS 08	5 mm	Category 2/F	NR	NR
		Category 5/D	NR	NR
	FBR	Category 2/F	28.9973	31.7838
		Category 5/D	22.5796	23.8296
IS 09	5 mm	Category 2/F	NR	NR
		Category 5/D	NR	NR
	FBR	Category 2/F	28.9973	31.7838
		Category 5/D	22.5796	23.8296

Source: ABC Techno Labs India Pvt. Ltd.

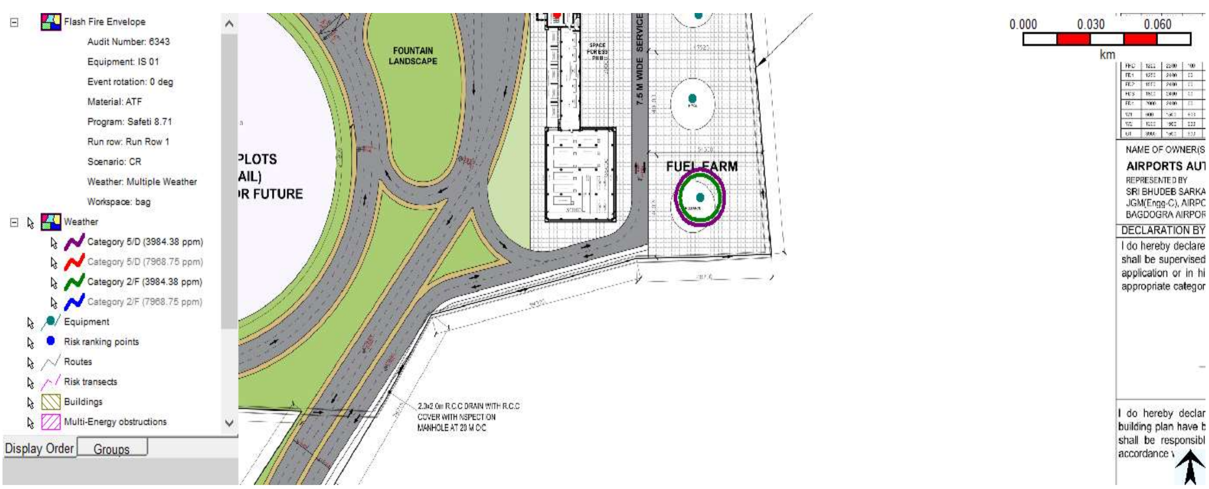


Figure 7.17: Flash Fire (CR) Consequence Contour for Blowout Scenario (IS 01)

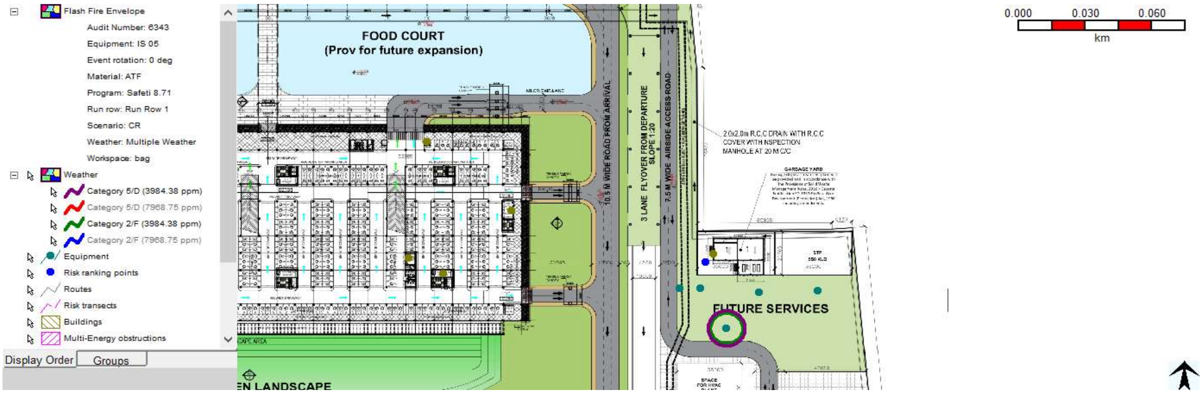


Figure 7.18: Flash Fire (10 mm) Consequence Contour for Blowout Scenario (IS 05)

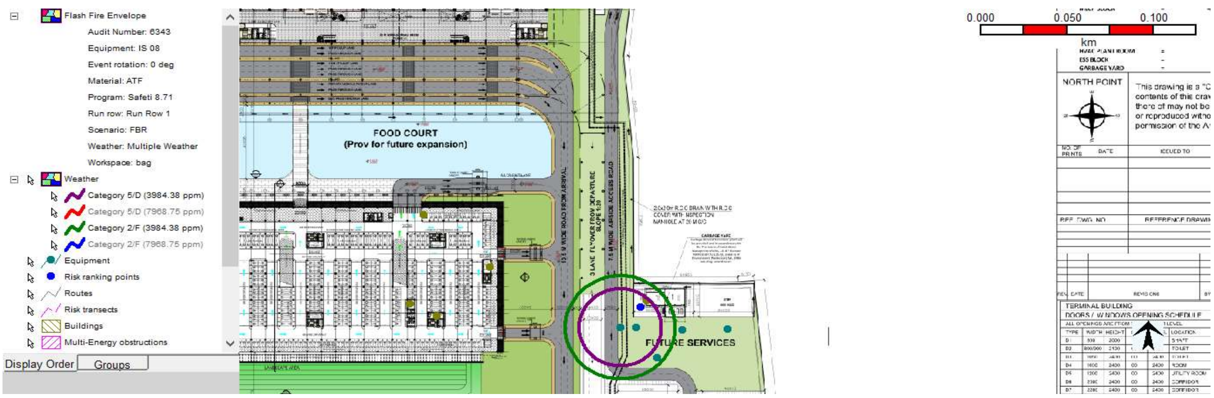


Figure 7.19: Flash Fire (FBR) Consequence Contour for Blowout Scenario (IS 08)

D. Toxic Dispersion

There is no toxic hazard in the facility.

E. Vapour Cloud Explosion

A vapour cloud explosion involves a flame moving through a fuel-air mixture. In absence of turbulence generation, the cloud will burn as a flash fire without generation of high over pressure. However significant turbulence can be generated by obstacle encountered by a flame as it is propagated through the vapour cloud in obstructed region. It is that explosion that occurs in the presence of obstacle that can generate overpressure with potential for extensive damage. In order to model vapour cloud explosion, the Obstructed Region Explosion Model available in SAFETI 8.2 has been used and a brief overview has been provided below.

OREM in PHAST would enable a user to model the blast effects from vapour clouds dispersing through regions containing obstacles.

Explosions in Obstructed Regions have been modeled in the Multi-Energy (ME) Model. ME Obstruction set has been used for defining Obstructed Regions and it consider the following:

- ✓ Degree of expansion (2D/ 3D);
- ✓ Volume (Blockage ratio):

- ✓ Surface of area of obstruction source and Flame path length

Late Explosion Overpressure Distances is provided below;

Table 7.7: Late Explosion Overpressure Distances

Path	Scenario	Weather	Overpressure level [bar]	Maximum distance [m]	Diameter [m]
IS 01	CR	Category 5/D	0.02068 0.1379 0.2068	28.9522 13.6835 12.7617	37.9044 7.36698 5.52348
IS 02	CR	Category 5/D	0.02068 0.1379 0.2068	28.9522 13.6835 12.7617	37.9044 7.36698 5.52348
IS 03	CR	Category 5/D	0.02068 0.1379 0.2068	28.9522 13.6835 12.7617	37.9044 7.36698 5.52348
IS 04	CR	Category 5/D	0.02068 0.1379 0.2068	28.9522 13.6835 12.7617	37.9044 7.36698 5.52348
IS 08	FBR	Category 2/F	0.02068 0.1379 0.2068	43.4642 32.6169 31.962	26.9284 5.23371 3.92403
		Category 5/D	0.02068 0.1379 0.2068	36.9491 23.2942 22.4698	33.8983 6.58836 4.9397
IS 09	FBR	Category 2/F	0.02068 0.1379 0.2068	43.4642 32.6169 31.962	26.9284 5.23371 3.92403
		Category 5/D	0.02068 0.1379 0.2068	36.9491 23.2942 22.4698	33.8983 6.58836 4.9397

Source: ABC Techno Labs India Pvt. Ltd.

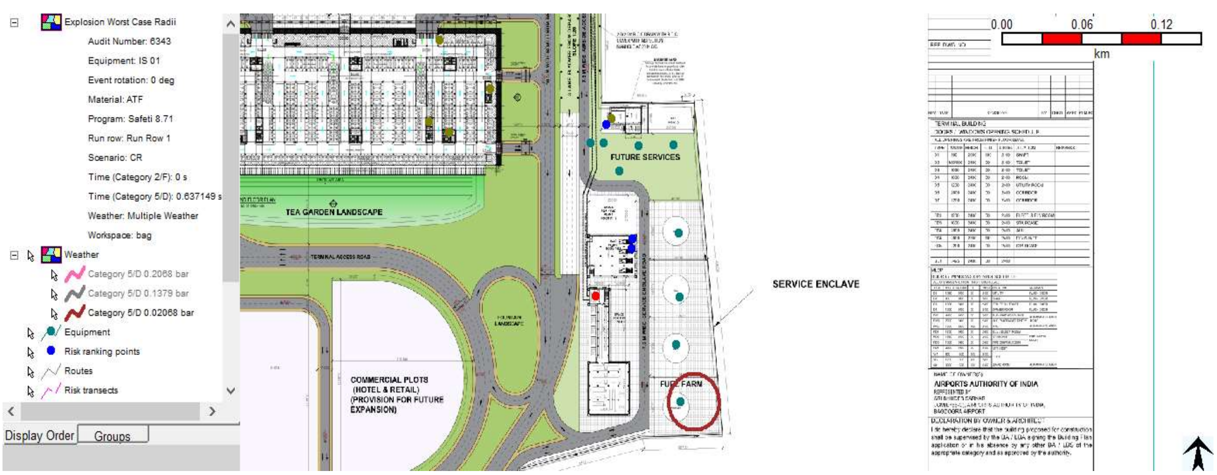


Figure 7.31: Fire Ball Consequence Contour for Blowout Scenario (IS 01)

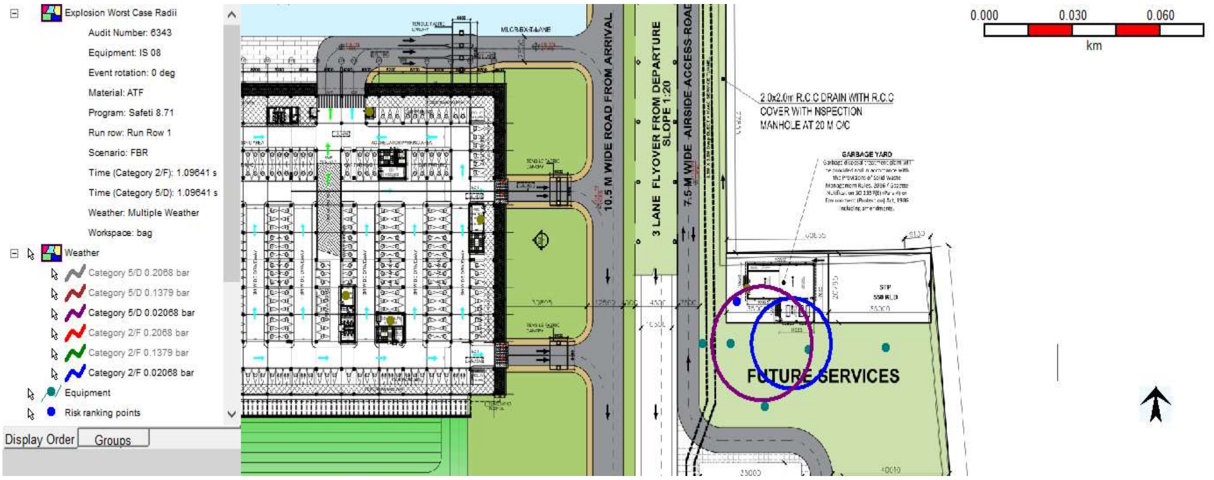


Figure 7.32: Fire Ball (FBR) Consequence Contour for Blowout Scenario (IS 08)

7.1.4 Failure Frequency Analysis

As a part of the process of determining risk the failure frequencies of the hazard events are calculated. Component failures are the primary initiating events for most hazards and accidents and there are various potential causes for component failure resulting in sources of leakage, which may release contained fluids to the atmosphere. Failure scenarios can range from small gasket leaks in a flange joint to rupture resulting in catastrophic failure of a pipeline section. Major failure modes associated with different operational areas are listed below:

- ✓ *Failure of weld joints / gaskets (sample points, instrument connections etc.);*
- ✓ *Valve gland leakages; and*
- ✓ *Leaks/ full bore rupture of the pipe work.*
- ✓ *Tank Rupture*

These part counts are combined with historical data from the OGP database to give an overall potential leak frequency for each isolatable section which are then divided into small, medium, large and full bore as described in the methodology section of this report.

The base failure frequency for Valves, Flanges and Pumps are sourced from OGP 434-1.

7.1.4.1 Calculation of Individual & Societal Risk

Individual Risk or IR represents the geographical distribution of risk to any individual.

Societal Risk is representing the risk the project poses to society as a whole. The Societal Risk or Group risk (F-N) curves indicate the cumulative frequency (F) of (N) number of fatalities. Society is typically not willing to accept industrial installations that result in many fatalities, even with a low frequency rate!

The estimation of risks in the software is done through estimation of "risks" attributed to each failure case by determining the impact in terms of fatalities. In this step, the hazard or effect zone information, ignition source, population distribution, meteorological data and other relevant details are combined to determine risks.

In order to estimate risks (IR or SR), the number of fatalities for each incident outcome case is calculated and the frequencies of outcomes with equal fatalities summed up.

After determination of potential sources of accidents and their zone of effect, the risk is quantified in terms of likelihood of fatalities due to these accidents by combining the frequency and severity (consequences). The commonly used risk indicators for onshore facilities are:

- ✓ Individual Risk per Annum (IRPA),
- ✓ Potential Loss of Life (PLL) and
- ✓ Societal Risk for the facilities

The risk at any particular location is expressed as Location Specific Individual Risk (LSIR). The LSIR is then combined with personnel occupancy levels to obtain the fatality risk expressed as individual risk. The estimated risk levels are assessed against Company Individual risk tolerable criteria for existing facilities to establish whether the project facilities can be regarded as in compliance with them.

- ❑ **Individual Risk**

Individual risk is defined as the frequency at which a named individual would be killed as a result of exposure to a hazard.

Individual Risk = LSIR X Occupancy

Where,

'Occupancy' is the proportion of time the individual is exposed to the hazard.

- ❑ **Societal Risk**

Assessment of societal risks is even more important than assessment of individual risk because they involve the likelihood of multiple fatalities. Societal risk is the risk to any person or group of persons who are not connected to project facilities and are outside the facility fence line.

- ❑ **F-N Curve**

It is helpful to consider group risk in the demonstration that risks are ALARP. This allows consideration to be given to events, which, although low in frequency, may cause multiple injuries or fatalities. Group risk can be presented in the form of a plot of cumulative frequency versus number of fatalities (F-N curve).

F = frequency (experienced or predicted)

N = no. of multiple fatalities.

'N' includes indirect deaths caused as a result of the main event occurring and can therefore be difficult to predict e.g., many people may die years after exposure to a toxic chemical.

7.1.4.2 COMPARISON TO RISK ACCEPTANCE CRITERIA

This penultimate step compares the estimated risk with respect to the Company's internal risk acceptability criteria or specific legislative or regulatory (as applicable in the country of operation) risk acceptability criteria. In this step, the risk "band" is determined- typically, the project risk band is determined to be negligible, acceptable, not acceptable are the risk assessment stage determines whether the risks are “Broadly Acceptable”, “Intolerable” or “Tolerable if ALARP”.

Individual Risk Criteria (IR)

Company’s Individual Risk Criteria is provided below.

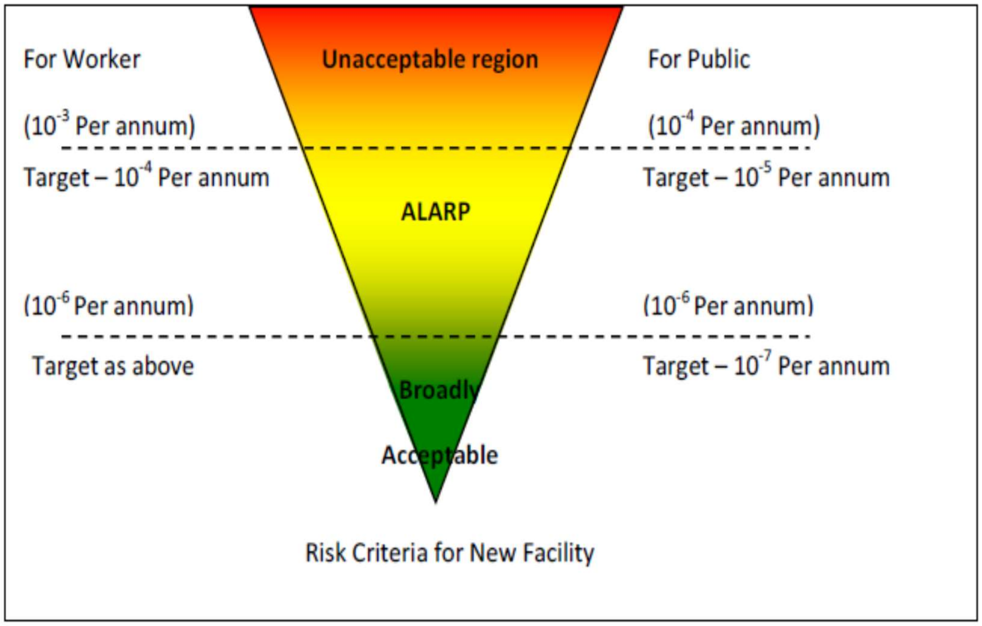


Figure 7.21: Individual Risk Criteria

Societal Risk Criteria

Societal risk criteria for AAI are used to limit the risks to a group of people and it is expressed as an F-N Curve. Since there are no off-site population near to site, F-N curve isn’t applicable.

7.1.4.3 FAILURE FREQUENCY ANALYSIS

As a part of the process of determining risk the failure frequencies of the hazard events are calculated. Component failures are the primary initiating events for most hazards and accidents and there are various potential causes for component failure resulting in sources of leakage, which may release contained fluids to the atmosphere. Failure scenarios can range from small gasket leaks in a flange joint to rupture resulting in catastrophic failure of a pipeline section. Major failure modes associated with different operational areas are listed below:

- ✓ Failure of weld joints / gaskets (sample points, instrument connections etc.);
- ✓ Valve gland leakages; and
- ✓ Leaks/ full bore rupture of the pipe work.
- ✓ Tank Rupture

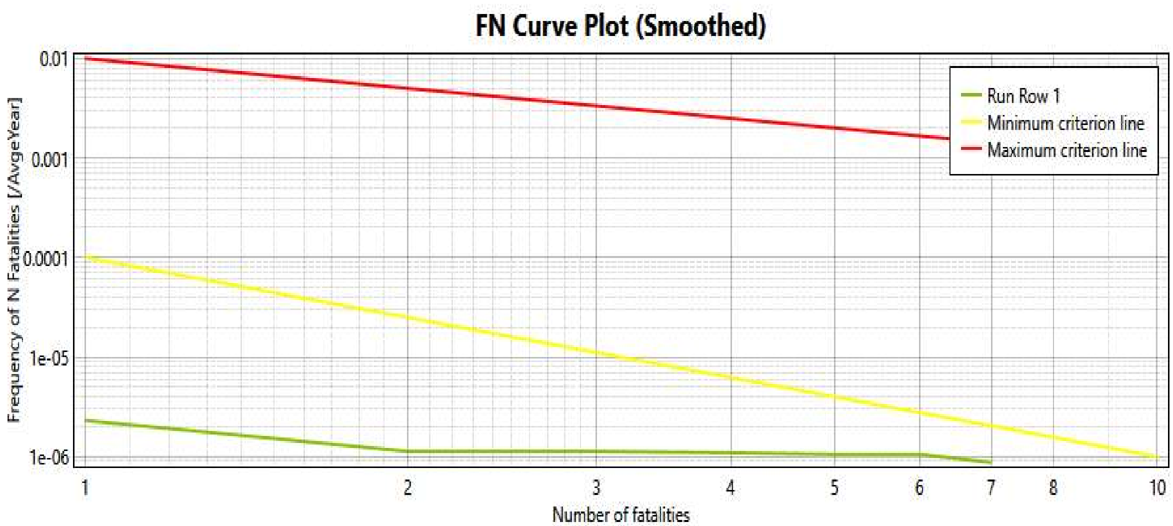
These part counts are combined with historical data from the OGP database to give an overall potential leak frequency for each isolatable section which are then divided into small, medium, large and full bore as described in the methodology section of this report. The base failure frequency for Valves, Flanges and Pumps are sourced from OGP 434-1.

7.1.4.4 IGNITION PROBABILITIES

The potential for ignition mainly depends upon the size and composition of a given release and the number of potential ignition sources available. Electrical equipment in hazardous areas is usually designed such that it will not present a potential ignition source (e.g., flameproof/ intrinsically safe). As such, in most cases (excluding hot surfaces or auto ignition of gas due to static charge) a fault would have to be present in an item of equipment before it becomes a potential ignition source.

However, should a flammable mixture be of sufficient size, then non-rated equipment outside the hazardous area could provide a source of ignition. Other potential ignition sources may be hot surfaces such as heaters, sparks caused by mechanical impact or static charge auto ignition due to high pressure gas escaping through an orifice.

Ignition Probabilities used for the RA study has been taken from Institute of Petroleum Database. The various ignition probabilities have been calculated based on the release rate of each identified scenarios. The following Look-Up Curves from OGP 434-6 has been used to calculate the Ignition Probability;



Source: ABC Techno Labs India Pvt. Ltd.

Figure 7.22: IP Look Up Curve

This RA Study as per OGP 434-6 has considered immediate ignition probability as 0.001 and it is independent of the release rate. The delayed ignition probability is calculated based on the Total ignition probability taken from the Look Up Curve and Immediate ignition probability.

7.1.5 RISK ESTIMATION

The individual risk levels to personnel and potential loss of life levels at each study area were calculated by combining the consequences and frequencies of the accident scenarios; in accordance with the Company Risk Tolerable Criteria as described in earlier section. All the hazard scenarios that have the potential to impact these areas were included in the risk assessment.

7.1.5.1 Location Specific Individual Risk

The LSIR was estimated based on component failure frequencies and event probability for release scenarios. Note that the LSIR levels represent the cumulative risk from all the major accident events at the project facilities without taking into account personnel exposure factor, vulnerability and probability of escape. The overall Location Specific Individual Risk contours and FN Curve are developed considering all scenarios pertaining to all Isolatable Sections and are provided in Sections below.

The LSIR levels at different locations are provided in the Table below.

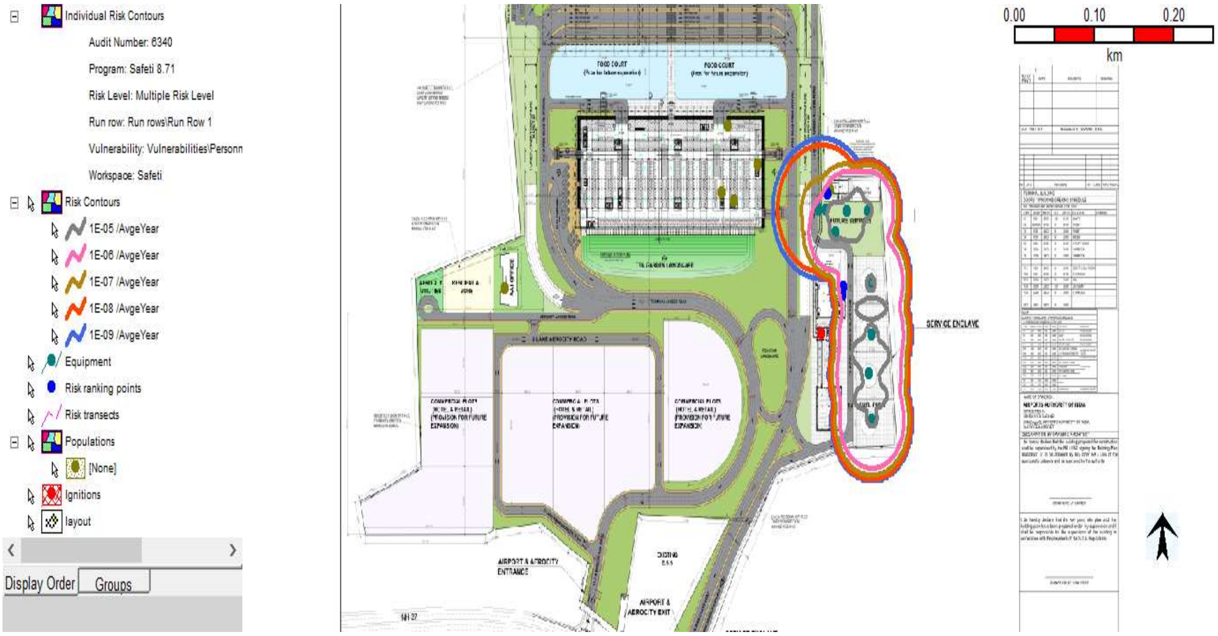
Table 7.8: LSIR level at different locations

Risk Ranking Points	LSIR Values	IRPA Values	RISK LEVEL
Control room	2.86E-07	8.2E-09	Acceptable
HAVC plant room	9.03E-07	2.6E-08	Acceptable
office room	9.73E-07	2.8E-08	Acceptable

Source: ABC Techno Labs India Pvt. Ltd.

The above LSIR level is generated on the basis that each target location considered is permanently inhabited by a single individual. LSIR level are indicative of the potential magnitude or intensity of the risk, but the risks will only be realised at a given location if personnel will be present at that location 24/7.

It may be noted that the above risk estimation is based on the basic failure frequency listed for the various components. Consequences were assessed based on the tank inventory. Some of the specific design aspects such as design overpressure and corrosion allowance, provision of PSVs, Material of Construction complying with NACE can bring down the failure frequency by an order of magnitude. Detection and control such as Fire & Gas detection systems which generate alarm drawing the attention of operators and/or activate safe shutdown with a minimum PFD of 1E-01 should also be considered as risk management hierarchy.



Source: ABC Techno Labs India Pvt. Ltd.

Figure 7.23: LSIR Contour

7.1.5.2 INCREMENTAL INDIVIDUAL RISK PER ANNUM

Individual Risk or Individual Risk Per Annum is determined on a case-by-case basis for each individual working. The individual risk levels have been calculated by multiplying the above LSIR levels by the exposure factor (Occupancy Level).

The results of these calculations based on worker groups are presented in below Table;

Table 7.9: Incremental Individual Risk Per Annum (IRPA)

S. No.	Worker Groups	LSIR (Avg/ year)	Occupancy	IRPA (Avg/ Year)
1	Operators	2.3E-08	0.22	5.06E-09
2	Maintenance	2.3E-08	0.33	7.59E-09

Source: ABC Techno Labs India Pvt. Ltd.

From the above Table, the Individual Risk is following into Acceptable Region.

7.1.6 RISK EVALUATION

As per Risk Tolerance Criteria for Individual Risk and Societal Risk, the Individual Risk and Societal Risk value for all Worker groups falls within the Acceptable Region.

7.1.7 ALARP DEMONSTRATION AND COST BENEFIT ANALYSIS (CBA)

ALARP Demonstration is not necessary as the Individual Risk and Societal Risk falls in Acceptable Region.

7.1.8 CONCLUSIONS & RECOMMENDATIONS

A qualitative review was performed for possible accidents that may occur, based on industry fire accident experience or judgment where necessary. Potential failure scenarios are developed based on hazard identification and QRA studies conducted for the BAGDOGRA INTERNATIONAL AIRPORT ATF Tank Farm, considering the nature of process, materials being processed and handled.

- ✓ Individual risk members of the public is within 10-6 per year.
- ✓ The highest individual risk to personnel working in the tank farm is 1.72E-04 per year (Tank Farm hydrant pump operation officers) which is in the middle part of ALARP region. The societal risk is in the lower part of ALARP region for events involving up to 3 fatalities, and in Acceptable region for events involving 3 fatalities. No event with higher than 3 fatalities is predicted.
- ✓ As such, the ATF Tank Farm facility at BAGDOGRA INTERNATIONAL AIRPORT meets the criteria for individual risk and societal risk. The tank farm facility inside the Airport will have all necessary provisions for fire protection. The following observations are made on the results of consequence analysis:
- ✓ There is no impact on building from any of pool fire scenarios.
- ✓ The escalation radiation of 37.5 KW/m2 is confined within the process area and escalation potential for worst case scenario is not envisaged from facility to surrounding area.
- ✓ In case of dyke fire ATF tank, thermal radiation intensity does not reach 37.5 kW/m2 and thermal radiation intensity of 4 kW/m2 falls well within the BAGDOGRA INTERNATIONAL AIRPORT Tank Farm boundary.
- ✓ The following observations are made on the results of fire risk analysis:
- ✓ The fire risk contour of 1E-04/ year frequency for heat radiation intensity 4 kW/m2 covers the whole tank farm and hydrant pump house boundary. However, the administration building, storeroom and workshop building are outside the contour.
- ✓ The fire risk contour of 1E-04/ year frequency for heat radiation intensity 12.5 kW/m2 within the tank farm and hydrant pump house boundary. However, the buildings are outside the contour. It is concluded that all building are safe in case of fire in any of the tank and pumps.
- ✓ The fire risk contour of 1E-04/ year frequency for heat radiation intensity 37.5 kW/m2 covers mainly ATF Tank and hydrant pumps facility. Hence there is no requirement of passive fire protection (PFP) of tanks.

7.1.9 RISK REDUCTION MEASURES

The risk mitigation measures already being taken at Bagdogra Airport are as given below:

- ✓ Prompt action in the event of an accidental release of HSD or ATF is essential.
- ✓ Where there is a possibility of a flammable liquid spill, provisions have been made to ensure as follows:
- ✓ The spread of the spill is limited;

- ✓ Non-flammable absorbent material is available for immediate use;
- ✓ Ignition sources can be quickly removed; and
- ✓ The area is well ventilated.
- ✓ Routine testing and inspection are carried out for storage area, hoses and fueling tanker and record will be maintained.
- ✓ Leakages from tanker is prevented by a suitable regime of preventive maintenance and inspection.
- ✓ Heat and smoke detectors will be provided at strategic locations.
- ✓ Adequate firefighting facilities have been provided near storage and handling of HSD and ATF.
- ✓ Firefighting facilities are tested as per schedule.
- ✓ Ground staff near aircraft has been trained to take measure in the event of spillage and during fire emergency.
- ✓ Fueling in Aircraft and DG sets 'day tank' is done under the supervision of trained operators.
- ✓ Open vents is provided of goose neck type, covered with a 4 to 8 mesh screen to discharge the vapors of hydrocarbons from storage tanks,.
- ✓ Every storage tank and tanker, including all metal connections, is electrically continuous and has been effectively earthed.
- ✓ Static grounding of aircraft is ensured whenever the aircraft is parked; including during refueling and defueling.
- ✓ Check list for operators for checking safety system and equipment is prepared and check records kept in safe custody.
- ✓ The critical operating steps are displayed on the board near the location where applicable.
- ✓ Standard Operating Procedure (SOP)" are followed while unloading or fueling the aircraft.
- ✓ Mock drills are conducted in every three months involving all concerned agencies.
- ✓ All concerned agencies are provided Disaster Management Plan and regular interaction are made.

7.1.10 RISK MITIGATION MEASURES FOR FUELLING OF AIRCRAFTS

- ✓ Earthing and bonding connections are attached and mechanically firm.
- ✓ Equipment performing aircraft servicing function is not positioned within 3 m radius of aircraft fuel vent openings.
- ✓ Equipment other than that performing aircraft servicing functions are not positioned within 15 m of aircraft during fuel servicing operations.
- ✓ The accessibility to the aircraft by fire vehicles are established during aircraft fuel servicing.
- ✓ Handheld intrinsically safe communication devices used within 3 m from the fuel vent is intrinsically safe.
- ✓ For open hose discharge capacity of the aircraft fueling system, at least one listed wheeled extinguisher having a rating of not less than 80-B.

- ✓ Presence of at least 2 x 9kg ABC dry powder fire extinguishers at both sides of the refueling browser / dispenser is ensured.
- ✓ Spark plugs & other exposed terminal connections are insulated.
- ✓ All vehicles, other than those performing fuel servicing, are not driven or parked under aircraft wings.
- ✓ Electric tools, drills or similar tools likely to produce sparks or arcs are not used.
- ✓ The ground service activities do not impede the egress should there be an emergency.
- ✓ A clear area for emergency evacuation of the aircraft is maintained at the rear (or front) aircraft exit door.
- ✓ Provision of adequate instrumentation and controls for overfill protection of storage tanks in the tank farm on the same lines as specified in OISD 244.

7.1.11 MEDICAL FACILITIES

First aids facilities should be made available at the project site and a 24 hour standby vehicle (ambulance) should also be available at the well site for quick transfer of any injured personnel to the nearest hospital, in case an accident occurs and medical emergency arises. Prior arrangements should be made with the nearby hospitals to look after the injured persons in case of medical emergency during operations of airport.

7.2 DISASTER MANAGEMENT PLAN

7.2.1 INTRODUCTION

The important aspect in emergency management is to prevent by technical and organizational measures, the unintentional escape of hazardous materials out of the facility and minimize accidents and losses.

Emergency planning demonstrates the organization's commitment to the safety of employees and increases the organization's safety awareness. The format and contents of the Disaster Management Plan have been developed taking into consideration the regulatory guidelines, other applicable documents and accepted industry good practice principles formulated as a result of lessons learned in actual emergencies requiring extensive emergency response. A plan can work smoothly and effectively only if the instructions are correctly and promptly followed and action taken at various levels is well coordinated.

The disasters which are likely to affect Bagdogra Airport are broadly categorized under three headings.

1. Natural: Earthquake, Cyclones, Floods etc.
2. Man-made: Chemical disasters, Biological disasters, nuclear disasters, Radiological disasters, and Airport Emergences like Aircraft crash on and off site, etc. and
3. Hybrid: Epidemics etc.

Bagdogra Airport is more likely to be susceptible to floods because of its low lying topography and close proximity to Mahananda River especially during the months of June to September. In addition to this, Bagdogra Airport is also susceptible to Earthquakes because of its location in seismic zone 5.

Therefore, in order to mitigate the effect of such disasters and to restore the normal operation at the earliest at the airport, it is essential to put in place a plan for comprehensive preparedness and response for handling anticipated disasters at the airport

7.2.2 Objective of Emergency Planning

The Emergency Response Plan defines general functions, roles and responsibilities of AAI operational units and other responding agencies in order to make necessary actions in the event of an emergency at the Airport. This plan mainly details about the communication procedure and functions amongst the agencies responsible for providing emergency response to an airport emergency. The concept of the ERP is mainly based on fact that all concerned responding agencies have appropriate set procedures and the required capability to mitigate the emergency at the airport and are in synergy with this ERP.

Further the plan has been prepared on the belief that the responding agencies are well versed with the concept of human factor principle and shall consider the same while mobilizing their resources and responding to an emergency at the Airport.

7.2.3 Objective of Emergency Response planning

Emergency Response Plan (ERP) defines procedures for handling an airport emergency in short duration with coordinated response, along with the objective of minimizing the effects of emergency particularly in view of safeguarding lives both on and off the aerodrome and maintaining aircraft operations to handle various aircraft related and non-aircraft related emergencies anticipated at Bagdogra Airport. ERP also outlines the duties and responsibilities of the various personnel and agencies associated with handling airport emergencies.

The aim of this ADMP is to set forth the procedures for coordinating the response of various agencies both on and off the airports, for controlling / mitigating the severity of any disaster so as to be able to cope up with the aviation related emergencies, natural disasters anticipated in the geographical location of Bagdogra Airport and also use surge capacity of the Airport.

- ✓ To protect and minimize the loss of lives and property/infrastructure from disasters.
- ✓ Promote a culture of prevention and mitigation through curriculum revision, Information Education Communication (IEC) awareness campaign plans at all levels, identifying hazards and conducting regular mocks drills accordingly.
- ✓ To build the capacity of all stakeholders in the airport to cope with the disaster(s) and promote community based disaster management through various awareness programme.
- ✓ Mainstreaming disaster management concerns into development planning processes.
- ✓ Develop efficient disaster response/relief mechanisms in the airport.
- ✓ Mitigation of accidents at source,
- ✓ Prevention of deterministic health effects in individuals,

- ✓ Providing first-aid and treatment of injuries,
- ✓ Reducing the probability of stochastic effects in the population
- ✓ Reduction of psychological impact on the population
- ✓ Protection of environment and property.

The scope of ERP is limited to responding to airport emergencies within Airport Boundary only and from the Airport Boundary with the extent as far as practicable at the time of accident.

7.2.4 Airport Emergency Committee (AEC)

AEC is highly strategic in nature, framed to provide safe, effective response to different types of emergencies at Bagdogra International Airport. It is convened importantly, in case of emergency related to Aircraft Crash – Within Airport; It includes both actual emergency and at the time of conducting emergency exercise. The purpose of Airport Emergency Committee is to ensure that Bagdogra International Airport, as a whole, is equipped to provide efficient and effective response to different types of airport emergencies. The Committee will consider all aspects of emergency planning including the following, which are not in order of priority.

1. Identification of core components of AEP to identify how and when these are to be tested, whether in parts or the entire emergency plan, according to the DGCA/ICAO recommendations or if corrective actions are required.
2. Develop comprehensive contingency plans.
3. Review response capability and issues from external emergency services.
4. Review external emergency services statutory obligation to respond to significant emergencies arising within their geographical area. Discuss and consider plans for external emergency services to become involved with the process of AEP planning and the resultant training requirements.
5. Planning of annual emergency exercise to determine the scope of each exercise and the participants of each exercise. f. Hold Annual meetings and keep minutes of the meetings on file.

7.2.5 Routine Yearly Meeting

The committee consider all aspects of the emergency planning; it shall include but not limited to the following

- ✓ To develop comprehensive contingency plans and ascertain how and when these are to be tested, in compliance to DGCA / ICAO recommendations as per the applicability.
- ✓ Planning and Execution in case of emergency exercises and to determine the feasibility of each exercise and the participants of each exercise.
- ✓ Review response capability and challenges from external emergency services.
- ✓ Continuously striving for improvement in the Airport Emergency Response Plan
- ✓ Workout for applicable mutual aid agreements.

7.2.6 Post Emergency

- ✓ The Airport Emergency Committee (AEC) will take control of the Emergency Operations Center and acts as the overall controlling authority during the emergency management process
- ✓ To ensure effective communication with affected air operator or Airline and GHA EOC; MCP; ATC and various other government and non-government agencies where required
- ✓ Take decision for commencement of the normal operations while the emergency operations are ON. (It plays a vital role in taking the decision for closure of Runway and notification if required).
- ✓ Formulate strategic plans to give support to the rescue operations, and to handle request and demands from the passengers, friends & relatives, Airline and GHA, media, etc.
- ✓ To take executive decisions for the overall mitigation of emergency and liaise with all authorities or agencies for their resources and expertise.
- ✓ Act as a focal point for communication to and from the AAI senior management, stakeholders / concerned agencies including the government and non-government authorities.
- ✓ Regulate / authorize release of information to the media / public on the facts of the emergency.
- ✓ Ensure and arrange for photography and videography of the scene of the accident and for the preservation of audio / video tapes messages signals and other records. A Safety Investigation Coordinator (SIC) and team shall be constituted in accordance with DGCA Air Safety Circular Aircraft (Investigation of Accidents and Incidents) Rules, 2017, to assist in accident investigation.
- ✓ Facilitate DGCA / AAIB investigation, if applicable
- ✓ Maintain chronological log of all actions / events and ensure relevant documentation records.
- ✓ AECC – Chairman at EOC shall initiate termination of the declared emergency (real or mockup exercise)

7.2.7 Types of Emergencies

The emergencies at the Bagdogra International Airport can be classified under several headings. These headings are listed below together with a description of the type of emergency.

7.2.7.1 Fires on the Ground

Fire on the ground can be aircraft related and non-aircraft related. Fire involving aircraft can be at any location on the taxiway or apron area where the aircraft is parked. Non-aircraft related fire involves mainly the terminal buildings, ATF tanker and HSD storage, etc.

7.2.7.2 Natural Disasters

The airport is located in Seismic Zone V as per seismic classification. Seismicity is not a natural hazard for Bagdogra International Airport project. However, necessary design measures have been taken for making structure earthquake proof

7.2.8 Key Functions of Supporting Organizations/Agencies in Mitigation of Airport Emergencies

The key functions of supporting Organizations/Agencies in Mitigation of Airport Emergencies are listed in table 7.9.

Table 7.9: Key Functions of Supporting Organizations/Agencies in Mitigation of Airport Emergencies

S. No	Name of the Organizations/Agencies	Roles & Responsibilities
1.	Bagdogra International Airport Fire Service	✓ Fire-fighting operations ✓ Post-accident fire protection ✓ Evacuate injured passengers to hospitals ✓ Support structural fire-fighting and evacuation ✓ Support mitigation of dangerous foods accidents/incidents ✓ Inform fire brigade at Bagdogra International Airport.
2.	Terminal Building Management	✓ Activate Key Officials and other external agencies/services such as hospitals, panel doctors, ambulance services, ✓ Activate the Emergency Response and Interaction Centre (ERIC) Group ✓ Set up the Emergency Coordination Centre (ECC), Friends and Relatives Reception Centre (FRRC) ✓ Passenger facilitation and business recovery at terminal buildings ✓ Support terminal building evacuation
3.	Engineering	✓ Provide technical support and assistance ✓ Support recovery efforts
4.	Local Police	✓ Guarding of site and preservation of evidence Bagdogra International Airport including eye-witness accounts and photography. ✓ Maintain law and order at the side.

7.2.9 Emergency Operations / Coordination Centers

Established for Mitigation of Emergencies during a major disaster such as severe fire outbreak at terminal building, the various emergency operations will be established immediately to mitigate the disaster. The emergency operations and coordination centers at Bagdogra International Airport will comprise Crisis Management Centre (CMC), Emergency Coordination Centre (ECC), and Friends and Relatives Reception Centre (FRRC). Each of them has its own functions and roles to perform during the crisis.

7.2.10 Crisis Management Centre (CMC)

Established by the AAI, the Crisis Management Centre is to function as an overall overseeing and controlling authority of the crisis mitigating process during a major on ground fire. The committee of the Crisis Management Centre comprises the following permanent and supporting members: The functions of the CMC include:

- ✓ Formulate strategic plans and policies, as well as engage in high level decision making for the mitigation of crisis.
- ✓ Control, coordinate and support operations during an Incident.
- ✓ Oversee the work and progress of protracted fire-fighting and rescue, and salvage operations.
- ✓ Liaise with the airline concerned, local authorities, ministries, and governmental departments for support.
- ✓ Arrange and provide welfare to the staff involved in the mitigation of crisis.
- ✓ Regulate the release of information to the public on the facts of the aircraft disaster.
- ✓ Issue press releases and organize press conferences.
- ✓ Ensure that the post-accident operations are completed expeditiously so that the Bagdogra International Airport can resume normal operations in the shortest possible time.

7.2.11 EMERGENCY COORDINATION CENTRE (ECC)

Located near to Entry Gate, the Emergency Coordination Centre will be established by the Airport Director, during a major disaster, to coordinate the response and functions of the external supporting organizations, agencies, and services involved in the mitigation of the emergency.

The committee of ECC comprises the following officials:

- Terminal Manager - Chairman
- Engineering In-charge - Alternate Chairman
- Manager - Civil
- Manager - Electrical
- Security Officer
- CISF Representative
- Police Representative

Functions of the ECC include:

- Support incident site fire-fighting and rescue operations through liaison and coordination with the external organizations/agencies/ services.
- Facilitate mobilization of external resources to the crash site, such as issuing emergency passes and arranging with Apron Control for "Follow-me" vehicles.
- Arrange and facilitate visits by the VVIPs to the site (if any).

7.2.12 ASSEMBLY AREA (AA)

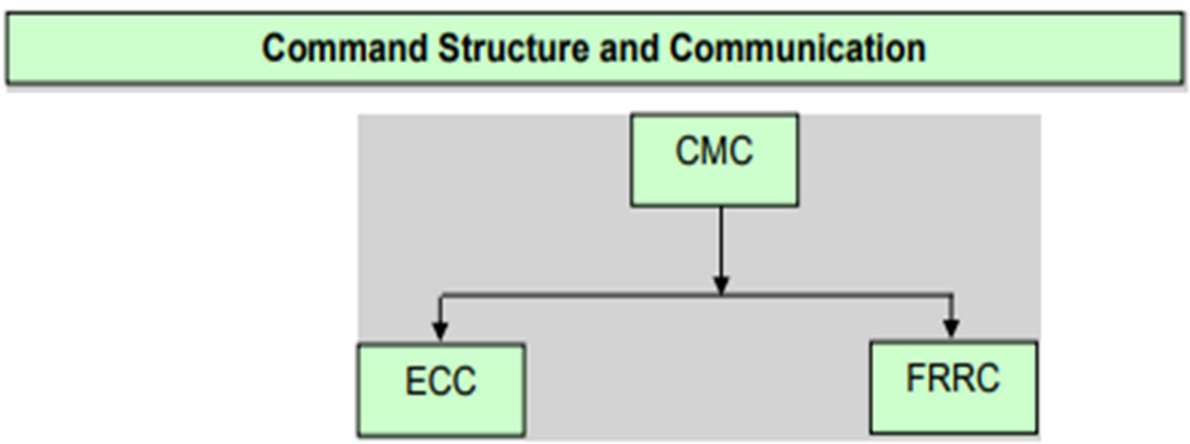
Assembly area is an area set up near the incident site to temporarily receive the uninjured casualties until the arrangements to transport them to the Hospital is made. Two Assembly Areas (AA) will be near parking in front of terminal building.

7.2.13 FRIENDS AND RELATIVES RECEPTION CENTRE (FRRC)

The FRRC serves as a secure area, away from the attentions of the media, for the friends and relatives of those involved in an accident. The documentation process within the FRRC helps to confirm who was on the site/aircraft and facilitates the reunion. On receiving the "Fire" message, Terminal Director will set up the FRRC. The staff shall man the FRRC, and the police shall take charge of the security of the area. At the FRRC, the airline staff shall:

- ✓ Attempt to verify the identity of the visitors on entry;
- ✓ Conduct documentation and briefing;
- ✓ Update with the latest information including passenger manifest, that has been officially cleared;
- ✓ Provide care and comfort including refreshments;
- ✓ Arrange for doctors and/or CARE officers through ECC on a need basis.

Command structure and communication flow among various emergency / coordination centers is given below:



7.2.14 MEDIA MANAGEMENT

Airport Director – Chairman and his team shall take the lead to handle all press matters. They are single point media interaction. They will be responsible for developing the overall information management plan, with emphasis on strategies to manage the information flow. They will also be responsible for the preparation of press releases and the organization of press conferences.

All press personnel will first be directed to Airport Director's Media Centre. At the Media Centre, press briefing, communications and transportation service for taking the press personnel to and from the accident site, when permissible, will be arranged/provided. No unauthorized persons shall be allowed in the Media Centre. Only members of the press, free-lance reporters and photographers wearing a valid pass issued by Airport Director will be admitted to the Media Centre, or transported to the scene of the accident

7.2.15 EMERGENCY PROCEDURES

Fires on the Ground (Aircraft Related Fires Occurring in Aircraft Movement Areas)

An aircraft can catch fire while it is taxiing in the movement area or parked. Such a scenario can arise from a defect or malicious act, and may develop into a major disaster. When the aircraft on the ground on fire is sighted, Airport Fire Service through the crash alarm communication system will be informed and provide details of the aircraft fire, for example:

- ✓ Location of aircraft;
- ✓ Nature of fire (e.g. undercarriage fire, engine fire);
- ✓ Number of POB; and
- ✓ Presence of dangerous goods, if known.

The Air Traffic Controller shall give clearance to the responding fire vehicles to enter the runway/taxiway as soon as possible.

If the fire is large and has caused extensive damage to the aircraft and external resources are required to aid in the mitigation process, the Air Traffic Controller shall declare "Aircraft on Fire".

The standard text and format used for the "Aircraft on Fire" message shall be as follows: AIRCRAFT ON FIRE:

- ✓ Aircraft Operator;
- ✓ Aircraft Type & Flight Number; Location of Aircraft;
- ✓ Nature of Fire (e.g. undercarriage fire, engine fire);
- ✓ Number of Persons on Board (POB);
- ✓ Any Dangerous Goods on Board.

(*The information shall be provided if it is available and applicable.)

The use of the phrase "Aircraft on Fire" is to give distinction and therefore avoid confusion between aircraft crash and aircraft on the ground on fire

Fires on the Ground (Non-Aircraft related Fires)

Fire may occur at any of the part of Bagdogra International Airport. If out of control, such a fire may cripple the key Bagdogra International Airport facilities and disrupt the normal operations. During a fire occurrence, however small it may appear to be, any person discovering it shall:

- Raise the fire alarm via the nearest manual call point. If no manual call point is readily available, raise the alarm by other available means.
- Inform the Fire Service immediately of the exact location of the fire via the following telephone numbers.

Operate a suitable fire extinguisher where readily available, or any water hose reel within range. [*Note: Attempt to put out the fire using a fire extinguisher shall only be carried out if the fire is small (i.e., at incipient stage) and does not pose any danger to the operator. Also take note that water shall not be used on fire involving liquid such as HSD, as well as on energized electrical equipment unless such equipment has been de-energized.)

On receipt of a structural fire call, the Fire Operator shall request the caller to provide the following details:

- ✓ Location of fire;
- ✓ Type of fire;
- ✓ Name of caller;
- ✓ Telephone number of caller.

7.2.16 TRAINING AND EDUCATION

Regular training would be provided to all personnel who have a role in planning and operational response to an emergency. The main goal of training for emergencies is to enable the participants to understand their roles in the response organization, the tasks associated with each position and the procedures for maintaining effective communications with other response functions and individuals. The training objectives are:

- ✓ To familiarize personnel with the contents and manner of implementation of the plan and its procedures,
- ✓ To train personnel in the performance of the specific duties assigned to them in the plan and in the applicable implementation procedures,
- ✓ To keep personnel informed of any changes in the plan and the implementing procedures,
- ✓ To maintain a high degree of preparedness at all levels of the Emergency Response Organization,
- ✓ Train new personnel who may have moved within the facility organization;
- ✓ Test the validity, effectiveness, timing and content of the plan, and
- ✓ Update and modify the plan on the basis of experience acquired through exercises and drills.

7.2.17 MOCK DRILLS AND EXERCISES

Mock drills constitute another important component of emergency preparedness. They refer to the re-enactment, under the assumption of a mock scenario, of the implementation of response actions to be taken during an emergency. Emergency drills and integrated exercises have the following objectives.

- ✓ To test, efficacy, timing, and content of the plan and implementing procedures;
- ✓ To ensure, that the emergency organization personnel are familiar with their duties and responsibilities by demonstration;
- ✓ Provide hands-on experience with the procedures to be implemented during emergency; and
- ✓ Maintain emergency preparedness. The frequency of the drills would vary depending on the severity of the hazard.

However, drills would be conducted once in a year. Scenarios may be developed in such a manner as to accomplish more than one event objective. Drills and exercises will be conducted as realistically as is reasonably practicable. Planning for drills and exercises would include:

- ✓ The basic objectives,
- ✓ The dates, times and places,
- ✓ The participating organizations,
- ✓ The events to be simulated,
- ✓ An approximate schedule of events,
- ✓ Arrangements for qualified observers, and
- ✓ An appropriate critique of drills/exercises with participants.

Evaluation of drills and exercises would be carried out which would include comments from the participants and observers. Discrepancies noted by the drill observers during the drill shall be pointed out during the drill. The individual responsible for conducting the drill or exercise would prepare a written evaluation of the drill or exercise. The evaluation would include assessments and recommendations on:

- ✓ Areas that require immediate correction;
- ✓ Areas where additional training is needed;
- ✓ Suggested modifications to the plan or procedures; and
- ✓ Deficiencies in equipment, training, and facilities.

The evaluation of a drill or exercise shall be submitted to the terminal manager for review and acceptance who shall then determine the corrective actions to be taken and assign the responsibility to appropriate personnel.

The Safety In-charge would track all approved drill and exercise corrective actions as a means of assuring that corrections are made in a reasonable amount of time, and shall advise the Terminal Manager of the status of implementation of corrective actions. Records of drills, exercises, evaluations, and corrective actions would be duly maintained.

7.2.18 Updating of Emergency Plan

The Bagdogra International Airport Emergency Plan and implementing procedures would be reviewed and updated to ensure compliance with relevant regulations and applicable state and local emergency plans. The need for updating is based on following aspects:

Written evaluations of mock drills exercises which identify deficiencies or more desirable methods, procedures, or organizations;

- ✓ Changes in key personnel involved in the organization;
- ✓ Changes in the facility organization structure;
- ✓ Changes in regulations;
- ✓ Recommendations received from other organizations and state agencies.

7.2.19 SOCIAL IMPACT ASSESSMENT AND R&R ACTION PLAN

For proposed construction of Taxiway, Apron, Terminal Building & Miscellaneous works, about 104.65 acres of land will be utilized. It has been already acquired for the purpose of the project. The area for airport development has been acquired by AAI. Hence, Social Impact Assessment and R&R Action plan are not required as there is no project affected person because of no land acquisition.

CHAPTER 8: PROJECT BENEFITS

8.1 INTRODUCTION

Airports play an eminent role in the economic development of a region, as well as the nation. Airports facilitate fast movement of man and materials, thereby fostering trade and commerce. Airports offer increased accessibility, which in turn fuels the tourism sector. With an increase in the number of visitors and airport users, more money flows in to the local economy. With increased economic activity and employment, consumer behaviour changes, raising the standard of living of the people in the region. Thus, the availability of airports provides a thrust to the GDP of the local region, having a positively impact on the national economy. Since the establishment of Bagdogra International Airport, it has witnessed sustained growth in past decades in terms of air services as well as passenger traffic. In view of the future traffic growth, there is an urgent requirement of proposed capacity enhancement activities.

Due to the fast and previously unforeseen growth of air traffic at Bagdogra International Airport in the last few years it was necessary to review the air traffic forecast. Their view concluded that the actual growth was even higher than anticipated in the most optimistic forecasts from previous efforts. This growth will be met through improvement, modification/up-gradation/augmentation and modernization of existing Airside/Landside facilities and infrastructure.

Air traffic at Bagdogra crossed 1 million for the first time, growing at 43.6% percent in 2014–15. In 2019–20, the airport served 3.2 million passengers, which was an increase of 11.2% from the previous year, making it the 17th-busiest airport in India. It is one of the few airports in India with zero sales tax on aviation turbine fuel.

8.2 PROJECT BENEFITS

The proposed airport project shall cater to future aviation needs in terms of air space management and airport operations to derive maximum benefits for passengers, stakeholders, all other airport users and surrounding communities. The direct and indirect benefits are broadly classified into the following categories.

8.2.1 PROJECTED FINANCIAL BENEFITS

Direct Benefits

The major financial revenue generated by airport are accounted as aeronautical and non-aeronautical revenues parts of which is paid out as tax revenues to the government exchequer. Bagdogra International Airport is planned to be developed to a 10 Million Passenger Per Annum airport handling capacity. A dedicated GA operations terminal is envisaged to generate similar enormous revenues to the government exchequer. Bagdogra International Airport has significant growth potential on international export of general cargo, including readymade garments, Tea Products and E-commerce based domestic air cargo. The airport also has attractive captive international export market for perishables and international import market of machinery for the nearby manufacturing units. Planned cargo capacity and associated infrastructure enhancement will lead to increase in airport cargo volumes over a period of time. Given the plans for capacity enhancement, Bagdogra International Airport cargo market share is expected to be significantly high as the planned capacity enhancement will be developed and operated by AAI.

In-direct Benefits

The proposed project will stimulate local economy in the vicinity and is expected to grow rapidly due to direct & indirect impact of aviation and related businesses. The proposed project will also attract large scale investment opportunities around proposed airport by other parties due to airport development.

8.2.2 SOCIO-ECONOMIC BENEFITS

Some of the key socio-economic benefits induced by implementation of proposed project are:

- Providing alternate air transport facility to unserved population.
- Socio-economic opportunities for business and employment generation
- Development of ancillary industries and trade centres
- Skill development and technical expertise enhancement possibilities due to influx of aviation related institutions
- Improvement in quality of life, flight safety awareness and literacy of people in the area
- Infrastructure development in the vicinity of Bagdogra International Airport through augmentation of transport and connectivity.

Direct and Indirect Employment Benefits

It is expected about 500 direct & indirect employment during construction phase and 2000 direct and indirect employment during operational phase of the project after expansion. Socio-economic opportunities for business and employment for people, skill development and technical expertise enhancement possibilities due to influx of aviation related institutions will be developed. The financial benefits envisioned from the project due to aviation business leading to stimulation of economic growth. Stimulation of local economy due to direct & indirect impact of aviation and related business, large investments around the proposed airport by other agencies due to the development of Bagdogra International Airport. Also, during construction phase, the EPC contractors are likely to use unskilled labourers from the nearby settlements.

Direct Employment: Employment generated by activities on site at the Airport. These include the airport operations and management, aircraft maintenance, storage facilities, charter services and leasing activities, airlines, shops and other concessions, catering ground engineering and handling air traffic control and car parking facilities.

Indirect Employment: Employment generated through activities off site by organizations and companies supplying goods and services to the airport. These jobs may be locally based or more remote from the airport, depending on the nature of supply chain.

Induced Employment: Employment generated through spending habits of salaried employee both in direct and indirect activities. This category is likely to provide jobs at regional level.

CHAPTER 9: ENVIROMENTAL COST BENEFIT ANALYSIS

9.1 GENERAL

Bagdogra International Airport is a strategic project which will offer a spectrum benefits in addition to augmenting airport services. The financial analysis of the project has been carried out based on the estimation of operating cost (OPEX) and capital cost (CAPEX) for different planning horizons. The revenues from aeronautical and non-aeronautical sources are considered for the above analysis. It is inferred from the detailed analysis that the project is more than capable of maintaining cash flow/ generate cash from the first year of its commencement.

As per EIA Notification S.O. 1533 (E), dated 14th September 2006 and its further amendments, the chapter on environmental cost benefit analysis is to be prepared, if prescribed at scoping stage. The scope of the EIA/EMP has been prescribed vide the Terms of Reference (TOR) issued by SEIAA, West Bengal vide File No. 2807/EN/T-II-1/536/2023 dated 13.12.2023. The conditions enlisted in the ToR does not specifically mention that Cost-Benefit Analysis (CBA) to be addressed. However, some important benefits derived from the project are given below.

9.2 KEY BENEFITS

- AAI has committed in developing of Bagdogra International Airport into state-of-art Airport serving business markets, tourism, and keeping pace with the growth in Air traffic.
- Bagdogra International Airport has been planned to be developed as a Green airport (carbon neutral status) as per ICAO standards, with key objective of Environmental Sustainability to be achieved through, optimization of resource & Energy Conservation thereby reducing the carbon emissions to the extent possible.
- The airport will minimize the dependency on conventional sources of energy by utilization of solar energy and optimizing energy demand through compliance to ECBC guidelines.
- The transport infrastructure within the influence area of Bagdogra International Airport will be augmented proposed Direct Western connectivity will be developed thereby reducing the traffic congestion and will provide hassle-free movement of air passengers.
- The development strategy of Bagdogra International Airport will induce simultaneous development of nearby areas on socio-economic and infrastructural verticals foreseeing.

CHAPTER 10: ENVIRONMENTAL MANAGEMENT PLAN

10.1 INTRODUCTION

Environmental Impact Assessment (EIA) is identified as environmental impacts that are likely to arise during construction and operation of the proposed facilities in Bagdogra International Airport. The Chapter - 4 of this report has examined both adverse and beneficial impacts on each physical, biological and socio-economic parameters of environment during construction and operation phases of the proposed development of Bagdogra International Airport. The environmental impact assessment has examined the extent to which these impacts would be mitigated through the adoption of standard practices, guidelines and complying with regulatory requirements. The Environmental Management Plan (EMP) describes both best practice measures and site specific measures. The implementation of EMP is aimed at mitigating potential environmental impacts associated with the construction and operation phases of proposed development of Bagdogra International Airport.

Environmental management plan is concerned with a planned, integrated programme aimed at ensuring that identified and unidentified impacts of a proposed upgradation & expansion of existing Airport are contained and brought to an acceptable minimum. It provides confidence on the part of project planners that a reliable scheme will be put in place to deal with any contingency that may arise during all phases of construction and operation.

The proper Environmental Management Plan (EMP) should be prepared for the proposed upgradation & expansion of existing Airport to minimize negative impacts on the basis of prevailing environmental conditions and likely impacts of proposed activity on various environmental parameters. Environmental Management Plan will also facilitate monitoring of environmental parameters.

Environmental Management Plan is required for the formulation, implementation and monitoring of environmental mitigation measures. EMP includes schemes for proper and scientific treatment and disposal mechanism for polluted emission, effluent, sewage, solid and hazardous wastes. Apart from this, landscaping and green belt development, safety aspect of the workers, noise control etc. are also included in the EMP. Adequate budgetary provisions are also made for EMP implementation. The plan for implementation of environmental management plan should be framed. The detailed capital and recurring (per annum) budget should be earmarked for pollution control/monitoring equipment; operation and maintenance of pollution control facilities.

This Environmental Management Plan has the following specific long-term objectives:

- *Ensure compliance with legislation and Company policy;*

- *Achieve, enhance and demonstrate sound environmental performance built around the principle of continuous improvement;*
- *Integrate environment fully into the business;*
- *Rationalize and streamline environmental activities to add value in efficiency and effectiveness;*
- *Encourage and achieve the highest performance and response from individual employees and contractors;*
- *Provide standards for overall planning, operation, audit and review;*
- *Enable management to establish environmental priorities;*
- *Be applicable throughout the organization.*

10.2 PURPOSE OF ENVIRONMENTAL MANAGEMENT PLAN (EMP)

The proposed upgradation & expansion of existing Airport may have some pollution potential to cause both short term and long-term environmental degradation. While the industrial development is indispensable for the socio-economic development of the region as well as of the country, the environmental aspects can never be ignored because of widespread and far-reaching environmental degradation. Along with control and regulatory measures, management solutions are yielding fruitful results towards environment.

With the availability of cost effective advanced technology and innovative management ideas, the EMP can act as an effective management tool to provide management solutions to all environmental pollution problems including that of associated regulatory compliance. Various purposes of the Environmental Management Plan at the proposed upgradation & expansion of existing Airport of AAI are:

- *To treat and dispose of likely pollutants viz. liquid, gaseous and solid & hazardous wastes so as to meet statutory requirements with appropriate technology,*
- *To support and implement proposed upgradation & expansion of existing Airport of AAI to achieve environmental standards and to improve the methods of environmental management,*
- *To promote green-belt development,*
- *To encourage good working conditions for employees,*
- *To implement best practices for environmental management,*
- *To reduce fire and accident hazards,*
- *Budgeting and allocation of funds for Environmental Management System,*
- *To adopt cleaner technologies and waste minimization program.*

10.3 CORPORATE, HEALTH, SAFETY AND ENVIRONMENT (HSE) POLICY

It is of utmost concern for a Company to conduct its business in a manner that will promote the protection of the occupational health, safety and welfare of its employees and others involved in or affected by its business operations and address environmental concerns regarding sustainable development.

- To be a responsive and responsible corporate citizen, the AAI will develop an organizational culture of Environment, Health & Safety excellence.
- As an integral part of the AAI's business performance, the Project Proponent is committed to achieve high levels of performance in Environment, Health & Safety for which an EHS policy will be implemented.

The EHS policy of the AAI will be continuously reviewed and improved which is essential for the future success of the Company.

The main aims under the said Policy are to:

- Effectively manage, monitor, improve and communicate the environmental performance.
- Take all reasonable steps to prevent pollution.
- Set realistic and measurable objectives and targets for continual improvement of the environmental performance.
- Ensure that all employees and contractors are trained to understand their environmental responsibilities and create an environment that adheres to the Company's Policies, procedures and applicable regulations.
- Hold leadership accountable for good environment performance of our operations and projects. Inherent in that accountability will be the commitment of management to provide resources and successfully create an appropriate environment.
- Comply fully with all relevant legal requirements, codes of practice and regulations.
- Reduce, recycle and reuse natural resources.
- Minimize waste and increase recycling within the framework of waste management procedures.
- Identify and manage environmental risks and hazards.
- The project proponent shall regularly review this policy and ensure that corrective and preventative actions are taken in order to ensure continual improvement.
- To treat all the pollutants viz. liquid and gaseous, which contribute to the degradation of the environment, with appropriate technologies.
- To comply with all regulations stipulated by the Central/State Pollution Control Boards related to air emissions and liquid effluent discharge as per air and water pollution control laws.
- To handle hazardous wastes as per the Hazardous Waste Hazardous & Other Wastes Rules, 2016 of the Environment (Protection) Act, 1986.
- To encourage support and conduct developmental work for the purpose of achieving environmental standards and to improve the methods of environmental management.
- To make continuous efforts to improve environment.

- The system of reporting of Non-conformances/ violation of any Environmental Law/Policy will be as per the management system.

10.4 ADMINISTRATIVE ASPECTS

The key benefits of EMP are that it provides the organization with means of managing and improving its environmental performance thereby allowing it to contribute to better Environmental Quality. The other benefits include cost control and improved relations with stake holders. EMP includes 4 major elements:

- Commitment & Policy
- Planning
- Implementation
- Measurement & Evaluation

Commitment & Policy

AAI will strive to provide and implement the Environment Management Plan that incorporate all issues related to environmental and social components and will comply with the suggestions given by Ministry of Environment, Forests & Climate Change (MoEF&CC), West Bengal Pollution Control Board (WBPCB). In this regard, AAI has a well laid Environmental Policy which is approved by their Board of Directors.

Planning

This includes identification of environmental impacts, and setting environmental objectives. AAI is committed to follow the said plan in letter and in spirit. Pollution Control Arrangements/mitigation measures for different types/sources of pollution.

Implementation

AAI believes in preservation of the Environment and will ensure efficient operation of its pollution control equipment/systems. AAI will ensure that trained manpower is available for operating, maintaining, and documenting the effective environmental operations

10.4.1 SOP IN CASE OF ANY VIOLATION OBSERVED

- ✓ The cases of violations/deviation/non-compliances/major accident, Head of Environment Department will do immediate reporting to the Directors and Board of Directors of the Company.
- ✓ It shall be reported to the Board of Directors by EHS-Manager (Head of EMC) through Director, AAI and shall identify designate responsible person for ensuring compliance with the Environmental Laws and Regulations.
- ✓ Conduct reviews of our operations to monitor environmental performance.
- ✓ Comply with all relevant environmental laws and regulations to minimize risks to health, safety and the environment.
- ✓ Work with local government, regulatory authorities and communities to ensure safe handling, use and disposal of all materials, resources and products.

10.4.2 GOOD NEIGHBOURHOOD PRACTICES

AAI is dedicated to operations of Airport which includes good relationships with neighbors and a commitment to environmental protection and compliance with all applicable federal, state, and local regulations.

To be a "good neighbor" in the areas, three objectives are to be followed:

- Protection of public safety;
- Protection of the environment; and
- Respect for the property rights of others.

These objectives shall be achieved through use of sound management processes as part of the responsibility to act as a "good neighbor." This shall be achieved by designing and implementing EMP very effectively.

- Respect the property and the rights of others
- Minimize surface disturbances;
- Practice good housekeeping;
- Remediate and restore the site in a timely manner in compliance with applicable regulations; and
- Drive responsibly on public and private roads.
- Promote safety of the general public
- Train personnel in safe operating practices;
- Conduct emergency planning where applicable; and
- Post signage and warnings in accordance with regulations.
- Protect the environment:
- Train personnel on environmental protection in compliance with applicable regulations;
- Maintain equipment and utilize good work practices;
- Seek to understand the land owner, and surface user concerns and possible questions regarding:
- ✓ Groundwater aquifers and surface water;
- ✓ Air quality;
- ✓ Ecology and livestock protection;
- ✓ Housekeeping;
- ✓ Noise;
- ✓ Surface disturbance; etc.
- Follow regulations for waste management and environmental protection

10.5 ENVIRONMENTAL MANAGEMENT PLAN

Environmental management Plan (EMP) includes action to protect environment by using instruments, adoption of industrial best practices, surveillance and statutory norms. To mitigate the adverse impacts, if any, caused due to proposed upgradation & expansion of existing Airport, the EMP has been formulated. The EMP has prescribed environmental monitoring and implementation of environmental protection measures during all phases of the proposed project activities. The environmental and socio-economic aspects are dealt with likely environmental control measures are suggested as under:

- ✓ Air Quality Management Plan
- ✓ Noise & Vibration Management Plan
- ✓ Water Resources & quality Management Plan
- ✓ Soil Quality Management Plan
- ✓ Ecology Management Plan
- ✓ Disturbance to community resources & safety management plan
- ✓ Employment and Socio economic management plan
- ✓ Culture, Aesthetics and Archaeological sites management plan
- ✓ Occupational Health & Safety Management Plan

Also the following management plan will be followed strictly during the proposed upgradation & expansion of existing Airport:

- ✓ Waste Management Plan
- ✓ Greenbelt Plan
- ✓ Road Safety and Traffic Management Plan
- ✓ Management of Social Issues and Concerns.

10.5.1 AIR QUALITY MANAGEMENT PLAN

Construction Phase

The impact of construction activity on ambient air quality is a cause for concern mainly in the dry months due to settling of dust particles. The main sources of dust emissions during the construction period are the movement of equipment at the site and dust emitted during the levelling, grading, earthworks and other construction related activities. Exhaust emissions from vehicles, DG sets and construction equipment deployed during the construction phase also result in marginal increase in the levels of SO2, NO2, unburnt hydrocarbons and particulate matter (PM10 & PM2.5). The impact will however, be reversible, marginal and temporary in nature.

The following measures will be adopted during construction phase to mitigate the impact on ambient air quality:

- Dust suppression systems (water spray) will be used as per requirement at the construction site.
- Construction materials and earth will be fully covered during transportation to the construction site by road.
- Standards prescribed by the CPCB/ West Bengal Pollution Control Board (WBPCB) for stack height and emissions from DG sets will be complied.

- Preventive maintenance will be carried out for vehicles and pollution check (PUC certified) will be mandatory on periodic basis for all the vehicles approaching to the construction site.
- Earth moving equipment, typically a bulldozer with a grader blade and ripper will be used for excavation work.
- Ensuring the use of PPE at the construction site.
- Use acoustic enclosures or soundproof materials to attenuate the noise produced by the generator.

Operation Phase

During the operational phase of Bagdogra International Airport after proposed development, the intermittent air emissions will be generated from aircraft engines during approach, landing, taxing, take-off and initial climb, which is termed as reference Landing and Take-off Cycle (LTO cycle). The air pollutants of concern from the aircrafts emissions are un-burnt Sulphur Dioxide, Hydrocarbons (HC), Carbon Monoxide (CO) and Oxides of Nitrogen (NOx) as per ICAO guidelines. Exhaust emissions from DG sets will be intermittent source of emissions as DG sets will be operated only during grid power failure.

The maximum incremental GLCs due to the proposed expansion project has been calculated due to Aircraft, GSE, APU's & Vehicular traffic.

The predicted incremental GLC's when superimposed over the Baseline concentration, the resultant concentration is well within the NAAQS limits.

However, Bagdogra International Airport will be moving ahead to achieve Carbon Neutrality in short period of time.

The following methods of abatement of pollution will be employed for the air pollution control at the source level during operation phase of Bagdogra International Airport after proposed development:

- Compliance of all standards prescribed by the ICAO during operation of aircrafts by preventive maintenance and monitoring.
- Proper traffic management plan will be prepared to ensure that there is no traffic congestion in front of new integrated terminal building. It will help in reduction of vehicular emissions from the airport.
- Ground vehicles at the airport will be maintained and have a "Pollution under Control" certificate.
- Development of greenery and landscaping at the airport for improving ambient air quality.
- Monitoring of ambient air quality/ source emissions will be carried out as per monitoring plan.
- AAI aspire to achieve leadership position in the Airport Carbon International's (ACI) Accreditation Program.
- AAI will implement carbon neutralization mechanism by following measures, there ensuring 100% renewable energy sources.

- ✓ Conversion of conventional airport owned vehicles to EVs
- ✓ Transition to lower GWP refrigerants.
- ✓ Transition to non-CO2 type fire extinguishers

10.5.2 NOISE & VIBRATION MANAGEMENT PLAN

Construction Phase

During the construction phase, noise will be generated through the operation of construction machines, excavators and DG sets. The following measures will be taken into consideration to mitigate the noise at the construction site:

- Provision of rubber padding/ noise isolators to DG sets and construction machines.
- Preventive maintenance of the machine/ equipment will be carried out.
- Provision of silencers to modulate the noise generated by machines.
- All construction equipment used for an 8-hour shift will conform to a standard of less than 75dB (A).
- Machinery and vehicles will be maintained regularly, with particular attention to silencers and mufflers to keep construction noise levels minimum.
- Workers in the vicinity of high noise levels shall wear earplugs, helmets and be engaged in diversified activities to prevent prolonged exposure to noise levels of more than 90 dB(A) per 8-hour shift.
- Monitoring of ambient noise level/ source emission will be carried out as per details given in Chapter 6 or as stipulated by the CPCB/ WBPCB.

Operation Phase

During the operational phase of Bagdogra International Airport after proposed development, the major noise generating sources like Air Craft traffic, passenger cars, DG sets, etc., are considered and the maximum incremental noise due to the proposed expansion project has been calculated. It was observed that the noise levels at the airport boundary will vary up to 64.4 dB (A). From the noise modelling, it can be stated that the impact on the present noise levels due to proposed airport operations of DG set and GSE movement will be restricted to the work zone environment only.

AAI as part of noise management will follow the International Civil Aviation Organization (ICAO) a four-point "balanced approach" that includes:

Reduction of noise at source:

The new and latest aircrafts which are designed with minimum source noise levels shall be allowed at the airports.

Land-use-planning:

Proper land use planning with super-imposition of probable noise contours which will help to reduce the noise induced health impacts.

Noise abatement operational procedures:

- Strict adherence to DGCA/ICAO prescribed environmental guidelines & circulars on airport operations.
- Vehicles Movements- Speed limits on all access roads and tracks to be adhered to.
- Screens, enclosures, barriers, exhaust silencers/ mufflers for vehicles are to be installed for noise control.
- Terminal Buildings will be made sound proof.
- Restricted usage of ground engine run-ups to reduce noise.
- Restricted use of thrust reversal while landing of aircraft to minimize noise in lateral direction as depicted in fig below.
- Aircrafts with certified engines only shall be allowed to land and take-off to the extent possible to reduce the noise impacts on the surroundings.
- Dual nozzle in the aircraft will reduce the noise levels.
- Proper scheduling of the aircrafts to minimize the noise levels.
- Switching off as many engines as possible during idling and taxing.
- DG sets with acoustic enclosures.
- Proper maintenance of ground servicing equipment & will provide PPE (ear protecting devices) for ground workers.
- There will be rotational shift for the workers.

10.5.3 WATER RESOURCE AND QUALITY MANAGEMENT

Construction Phase

The following mitigation measures will be adopted to avoid impacts on water quality during construction phase:

- Efforts will be made to conserve the water; by the efficient usage and work should be planned to minimize generation of wastewater on the site.
- STP at construction camps/ sites and the proposed facilities shall be properly designed to handle peak wastewater load and properly maintained.
- Record of water consumption on a daily basis will be maintained.
- Control of spillage of fuel oil and storage of oil barrels on cemented floor, to prevent impact on ground water quality.
- Storm water must be diverted from the work areas to prevent sedimentation and pollution and disposed off as per laws.
- Reuse of treated wastewater for greenery and landscaping.

Operation Phase

The following measures will be taken to protect water quality at the Bagdogra International Airport during operation phase:

- Sewage generated will be collected and sent to sewage treatment plant for proper treatment and disposal.
- Use of treated water for non-potable purposes like flushing, HVAC and for landscaping purposes.
- Achieving Zero Discharge concept by reusing the treated water within the project premises (airport).
- Water Conserving Fixtures will be fitted to all taps and other facilities to minimize the usage of water and generation of wastewater from the sources.
- Waterless or water free urinals will be installed at the premises for the reduction of usage of water.
- Open Rainwater Harvestings pits are proposed to harness and manage storm water runoff, thereby reducing the load of external outfall drains.
- Silt ponds are proposed near every outfall location to prevent the silt getting into the receiving water bodies.
- During monsoon period, regular aquatic monitoring will be carried out to ascertain that there is no impact on surface water bodies.
- The existing drainage design of Bagdogra International Airport will be integrated with the proposed drainage master plan in order to reduce the impact of flooding.
- Regular testing and analysis of treated waste water from STP to ensure effectiveness of STP and compliance of discharge standards.

10.5.4 SOIL QUALITY MANAGEMENT PLAN

Construction Phase

During the construction phase of proposed development of Bagdogra International Airport, the following measures shall be adopted to minimize adverse impacts in soil.

- To prevent the soil contamination through the leakage or spillage of fuel oil, oil containers will be stored and handled carefully on cement lined floor.
- The top soil from all areas to be permanently covered will be stripped to a specified depth of 100 mm and stored in early earmarked area as stockpiles, and this can be used for the greenbelt development plan or covering all the disturbed areas within the project area.
- Sediment retention structures will be placed downslope of the stockpiles.
- Separate temporary raw material handling yard will be provided in this project and it would be separated by enclosures. Cement will be separately stored in sheds. Sand and aggregate will be stacked neatly.
- Excavation must be carried out in a way which keeps topsoil and underlying soils separate to prevent the potential contamination of subsoil.
- All metal, paper, plastic wastes, debris and cuttings shall be collected from the site as soon as particular construction activity is over.

Operation Phase

The following measures shall be adopted to minimize adverse impacts in soil, during operation phase.

- Fuel, Waste oil from Aircrafts, machineries, DG sets and aircraft maintenance area shall be stored in HDPE containers and stored in isolated paved areas. These paved surfaces will be provided with the drains and oil interceptors installed in the drains. It shall be sold to authorized vendors on regular basis.
- Aircraft fuel will be stored in separate isolated area with paved area to prevent contamination of soil due to spillage. Drains shall be provided in and around the storage yards and drains will be fitted with oil interceptors.
- No left-over construction debris or material should be stored at site.
- Maintain natural drainage pattern, vegetation buffer zones to protect water bodies.
- Limiting sediment movement using silt fences and straw bales or using settling ponds before discharging
- Timber yielding trees will be prioritized for transplantation and landscaped for stabilization of the top soil.

10.5.5 SOLID WASTE MANAGEMENT PLAN

Construction Phase

During the construction phase, following measures shall be taken for solid waste management:

- Collection & segregation of solid waste generated from the labour camps and construction site by adhering strictly to 5 R's waste hierarchy principles like Refuse, Reduce, Reuse, Repurpose and Recycle and the sequence priority is as depicted in below figure 10.1.

Figure 10.1: Sequence priority of 5 R's principle

- Construction and Demolition waste will be managed inline to C&D waste rules, 2016.
- All metal, wooden, paper, plastic wastes, debris and metal cuttings shall be collected from site as soon as particular construction activity is over and disposed in suitable manner.
- Municipal waste generated will be collected and disposed in environmentally sound manner.

Operation Phase

The following mitigation measures will be taken for management of solid waste during operation phase of Bagdogra International Airport after proposed development.

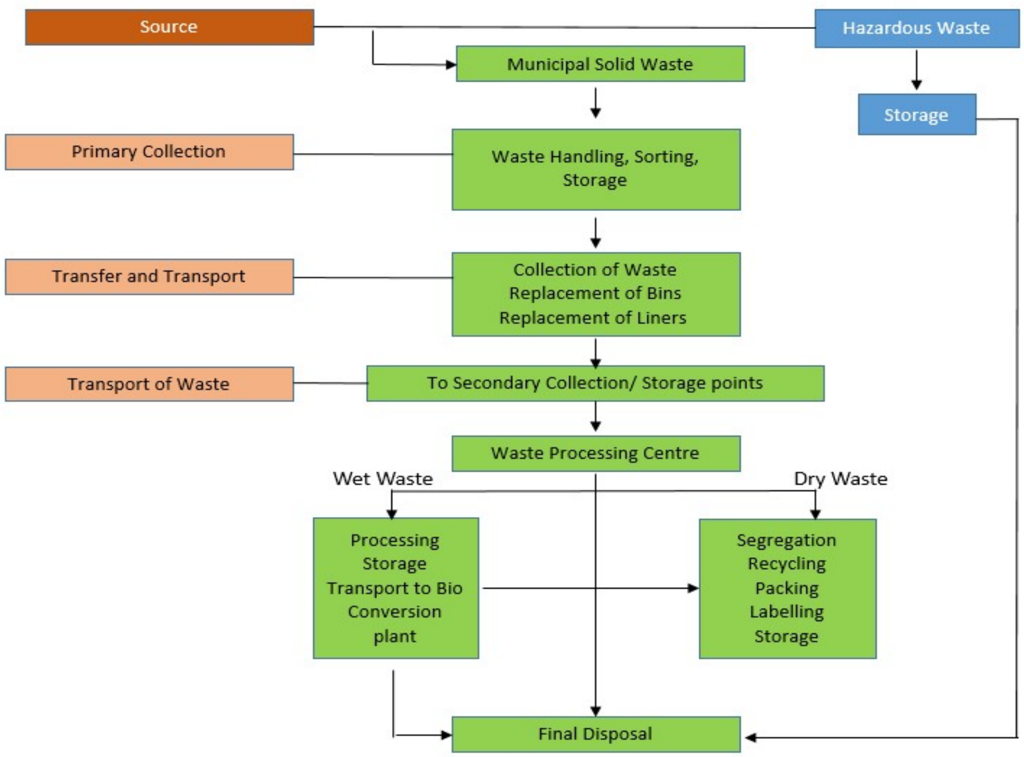


Figure 10.2: Waste Management Handling Plan

- Solid wastes management at Bagdogra International Airport after proposed development will be carried out as per Solid Wastes Management Rules, 2016.
- Solid wastes will be collected in designated waste bins based on their types, placed at the strategic locations in the airport.
- By the prioritisation of waste hierarchy, reduction in the waste disposal to landfill, promotion of sustainable management of resources, optimisation of the use of sustainable materials and reduction in contamination by reuse or recycle etc. can be implemented at the project site.
- Minimise the waste production by refusing to use materials such as single use plastics and non-recyclable.

- Different types of waste encountered at airport during the operation phase are
  1. Municipal Solid Waste (MSW)
  2. Construction and Demolition waste (C&D)
  3. Green Waste
  4. Food Waste
  5. Waste from aircraft flights
  6. Lavatory waste
  7. Spill clean-up and remediation waste
  8. Hazardous materials
- Municipal Solid Waste collection bins will be placed at strategic locations in the new integrated terminal building.
- C&D waste is any non-hazardous solid waste from land clearing, excavation, and/or the construction, renovation or repair of structures, roads and utilities. C&D waste commonly includes concrete, wood, metals, drywall, carpet, plastic, pipe, land clearing debris, cardboard.
- Green Waste is categorized as MSW and is also referred to as yard waste. Green waste consists of tree, shrub and grass clippings, leaves, weeds, small branches, seeds, pods and similar debris generated by landscape maintenance activities.
- Deplaned Waste or waste from aircraft flights is a specific type of MSW that is removed from passenger aircraft. These materials include bottles and cans, newspaper and mixed paper, plastic cups and service ware, food waste, food soiled paper, and paper towels.
- Lavatory Waste falls under the category of special waste and is generated when the lavatory tanks of the airplanes are emptied via hose and pumped into a lavatory service vehicle, Recycling, Reuse and Waste Reduction at Airports.
- Spill cleanup and remediation wastes are another type of special waste. These materials are generated during cleanup of spills and/or the remediation of contamination from various types of sites on an airport (e.g. storage tanks, vehicular leaks, spills from maintenance activities, etc.).
- All the hazardous waste (oils, solvents and other chemical waste from activities such as aircraft and ground vehicle washing and cleaning, fuelling operations, aircraft maintenance and repair including painting and metalwork)will be disposed as per the Hazardous waste (Handling and disposal) Rules, 2016 and amendments thereof. Spill kits and fire prevention equipment will be made available and trained personnel will be deployed for the handling of hazardous waste materials.
  - ✓ Waste Audit can be done at the project site for the implementation of Solid Waste Management Plan.
  - ✓ Decentralized waste management system will be in place for the all kind of solid waste generating at the project site.

- ✓ All the Organic waste can be composted for use as fertilizer or soil improvement.
- ✓ Disposal of recyclable waste for recycling.
- ✓ Disposal of segregated waste to landfill.

Approx. 5.12 tonnes/day solid waste will be generated from Bagdogra International Airport after proposed development. The waste generated in the airport is segregated at source in the bins having compartment for biodegradable and non-biodegradable waste. The segregated waste is transported to the temporary storage area.

The waste is stored temporarily at site in the designated storage area with demarcated compartments for biodegradable & non-biodegradable. Biodegradable waste will be composted in Organic Waste Converter. The Non-biodegradable solid wastes will be supplied to the authorized recyclers. Organic Waste Converter (OWC) is a composting machine that converts wet organic waste into Odour-free, nutrient–rich compost. The end product is organic manure which can be used instead of chemical fertilizer to gardening.

10.5.6 Vehicle Parking and Traffic Management

During the pre-development and development phase of the project, the major traffic is due to the transportation of excavated rocks/debris from the hill cutting, construction raw materials and construction debris. However, there are no major residential areas near the immediate vicinity of the project site. A construction vehicle traffic circulation and management plan has been conceived for safe movement of transportation vehicles. Following measures are adopted on project site for traffic management:

- Movement of the construction vehicles shall be in accordance with the transport circulation and management plan of Bagdogra International Airport.
- Moderate vehicle speeds maintained to avoid any nuisance to the nearby residents.
- Proper barricade and signage made along the transportation route to avoid any accidents.
- Adequate parking facility will be provided.
- Adequate washing facility provided for vehicles within the project site.
- Periodical maintenance of vehicles carried out so that source noise levels are under control.
- All the vehicles to be environmentally compliant with PUC certificates.
- Sensored parking system(In-ground sensors/Surface mount sensors) shall be implemented which can allow real-time parking information to be viewed on multiple devices and allow for easy parking, space availabity and no congestion nuisance at parking space.

Presently only surface parking is available. After increase of passenger flow MLCP is proposed for an area of 2.08 Ha. For the master plan, a multi-level car parking (MLCP) of 1010 parking spaces is planned.

10.5.7 Measures to Encourage Reduction in Carbon Foot Print

At Airport Authority of India (AAI), we recognize the significance of conserving energy and reducing emissions for ensuring sustainable business operations. In our overall emission footprint, around 75% of emissions is Scope 3 (Indirect emissions), around 24 to 25% is Scope 2 (Indirect GHG emissions due to purchased grid electricity) and less than 1% is Scope 1 (Direct GHG emissions). Since, Scope 1 and 2 emissions are directly under our operational control, therefore, we will make immediate efforts to reduce it to the maximum extent.

The Scope 1 emissions at airport primarily include emissions from airport owned/outsourced vehicles, refrigerants, fire extinguishers, and through diesel generators for ensuring back-up electricity, while the Scope 2 emission is due to grid-based electricity.

The Scope 3 emissions include emissions due to stakeholders' vehicles and electricity consumption, aircraft landing and take-off emissions, aircraft engine testing, staff business travel, employee and passengers commuting, offsite emissions due to waste disposal and treatment, etc

We are committed towards enhancing energy efficiency and absolute GHG emission reduction through various interventions and collaborative efforts with our stakeholders. Also, we aspire to achieve leadership position in the Airport Carbon International's (ACI) Airport Carbon Accreditation (ACA) Program. In this regard, we have defined systems for developing annual emission inventory (greenhouse gas emissions) in line with ISO 14064 and ACA Level 4+ requirement, which is the highest-level accreditation. The ACA Program is the only institutionally endorsed, global carbon management certification programme for airports. Based on our baseline emissions and future projections, we have developed a detailed roadmap for achieving carbon neutrality and net zero status in accordance with ACA guidelines.

As per ACA Program, Level 3+ i.e., neutrality is achieved by reducing scope 1 and 2 emissions and offsetting residual Scope 1 and 2 carbon emissions as well as emissions from staff business travel, using internationally recognized offsets. However, the net zero concept requires emission reductions to a greater degree than carbon neutrality – ideally down to zero. However, it does allow for removal of any residual emissions from the atmosphere e.g., relying on natural processes (carbon sinks such as forests) or dedicated technologies (carbon capture & storage). Key emission reduction measures and target completion timelines for each category of emissions are mentioned below:

Table 10.1: Scope 1 emissions reduction measures

Emission sources	Reduction measures	Target actions
Fuel emissions from airport owned/ outsourced vehicles	Transition to Electric Vehicles (EVs) and explore Green Hydrogen/ lower power consuming technology	✓ Replace conventional vehicles to EVs in FY 26 and 27 (except fire tenders and ambulances) ✓ Procurement of additional EVs, if required in FY 27 ✓ Explore feasibility of using Green Hydrogen powered vehicles/equipment to replace high power consuming vehicles/equipment ✓ Purchase Certified Emission Reductions (CERs) for residual emissions from FY 26 onwards.

Emission sources	Reduction measures	Target actions
Fuel emissions from airport owned/outsourced vehicles	Installation of Electric Vehicle Charging Station (EVCS)	✓ Install one EVCS at the city side ✓ Depending upon the requirement, install additional EVCS both in airside and city side in future
Refrigerant emissions from Air Conditioners (ACs) and chillers	Conversion of high Global Warming Potential (GWP) refrigerants to a lower GWP refrigerants	✓ Since FY 23, initiated phase-wise replacement of ACs having R22 refrigerants (HCFC-22) with R32 refrigerant (HFC-32), which has zero Ozone Depletion Potential (ODP) and has 61.5% less GWP as compared to R22 and same will be completed by FY 26. ✓ Other higher GWP refrigerants will be replaced in subsequent years depending upon the availability of business viable alternatives.
Emissions due to CO2-type Fire Extinguishers	Conversion of CO2 based fire extinguishers to non-CO2 type fire extinguishers	✓ The replacement of existing CO2 based fire extinguishers to non-CO2 type fire extinguishers to the maximum extent possible has been completed during FY 23. ✓ Purchase CERs for residual emissions due to top-up of remaining CO2-type Fire Extinguishers from FY 26 onwards.
Emissions due to operating diesel generators	Explore transition to battery storage alternate technology	✓ Explore battery storage options as a part of long-term strategy to replace diesel generators, which is subject to availability of business viable alternate technology that can have potential to meet airport specific electricity back-up requirements ✓ Purchase CERs for residual emissions from FY 24 onwards.

Table 10.2: Scope 2 emissions reduction measures

Emission sources	Reduction measures	Target actions
GRID electricity consumption	Transition to green electricity	✓ Procure green electricity from FY 26 onwards.
	On-site renewable energy generation	✓ Install on-site solar plant (rooftop) in future.
	Green Building certification	✓ Obtain IGBC Green Building Certification for new terminal to minimize the energy requirement and enhance sustainable consumption of resources.
	Improve energy efficiency in existing terminals	✓ Replace conventional lights with energy efficient lighting ✓ Conduct energy audit in FY 26 to identify potential opportunities to optimize operational efficiency of electrical installations and to conserve electricity.

Table 10.3: Scope 3 emissions reduction measures

Emission sources	Reduction measures	Target actions
Fuel emissions from stakeholders' conventional vehicles, Ground Support Equipment (GSE) and Ground Support Vehicles (GSV)	Transition to EVs, e-GSEs and e-GSVs	✓ Develop stakeholder partnership plan to engage stakeholders for encouraging them to make transition towards electric vehicles, electric GSEs and electric GSVs ✓ Provide EVCS both on airside and city side. ✓ Explore feasibility of introducing aircraft push-back technology to replace high power consuming equipment
Electricity consumption by stakeholder	Transition to green electricity	✓ Encourage stakeholders to adopt green electricity ✓ Provide green electricity to our stakeholders operating at our terminals from FY 26 onwards ✓ Encourage stakeholders operating outside airports' premises to install roof top solar plant and procure green electricity either via green tariff, or Power Purchase Agreement (PPA) or via purchasing Renewable Energy Certificates (RECs).
Emissions due to aircraft's Auxiliary Power Unit (APU)	Installation of Bridge Mounted Equipment (BMEs) and Preconditioned Air (PCA) supply systems at Passengers Boarding Bridges (PBBs)	✓ Install BMEs and PCA systems at PBBs to reduce the usage of APUs while aircraft are on ground ✓ Encourage stakeholders to have electric GSE for aircraft those have parking slots away from PBBs.
Emissions due to staff business travel	Encourage virtual meetings	✓ Encourage virtual meetings for minimizing the business travel ✓ Purchase CERs to offset emissions due to essential business travel from FY 26 onwards.
Emissions due to aircraft landing and takeoff	Use of Sustainable Aviation Fuel (SAF) by airlines	✓ Encourage airlines to adopt SAF, which has significantly less lifetime emissions as compared to conventional jet fuel/aircraft turbine fuel ✓ Support the transition to SAF by providing required infrastructure.
Emissions due to commuting to and from airport	Encourage stakeholders to transition to electric vehicle	✓ Encourage stakeholders to adopt electric vehicles usage ✓ Provide EVCS to support transition to EVs.

Bagdogra International Airport's commitment towards achieving carbon neutrality and net-zero status

Carbon Neutrality – We will be purchasing Certified Emission Reductions/Carbon Credits from FY 26 onwards for offsetting residual scope 1 and scope 2, and part of Scope 3 - staff business travel-related emissions to achieve carbon neutrality.

Net-Zero Status – We will implement carbon neutralization mechanism via carbon removal technologies to remove residual emissions for achieving net zero status in the long-term in accordance with Airport Carbon Accreditation program's requirements. We are working towards developing carbon management plan for reducing absolute emissions in line with IPCC 1.5-degree Celsius pathway for achieving net zero status.

These interventions will assist us in reducing our environmental footprint, which is essential for ensuring sustainable operations and for making a positive impact

10.5.8 GREEN BELT DEVELOPMENT PLAN

As part of environmental sustainability measures to develop Bagdogra International Airport as a green airport, statutory requirements of tree transplantation/ plantation and to create natural ambience befitting a landmark international airport, several green areas shall be developed within airport site. A holistic Green Plan/ Landscape Master Plan is being prepared in this regard, inclusive of elements like afforestation, tree transplantation, green turf, ponds/water bodies with fountains, etc. Due care will be taken to avoid attracting birds due to proposed tree transplantation & landscape development.

Green belt and landscaping plan for Bagdogra International Airport is given in Figure 10-7.

Only indigenous trees will be planted as a part of green belt/plantation. Existing trees inventory is given in Table 10.4. Based on ecology studies, important indigenous trees species for green belt/plantation are as given in Table 10.5.

Table 10.4: The List of Existing Trees

S.No.	Botanical Name	Common Name
1.	*Albizia lebbeck*	Sirish
2.	*Terminalia arjuna*	Arjun
3.	Senna siamea	Minjiri
4.	*Alstonia scholaris*	Chatim
5.	*Delonix regia*	Gulmohar
6.	*Ficus racemosa*	Dumar

Table 10.5: The List of Proposed Trees

S. No.	Botanical Name of Shrubs (Multi branch and Good Foliage)
1	*Michelia champaca*
2	*Spathodea campanulata*
3	*acrocarpus fraxinifolius*
4	*Tabebuia chrysantha*
5	*chorisia speciosa*
6	*Wrightia tomentosa*
7	*Albizia Lebbeck*
8	*Azadirachta indica*
9	*Terminalia mantaly*
10	*Pongamia pinnata*
11	*Magnolia grandiflora*
12	*Phoenix sylvestris*

S. No.	Botanical Name of Shrubs (Multi branch and Good Foliage)
13	*Washingtonia robusta*
14	*Conocarpus*
15	*Grevillea robusta*
16	*Bauhinia purpurea*
17	*Jacaranda mimosifolia*
18	*Cassia fistula*
19	*Lagerstroemia indica*
20	*Plumeria rubra*
21	*Spathodea campanulata*
22	*Saraca indica*
23	*Plumeria alba*
24	*Peltophorum pterocarpum*
25	*Nerium oleander*
26	*Butea monosperma*
27	*Tecoma gaudichaudi*

The proposed green spaces shall be developed as per their contextual and functional requirements and overall environmental and landscape planning approach. The proposed Green Space & Landscape development is planned considering key airport related constraints, such as

1. Bird Menace: Trees and shrubs attract insects and birds, which are potential threat to aircraft operations within and around airport. This requires careful selection of trees to be planted on airport premise, as a part of Airport safety measures. The proposed Green Space & Landscape development is planned considering this.
2. Height Restrictions: Development of green areas and planting of trees including their types (height at maturity) is guided by height restrictions imposed by Airport Authority of India. Hence, any type of dense vegetation's with very high trees cannot be developed in vicinity of airport. The proposed Green Space & Landscape development is planned considering this.
3. Restrictions in Operational Area: As part of airport operational requirements, major land area is defined as Airside or Operational Area where in regular movement of flight movement demands clear and safe area, without any form of vegetation except grass, which may affect the flight operations due to birds attracted by vegetation. The proposed Green Space & Landscape development is planned considering this.

   Key objective of proposed Green Space & Landscape development of Bagdogra International Airport is to create a unique, world class green environment for Bagdogra International Airport, drawing inspiration from local landscape ensuring sustainability, and offering a memorable experience for passengers, staff and visitors alike. Creation of a strong green identity for Bagdogra International Airport is one of the guiding principles and this approach is reflected in a powerful synergy in landscape by integrating vegetation cover and water bodies in perfect harmony in landside area of Bagdogra International Airport.

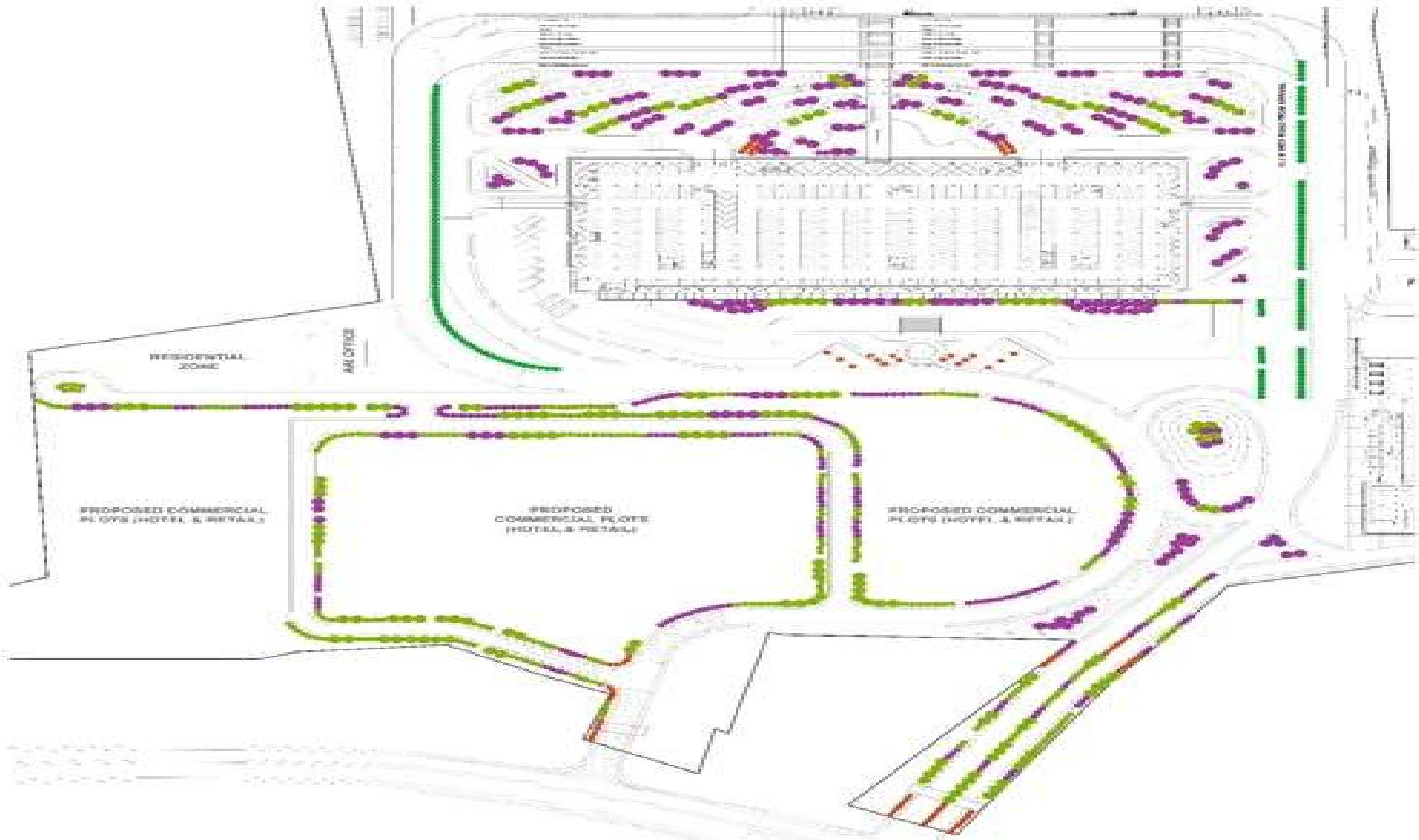


Figure 10.3: Green Belt and Landscape Plan for Bagdogra International Airport

10.5.9 DEMOGRAPHIC AND SOCIO-ECONOMIC ENVIRONMENT MANAGEMENT PLAN

- During the construction phase of the proposed development of Bagdogra International Airport, about 2000 skilled, semiskilled and unskilled workers will get direct and indirect employment opportunities, which will have beneficial impact on the socio-economic conditions of the area. The following suggestions are given below to strengthen the beneficial impacts:
- Preference will be given to locals for direct and indirect employment opportunity.
- Local suppliers for machineries and construction materials will be given preference.
- Local transporters will be preferred for transportation of machinery/earth/materials.
- To train unskilled local work, short-term skill development course will be organized in the area.
- All the applicable guidelines under relevant acts and rules related to labour welfare and safety shall be implemented during the construction work activities.
- Proper sanitary and drinking water facilities will be provided to workers living in the construction camps within the premises of the BAGDOGRA INTERNATIONAL AIRPORT.
- Helmets will be provided to the workers engaged in the construction activities.
- Safety belts will be provided to the workers engaged in the construction activities at heights.

10.5.9.1 ENSURING SAFETY OF LOCAL COMMUNITIES

- Since the project involves the movement of heavy vehicles and machinery in the area, the issue of public safety of the villagers, especially children, is an important concern.
- During the operational phase after commissioning and for the rest of the project activities proper safety measures will be undertaken both for transportation as well as the other operations.
- The movement of traffic is also likely to disrupt access conditions of the inhabitants residing close to the access road. The increase in traffic will have implications on their safety too, as well as create congestion, potential delays and inconvenience for pedestrians.
- The mitigative measures in this regard have been discussed in detail under the Road Safety & Traffic Management Plan.

10.5.9.2 CORPORATE ENVIRONMENTAL RESPONSIBILITY (CER)

- AAI proposed to allocate INR 3.87 Crores towards Corporate Environmental Responsibility (CER) within the study area for a period of 5 years (2024-2029) as per Office Memorandum of MoEF&CC vide F. No. 22-65/2017.IA.III dated 30.09.2020.

CER Summary	Value (Crore INR)
Total Project cost (Crores INR)	1549
Total CER Cost (5 years) (Crores INR) (0.25%)	3.87
Average CER cost per Year (Crores INR)	0.77

Source: AAI

10.5.10 HABITAT MANAGEMENT

AAI has incorporated Habitat Management Plan in Airside as one among Environmental Management Plan.

The purpose of this study is to describe Standard Operating Procedure for Habitat Management at Airside including grass cutting and turf management and vegetation at runway, taxiway green area, the edges and shoulder areas, track, footpath, drain, between footpath slabs, in spaces of perforated slabs, besides roadside and airfield lighting installations and signage structures, cutting of earth-scrappers, weeding of grass from footpaths, clearing grass/bushes around signage's, clearing of cut grass, weeds and debris from movement area.

Roles and Responsibility:

- E&M team (Civil) shall ensure that the sufficient manpower along with the required machinery (tractors or handheld machines, grass collection machine or trawler) shall be made available on everyday basis.
- E&M team will ensure that the operators of the grass cutting machines are fully trained to utilize the machines/ equipment and hold valid with ADP, wherever applicable.
- Before deployment in Airside, E&M team shall coordinate with Safety Team for conducting the Airside Safety training of the manpower.
- A schedule of grass cutting, and other related activities will be prepared by E&M team (Civil) and disseminated to all Head- Airside Operatore (ASO), AOCC, Apron Control and WHM team.
- The manpower and machinery will report at Apron Control. E&M team will ensure that the operators shall inspect and ensure that all the machinery are fully serviceable and proper h/o and t/o was recorded.
- The Executive Airside Operations shall inform WHM team about the location where the grass cutting activities are being carried out, to monitor and if require enhance bird scaring activities to control bird movement.
- All the grass, bushes, mud or any other material shall be removed from the site and safely disposed-off. Burning of grass is not allowed.
- While carrying grass cutting activities, if any incident occurred or any machinery gets unserviceable or there is some obstruction to the safe movement of the aircraft, same shall be informed to Apron Control or AOCC or ATC and necessary action shall be initiated.

10.5.11 WILDLIFE HAZARD MANAGEMENT

Wildlife associated with safety issues at airports include birds, mammals and reptiles and therefore Bagdogra International Airport has also incorporated Wildlife Hazard Management plan for the Airport.

The 3 primary attractants/needs for wildlife at airport are:

1. Food: Many hazardous birds visit airports to feed on turf grasses planted alongside runways and taxiways, feed on insects in airport grasslands, as well as earthworms that come to the

surface following heavy rain. Raptors (e.g., hawks and owls) use airport grasslands and weedy areas to hunt for voles and other small mammals. Seeds and fruits produced by airport landscaping plants and naturally-occurring trees and shrubs can attract many types of birds.

2. Water: Surface water, including natural water bodies, poorly drained areas, aquaculture facilities, and exposed storm water detention/retention facilities often attract the birds to come over airport area.
3. Cover/Shelter: It is integral to sustained wildlife use of an area and is important to many behaviours of animals like roosting, nesting, denning, hiding or escape and foraging.

10.5.11.1 Proactive Measures to Prevent Presence of Wildlife on Airside

- The total boundary wall including the security gates are constructed in such a way that dogs cannot enter, as far as practicable gain access into the airside. All drains where dog might get access are covered with steel barricades.
- WHM officer conduct a boundary wall patrol; drain checks each morning and on regular basis for checking of breaches done on wall or in the drains.
- All sections of the wall and drains where dogs might be able to gain access to the airside are reported to E&M team for immediate action for rectifying the same.
- E&M department shall repair the fence and drain or modify from where access gained by the wildlife can be blocked.

10.5.11.2 Control at Airport Access Security Gates

- Airport security group (CISF) at all the entry gates have been briefed and made aware to be more vigilant so that dogs or other wildlife do not enter the operational area through the operating gates.
- CISF has been requested to inform airside operations / wildlife department whenever dog or any other wildlife presence is observed in operational area.
- Removal and prevention of any food source for dogs/wildlife on airside
- In ramp safety meetings all airlines and their appointed in- flight catering and cleaning agencies are informed to ensure that no food to be thrown in airside.
- Regular cleaning of operational areas and removing of garbage bins in close compactor by hired garbage contractor.
- All disposal containers are wildlife proof and eliminate open dumps inside airport.

10.5.11.3 Airport Bird Strike Control Programme

AAI has wildlife management plans, which often incorporate several conventional bird control programs for inside and outside airport.

A. Inside Airport

- Bird activity logging as well as monitoring and Scaring of birds
- Removing/minimizing the nesting and roosting areas.

- Cleaning of drains and reducing the amount of water lying on the airport grounds.
- Maintaining the grass at a length up to recommended length or whichever is suitable for the airfield topography to deter bird presence.
- Minimizing available food/water at operational areas.
- Harassing birds by using firecracker, six shot guns.
- Appropriate management of garbage, waste, and trash at the Airport,
- Periodic rodent and pest control at operational areas.
- Measures to prevent roosting and removing nest from pylon light, windsocks and other structures.

B. Outside Airport

- Joint inspections along with local authorities be conducted every month of wards up to 10 km of radius from ARP of AAI. Conducting periodical meetings with local Municipal officials of all wards adjacent.
- Educating Butcher shop owner for proper disposing of waste in coordination with Municipality officials.

10.5.11.4 DISSEMINATION OF BIRDS

A. Defence Systems

- Firecrackers by bird Scarers alongside of runway.
- Bird scaring pistol (Exploding and Whistling Sound)
- Vehicle mounted Scarecrow.
- Zone guns placed along the runway.
- Pesticides spraying done behind grass cutting.

B. Use of Barriers

- Covering open drain near to Runway, Taxiway and Apron with suitable nylon net to avoid bird attraction.
- Removing vegetation from drain if any in continues process.
- The fitting of anti-perching spikes on all airside structures, such as sign ages, aerobridges, and lights.

C. Use of Chemicals

- Insecticides are used to kill off insects after grass cutting and during pre & post monsoon operations.
- No lethal chemicals will be used for any direct poisoning of any birds or any wildlife.

Airport Authority of India (AAI) will be responsible for the implementation of mitigation measures suggested in EMP for construction and operation phases for Bagdogra International Airport after proposed development. Environmental Management Plan for Bagdogra International Airport after proposed development is presented in Table 10.6.

Table 10.6: Summary of Environment Management Plan

Sl.No	Environmental Aspect/Issue	Management Measures	Responsibility	
			Construction Agency	Supervision/ Monitoring
Construction Stage				
	Activities to be carried out by the Contractor.			
C.1	Site Clearance			
C.1.1	Filling by Earth	Bagdogra International Airport is level plain; therefore, no major cutting and filling is required for proposed development. Excavated earth for generated, shall be used at Bagdogra International Airport for filling and levelling. Additional earth, required will be procured from approved quarry. Simultaneous to filling compaction and water sprinkling will be carried to suppress dust emissions.	Contractor	Environmental expert/Qualified person
C.1.3	Construction Wastes Disposal	The pre-identified disposal locations will be a part of comprehensive waste disposal and solid waste management plan to be prepared by the Contractor in consultation AAI. Construction and demolition wastes generated from the project will be collected and disposed as per the provision of Construction and Demolition wastes Rules 2016. Inert and unusable waste will used for filling or disposed to landfill site. Recyclable and reusable construction and demolition wastes will have resale values and sold to scrap dealers. Contractor will ensure that any spoils of material unsuitable for fill will not be disposed near any water course, agricultural land, and natural habitat like grass lands or pastures. All waste materials will be completely disposed and the site will be fully cleaned and certified by Environmental Expert of AAI.	Contractor	Environmental expert/Qualified person
C.1.4	Stripping, stocking and preservation of top soil	The top soil from all areas to be permanently covered will be stripped to a specified depth of 150 mm and stored in stockpiles. A portion of the area at the airport will be earmarked for storing topsoil. The locations for stock piling will be pre-identified in consultation and	Contractor	Environmental expert/Qualified person

		with approval of Environmental Expert of AAI. The following precautionary measures will be taken to preserve them till they are used: (a) Stockpile will be designed such that the slope does not exceed 1:2 (vertical to horizontal), and height of the pile is restricted to 2 m. To retain soil and to allow percolation of water, the edges of the pile will be protected by silt fencing. (b) Stockpiles will not be surcharged or otherwise loaded and multiple handling will be kept to a minimum to ensure that no compaction will occur. The stockpiles shall be covered with gunny bags or vegetation. (c) It will be ensured by the contractor that the top soil will not be unnecessarily trafficked either before stripping or when in stockpiles. Such stockpiled topsoil will be utilized for covering all disturbed areas including borrow areas top dressing or filling up of plantation /landscaping area, construction of internal roads and pavements.		
C.1.5	Accessibility	The contractor will take care that vehicles brining man and materials approaching to the site is not disturbing local road and public access.	Contractor	Environmental expert/Qualified person
C.2	Procurement of Construction Materials			
C.2.1	Earth for Construction Filling	During dry seasons frequency of water sprinkling will be increased in the settlement areas and Environmental Expert of AAI will decide the numbers of sprinkling depending on the local requirements. Contractor will rehabilitate the borrow areas as soon as borrowing is over from a particular borrow area in accordance with the Guidelines for Redevelopment of Borrow Areas.	Contractor	Environmental expert/Qualified person
C.2.2	Quarry Operations	The contractor shall procure materials from approved quarries if applicable.	Contractor	Environmental expert/Qualified person
C.2.3	Transporting Construction Materials and Haul Road Management	Contractor will maintain all roads, which are used for transporting construction materials, equipment and machineries as précised. All	Contractor	Environmental expert/Qualified person

		vehicles delivering fine materials to the site will be covered to avoid spillage of materials. All existing roads used by vehicles of the contractor or any of his sub-contractor or suppliers of materials, will be kept clear of all dust/mud or other extraneous materials dropped by such vehicles. Contractor will arrange for regular water sprinkling as necessary for dust suppression of all such surfaces. The unloading of materials at construction site in/close to settlements will be restricted to daytime only.		
C.2.4	Construction Water	The contractor will source the requirement of water preferentially from State Government/Bore wells or from tankers. A copy of the permission will be submitted to AAI prior to initiation of construction. The contractor will take all precaution to minimize the wastage of water in the construction phase of the airport.	Contractor	Environmental expert/Qualified person
C.3	Construction Work			
C.3.1	Drainage and Flood Control	Contractor will ensure that no construction materials like earth, stone, or appendage disposed so as not to block the flow of water in natural and cross drainage channels. There is provision of construction of culvert over the natural drain passing through alignment of extension of runway. Pollutants / undesirable waste shall not be allowed to enter into the drainage system. Sediment barriers shall be constructed for all outlets connecting to the main drains from the landscape areas. Runoff reaching roadway drainage from parking areas, food courts, and fuel station shall be routed through oil/grease separator units. Silt ponds are proposed near every outfall location to prevent the silt getting into the receiving water bodies. During monsoon period, regular aquatic monitoring will be carried out to ascertain that there is no impact on surface water bodies. On regular basis maintenance activities shall be reviewed and documented.	Contractor	Environmental expert/Qualified person
C.4	Pollution			
C.4.1	Water Pollution			

C.4.1.1	Water Pollution from Construction Wastes	The Contractor will take all precautionary measures to prevent the wastewater generated during construction from entering into streams or water bodies. All waste arising from the airport site will be disposed in the manner that is acceptable (as per C&D standards) to the West Bengal State Pollution Control Board (WBPCB).	Contractor	Environmental expert/Qualified person
C.4.1.2	Water Pollution from Fuel and Lubricants	The contractor will ensure that all construction vehicle parking location, fuel/lubricants storage sites, vehicle, machinery and equipment maintenance and refuelling sites will be located as per approved construction site layout plan. Contractor will ensure that all vehicle/machinery and equipment operation, maintenance and refuelling will be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground. Oil interceptors will be provided for vehicle parking, wash down and refuelling areas as per the design provided. Contractor will arrange for collection, storing and disposal of oily wastes to the pre-identified disposal sites. All spills and collected petroleum products will be disposed in accordance with MoEF&CC and WBPCB guidelines.	Contractor	Environmental expert/Qualified person
C.4.2	Air Pollution			
C.4.2.1	Dust Pollution	The contractor will take every precaution to reduce the level of dust from construction sites involving earthwork by sprinkling of water, encapsulation of dust source and by erection of screen/barriers. The unloading area, crushers and conveyor belts will be enclosed and provided with dust suppression equipment. Jets of water will be provided at the mouth of the crushers to ensure that the stones are thoroughly wet during the crushing. Alternatively, only crushers licensed by the WBPCB shall be used to procure materials.	Contractor	Environmental expert/Qualified person
C.4.2.2	Emission from Construction Vehicles, Equipment and Machineries	Contractor will ensure that all vehicles, equipment and machinery used for construction are regularly maintained and confirm that pollution emissions levels comply with the relevant requirements.	Contractor	Environmental expert/Qualified person

		The Contractor will submit PUC certificates for all vehicles/equipment/machinery used for the project. Monitoring results will also be submitted to AAI as per the monitoring plan.		
C.4.3	Noise Pollution			
C.4.3.1	Noise Pollution: Noise from Vehicles, Plants and Equipment	The contractor will confirm the following: All plants and equipment used in construction shall strictly conform to the MoEF & CC/CPCB/WBPCB noise standards. All vehicles and equipment used in construction will be fitted with exhaust silencers. Servicing of all construction vehicles and machinery will be done regularly and during routine servicing operations, the effectiveness of exhaust silencers will be checked and if found defective will be replaced. Limits for construction equipment used in the project such as compactors, rollers, front loaders, concrete mixers, cranes (moveable), vibrators and saws shall not exceed 75 dB (A) (measured at one meter from the edge of equipment in the free field), as specified in the Environment (Protection) rules, 1986. Monitoring shall be carried out at the construction sites as per the monitoring schedule and results will be submitted to AAI.	Contractor	Environmental expert/Qualified person
C.5	Safety			
C.5.1	Personal Safety Measures for Labour	The contractor will provide: Protective footwear and protective goggles to all workers employed on mixing asphalt materials, cement, concrete etc. Welder's protective eye-shields to workers who are engaged in welding works Earplugs to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation. Adequate safety measures for workers during handling of materials at site will be taken up. The contractor will comply with all regulations regarding safe scaffolding, ladders, working platforms, stairwells, excavations, trenches and safe means of entry and egress.	Contractor	Environmental expert/Qualified person

		The contractor will make sure that during the construction work all relevant provisions of the Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 are adhered to. The Contractor will mark 'hard hat' and 'no smoking' and other 'high risk' areas and enforce non-compliance of use of PPE with zero tolerance.		
C.5.3	Risk from Electrical Equipment(s)	The contractor will take all required precautions to prevent danger from electrical equipment and ensure that: No material will be so stacked or placed as to cause danger or inconvenience to any person or the public. All necessary fencing and lights will be provided to protect the public in construction zones. All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provision.	Contractor	Environmental expert/Qualified person
C.5.4	Risk Force Measure	The contractor will take all reasonable precautions to prevent danger to the workers and public from fire, etc. resulting due to construction activities. The contractor will make required arrangements so that in case of any mishap all necessary steps can be taken for prompt first aid treatment. Construction Safety Plan prepared by the Contractor will identify necessary actions in the event of an emergency.	Contractor	Environmental expert/Qualified person
C.5.5	First Aid	The contractor will arrange for : a readily available first aid unit including an adequate supply of sterilized dressing materials and appliances as per the Factories Rules in every work zone availability of suitable transport at all times to take injured or sick person(s) to the nearest hospital Equipment and trained nursing staff at construction camp.	Contractor	Environmental expert/Qualified person

C.5.6	Informatory Signs and Hoardings	The contractor will provide, erect and maintain informatory/safety signs, hoardings written in English and Regional language, wherever required at the construction site.	Contractor	Environmental expert/Qualified person
C.6	Archaeological Property			
C.6.1	Chance Found Archaeological Property	All fossils, coins, articles of value of antiquity, structures and other remains or things of geological or archaeological interest discovered on the site shall be the property of the Government and shall be dealt with as per provisions of the relevant legislation. The contractor will take reasonable precautions to prevent his workmen or any other persons from removing and damaging any such article or thing. He will, immediately upon discovery thereof and before removal acquaint the Environmental Expert of AAI of such discovery and carry out the instructions for dealing with the same, waiting which all work shall be stopped. The AAI will seek direction from the Archaeological Survey of India (ASI) before instructing the Contractor to recommence the work in the site.	Contractor	Environmental expert/Qualified person
C.7	Labour Camp Management			
C.7.1	Accommodation	Contractor will follow all relevant provisions of the Building and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for construction and maintenance of labour camp. The contractor will maintain necessary living accommodation and ancillary facilities in functional and hygienic manner at the construction site.	Contractor	Environmental expert/Qualified person
C.7.2	Potable Water	The contractor will construct and maintain labour accommodation in such a fashion that uncontaminated water is available for drinking, cooking and washing. The Contractor will also provide potable water facilities within the precincts of workplace in an accessible place, as per standards set by the Building and other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. The contractor will also guarantee the following:	Contractor	Environmental expert/Qualified person

		a) Supply of sufficient quantity of potable water (as per IS) in workplace/labour camp site at suitable and easily accessible places and regular maintenance of such facilities. b) If any water storage tank is provided that will be kept such that the bottom of the tank at least 1mt. from the surrounding ground level. c) Testing of water will be done every month as per parameters prescribed in IS 10500:2012. Environmental Expert of AAI will be required to inspect the labour camp once in a week to ensure the compliance of the EMP.		
C.7.3	Sanitation and Sewage System	The contractor will ensure that: The sewage system for the camp will be designed, built and operated in such a fashion that no health hazards occurs and no pollution to the air, ground water or adjacent water courses take place Separate toilets/bathrooms, wherever required, screened from those from men (marked in vernacular) will be to be provided for women Adequate water supply is to be provided in all toilets and urinals All toilets in workplaces will be with dry-earth system (receptacles) which are to be cleaned and kept in a strict sanitary condition Night soil is to be disposed of by putting layer of it at the bottom of a permanent tank prepared for the purpose and covered with 15 cm. layer of waste or refuse and then covered with a layer of earth for a fortnight.	Contractor	Environmental expert/Qualified person
C.7.4	Waste Disposal	The contractor will provide garbage bins in the camps and ensure that these are regularly emptied and disposed off in a hygienic manner as per the Solid Waste Management Rules, 2016.	Contractor	Environmental expert/Qualified person
C.8	Contractor's Demobilization			
C.8.1	Clean-up Operations, Restoration and Rehabilitation	Contractor will prepare site restoration plan. The clean-up and restoration operations will be implemented by the contractor prior to demobilization. The contractor will clear all temporary structures; dispose all garbage, night soils and POL wastes as per Waste Management practices.	Contractor	Environmental expert/Qualified person

		All construction zones will be left clean and tidy, at the contractor's expense, to the entire satisfaction to the Environmental Expert of AAI.		
Operation Stage				
O. 1	Air Pollution	Compliance of all standards prescribed by the ICAO during operation of aircrafts by preventive maintenance and monitoring. DG sets will be provided with stacks as per the CPCB guidelines. Proper traffic management will be prepared to ensure that there is no traffic congestion at airport. It will help in reduction of vehicular emissions from the airport. Vehicles at the airport will be maintained and will have a "Pollution Under Control" certificate. Development of greenery and landscaping at the airport will be helpful in improving ambient air quality. Monitoring of ambient air quality/ source emission will be carried out as per monitoring plan.	AAI	Environmental expert/Qualified person
O. 2	Water Pollution	Continuous efforts will be made to reduce water consumption using less water required cisterns. As part of water conservation, all the sensor based water taps and water free urinals will be installed. Efforts will be made to stop wastage and leakage of water. Reused treated waste water for gardening and horticulture at Bagdogra International Airport. Collection of waste water and treatment of waste water in ASBR/MBR/MBBR based Sewage Treatment Plant (STP). Regular testing and analysis of treated waste from STP to ensure effectiveness of operation of STP and compliance of discharge standards. Ground Water Recharge pits are constructed for seeping of rain water.	AAI	Environmental expert/Qualified person
O. 3	Soil	Approx. 5.12 tonnes per day solid waste will be generated from the terminal buildings at BAGDOGRA INTERNATIONAL AIRPORT, which will be collected, segregated in BAGDOGRA INTERNATIONAL AIRPORT's Solid Waste Yard and handed over to external agency for disposal as per Solid Waste Management Rule, 2016. Municipal waste collection bins will be placed at strategic locations in the new integrated terminal buildings. It is ensured that agency hired for disposal of solid wastes is disposing solid waste as per the provisions of the Solid Waste Management Rule, 2016. Solid waste	AAI	Environmental expert/Qualified person

		generated from the airport is transported in close containers. Used lubricating waste oil and oil contaminated cloths etc. will be collected separately in containers and will be sold to authorized recyclers as per WBPCB guidelines. Bagdogra International Airport has separate Hazardous Waste Yard for its hazardous waste disposal to avoid leachate to be drained and polluting the soil in airport premises. At Fuel farm, SOP will be followed for transfer of fuels to avoid any kind of leakage to avoid impact /contamination of soil.		
O. 4	Noise Pollution	All standards prescribed by the ICAO/ MoEF & CC shall be adhered during the operation of aircrafts by preventive maintenance and monitoring will be complied. Restriction to the noisy aircrafts. Runway orientation is made in such a way that there won't be adverse impact on nearby settlement. Planning shall be done in such a way that there won't be adverse impact on nearby settlement. Proper traffic management plan is prepared to ensure that there is no traffic congestion at airport. It helps in reduction of vehicular emissions from the airport. DG sets is provided with acoustic enclosure as per WBPCB guidelines. Terminal building is sound proof. Ground staff wears earplug while attending the aircraft. Green belt, landscaping and boundary at the airport act as barrier for noise. Monitoring of ambient air quality/ source emission will be carried out as per monitoring plan. Bagdogra International Airport has adopted 4 point approach to mitigate noise pollution:1)Reduction of noise at source 2)Land-use planning and management 3)Noise abatement operational procedures 4)Operating restrictions	AAI	Environmental expert/Qualified person
O. 5	Energy Conservation	At the proposed Terminals and Ancillary Buildings necessary Green Building measures will be followed for minimum conservation of energy in line with "Energy Conservation Building Code –2017", "National Building Code 2016". The Terminal is targeted to achieve Green Rating for Integrated Habitat Assessment (GRIHA) rating, and all other building shall follow a minimum energy requirement as per ECBC.	AAI	Environmental expert/Qualified person

		The solar plant will create significant environment benefits over its lifetime. Based on the availability of the land & feasibility solar plant will be planned at Bagdogra International Airport. Solar energy to the maximum extent will be used, and the possibility of wind energy will be explored to minimize the usage of conventional energy sources. As long term vision carbon neutrality will be implemented in the Bagdogra International Airport by the conversion of conventional airport owned vehicles to EVs, by switching to lower GWP refrigerants and to non-CO_2 type fire extinguishers. AAI is committed towards enhancing energy efficiency and absolute GHG emission reduction through various interventions and collaborative efforts with stakeholders. AAI aspire to achieve leadership position in the Airport Carbon International's (ACI) Airport Carbon Accreditation Program. Bagdogra International Airport has adopted effective measures to encourage reduction in carbon footprints and achieve carbon neutrality.		
O. 6	Terrestrial Ecology	Landscaping/ greenery will be developed at the airport. On vacant additional land, Landscaping/greenery will be developed. Green Space & Landscape development is an integral part of Bagdogra International Airport Master Plan, and an important element of its environmental sustainability measure. The plantation will be done considering the native species to promote biodiversity and stewardship of natural heritage and ornamental species to enhance the elegance and aesthetics of airport and its surroundings.	AAI	Environmental expert/Qualified person
O. 7	Traffic Management	All vehicles will be parked at designated parking area only. Road crossings will be well marked, signalled and informatory and warning signage will be retro reflective type provided, clearly visible in the night. Improved road infrastructure, widening of roads as per requirements of airport will be implemented along with co-ordination of State authorities. For the master plan, a multi-level car park (MLCP) of 1010 parking spaces is planned.	AAI	Environmental expert/Qualified person

O. 8	Occupational Hazards and Safety	*General Safety Measures* Electrical equipment will be grounded, well insulated and conform to applicable codes. Employees will be provided with hard hats, safety boots, eye and ear protection and snug fitting gloves, as appropriate. *General Health Measures* Necessary control measure like ear muff and ear plug, high visible vest with refractive tape will be provided to ground staffs at the airport. Pre-employment and periodic audiometric medical examinations will be conducted for personnel potentially exposed to high noise areas. OISD Standard 235 Storage, Handling, Refuelling and Fire Fighting at Aviation Fuelling Stations, JIG 2 (issue 12) and EI 1540 Design, construction, Commissioning, maintenance and Testing of Aviation fuel Facilities. All the precautionary measures will be provided for the storing of fuel at the airport.	AAI	Environmental expert/Qualified person

Source: ABC Techno Labs India Pvt. Ltd.

For Construction Phase:

Module I : Environmental Overview

Module II : Environmental Regulations and Acts Relevant to Construction Activities

Module III : Environmental Impact Assessment during Construction at Airport

Module IV : Environmental Sound Construction Management at Airport

For Operation Phase:

Module I : Airports and Environmental Issues

Module II : Environmental Regulations and Acts Relevant to Operation of Airport

Module III : Source of Pollution at Airport

Module IV : Environmental Impact Assessment during Operation of Airport

Module V : Environmental Management Plan for Airport

Module VI : Noise Mitigation at Airports

Module VII : Planning of environmentally Sustainable Operation of Airport

Module VIII : Long Term Environmental Issues in Airports Management

10.6 ENVIRONMENTAL MANAGEMENT CELL (EMC)

An Environmental Management Cell (EMC) will be headed by Assistant General Manager supported by adequate number of personnel having sufficient educational and professional qualification and experience to discharge responsibilities related to environmental management including statutory compliance, pollution prevention, environmental monitoring, preventive maintenance of pollution control equipment and green belt development & maintenance. Organogram for Environmental Management Cell is given Figure 10-8.

Environmental Management cell will implement and review the compliance of the applicable stipulated conditions specified in Environmental Clearance and Consent for Establish/Consent to Operate.

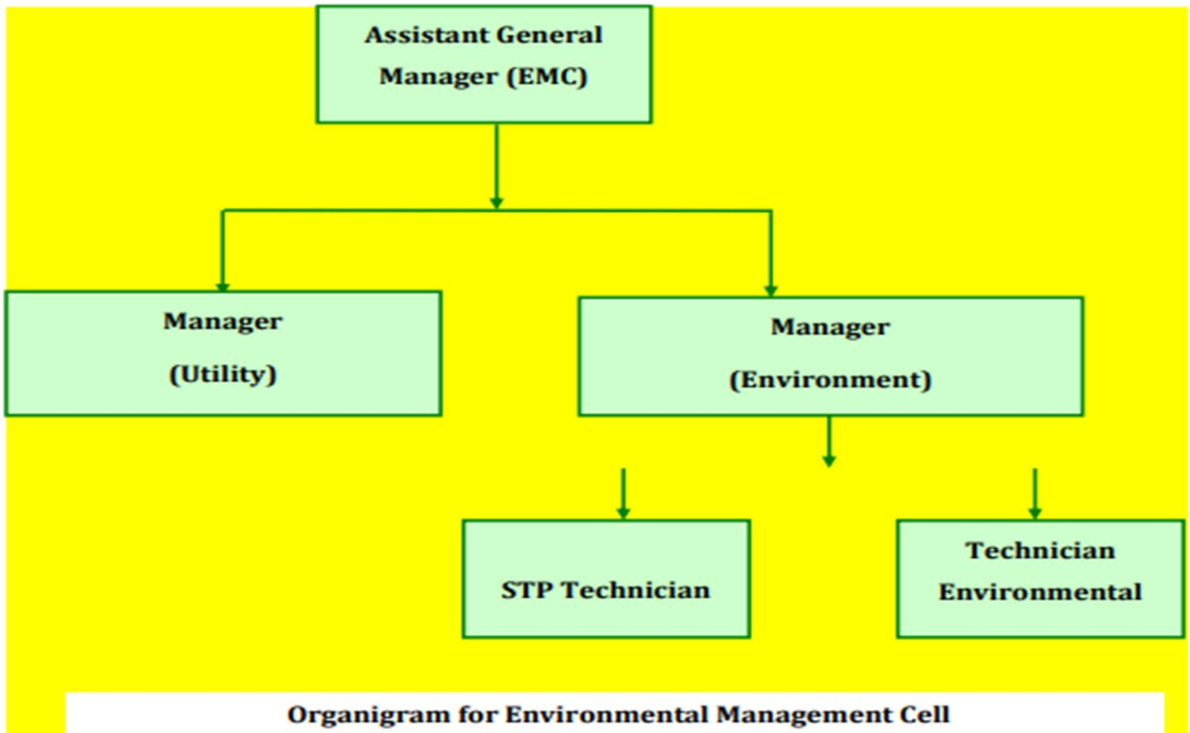


Figure 10.8: Organogram for Environnemental Management Cell

10.7 COST OF EMP

For implementation of mitigation measures and environmental management plan to mitigate the potential adverse impacts during the construction and post construction phase of total budget of INR 5 Crores will be implemented as Capex and Total budget of INR 0.5 Crore will be implemented as recurring expenses in phases for implementation of environmental management plan for the proposed project. The Environment Management Plan cost include cost towards DG Sets Acoustic enclosures, STP, Rain water harvesting, Green Area development, Waste yard, OWC and other Energy conservation measures.

Total project cost is approximately INR 1549 Crores (approx.) for proposed upgradation & expansion of existing Airport and the cost for Environment Management has been included in the total project cost. Costs are calculated based on the current charges of an accredited laboratory/consultant/contractor to perform the above said work.

CHAPTER 11: SUMMARY & CONCLUSIONS

11.1 INTRODUCTION

Bagdogra Airport is an international airport and gateway to the hill stations of Darjeeling, Gangtok and other parts of the North Bengal region, located at the western part of the city Siliguri in northern West Bengal. The Airport belongs to IAF and AAI operates Civil Enclave which spreads over an area of 13.77 acres. The airport belongs to the Indian Air force and its civilian operations are overseen by Airports Authority of India. AAI maintains a civil enclave at the Airport. The present Airport has a single runway 18/36 having dimensions of 2744m X 45.75m and belongs to IAF. The existing apron has 05 nos. of parking bays (04 nos. Code C and 01 no. Code D). The existing Terminal Building has an area of 9241 sqm for handing 810 peak hour passengers having an annual capacity of 2.5 MPPA.

The proposed expansion project is Development of Civil Enclave with infrastructure such as New Terminal Building, Car Parking, Apron, Link Taxiways etc. and associated city side / airside infrastructure on approx. 105 Acres of Land is planned. This civil enclave is proposed in two phases, namely:

Phase 1: In Phase-1, terminal building having area of 69,162 sqm (including 16875 Sqm Basement) and 6 number aerobridges and 10 Code C apron "Apron Bays" with 2 Nos. Link Taxi will be constructed. Proposed construction of Phase-1 of New Integrated Terminal Building is expected to be completed by March 2036.

Phase 2: In Phase-2, terminal building having area of 50000 Sqm and 4 number aerobridges and 6 Code C apron "Apron Bays" will be constructed in future.

11.2 BRIEF DESCRIPTION OF PROJECT

11.2.1 PROJECT ACTIVITIES

M/s. Airport Authority of India proposes to develop civil enclave of Bagdogra International Airport. The brief description of the project is given in Table below.

Name of project	Proposed Expansion Of New Civic Enclave of Bagdogra International Airport to Enhance the Passenger Handling Capacity up to 10 MPPA at Bagdogra, West Bengal by M/S Airport Authority Of India.
Location	LR Plot Nos. 88/362, 122/364, 439, 440, 444, 137, 138, 123/350, 124, 123, 125, 139, 140, 141, 143/347, 143, 129, Mouza: Abhiram–67, P.S: Phansidewa, LR Plot No. 121/163, Mouza: Abhiram-67, PS: Bagdogra, LR Plot Nos. 16, 17, 18, of Mouza: Turibhita , PS: Bagdogra, Dist: Darjeeling, West Bengal.
Land Area	Total 104.65 acres land acquired/proposed for New Terminal Building out of which 98.72 acres has already been acquired and for 5.93 acres working permission given by IAF
Screening Category	7(a)- "AIR PORTS"

Project Profile	The proposed expansion project is Development of New Civil Enclave with infrastructure such as New Terminal Building, Car Parking, Apron, Link Taxiways etc. and associated city side / airside infrastructure on approx. 105 Acres of Land is planned. These civil enclave is proposed in two phases, namely: Phase 1 In Phase-1, terminal building having area of 69,162 sqm (including 16875 Sqm Basement) and 6 number aerobridges and 10 Code C apron Apron Bays with 2 Nos. Link Taxi will be constructed. Proposed construction of Phase-1 of New Integrated Terminal Building is expected to be completed by March 2036. Phase 2 In Phase-2, terminal building having area of 50000 Sqm and 4 number aerobridges and 6 Code C apron Apron Bays will be constructed in future.
Cost of the Project	1549 Crores
Resource Requirement	
Source & Quantity Of Water	Total Water Requirement: 2540 KLD Fresh Water Requirement: 1153 KLD Recycled Water: 1387 KLD Waste Water Generation:1622.67 KLD
Power Requirement	Maximum Demand: 5.84 MW
	Transformer: 4 x 2500 KVA (3W + 1S) DG Sets: 5 x 1500 KVA + 1 x 750 KVA
Man Power	Construction Phase: Total: 500 Nos. Temporary/Contractual: 450 Nos. Permanent: 50 nos. Operation Phase: Total: 2000 Nos. Temporary/Contractual: Permanent:
Solid & Hazardous Waste Management and Disposal	Solid Waste: 5.12 TPD Hazardous Waste: 0.6 TPD
Green Belt	Green belt area 24926 Sqm. as proposed.

11.2.2 JUSTIFICATION OF PROPOSED DEVELOPMENT AT BAGDOGRA INTERNATIONAL AIRPORT

Air traffic at Bagdogra existing airport crossed 1 million for the first time growing at 43.6% percent in 2014-15. In 2019-20, the airport served 3.2 million passengers which was an increase of 11.2% from the previous year, making it the 17th-busiest airport in India. It is one of the few airports in India with zero sales tax on aviation turbine fuel.

With surging demand for large number of domestic and international companies into the sector, India's aviation industry ensures to witness a phenomenal growth in the near future.

The passenger handling capacity in future may continue to increase. In view of rapid growth in passenger traffic & Aircraft movement, operational infrastructure needs to be upgraded to serve the estimated demand of 10 MPPA.

11.2.3 LOCATION DETAILS

Bagdogra International Airport falls under Bagdogra and Phansidewa P.S. of Siliguri Sub-Division and Darjeeling District. Geographically, airport is situated at latitude 26°41'6.22"N, longitude 88°19'31.77"E, and altitude of range 143-150 m above MSL. Bagdogra International Airport is located near National highway, NH-27 (Purnea-Siliguri Road) connecting Siliguri with many districts of West Bengal and other states like Assam, Bihar etc.

11.2.4 RESOURCES REQUIREMENT

Land Requirement

A total 139.32 Acres of land is required for the project. In which 34.68 Acres is existing land area and 104.65 acres land has been proposed for development of civil enclave (including New Terminal Building, Aprons etc.) out of which 98.72 acres has already been acquired and for 5.93 acres working permission given by Indian Air Force.

Water Requirement

Construction phase:

Total Domestic water consumption during construction phase for approx. 50 nos. of workers will be 20 KLD, which will be met through bore-wells.

Operation phase:

The daily consumption of water during operation phase after proposed expansion will be about ~2540 KLD out of which ~1153 KLD will be fresh water and ~1387 KLD will be recycled water. The water requirement will be met through ground water (bore-wells). The water requirement for plantation, HVAC & flushing will met through STP Treated water.

Sewage Treatment

As a part of existing operations, Soak Pits are used for treatment of waste water. For development of this project 1800 KLD capacity of STP (MBR/MBBR/SBR etc.) is proposed. To reduce the load on fresh water demand AAI is committed in implementing the Zero discharge concept for sewage system. The entire sewage that is generated will be recycled and reused for non-potable purposes. About 1622.67 KLD of wastewater will be generated from airport operations, which will be treated through STP (MBR/MBBR/SBR etc.) total capacity of 1800 KLD, will be developed on modular basis. Treated wastewater will be used for Landscaping or other purposes.

Power Requirement

The total estimated power demand for Bagdogra International Airport Operations is:

- Maximum Demand: 5.84 MW
- Connected Load: 7.18 MW

- Main Source: WBSEDCL
- Transformer Capacity : 4 x 2500 KVA (3W + 1S)
- DG Sets: 5 x 1500 KVA + 1 x 750 KVA

Solid Waste generation

Solid waste generated from the airport area comprises of Food waste, bottles and cans, newspaper and mixed paper, plastic cups and service ware, food waste, food soiled paper, paper towels, Sludge from STP etc. Total quantity of ~5.12 TPD of Solid Waste will be generated from Bagdogra International Airport Operation. All the waste will be handled inline to 5R principles of waste management (Reduce, Reuse-Recycle-Recover-Reprocess) to avoid the disposal of waste back to the environment, and to be aligned to the vision of Zero Waste to Landfill.

Hazardous Waste generation

Hazardous waste (0.6 TPD) Used Oil, Contaminated filters, Oily cotton waste, discarded drums etc. will be and will be handled in accordance with HWM rules 2016, amended till date and will be handled in line Hazardous Waste Management Rules, 2016 amended till date.

All other waste including biomedical waste, E-waste, C&D waste and others wastes will be disposed as per the applicable rules amended till date

Storm Water Drainage Network

Presently the Airside area is graded with open surface drain and the outlets of the same is connected to panchayat drains.

The storm water drainage system for existing developments & future development is planned with EC guidelines for SWID discharge of runoff. Considering the topography, development and grading requirements from operational and functional perspective, the entire Bagdogra International Airport area is demarcated into 5 major catchments. The storm water run-off generated from airside areas, paved surfaces like runway, apron, taxiways, are collected through extensive network of pipe / RCC / open channels / storm water drains and conveyed through oil water separator units in order to discharge oil free water into rainwater storage pond.

11.2.5 PROJECT COST

The cost of proposed development of Bagdogra International Airport is estimated as Rs. 1549 Crores.

11.3 SALIENT FEATURES OF THE BASELINE STUDY

The reconnaissance survey of the 10 Km radius area carried out from **1st March 2023 to 30th May 2023** and the field studies were carried out for one season during summer season for the EIA studies to collect baseline primary and secondary data for the present environmental scenario in the study area.

- **Topography and Physiography:** The entire topography is crisscrossed with rivulets, rivers and hills. The study area lies in the middle of the vast fertile plains (Tarai) south of the Himalayas, watered by innumerable rivers and rivulets rising from and flowing down the Himalayas. Topography of this district and its environs is characterized by uneven elevation of this region varies from 62 m to 350 m. The altitude falls from 350 m to above mean sea level at the foot of the Himalayas to 150 m above mean sea level over a distance of 25 km and then falls to about 60 m above mean sea level over a distance 110 km further south.
- **Micro Meteorology:** The ambient temperature during the study period was ranging between 15.0oC to 39.0oC. The relative humidity recorded at site ranged between 23% to 99% Predominant winds from East direction were observed. Total rainfall was observed 2.5 mm during the study period.
- **Ambient Air Quality:** Ambient air quality monitoring have been carried out at eight locations during winter season for PM2.5, PM10, SO2, NO2, NH3, O3, C6H6, BaP, Pb, As, Ni and CO. All monitored parameters at all AAQM locations met National ambient quality standards for industrial, residential, rural & other areas. PM10: The maximum and minimum concentrations of PM10 were recorded as 67 μg/m3 and 37 μg/m3 respectively. The maximum concentration was recorded at Babupara, Siliguri (AAQ7) and the minimum concentration was recorded at Chaupukuria (AAQ3). PM2.5: The maximum and minimum concentrations for PM2.5 were recorded as 33.0 μg/m3 and 18.0 μg/m3 respectively. The maximum concentration was recorded at the Babupara, Siliguri (AAQ7) and the minimum concentration was recorded at Chaupukuria (AAQ3). SO2: The maximum and minimum SO2 concentrations were recorded as 12.2 μg/m3 and BDL (<5 μg/m3). The maximum concentration was recorded at Babupara, Siliguri (AAQ7) and the minimum concentration was recorded at Chaupukuria (AAQ3). NOx: The maximum and minimum NOx concentrations were recorded as 22.4 μg/m3 and 12.4 μg/m3. The maximum concentration was recorded at Babupara, Siliguri (AAQ7) and the minimum concentration was recorded at Dakshin Bagdogra (AAQ2). CO: The maximum and minimum CO concentrations were recorded as 0.5 mg/m3 and BDL(<0.1 mg/m3). O3: The maximum and minimum O3 concentrations were recorded as 16.6 μg/m3 and 9.5 μg/m3. HC (methane and non-methane) and Volatile Organic Compounds (VOCs): It has been observed that the concentrations of Benzene (C6H6), BaP, Lead, Arsenic, Nickel and Ammonia are also below detectable limits at all locations and O3 present in locations are well within the standards prescribed by the Central Pollution Control Board (CPCB) for Industrial, Rural, Residential and Other area.
- **Noise Level:** Noise levels during daytime in the study area are found to be in the range 50.8 to 57.9 dB(A). The maximum noise level was observed to be 57.9 dB(A) at Project Site (N2) and a minimum of 50.8 dB(A) was observed at Chaupukuria (N3). Noise levels observed to fall in the range 42.8 to 48.9 dB (A) during the night time in the study area. A maximum of

48.9 dB (A) was observed at Babupara, Siliguri (N7) and a minimum of 42.8 dB (A) was observed at Chaupukuria (N3). Measured noise levels in study area are found to be in compliance with prescribed standards for ambient noise for the respective applicable categories.

- **Ground Water Quality:** Out of 8 locations of Ground water, The pH value of all ground water samples ranges from 6.74 to 7.41 and meets the Acceptable limit of drinking water standards. The TDS in ground water samples range from 109 to 241 mg/l meets the Acceptable limit of 500 mg/l in the ground water sampling locations. The total hardness of ground water samples range between 64 mg/l to 130 mg/l, meets Acceptable limit of 200 mg/l at the ground water sampling locations. The chloride content in ground water samples range from 24 mg/l to 66 mg/l, meets Acceptable limit of 250 mg/l at all the ground water sampling locations. Sulphate content in ground water sample ranges from 4 mg/l to 17 mg/l, meets Acceptable limit of 200 mg/l at all the ground water sampling locations. Fluoride content in ground water samples ranges from 0.11 mg/l to 0.29 mg/l, meets the Acceptable limit of drinking water standards. Nitrate content in ground water samples ranges from 1.0 to 9.0 mg/l, meets the acceptable limit of 45 mg/l at all the ground water sampling locations. The Calcium content in ground water samples range from 19 mg/l to 44 mg/l, meets permissible limit of 200 mg/l at all the ground water sampling locations.
- **Surface Water Quality:** Out of 8 locations of Surface Water, The pH value of all surface water samples ranges from 7.17 to 7.95. Electrical conductivity in surface water samples ranges from 258 μS/cm to 556 μS/cm. The TDS in surface water samples range from 142 to 309 mg/l which is below tolerance limit for all surface water samples. The total hardness of surface water samples range between 62 mg/l to 120 mg/l. The chloride content in surface water samples range from 39 mg/l to 84 mg/l which is below tolerance limit for all surface water samples. Sulphate content in surface water sample ranges from 8 to 28 mg/l which is below tolerance limit for all surface water samples. Fluoride content in surface water samples ranges from 0.1 mg/l to 0.21 mg/l which is below tolerance limit for all surface water samples. Nitrate content in surface water samples ranges from 2 mg/l to 21 mg/l which is below tolerance limit for all surface water samples.
- **Soil Quality:** Out of 8 locations, The pH values ranging from 6.57 to 7.08 indicating the slightly alkaline. The conductivity of the soil ranges from 0.069 to 0.157 mS/cm. The bulk density in the study locations ranged from 1.36 g/cc to 1.48 g/cc. The Available Nitrogen Content ranges between 44 kg/Ha to 91 kg/Ha in the locality. The value of Phosphorus content varies between 19.6 kg/Ha to 40.5 kg/Ha. This indicates that the soil has medium quantities of Nitrogen and Phosphorus. The Potassium content varies from 216 kg/Ha to 358 kg/Ha, which indicates that the soils have high levels of potassium. The Texture of the soil sample is predominantly Sandy loam and loam in most of the places. The sand, silt and clay properties were found to be in the range of 38.9% to 63.9%, 24.4% to 35% and 8.74% to 27.3%.

- **Ecology & biodiversity:** Floral Community During the primary survey, about 96 floral species observed. The most dominant tree species in the entire study area was dominated Acacia auriculiformis, Shorea robusta, Ziziphus jujuba, Borassus flabellifer, Lannea coromandelica, Cordia pinnata, Azadirachta indica etc. Most dominant shrubs in the study area were Calotropis procera, Hibiscus rosa-sinensis, Leea asiatica, Woodfordia fruticosa, Caesalpina pulcherrima, Nerium odorum, Ziziphus xylopyrus etc. Among the herb species observed are Cynodon dactylon, Datura metel, Amaranthus spinosus, Cyperus rotundus, Oplismenus burmannii, Imperata cylindrica etc.
- **Socio economic status:** The study area located inside Darjeeling district in West Bengal State which includes total 140 villages within study area. Total population in the study area is 364367 with 187616 male and 176751 female populations. Overall sex ratio is 942 females per 1000 male, indicating male population is marginally higher in the region as compared with the female. Total Scheduled Caste population is 113275 (31.08%) and total Scheduled Tribe population is 58330 (16%).

11.4 Salient Features of the impact and mitigation measures

Discipline	Potential Impacts/Issues	Mitigative Measures	Remarks
Construction Phase			
Air Quality	Increase in dust and NOx concentration	Sprinkling of water in the construction area and paving of unpaved roads	The impact is likely to be for short duration and confined locally to the construction site itself
Water Quality	Increase in suspended solids due to soil runoff during heavy rainfall.	Temporary sedimentation pond will be constructed	-
Noise Levels	Increase in noise level	Equipment will be kept in good condition to keep the noise level within 90 dB(A)	Workers will be provided necessary personal protective equipment e.g. ear plug, ear-muffs
Solid waste	Generation of domestic sewage	Proper care will be taken in segregating wastes & maintaining areas in a clean pest free state	Will be disposed suitably.
Terrestrial Ecology	Clearing of Vegetation	Plantation will be done along with construction of project	The area being an aviation zone, impact on terrestrial fauna will be negligible
Operation Phase			
Air Quality	Increase in CO, HC and NOx levels in the ambient air	Methods of abatement suggested in the EIA report will be employed for the air pollution control at the source level.	The resultant concentrations after superimposing on the maximum ground level concentrations indicate that the resultant levels would be well within the prescribed standards
Water Quality	Risk of contamination of ground or surface water	Adequate treatment facilities will be provided so that the	The wastewater after treatment will be reused to maximum possible extent. Hence, no

Discipline	Potential Impacts/Issues	Mitigative Measures	Remarks
		treated effluents conform to the regulatory standards.	significant impact is envisaged because of the project.
Noise Levels	Increase in noise levels	A noise management program will be developed and implemented.	Noise modeling results indicate that the noise levels after implementation of the project will be within the prescribed standards.
Solid waste	Food waste/Medical Waste/Oily Waste etc.	OWC will be Installed.	Solid Waste will be disposed off as per norms
Terrestrial Ecology	Interaction of wildlife and aircraft operation	Greenbelt will be developed	As emissions will be within limits, no active injury to the vegetation is envisaged
Socio-Economics	Strain on resources and infrastructure facilities	Local people will be preferred for about 50% of jobs.	Positive social changes are anticipated which leads to regional development

Source: ABC Techno Labs India Pvt. Ltd.

11.5 Analysis of Alternative

No alternative site was analyzed for development of proposed project as the project involves expansion of existing airport. Alternatives were analyzed in terms of technology. Alternative energy options, building material options, fixtures etc. were analyzed. Options having low cost (both capital & maintenance), low environmental impacts and high life are tried to be selected. Some of the chosen alternatives have high capital cost but low O&M cost. It is expected that reduction in traffic, congestion on roads, development of safe, reliable, fast & cost-effective public transportation system, reduced air & noise pollution and increased employment generation will be occurred.

11.6 Environmental Monitoring Plan

To ensure the effective implementation of the mitigation measures and environmental management plan during construction and operation phases of proposed development of Bagdogra International Airport, it is essential that an effective Environmental Monitoring Plan should be designed and followed. After development, environmental monitoring plan have been prepared for ambient air quality, water quality, soil characteristics and noise monitoring. Suitable mitigation measures will be taken in case of monitored parameters are exceeding the stipulated limits.

11.7 Additional Studies - Risk Assessment & Disaster Management Plan

Hazard occurrence at Bagdogra Airport may result in on-site implications, like, fire at the storage of HSD in barrels for DG sets followed by fire, bomb threat at terminal building, cargo terminal & aircraft and natural calamities like, earthquake, flood, etc. Other incidents, which can also result in a disaster at the Bagdogra International Airport are agitation/forced entry by external group of people, sabotage, air raids; and aircraft crash while landing or take-off.

Disaster management plan has been prepared comprising key functions of Airport operator, other supporting organizations/agencies/services for response during emergency at the Bagdogra International Airport.

11.8 COST OF EMP

Total budget of Rs. 5 Crores has been kept for implementation of environmental management plan during construction and operation phases of Bagdogra International Airport. The recurring cost per annum for Environmental Management, fund of Rs. 0.5 Crores has been allocated.

11.9 CONCLUSIONS

Anticipated adverse environmental impacts from development of Bagdogra International Airport will be localised, short term and low/moderate in nature, and visible only during construction phase. Adverse environmental impacts identified in EIA study due to the proposed project will be mitigated by implementation of mitigation measures/environmental management plan (EMP) described in EIA report and compliance of applicable environmental regulations. The proposed project will have long term and regional beneficial/positive direct and indirect impacts on employment, socioeconomic conditions, state economy, tourism and development of the area and region.

CHAPTER 12: DISCLOSURE OF CONSULTANT

This chapter describes about the environmental consultant engaged in preparation of Environmental Impact Assessment Report for **Proposed expansion of Civil Enclave of Bagdogra International Airport to Enhance the Passenger Handling Capacity up to 10 MPPA at Bagdogra, Dist: Darjeeling, West Bengal by M/s Airport Authority of India**.

12.1 INTRODUCTION

ABC Techno Labs India Private Limited (formerly ABC Environ Solutions Pvt. Ltd.) is an ISO 9001, ISO 14001 & OHSAS 18001 Certified Company & leading Environmental Engineering & Consultancy Company constantly striving towards newer heights since its inception in 2006. Our Company is dedicated to providing strategic services in the areas of Environment, Infrastructure, Energy, Engineering and Multilab.

It is the first firm to be accredited by NABET (National Accreditation Board for Education and Training), Quality Council of India, as an EIA Consultant, approved for carrying out EIA studies and obtaining environmental clearance for various sectors such as Thermal Power Plants, Infrastructure, Industrial Estates/Complexes/Areas, Mining, Township & area development and Building construction projects etc. ABC Techno Labs is equipped with in-house, spacious laboratory, accredited by NABL (National Accreditation Board for Testing & Calibration Laboratories), Department of Science & Technology, Government of India.

Since establishment ABC Techno Labs focus on sustainable development of Industry and Environment based on sound engineering practices, innovation, quality, R&D and most important is satisfying customers need. The company has successfully completed more than 100 projects of a variety of industries, in the field of pollution control and environmental management solutions. The company is also dealing in the projects of waste minimization and cleaner production technology.

The team of technocrats and scientist are well experienced to deal with the design, Manufacture, Fabrication, Installation, commissioning of Effluent/ Wastewater treatment plants, Sewage Treatment plants, and Combined Treatment plants. The company is having well-experienced team of Scientists & Engineers who are looking after environmental projects &well-equipped analytical laboratory with a facility including analysis of physical, chemical and biological parameters as per the requirements of the State Pollution Control Board and our clients.

12.2 SERVICES OF ABC TECHNO LABS INDIA PRIVATE LIMITED

12.2.1 ENVIRONMENTAL SERVICES

- Environmental Impact Assessment (EIA)
- Environmental Management Plan (EMP)
- Social Impact Assessment (SIA)
- Environmental Baseline data collection for Air, Meteorology, Noise, Water, Soil, Ecology, Socio-Economic and Demography etc;

- Environmental Monitoring
- Socio-Economic Studies
- Resettlement & Rehabilitation Plan
- Ecological & Human Health Risk Assessment Studies
- Ecological Impact Assessment
- Environmental Management Framework
- Solid Waste Management
- Hazardous Waste Management
- Internship & Training

12.2.2 TURNKEY PROJECTS

- Water Treatment Plants
- Sewage Treatment Plant
- Recycling & Water Conservation Systems
- Zero Discharge System

12.2.3 OTHER SERVICES

- Operation & Maintenance of Water & Waste Water Plants
- Water & Waste Water Treatment Chemicals
- Pilot Plant studies
- Feasibility studies & preparation of budgetary estimates

12.2.4 LABORATORY SERVICES

- Chemical Testing
- Environmental Testing
- Microbiological Testing
- Food Testing
- Metallurgical Testing

12.3 SECTORS ACCREDITED BY NABET

Sl.No.	Name of sectors	NABET Sector No	MoEF&CC Sl. No.
1	Mining of Minerals including Opencast/Underground Mining	1	1 (a) (I)
2	**Offshore& Onshore Oil and gas exploration, development & productions**	**2**	**1 (b)**
3	River Valley Projects	3	1 (c)
4	Thermal Power Plant	4	1 (d)
5	Mineral Beneficiation including palletisation	7	2 (b)
6	Metallurgical Industries – (Ferrous & non-ferrous)	8	3 (a)
7	Cement Plants	9	3 (b)
8	Petroleum Refining Industry	10	4 (a)
9	Asbestos milling and asbestos based products	12	4 (c)
10	Leather/Skin/hide processing industry	15	4 (f)
11	Chemical Fertilizers	16	5 (a)

Sl.No.	Name of sectors	NABET Sector No	MoEF&CC Sl. No.
12	Petro-chemical Complexes	18	5 (c)
13	Petrochemical based processing	20	5 (e)
14	Synthetic organic chemicals industry	21	5 (f)
15	Distilleries	22	5 (g)
16	Pulp & Paper industry	24	5 (i)
17	Sugar Industry	25	5 (j)
18	Oil & gas transportation pipe line (crude and refinery/ petrochemical products)	27	6 (a)
19	Isolated storage & handling of hazardous chemicals (As per threshold planning quantity indicated in column 3 of schedule 2 & 3 of MSIHC Rules 1989 amended 2000)	28	-
20	Airports	29	7 (a)
21	Industrial estates/ parks/ complexes/ areas, export processing Zones (EPZs), Special Economic Zones (SEZs), Biotech Parks, Leather Complexes	31	7 (c)
22	Common Hazardous waste treatment, storage and disposal facilities (TSDFs)	32	7 (d)
23	Ports, Harbours, Jetties, Marine terminals, break waters and dredging	33	7 (e)
24	Highways, Railways, Transport terminals, mass rapid transport system	34	7 (f)
25	Common Effluent Treatment Plants (CETPs)	36	7 (h)
26	Common Municipal Solid Waste Management Facility (CMSWMF)	37	7 (i)
27	Building and large Construction projects including shopping malls, multiplexes, commercial complexes, housing estates, hospitals, institutions	38	8 (a)
28	Townships and Area development projects	39	8 (b)

Source: ABC Techno Labs India Pvt. Ltd.

12.4 Study Team

ABC Techno Labs India Private Limited has carried out this Environmental Impact Assessment (EIA) study. The multidisciplinary team included expertise in Environmental Impact Assessment, Air & Water pollution & Control measures, Noise Control measures, Ecology & Bio-diversity, Soil Conservation, Land use, Geology & Hydrogeology, Risk Assessment and Socio-Economic expert. The team members involved in EIA study area:

Sl. No.	Name	Role
1.	Mr. Abhik Saha	**EIA coordinator – Airports** FAE- Air Pollution (AP) FAE – Ecology & Biodiversity (EB) FAE – Solid & Hazardous Waste (SHW)
2.	Wriddhi Pratim Bose	FAE – Water pollution (WP)

Sl. No.	Name	Role
		FAE – Solid & Hazardous Waste (SHW)
3.	Dr. R.K. Jayaseelan	FAE –Hydrogeology (HG)
4.	Dr. S. Veezhinathan	FAE – Geology (GEO)
5.	Arijit Panja	FAE – Land use (LU) FAE –Noise & Vibration (NV) FAE- Air Pollution (AP)
6.	Vinod Kumar Gautam	FAE – Risk Assessment (RH)
7.	Mohammad Akhtar	FAE - Air Quality Modeling & Prediction (AQ),
8.	Dr. N. Rama Krishnan	FAE – Socio-Economic Expert
9.	Heambika Balakrishnan	FAE- Soil Conservation (SC)
Team Members		
10.	Mr. Robson Chinnadurai	Senior Chemist
11.	Mr. Arpan Rakshit	Ecology & Biodiversity Field Chemist

DISCLOSURE AS PER NABET /QCI

Details as per Schedule of EIA Notification 2006, as amended till date	
Name of Proposal	***the Proposed expansion of Civil Enclave of Bagdogra International Airport to Enhance the Passenger Handling Capacity up to 10 MPPA at Bagdogra, Dist: Darjeeling, West Bengal by M/s Airport Authority of India***
Schedule as per EIA notification 2006	***7(a)***
Category	***B1***
NABET Sector No.	***29 - Airports***

Declaration by experts contributing to the Environmental Impact Assessment Report for the Proposed expansion of Civil Enclave of Bagdogra International Airport to Enhance the Passenger Handling Capacity up to 10 MPPA at Bagdogra, Dist: Darjeeling, West Bengal by M/s Airport Authority of India

I, hereby, certify that I was a part of the EIA team in the following capacity that developed the above EIA/EMP.

EIA Coordinator

Name	:	**Mr. Abhik Saha**
Signature	:	Abhik Saha
Period of involvement	:	February 2023 – Till date
Contact information	:	abc@abctechnolab.com

FUNCTIONAL AREA EXPERTS:

S. No.	Functional Areas	Name of the Expert/s	Involvement (Period)	Signature & Date
		Mr. Abhik Saha		Abhik Saha
2.	SHW		February 2023 – Till date	
3.	EB		February 2023 – Till date	
4.	AP		February 2023 – Till date	
5.	AQ	Mohammad Akhtar	March 2023 – Till date	
6.	RH	Vinod Kumar Gautam	March 2023 – Till date	Gautam
7.	HG	Dr. R.K. Jayaseelan	March 2023 – Till date	
8.	Geo	Dr. S. Veezhinathan	March 2023 – Till date	
9.	NV	Arijit Panja	February 2023 – Till date	

FUNCTIONAL AREA EXPERTS:

S. No.	Functional Areas	Name of the Expert/s	Involvement (Period)	Signature & Date
10.	LU/AP	Arijit Panja	February 2023 – Till date	Arijit Panja
11.	WP/SHW	Wriddhi Pratim Bose	February 2023 – Till date	Wriddhi Pratim Bose
12.	SC	Heambika Balakrishnan	March 2023 – Till date	B Hemambika
13.	SE	Dr. N. Rama Krishnan	March 2023 – Till date	[illegible]

Declaration by the head of the Accredited Consultant Organization

I, Mr. G. Murugesh, hereby confirm that the above mentioned experts prepared the EIA/EMP Report for the Proposed expansion of Civil Enclave of Bagdogra International Airport to Enhance the Passenger Handling Capacity up to 10 MPPA at Bagdogra, Dist: Darjeeling, West Bengal by Airport Authority of India. I also confirm that ABC Techno Labs India Pvt. Ltd. shall be fully accountable for any misleading information mentioned in this statement.

Signature :	
Name :	**Mr. G. Murugesh**
Designation :	**Chairman & Managing Director**
Name of the EIA Consultant Organization:	**ABC Techno Labs India Private Limited**
NABET Certificate No. & Validity Date:	**NABET/EIA/2225/RA 0290 Date 16th November 2025**

ANNEXURE 1: APPROVED TERMS OF REFERENCE (TOR)

STATE LEVEL ENVIRONMENT IMPACT ASSESSMENT AUTHORITY

Pranisampad Bhawan, 5th floor, LB 2, Sector-III, Salt Lake, Kolkata – 700 106
e-mail: environmentwb@gmail.com
Web Portal: www.environmentwb.gov.in

No. 2807 / EN / T – II – 1/ 536/ 2023 Date: 13th December, 2023

To
M/s. Airport Authority of India.,
Bagdogra,Dist.- Darjeeling
Pin: - 734421

Sub: ToR for doing EIA for the proposed expansion of New Civic Enclave of Bagdogra International Airport to Enhance the Passenger Handling Capacity up to 10 MPPA at LR Plot Nos. 88/362, 122/364, 439, 440, 444, 137, 138, 123/350, 124, 123, 125, 139, 140, 141, 143/347, 143, 129, Mouza: Abhiram–67, P.S: Phansidewa, LR Plot No. 121/163, Mouza: Abhiram67, PS: Bagdogra, LR Plot Nos. 16, 17, 18, of Mouza: Turibhita, PS: Bagdogra, Dist: Darjeeling, West Bengal (proposal no. SIA/WB/INFRA2/445111/2023)

Sir,

This is to inform you that SEIAA in its meeting on 08.12.2023 considered your online application (vide Proposal No. SIA/WB/INFRA2/445111/2023) as well as the recommendations of SEAC for issuance of ToR and agreed with the recommendation.
The ToR for conducting EIA study is attached herewith (annexure 1).
The ToR is valid for a period of 3 (three) years from the date of issue. EIA/EMP to be submitted before the expiry of the ToR for consideration of EC application
Enclo: Annexure 1&II

(Dharmdeo Rai)
Member Secretary, SEIAA

No. 2807/1/EN/T-II-1/536/2023 Date: 13th December, 2023

Copy forwarded for the information to:

The Secretary, State Level Expert Appraisal Committee, 'Paribesh Bhavan', LA, Salt Lake Sector III, Kolkata- 700106

Member Secretary, SEIAA

Annexure - I

A. STANDARD TERMS OF REFERENCE

1. Reasons for selecting the site with details of alternate sites examined/rejected/selected on merit with comparative statement and reason/basis for selection. The examination should justify site suitability in terms of environmental angle, resources sustainability associated with selected site as compared to rejected sites. The analysis should include parameters considered along with weightage criteria for short-listing selected site.
2. Details of the land use break-up for the proposed project. Details of land use around 10 km radius of the project site. Examine and submit detail of land use around 10 km radius of the project site and map of the project area and 10 km area from boundary of the proposed/existing project area, delineating project areas notified under the wild life (Protection) Act, 1972/critically polluted areas as identified by the CPCB from time to time/notified eco-sensitive areas/inter-state boundaries and international boundaries. Analysis should be made based on latest satellite imagery for land use with raw images.
3. Submit the present land use and permission required for any conversion such as forest, agriculture etc. land acquisition status, rehabilitation of communities/ villages and present status of such activities. Check on flood plain of any river.
4. Examine and submit the water bodies including the seasonal ones within the corridor of impacts along with their status, volumetric capacity, quality likely impacts on them due to the project.
5. Submit a copy of the contour plan with slopes, drainage pattern of the site and surrounding area, any obstruction of the same by the airport.
6. Submit details of environmentally sensitive places, land acquisition status, rehabilitation of communities/ villages and present status of such activities.
7. Examine the impact of proposed project on the nearest settlements.
8. Examine baseline environmental quality along with projected incremental load due to the proposed project/activities
9. Examine and submit details of levels, quantity required for filling, source of filling material and transportation details etc. Submit details of a comprehensive Risk Assessment and Disaster Management Plan including emergency evacuation during natural and man-made disaster integrating with existing airport
10. Examine road/rail connectivity to the project site and impact on the existing traffic network due to the proposed project/activities. A detailed traffic and transportation study should be made for existing and projected passenger and cargo traffic.
11. Submit details regarding R&R involved in the project
12. Examine the details of water requirement, use of treated waste water and prepare a water balance chart. Source of water vis-à-vis waste water to be generated along with treatment facilities to be proposed.
13. Rain water harvesting proposals should be made with due safeguards for ground water quality. Maximize recycling of water and utilization of rain water.
14. Examine details of Solid waste generation treatment and its disposal.
15. Submit the present land use and permission required for any conversion such as forest, agriculture etc.

16. Examine separately the details for construction and operation phases both for Environmental Management Plan and Environmental Monitoring Plan with cost and parameters.

17. Submit details of a comprehensive Disaster Management Plan including emergency evacuation during natural and man-made disaster.

18. Examine baseline environmental quality along with projected incremental load due to the proposed project/activities.

19. The air quality monitoring should be carried out as per the notification issued on 16th November, 2009.

20. Examine separately the details for construction and operation phases both for Environmental Management Plan and Environmental Monitoring Plan with cost and parameters.

21. Submit details of need-based EMP as per the office Memorandum issued by the MoEF&CC vide F.No.22-65/2017-IA, III dated 30/09/2020 should be strictly followed.

22. Submit details of the trees to be cut including their species and whether it also involves any protected or endangered species. Measures taken to reduce the number of the trees to be removed should be explained in detail. Submit the details of compensatory plantation. Explore the possibilities of relocating the existing trees.

23. Examine the details of afforestation measures indicating land and financial outlay. Landscape plan, green belts and open spaces may be described. A thick green belt should be planned all around the nearest settlement to mitigate noise and vibrations. The identification of species/ plants should be made based on the botanical studies.

24. Public hearing to be conducted for the project in accordance with provisions of Environmental Impact Assessment Notification, 2006 and the issues raised by the public should be addressed in the Environmental Management Plan. The Public Hearing should be conducted based on the ToR letter issued by the SEIAA, WB and not on the basis of Minutes of the Meeting available on the web-site.

25. A detailed draft EIA/EMP report should be prepared in accordance with the above additional TOR and should be submitted to the SEIAA, WB in accordance with the Notification.

26. Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the Project should be given.

27. The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.

28. Any further clarification on carrying out the above studies including anticipated impacts due to the project and mitigative measure, project proponent can refer to the model ToR available on Ministry website "http://moef.nic.in/Manual/Airport"

B. Additional Terms of Reference –

Mandatory documents

1. Consent to Operate from WBPCB along with certified compliance report of consent condition of the existing project as per the Notification issued by MoEF&CC vide F No. IA3-22/10/2022-IA.III[E 177258] dated 08.06.2022.
2. A detailed traffic management and traffic decongestion plan should be drawn up to ensure the current level of service on the roads within 5km radius of the project. Car parking space should be exclusively earmarked.

3. Statutory clearance as the approvals of storage of ATF/fuel from the Chief Controller of Explosives shall be obtained.
4. A certificate from the competent authority/agency handling MSW should be obtained indicating the existing civic capacities of handling and their adequacy to cater to the increased quantum of MSW generated from the expansion project.

Water & waste water

5. Detailed hydrogeological study report should be submitted. The amount of groundwater flowing blow the project area should be calculated and included in the report. Design of existing borewells and groundwater level with respect to ground surface and mean sea level should also be submitted.
6. Run off from paved surface (aircraft operation and maintenance areas) should be routed through drains to oil separation tanks and sediment basins before those are discharged..
7. Storm water drains are to be built for discharging storm water from the airfield to avoid flooding, waterlogging in the project area. Domestic and industrial wastewater should not be allowed to be discharged into storm water drains.
8. A detailed drainage plan for storm water should be submitted.
9. A certificate from the competent authority for discharging treated effluent/drainage system along with final disposal point should be submitted.

Need based EMP

10. EMP as per Office Memorandum of MoEF & CC vide F. No. 22-65/2017.IA.III dated 30.09.2020 to be submitted. Consents from the beneficiaries of the social part of EMP should be furnished. Any other local need should be identified.

Noise

11. Noise level survey should be carried out as per prescribed guidelines and a report should be submitted along with the EIA report.

Land use and physical planning

12. Existing landform with contours and proposed Grading Plan to be submitted.
13. Water and soil conservation plans are to be prepared and submitted.
14. Topsoil should be isolated, preserved and reused at the same site for landscaping and plantation as per NBC 2016, Part 10.
15. A revised site plan showing buildings / structures, all external services, road layout, greenbelt, and all other relevant information to be submitted.
16. Individual floor plans of proposed building/s should be furnished, including building sections.
17. Environmental management plan for the existing stream flowing though the site should be submitted. Protection of embankment on both sides of the stream should be done as per guidelines. Water quality of the stream shall be monitored and reported at regular intervals.

Landscape and exclusive tree plantation

18. An inventory of on-site existing trees to be submitted.
19. Attempt should be made to save a maximum number of existing trees. If unavoidable, transplantation of the existing trees to suitable locations within the project site, preferably in the peripheral / boundary areas, should be carried out.
20. Details of compensatory plantation to be submitted for those trees that could not be saved.

21. An aesthetic landscape design and its perfect balance features appeals to the eye.
22. In stead of using Palms and other xerophytic plants in the landscape works, thick planting of local ornamental/flowering plants at a closer spacing in pure patches over a considerable stretch will enhance character of the airport lands. To blend the exterior environment with structural colours and make it more appealing, pure patches of trees like Michelia champaca, spathodea campanulata, acrocarpus fraxinifolius, Tabebuia chrysantha, chorisia speciosa, Wrightia tomentosa etc. are to be raised along the road sides as avenue plants and in the exterior side yard and pure thickets of mid sized tress like Cordia sebastina ,Bixa orellana, Tacoma stans, Butea monosperma, Alstonia scholaris, holarrhena antidysenterica etc may be planted over a considerable stretch in boulevards and over front yards to get necessary colour effect in different seasons and to gather an impression.

Building materials and energy consumption

23. PP shall adopt a bird-safe façade treatment with bird-friendly glass solutions that provide the greatest chance for birds to identify the glazing surfaces and avoid collision.
24. Energy consumption: WBECBC (No. 07-PO/O/C-I11/4M-14/2016(Part-1) dated 13th January, 2020) compliance documents and certificate from competent authority should be furnished.
25. Outdoor lighting shall conform to NBC 2016 and National Lighting Code 2010.

Misc.

26. Emergency preparedness plan based on Hazard identification and Risk assessment and Disaster Management Plan shall be implemented.

[The West Bengal Pollution Control Board shall arrange public hearing as per EIA Notification, 2006 on submission of draft EIA/EMP prepared by the Project Proponent as per the above mentioned ToRs. All the issues mentioned in the 'Public Hearing Report' and public consultation must also be addressed and incorporated in the final EIA / EMP report. The project proponent is requested to pursue the matter with the WBPCB for organizing the public hearing/consultation on submission of the draft EIA/EMP report as per the provision of EIA notification 2006 & its amendments. The project proponent is requested to submit the final EIA/EMP prepared as per the above mentioned ToRs and incorporating all the issues raised during Public Hearing / Public Consultation to the SEAC for further consideration of the proposal for environmental clearance.]

Annexure - II

Executive Summary

The Executive summary of the EIA/EMP report in about 8-10 pages should be prepared incorporating the information on following points:

1) Project name and location (Village, District, State, Industrial Estate (if applicable).
2) Products and capacities. If expansion proposal, then existing products with capacities and reference to earlier EC.
3) Requirement of land, raw material, water, power, fuel, with source of supply (Quantitative).
4) Process description in brief, specifically indicating the gaseous emission, liquid effluent and solid and hazardous wastes.
5) Measures for mitigating the impact on the environment and mode of discharge or disposal.
6) Capital cost of the project, estimated time of completion.
7) Site selected for the project - Nature of land - Agricultural (single/double crop), barren, Govt./private land, status of is acquisition, nearby (in 2-3 km.) water body, population, with in 10km. other industries, forest, eco-sensitive zones, accessibility, (note - in case of industrial estate this information may not be necessary).
8) Baseline environmental data - air quality, surface and ground water quality, soil characteristic, flora and fauna, socio-economic condition of the nearby population.
9) Identification of hazards in handling, processing and storage of hazardous material and safety system provided to mitigate the risk.
10) Likely impact of the project on air, water, land, flora-fauna and nearby population.
11) Emergency preparedness plan in case of natural or in plant emergencies.
12) Issues raised during public hearing (if applicable) and response given.
13) Environment Management Plan (EMP) as per Office Memorandum issued by the MoEF & CC vide F. No. 22-65/2017-IA.III dated 30.09.2020 with proposed expenditure.
14) Occupational Health Measures.
15) Post project monitoring plan.

ANNEXURE 2: CTO APPLICATION

12/1/23, 11:50 AM SPCB Admin Home

West Bengal Pollution Control Board

Online Consent Management & Monitoring System
West Bengal Pollution Control Board
(Department of Environment, Govt. of West Bengal)

Home | Consent Management | Logout

- Industry Profile
- Fee Calculator
- Delete InProgress Applications

Send us your feedback and suggestions

Welcome AIRPORTS AUTHORITY OF INDIA | Date : 1-12-2023

Consent Application Details

Application No : 4495188

Congratulations! Application submitted successfully.

Your Consent Application application has been received under the Application Number **4495188**. *(Note this number for future communication and know the online status of the application submitted)*
Submitted application is under processing. Please send the following documents by post/by hand. You may ignore sending the documents which have been uploaded online.

1) Copy of CFE Certificate 2) Copy of CFE Certificate 3) Project Report with details of emission, effluent, solid waste management plan, raw materials, finished products, manufacturing process including list of machinery 4) Copy of EC for EC Attracting projects 5) Paid bank challan,if any 6) Self certified site plan/lay out with road map/route map 7) Project Report with details of emission, effluent, solid waste management plan, raw materials, finished products, manufacturing process including list of machinery 8) Copy of EC for EC Attracting projects 9) Paid bank challan,if any 10) Any land related document (rent agreement, rent receipt, land deed, porcha, lease document as applicable) 11) Self certified site plan/lay out with road map/route map 12) Project Report with details of emission, effluent, solid waste management plan, raw materials, finished products, manufacturing process including list of machinery 13) Project Report with details of emission, effluent, solid waste management plan, raw materials, finished products, manufacturing process including list of machinery 14) Compliance status of CFE conditions (if any) 15) Copy of the last CFO certificate (for CFO renewal cases) 16) Copy of the last CFO certificate (for CFO renewal cases) 17) Compliance status report of previous directions / conditions (if any 18) Compliance status report of previous directions / conditions (if any 19) Current test reports for emission / effluent (in last one year) 20) Current test reports for emission / effluent (in last one year) 21) Paid bank challan,if any 22) Paid bank challan,if any 23) Hazardous Waste storage facility and handling system/procedure (with photographs) 24) Copy of Consent to Establish certificate 25) Copy of Consent to Operate certificate (in case Consent to Operate has not been obtained, submit copy of forwarding letter showing application has been submitted) and copy of last authorization status(if any) 26) Any land related document rent agreement, rent receipt, land deed, porcha, lease document as applicable 27) Any land related document rent agreement, rent receipt, land deed, porcha, lease document as applicable 28) Any land related document rent agreement, rent receipt, land deed, porcha, lease document as applicable 29) Compliance status of CFE conditions if any 30) Photograph of one updated Environmental Information display board(in bengali and english) of size 6' x 4' installed outside the main gate 31) Gross Capital Investment Certificate Self certified undertaking 32) Copy of Agreement of Membership of Common HW Treatment Storage Disposal Facility (CHWTSDF) in case the unit generates incinerable and disposable wastes(if any) 33) In case of application for renewal of Authorization, submit a Compliance Report w.r.t. previous authorization 34) Copy of last annual return(FORM-4) and latest manifest(FORM-10) 35) Agreement with CBWTF 36) Sansaction order from government 37) Permission from local aothority 38) Photocopy of CTE 39) Clinical establish certificate/CMOH license 40) Mode of treatment and disposal of hospital liquid waste 41) Dealer certificate 42) CTE Certificate 43) CTO Certificate 44) Manufacturing Process and Raw Material Details 45) Action Plan Endrosed/Receipt from Incharge Of State Urban Development Agency for setting of Plastic Waste Management System. 46) Current trade license 47) Copy of Consent to Establish certificate 48) Copy of Consent to Operate certificate 49) Copy of Hazardous waste Authorization certificate 50) Statement of built up area of hospital building and building plan 51) Identity Proof of Applicant (EPIC/ Aadhaar / Driving License/ PAN Card/ Passport) 52) Identity Proof of Applicant (EPIC/ Aadhaar / Driving License/ PAN Card/ Passport) 53) Proof of Ownership/Legal Occupancy (Rent Agreement,Rent Receipt, Parcha ,Land deed,Lease Documents etc. as applicable) 54) Proof of Ownership/Legal Occupancy (Rent Agreement,Rent Receipt, Parcha ,Land deed,Lease Documents etc. as applicable) 55) GST CERTIFICATE 56) Related Document 57) Gross Capital Investment Certificate(Self-Certified Undertaking). 58) Gross Capital Investment Certificate(Self-Certified Undertaking). 59) Gross Capital Investment Certificate(Self-Certified Undertaking). 60) Gross Capital Investment Certificate(Self-Certified Undertaking). 61) CTE Certificate 62) CTO Certificate

To view the submitted application form click onto "View Application Form" and To print the application form click onto "Print Application Form"

View Application Form | Print Application Form

In case documents have not been submitted online, kindly send the above documents at the earliest to start application processing on the below address or at corresponding regional office:

Site designed, hosted by National Informatics Center

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https://wbocmms.nic.in/indApplicationDetails/saveNew 1/1

ANNEXURE 3: PESO LICENSE

प्ररूप XV
(प्रथम अनुसूची का अनुच्छेद 6 देखिए)
FORM XV
(see Article 6 of the First Schedule)

अधिष्ठापनों में पेट्रोलियम के आयात और भंडारकरण के लिए अनुज्ञप्ति
LICENCE TO IMPORT AND STORE PETROLEUM IN AN INSTALLATION

अनुज्ञप्ति सं. (Licence No.) : **P/HQ/WB/15/821(P15829)** फीस रूपए (Fee Rs.) **50000/-** per year

M/s. Indian Oil Corporation Limited, BAGDOGRA AIR FILDS, DARJEELING, Bagdogra, Darjeeling Pulbazar, Taluka: Darjeeling Pulbazar, District: DARJEELING, State: West Bengal, PIN: 734421 को केवल इसमें यथा विनिर्दिष्ट वर्ग और मात्राओं में पेट्रोलियम **1010.00 KL** आयात करने के लिए और उसका, नीचे वर्णित और अनुमोदित नक्शा संख्या **P/HQ/WB/15/821(P15829)** तारीख **29/09/1980** जो कि इससे उपाबद्ध है, में दिखाए गए स्थान पर भण्डारकरण के लिए पेट्रोलियम अधिनियम, 1934 के उपबंधों या उसके अधीन बनाए गए नियमों तथा इस अनुज्ञप्ति की अतिरिक्त शर्तों के अधीन रहते हुए, यह अनुज्ञप्ति अनुदत्त की जाती है।

Licence is hereby granted to **M/s. Indian Oil Corporation Limited, BAGDOGRA AIR FILDS, DARJEELING, Bagdogra, Darjeeling Pulbazar, Taluka: Darjeeling Pulbazar, District: DARJEELING, State: West Bengal, PIN: 734421** valid only for the importation and storage of **1010.00 KL** Petroleum of the class and quantities as herein specified and storage thereof in the place described below and shown on the approved plan No **P/HQ/WB/15/821(P15829)** dated **29/09/1980** attached hereto subject to the provisions of the Petroleum Act, 1934 and the rule made thereunder and to the further conditions of this Licence.

यह अनुज्ञप्ति 31st day of December **2026** तक प्रवृत रहेगी।
The Licence shall remain in force till the 31st day of December **2026**

पेट्रोलियम का विवरण /Description of Petroleum	अनुज्ञप्त मात्रा (किलोलीटरों में) /Quantity licenced in KL
वर्ग क प्रपुंज पेट्रोलियम /Petroleum Class A in bulk	**NIL**
वर्ग क प्रपुंज पेट्रोलियम से भिन्न /Petroleum Class A, otherwise than in bulk	**NIL**
वर्ग ख प्रपुंज पेट्रोलियम /Petroleum Class B in bulk	**1010.00 KL**
वर्ग ख प्रपुंज पेट्रोलियम से भिन्न /Petroleum Class B, otherwise than in bulk	**NIL**
वर्ग ग प्रपुंज पेट्रोलियम /Petroleum Class C in bulk	**NIL**
वर्ग ग प्रपुंज पेट्रोलियम से भिन्न /Petroleum Class C,otherwise than in bulk	**NIL**
कुल क्षमता /Total Capacity	**1010.00 KL**

September 29, 1980

Chief Controller of Explosives

1). Amendment dated - 01/10/2013
2). Amendment dated - 07/02/2023

अनुज्ञप्त परिसरों का विवरण और अवस्थान
DESCRIPTION AND LOCATION OF THE LICENSED PREMISES

अनुज्ञप्त परिसर जिसकी विन्यास सीमाएं अन्य विशिष्टयां संलग्न अनुमोदित नक्शों में दिखाई गई है **Plot No: Airfield, BAGDOGRA, BAGDOGRA, Matigara, Taluka: Matigara, District: DARJEELING, State: West Bengal, PIN: 734421** स्थान पर अवस्थित है तथा उसमें निम्नलिखित **7 Under Ground tank(s) for CLASS B** सम्मिलित हैं।

The licensed premises, the layout , boundaries and other particulars of which are shown in the attached approved plan are situated at **Plot No: Airfield, BAGDOGRA, BAGDOGRA, Matigara, Taluka: Matigara, District: DARJEELING, State: West Bengal, PIN: 734421** and consists of **7 Under Ground tank(s) for CLASS B** together with connected facilities.

Note:-This is system generated document does not require signature.

Digitally signed by SHIVCHANDRA DAYAKANT MISHRA
Reason: Licence No. : P/HQ/WB/15/821
Location:Nagpur [P15829]

भारत सरकार
Government of India
वाणिज्य और उद्योग मंत्रालय
Ministry of Commerce & Industry
पेट्रोलियम तथा विस्फोटक सुरक्षा संगठन (पेसो)
Petroleum & Explosives Safety Organisation (PESO)
पाँचवा तल, ए-ब्लाक, सी.जी.ओ.कॉम्प्लेक्स, सेमिनरी हिल्स
नागपुर- 440006
5th Floor, A-Block, CGO Complex, Seminary Hills,
Nagpur - 440006

E-mail : explosives@explosives.gov.in
Phone/Fax No : 0712 -2510248, Fax-2510577

संख्या /No. : P/HQ/WB/15/821 (P15829)

दिनांक /Dated : 07/02/2023

सेवा में /To,

M/s. Indian Oil Corporation Limited,
BAGDOGRA AIR FILDS,
DARJEELING,
Bagdogra,
Darjeeling Pulbazar,
Taluka: Darjeeling Pulbazar,
District: DARJEELING,
State: West Bengal
PIN: 734421

विषय /Sub : Plot No, Airfield, BAGDOGRA, BAGDOGRA, Matigara, Taluka: Matigara, District: DARJEELING, State: West Bengal, PIN: 734421 में स्थित पेट्रोलियम वर्ग B अधिष्ठापन - पेट्रोलियम नियम 2002 के अंतर्गत प्रारूप XV में जारी अनुज्ञप्ति सं P/HQ/WB/15/821 (P15829) – संशोधन के संदर्भ में ।
Existing Petroleum Class B Installation at Plot No, Airfield, BAGDOGRA, BAGDOGRA, Matigara, Taluka: Matigara, District: DARJEELING, State: West Bengal, PIN: 734421- Licence No. P/HQ/WB/15/821 (P15829) - granted in form XV under Petroleum Rules 2002 - Amendment regarding

महोदय
/Sir(s),

कृपया आपके उपर्युक्त विषय से संबंधित पत्र संख्या OIN1248559 दिनांक 25/01/2023 का संदर्भ ग्रहण करें ।
Reference to your letter No. OIN1248559 dated 25/01/2023 on the above subject.

दिनांक 31/12/2026 तक वैध अनुज्ञप्ति संख्या P/HQ/WB/15/821 (P15829) दिनांक 07/02/2023 निम्नलिखित वर्ग एवं मात्राओं में पेट्रोलियम भंडारण के लिए यथा संशोधित कर इस पत्र के साथ लौटाई जा रही है ।
Licence No. P/HQ/WB/15/821 (P15829) dated 07/02/2023 valid upto 31/12/2026 is returned herewith duly amended with respect to Lay out Amendment, Capacity Amendment,

पेट्रोलियम का विवरण /Description of Petroleum	किलोलीटरों में अनुज्ञप्ति क्षमता /Quantity licenced in KL
वर्ग क प्रपुंज पेट्रोलियम /Petroleum Class A, in bulk	NIL
वर्ग क प्रपुंज पेट्रोलियम से भिन्न /Petroleum Class A, otherwise than in bulk	NIL
वर्ग ख प्रपुंज पेट्रोलियम /Petroleum Class B, in bulk	1010.00 KL
वर्ग ख प्रपुंज पेट्रोलियम से भिन्न /Petroleum Class B, otherwise than in bulk	NIL
वर्ग ग प्रपुंज पेट्रोलियम /Petroleum Class C, in bulk	NIL
वर्ग ग प्रपुंज पेट्रोलियम से भिन्न /Petroleum Class C,otherwise than in bulk	NIL
कुल क्षमता /Total	1010.00 KL

कृपया पावती दें।
Please acknowledge the receipt.

भवदीय /Yours faithfully,

((एस. डी. मिश्रा)
(Shivchandra D. Mishra))
विस्फोटक नियंत्रक
Controller of Explosives
कृते मुख्य विस्फोटक नियंत्रक
For Chief Controller of Explosives
नागपुर/Nagpur

Copy forwarded to :-
1. The D.M. , DARJEELING(West Bengal) with reference to his NOC No 173 Dated 17/03/1989
2. Jt. Chief Controller of Explosives, East Circle office, KOLKATA. A Copy of the licence along with approved plan is enclosed.

For Chief Controller of Explosives
Nagpur

Note:-This is system generated document does not require signature.
(अधिक जानकारी जैसे आवेदन की स्थिति, शुल्क तथा अन्य विवरण के लिए हमारी वेबसाइट : http://peso.gov.in देखें)
(For more information regarding status,fees and other details please visit our website: http://peso.gov.in)

Digitally signed by SHIVCHANDRA DAYAKANT MISHRA
Reason: Licence No. : P/HQ/WB/15/821
Location:Nagpur [P15829]

ANNEXURE 4: ENVIRONMENTAL STANDARDS

National Ambient Air Quality Standards

Sl.No.	Pollutants	Time weighted average	Concentration in ambient air		
			Industrial, Residential, Rural & Other Areas	Ecologically Sensitive Area (notified by Central Government)	Methods of Measurement
1	Sulphur Dioxide (SO_2), µg/m^3	Annual*	50	20	- Improved West & Gaeke
		24 hours**	80	80	- Ultraviolet fluorescence
2	Nitrogen Dioxides (NO_2), µg/m^3	Annual*	40	30	- Modified Jacob & Hochheiser (Na-Arsenite)
		24 hours**	80	80	- Chemiluminescence
3	Particulate Matter (size less than 10 µm) or PM10 µg/m^3	Annual*	60	60	- Gravimetric
					- TOEM
		24 hours**	100	100	- Beta attenuation
4	Particulate Matter (size less than 2.5 µm) or PM2.5 µg/m$_3$	Annual*	40	40	- Gravimetric
					- TOEM
		24 hours**	60	60	- Beta attenuation
5	Carbon Monoxide (CO) mg/m^3	8 hours**	2	2	- Non-Dispersive Infra Red (NDIR) Spectroscopy
		1 hour**	4	4	

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

*** 24 hourly /8 hourly values should be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days.*

Standard Soil Classification

Chemical Parameters	Ranking				
	Very Low	Low	Moderate	High	Very High
pH	<4, very Strongly Acidic	4-5, Strongly Acidic	5-8, Ideal for Plant Growth	8-9 Strongly Basic	>9 Very Strongly Basic
Electrical conductivity (µS/cm)	<2000, Non-saline	2000-4000 Saline	4000-8000 Moderately Saline	8000-16000 Highly Saline	>16000 Extremely Saline

Chemical Parameters	Ranking				
	Very Low	Low	Moderate	High	Very High
Total Nitrogen (%)	<0.05 Very Low	0.05-0.15 Low	0.15-0.25 Moderate	0.25-0.5 High	>0.5 Very High
Total Phosphorous (mg/kg)	<5 Very Low	5-10 Low	10-30 Moderate	30-60 High	>60 Very High
Sodium (mg/kg)	-	<200 Non Sodic	200-500 Moderate	>500 Sodic	
Potassium (mg/kg)	-	<150 Low	150-250 Moderate	250-800 High	>800 Very High
Calcium (mg/kg)	-	<1000 Low	1000-2000 Moderate	>2000 High	-
Magnesium (mg/kg)	<40 Very Low	40-100 Low	100-300 Moderate	>300 High	-
% Organic Matter	0.5-1.0 Very Low	1.0-2.0 Low	2.0-3.0 Moderate	3.0-5.0 High	>5 Very High

ANNEXURE 5: ANALYSIS METHODOLOGIES FOR WATER AND SOIL

A. Water

Sl. No	Parameters	Unit	Test Method	CLASS – C
1	Colour	Hazen	APHA 23rd EDITION 2120 C	300
2	Odour	-	APHA 23rd EDITION 2150 B	Not Specified
3	Taste	-	IS 3025 Part 8 (Reaff:2017)	Not Specified
4	Turbidity	NTU	IS : 3025 Part 10-1987 (Reaff: 2017)	1
5	pH at 25 °C	-	IS : 3025 Part 11- 1987 (Reaff: 2017)	6.5-8.5
6	Electrical Conductivity @25°C	µS/cm	IS : 3025 Part 14- 1987 (Reaff: 2019)	Not Specified
7	Total dissolved solids	mg/l	IS : 3025 Part 16-1987 (Reaff: 2017)	1500
8	Total Alkalinity as CaCO3	mg/l	IS : 3025 Part 23- 1987(Reaff:2019)	Not Specified
9	Total Hardness as CaCO3	mg/l	IS : 3025 Part 21-1987 (Reaff:2019)	Not Specified
10	Calcium as Ca	mg/l	IS : 3025 Part 40-1991 (Reaff:2019)	Not Specified
11	Magnesium as Mg	mg/l	APHA 22nd EDN-3500 Mg B	Not Specified
12	Chloride as Cl-	mg/l	IS : 3025 Part 32-1987 (Reaff: 2019)	600
13	Sulphate as SO4	mg/l	APHA 22nd EDN -4500-SO42- E	400
14	Nitrate as NO3	mg/l	APHA 23rd EDN -4500- NO3- B	50
15	Iron as Fe	mg/l	IS : 3025 Part 53-1987 (Reaff:2019)	50
16	Manganese as Mn	mg/l	APHA 23rd EDN -3111 B	Not Specified
17	Fluoride as F	mg/l	APHA 23rd EDN -4500-F B&D	1.5
18	Ammonia as N	mg/l	APHA 23rd EDN -4500- NH3 B&C	Not Specified
19	Barium as Ba	mg/l	APHA 23rd EDN -3111 D	Not Specified
20	Residual free Chlorine as Cl2	mg/l	APHA 23rd EDN -4500 Cl G	Not Specified
21	Sodium as Na	mg/l	IS : 3025 Part 45-1987 (Reaff:2019)	Not Specified
22	Potassium as K	mg/l	IS : 3025 Part 45-1987 (Reaff:2019)	Not Specified
23	Nickel as Ni	mg/l	APHA 23rd EDN -3111 B	Not Specified
24	Chloromines	mg/l	IS 3025 Part 26 (Reaff:2019)	Not Specified
25	Aluminium as Al	mg/l	IS:3025 Part:55-1987 (Reaff:2019)	Not Specified
26	Cadmium as Cd	mg/l	APHA 23rd EDN -3111 B	0.01
27	Lead as Pb	mg/l	APHA 23rd EDN -3111 B	0.1
28	Copper as Cu	mg/l	APHA 23rd EDN -3111 B	1.5
29	Zinc as Zn	mg/l	IS:3025 Part:49-1987 (Reaff:2019)	15
30	Total Chromium as Cr	mg/l	APHA 23rd EDN -3111 B	0.05
31	Arsenic as As	mg/l	APHA 23rd EDN -3113 B	0.2
32	Cyanide as CN	mg/l	APHA 22nd EDN -4500-CN E	0.05
33	Selenium as Se	mg/l	APHA 23rd EDN -3113 B	0.05
34	Mercury as Hg	mg/l	APHA 23rd EDN -3112B	0.005
35	Anionic Surfactants as MBAS	mg/l	APHA 23rd EDN 5540 C	1

Sl. No	Parameters	Unit	Test Method	CLASS – C
36	Phenolic Copounds as Phenol	mg/l	APHA 23rd EDN 5530 B,C	0.005
37	Total Nitrogen as N	mg/l	IS 3025 Part 34 (Reaff:2019)	Not Specified
38	Total Phosphorous	mg/l	IS 3025 Part 31 1988 (Reaff:2019)	Not Specified
39	Chemical Oxygen Demand	mg/l	IS 3025 Part 58 2006 Reaff:2017)	Not Specified
40	Dissolved Oxygen as O2	mg/l	IS 3025 Part 38 1989(Reaff:2019)	4
41	Biochemical Oxygen Demand @ 27 for 3 days	mg/l	IS 3025 Part 44 1993(Reaff:2019)	3
42	Sodium Absorbtion Ratio	mg/l	IS 11624: 1986 - RA: 2015	Not Specified
43	Mineral Oil *	mg/l	IS 3025 Part 39-1991 (Reaff:2019)	Not Specified
44	Poly Chlorinated Biphenyls (PCBs)	mg/l	APHA 23rd EDN -6630 B	Not Specified
45	Poly Nuclear Aromatic Hydrocarbon as PAH	mg/l	APHA 23rd EDN -6440 B	Not Specified
46	Bromoform	mg/l	APHA 23rd EDN -6200 B	Not Specified
47	Dibromochloromethane	mg/l		Not Specified
48	Bromodichloromethane	mg/l		Not Specified
49	Chloroform	mg/l		Not Specified
50	Total Coliforms	MPN/100ml	IS 1622: 1982 (RA 2019)	5000
51	E.Coli	MPN/100ml	IS 1622: 1982 (RA 2019)	Not Specified
52	DDT (Dichloro-Diphenyl-Trichloroethane)	mg/l	EPA 525.2	1
53	Lindane(γ-hexachlorocyclohexane)	mg/l		2
54	α-HCH	mg/l		0.01
55	β-HCH	mg/l		0.04
56	δ-HCH	mg/l		0.04
57	2, 4-dichlorophenoxyacetic acid	mg/l		30
58	Endosulphon	mg/l		0.4
59	Manocrotophos	mg/l		1
60	Ethion	mg/l		3
61	Chlorpyrifos	mg/l		30
62	Phorate	mg/l		2
63	Butalchlor	mg/l		125
64	Alachlor	mg/l		20
65	Atrazine	mg/l		2
66	Methyl Parathion	mg/l		0.3
67	Malathion	mg/l		190
68	Aldrin	mg/l		0.03

Source: ABC Techno Labs India Pvt. Ltd.

B. Soil

Sl. No	Parameters	Unit	Test Method
1	pH (1:5 Suspension)	-	IS -2720(Part 26) 1987(RA 2016)
2	Electrical conductivity (1:5 Suspension)	mS/cm	IS -14767:2000 (RA 2016)
3	Moisture	%	IS -2720(Part 2) 1987(RA 2015)
4	Bulk Density	g/cc	FAO Chapter 3, ABCTL/ SOIL/SOP 1
5	Water Holding Capacity	%	Soil Chemical Analysis By M. L. Jackson
6	Permeability	cm/hr	Soil Chemical Analysis By M. L. Jackson
7	Cyanide as CN	mg/kg	APHA 23rd Edn 4500 CN C & E
8	Acidity as CaCO3	mg/kg	APHA 23rd Edn 2310 B
9	Alkalinity as CaCO3	%	IS -3025 Par 23
10	Specific Gravity	-	IS -2720 -Part 3
11	Porosity	%	IS -2720 -Part 36
12	Infiltration Rate	mm/hr	Soil Chemical Analysis By M. L. Jackson
13	Total Nitrogen as N	Kg/ha	IS -14684:1999, Reaff:2008
14	Available Phosphorous	Kg/ha	FAO Chapter 3, ABCTL/ SOIL/SOP 2
15	Available Potassium	Kg/ha	FAO Chapter 3, ABCTL/ SOIL/SOP 7
16	Exchangeable Calcium as Ca	m.eq/100g	FAO Chapter 3, ABCTL/ SOIL/SOP 4
17	Exchangeable Magnesium as Mg	m.eq/100g	FAO Chapter 3, ABCTL/ SOIL/SOP 5
18	Exchangeable Sodium as Na	m.eq/100g	FAO Chapter 3, ABCTL/ SOIL/SOP 6
19	Cation Exchange Capacity, m.eq/100g	m.eq/100g	IS -2720(Part 24) (RA 2015)
20	Organic Carbon	%	IS 2720 (Part 22):1972 (RA 2015)
21	Organic matter	%	
22	Texture Classification		Robinson Pipette Method
	Sand	%	
	Clay	%	
	Silt	%	
23	Copper as Cu	mg/kg	EPA 3050 B & 7000B
24	Zinc as Zn	mg/kg	
25	Manganese as Mn	mg/kg	
26	Nickel as Ni	mg/kg	
27	Iron as Fe	mg/kg	
28	Lead as Pb	mg/kg	
29	Cadmium as Cd	mg/kg	
30	Chromium as Cr3+	mg/kg	By Calculation
31	Chromium as Cr6+	mg/kg	EPA 7196 A
32	Antimony as Sb	mg/kg	EPA 3050 B & 7000B
33	Arsenic as As	mg/kg	
34	Barium as Ba	mg/kg	
35	Cobalt as Co	mg/kg	
36	Molybdenum as Mo	mg/kg	
37	Mercuryas Hg	mg/kg	EPA 7471A
38	Sodium absorbtion ratio	-	By Calculatuion
39	Boron as B	mg/kg	ABCTL/SOP/ S/13
40	Chloride as Cl	mg/kg	IS -3025 Par 32
41	Sulphate as SO4	mg/kg	IS -2720 -Part 27
42	Carbonate as CO3	%	Titration with Acid

Source: ABC Techno Labs India Pvt. Ltd.

ANNEXURE 6: NABL CERTIFICATE OF ABC TECHNO LABS INDIA PVT. LTD.

National Accreditation Board for Testing and Calibration Laboratories

CERTIFICATE OF ACCREDITATION

ABC TECHNO LABS INDIA PRIVATE LIMITED

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

ABC TOWER, NO:400,13TH STREET, SIDCO INDUSTRIAL ESTATE-NORTH PHASE, AMBATTUR, CHENNAI, THIRUVALLUR, TAMIL NADU, INDIA

in the field of

TESTING

Certificate Number: TC-5770

Issue Date: 03/04/2020 Valid Until: 02/04/2022

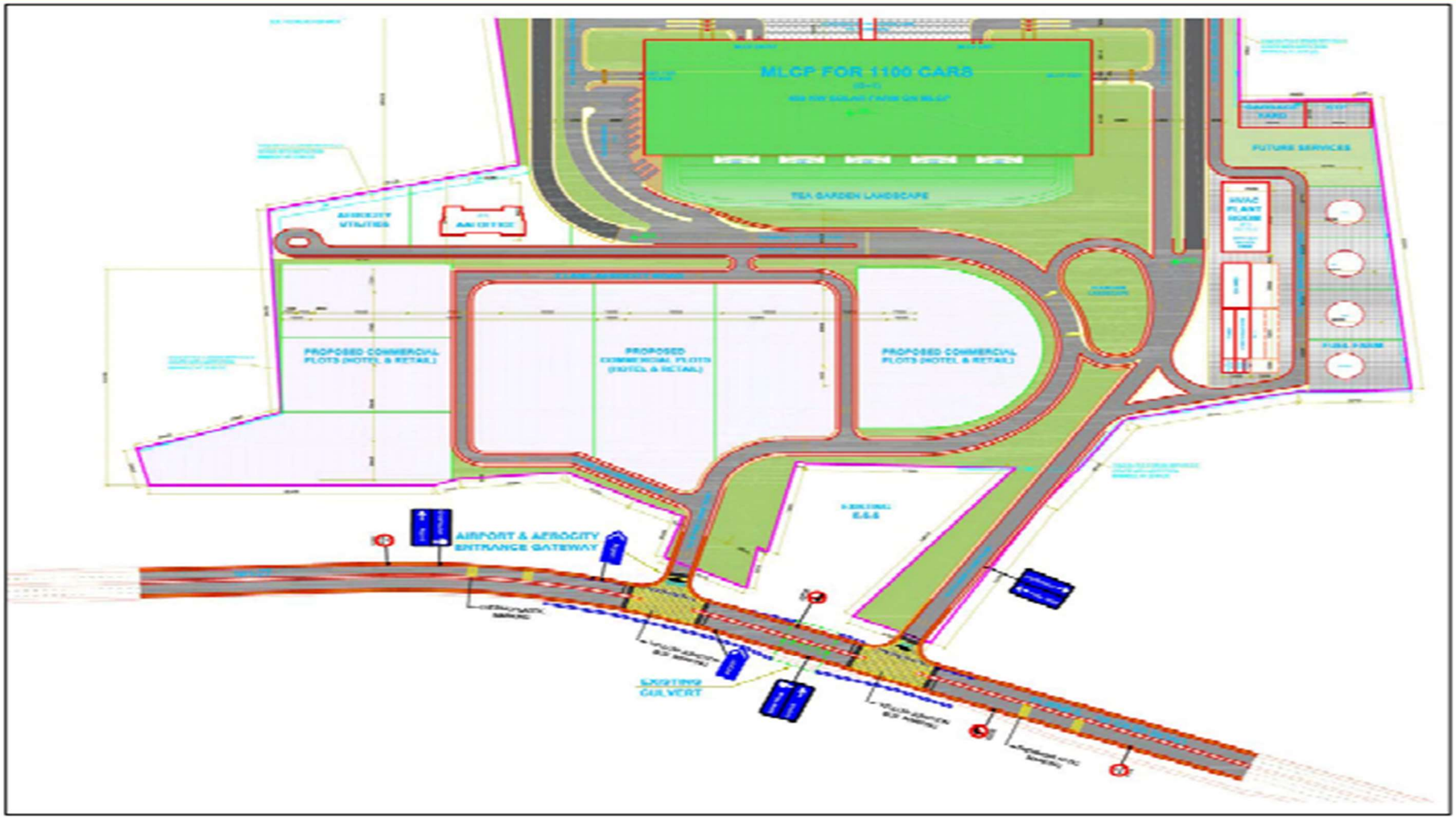
This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.

(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

ANNEXURE 7: TRAFFIC MANAGEMENT PLAN.



ANNEXURE 8: LAND DOCUMENT

GOVERNMENT OF WEST BENGAL
OFFICE OF THE BLOCK DEVELOPMENT OFFICER
PHANSIDEWA DEVELOPMENT BLOCK
E-mail: bdophansidewa@gmail.com, Phone & Fax No.: 0353-2587342

MEMO NO: 1807 /Dev/Phd. **DATE:-11/10/2023**

To,
The Air Officer Commanding
Air Force Station,
20; wing Bagdogra
Bagdogra.

Sub:- Avation NOC for New Civil Enclive at Bagdogra Airport

The undersigned would like to inform you the the location of the site of the proposed New Civil Enclive at Bagdogra Airport (Total Hight - 45.00 Mtr.), (1)Land schedule.- 3.52 Acre, Mouza.- Abihiram, J.L. No.- 67, Plot No.- 106,92,103,&96(RS), 143,123,140,129,125,139,141,143/347(LR), Khatian No.- 423,422,409(LR OLD), 559(LR NEW) and (2)Land schedule.- 5.93 Acre, Mouza.- Abihiram, J.L. No.- 67, Plot No.- 271(PT) with another Mouza.- Turivita, J.L. No.- 68, Plot No.- 152(PT) and (3)Land schedule.- 95.20 Acre, Mouza.- Abihiram, J.L. No.- 67, Plot No.- 154/271, 154/272, 157/273,157/274,157/275,337,335,333,94,101,88/269,&93(RS), 88/362,122/364,439,440, 444,137,138,123,350 &124(LR) at Bagdogra Airport, P.O.+P.S..- Bagdogra, District.- Darjeeling, of Airports Authority Of India, Represented by - Sri. Bhudeb Sarkar, JGM(Engg-C), Office of Airport Director, Bagdogra Airports, Airports Authoritu Of India, District Darjeeling, Pin.-734121, having the following Geographical position as mentioned hereunder as per documents submitted by the above said agency. The documents are enclosed herewith for your information and taking necessary action.

Aviation N.O.C may be issued to the concerned agency as if possible.

1. Latitude of the Site : 26°-40'-13.72" (N)
2. Longitude of the Site : 88°-19'-19.38" (E)
3. Distance from Airport : 1.657 KM.
4. Angel / Bearing of the Site : 210°-53'-13.60"
5. Elevation of the Site : 117.874 Mtr.

11/10/23
Block Development Officer
Phansidewa Development Block
Block Development Officer
Phansidewa Development Block
Phansidewa, District - Darjeeling
&
Executive Officer
Phansidewa Panchayat Samity

Office Of The
Hetmuri Singhijhora Gram Panchayat
P.O. – Tarbandha :: Dist- Darjeeling

Email Id :: pradhan.hetmurisinghijhora@gmail.com

Memo No: 551/HSGP/2023 **Date : 27/09/2023**

To whom it may concern

This is to state that our Gram Panchayat has no objection if ground water is extracted for the proposed New Civil Enclave of Airports Authority of India at Bagdogra Airport, PS– Bagdogra, PO- Bagdogra, Dist – Darjeeling in the premises whose Land Schedule is given below.

Land Schedule: (3.52 Acres)

Plot No: 106, 92,103 & 96(RS), 143, 123, 140, 129, 125 139, 141 & 143/347 (LR)
,Khatian No: 423, 422, 409(LR OLD), 559(LR NEW),

Mouza: ABHIRAM
JL No: 67
PS: BAGDOGRA
Dist: DARJEELING

Land Schedule: (5.93 Acres)

Plot no : 271 (PT)
JL No : 67
Mouza : ABHIRAM
PS: BAGDOGRA
Dist: DARJEELING

Plot no: 152 (PT)
JL No: 68
Mouza: TURIVITA
PS: BAGDOGRA
Dist: DARJEELING

Land Schedule:(95.20 Acres)

Plot No : 154/271, 154/272, 157/273,157/274,157/275 337, 335, 333, 94, 101 88/269, 93 (RS)
88/362, 122/364, 439, 440, 444, 137, 138, 123/350, 124 (LR)
Mouza: ABHIRAM
PS: BAGDOGRA
Dist: DARJEELING

Pradhan 22.09.23
Hetmuri Singhijhora Gram Panchayat

Pradhan
Hetmuri Singhijhora Gram Panchayat

ANNEXURE 9: TREE FELLING DOCUMENT

Form I (C)

****Certificate in connection with Felling / Disposing of trees(s) in Non-forest areas by Panchayat / Municipality / Municipal corporation / Others**

[See rules 4 (3) (e)]

(1) This is to certify that ~~Shri / Smt. / Ms~~. / Organization/ **AIRPORTS AUTHORITY OF INDIA** Village/~~Road /Street/Ward No~~ **Abhiram & Turivita** Police Station **Bagdogra** . District **Darjeeling** Pin **734014** has applied to the competent authority to fell/dispose of **1740** No. of tree(s) from ~~his / her~~ / their own /leased land bearing plot No. **RS plot no - 106, 92, 103, 96, 154/271,154/272, 157/273, 157/274,157/275, 337, 335, 323, 94, 101, 102, 88/269, 93(Abhiram). CS plot no – 271(PT), 152(PT)** J. L. No **67 & 68** Mouza/~~Ward No~~. **Abhiram & Turivita** Police Station **Bagdogra** Panchayat / ~~Block /Municipality / Municipal Corporation / Others~~ **Hetmuri Singhijhora** District **Darjeeling**.

(2) The above application is recommended *

(3) The above application is not recommended for the following reasons * .

(i)

(ii)

(iii)

27.09.23

Signature ..**Pradhan Hetmuri Singhijhora Gram Panchayat P.O. Tarbandha, Dist. Darjeeling**

Name in Full:

Designation:

Seal :

Place :
Date :

- * Please strike out which ever is not applicable.
- ** The Certificate may be issued by the Pradhan, Chairman, Municipal commissioner of concerned Gram Panchayat, Municipality, Municipal corporation or by the concerned authority of notified area authority, Industrial Township etc. respectively.

ANNEXURE 10: HYDROGEOLOGICAL STUDY REPORT

Report
On
Hydrological Investigation
Using Electrical Resistivity Survey
For Ground Water
Exploration
For
Development of
New Civil Enclave
At
Bagdogra Airport, West Bengal.
(W.O. No. - GEPL / Bagdogra / 2023 / 331;
Dated : 02.05.2023)

Name of Client

C.P. KUKREJA ARCHITECTS
Ashirwad Building, D - 1,
Green Park, New Delhi - 110 016.

Name of Testing Agency

GEOTEST ENGINEERS PVT. LTD.
(An ISO 9001 : 2015 Certified Company)
(WITH NABL ACCREDITED SOIL LABORATORY)
Soil Investigators, Foundation Consultants & Land Surveyors
6A, Milan Park, Kolkata - 700 084.
Phone : 91-33-2430-3494 / 8103 / 9717
email : geotest.engineers@gmail.com
website : www.geotestengg.in

REPORT NO. : GT / CP / 21 A / 2023 - 2024

REPORT SHEET

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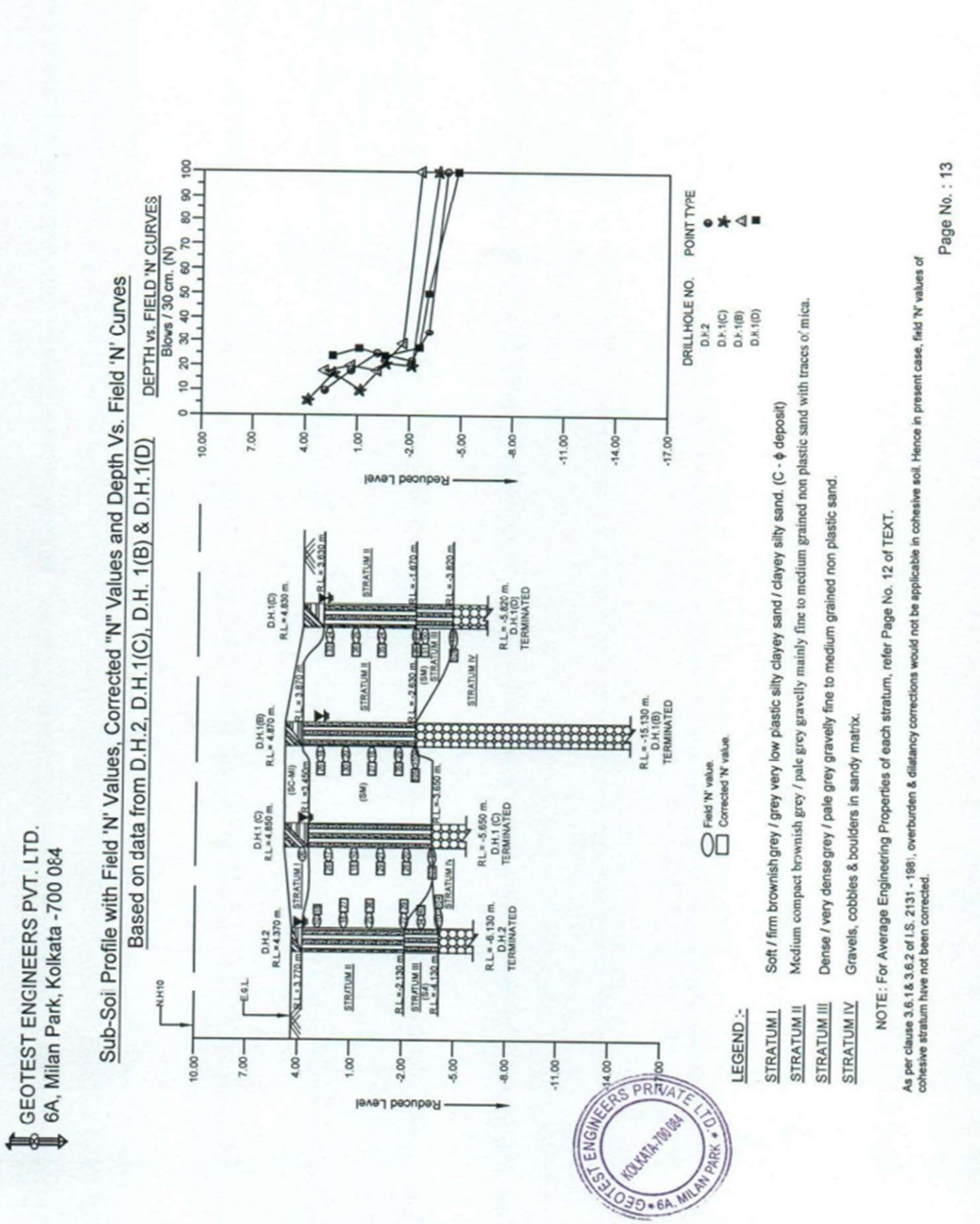
Soil Investigators & Land Surveyors
Ph. : 91-33-2430 3494 / 8103 / 9717



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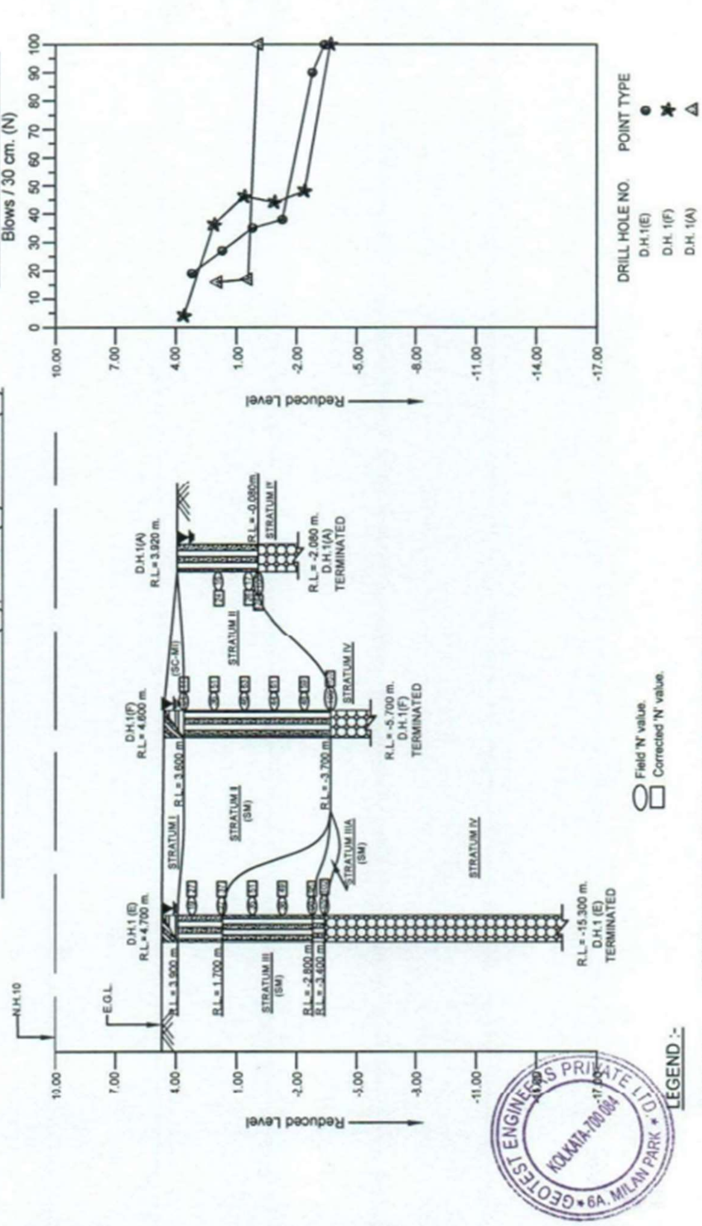
6A, Milan Park, Kolkata -700 084

Sub-Soil Profile with Field 'N' Values, Corrected "N" Values and Depth Vs. Field 'N' Curves



LEGEND :-

STRATUM I — Soft / firm brownish grey / grey very low plastic silty clayey sand / clayey silty sand. (C - φ deposit)

STRATUM II — Medium compact brownish grey / pale grey gravelly mainly fine to medium grained non plastic sand with traces of mica.

STRATUM III — Dense / very dense grey / pale grey gravelly fine to medium grained non plastic sand.

STRATUM IIIA — Very dense brownish grey / grey gravelly sand.

STRATUM IV — Gravels, cobbles & boulders in sandy matrix.

NOTE : For Average Engineering Properties of each stratum, refer Page No. 12 of TEXT.

As per clause 3.6.1 & 3.6.2 of I.S. 2131 - 1981, overburden & dilatancy corrections would not be applicable in cohesive soil. Hence in present case, field 'N' values of cohesive stratum have not been corrected.

Page No. : 12

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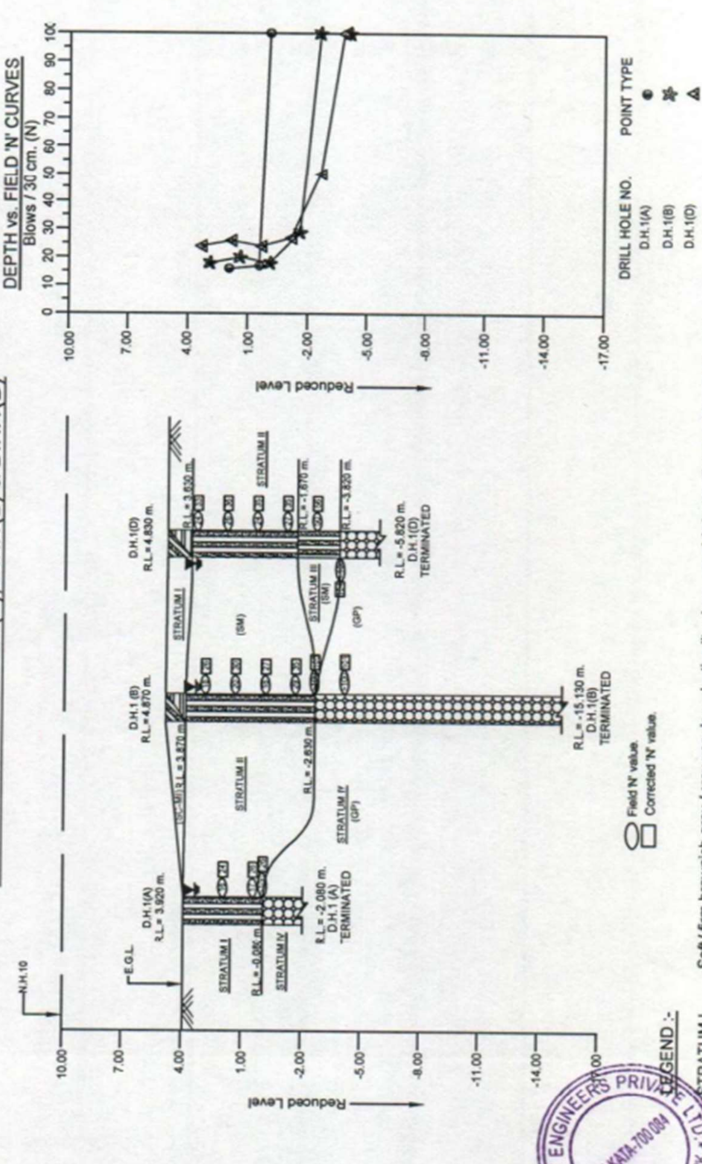
GEOTEST ENGINEERS PVT. LTD.
6A, Milan Park, Kolkata -700 084

Sub-Soil Profile with Field 'N' Values, Corrected "N" Values and Depth Vs. Field 'N' Curves

Based on data from D.H.1(A), D.H.1(B) & D.H.1(D)



LEGEND :-

STRATUM I Soft / firm brownish grey / grey very low plastic silty clayey sand / clayey silty sand. (C - ϕ deposit)

STRATUM II Medium compact brownish grey / pale grey gravelly mainly fine to medium grained non plastic sand with traces of mica.

STRATUM III Dense / very dense grey / pale grey gravelly fine to medium grained non plastic sand.

STRATUM IV Gravels, cobbles & boulders in sandy matrix.

NOTE : For Average Engineering Properties of each stratum, refer Page No. 12 of TEXT.

As per clause 3.6.1 & 3.6.2 of I.S. 2131 - 1981, overburden & dilatancy corrections would not be applicable in cohesive soil. Hence in present case, field 'N' values of cohesive stratum have not been corrected.

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Page No. : 11

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GEOTEST ENGINEERS PVT. LTD.
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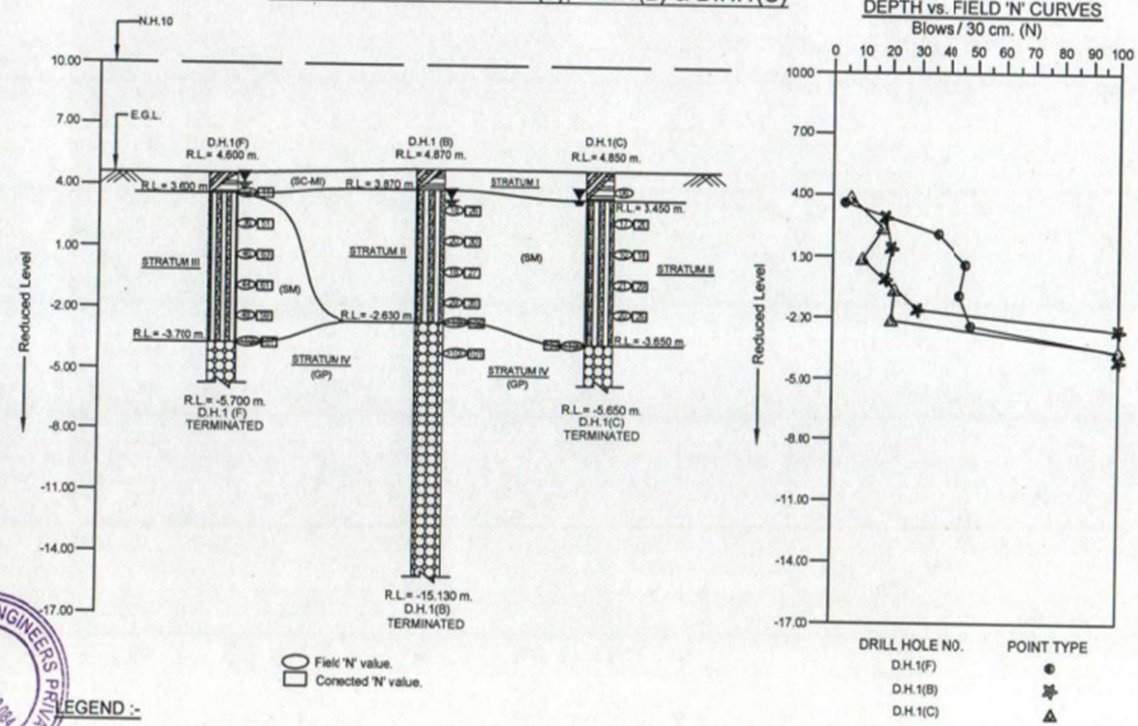
Sub-Soil Profile with Field 'N' Values, Corrected "N" Values and Depth Vs. Field 'N' Curves

Based on data from D.H.1(F), D.H.1(B) & D.H.1(C)



LEGEND :-

STRATUM I	Soft / firm brownish grey / grey very low plastic silty clayey sand / clayey silty sand. (C - φ deposit)
STRATUM II	Medium compact brownish grey / pale grey gravelly mainly fine to medium grained non plastic sand with traces of mica.
STRATUM III	Dense / very dense grey / pale grey gravelly fine to medium grained non plastic sand.
STRATUM IV	Gravels, cobbles & boulders in sandy matrix.

NOTE : For Average Engineering Properties of each stratum, refer Page No. 12 of TEXT.

As per clause 3.6.1 & 3.6.2 of I.S. 2131 - 1981, overburden & dilatancy corrections would not be applicable in cohesive soil. Hence in present case, fied 'N' values of cohesive stratum have not been corrected.

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Page No. : 10

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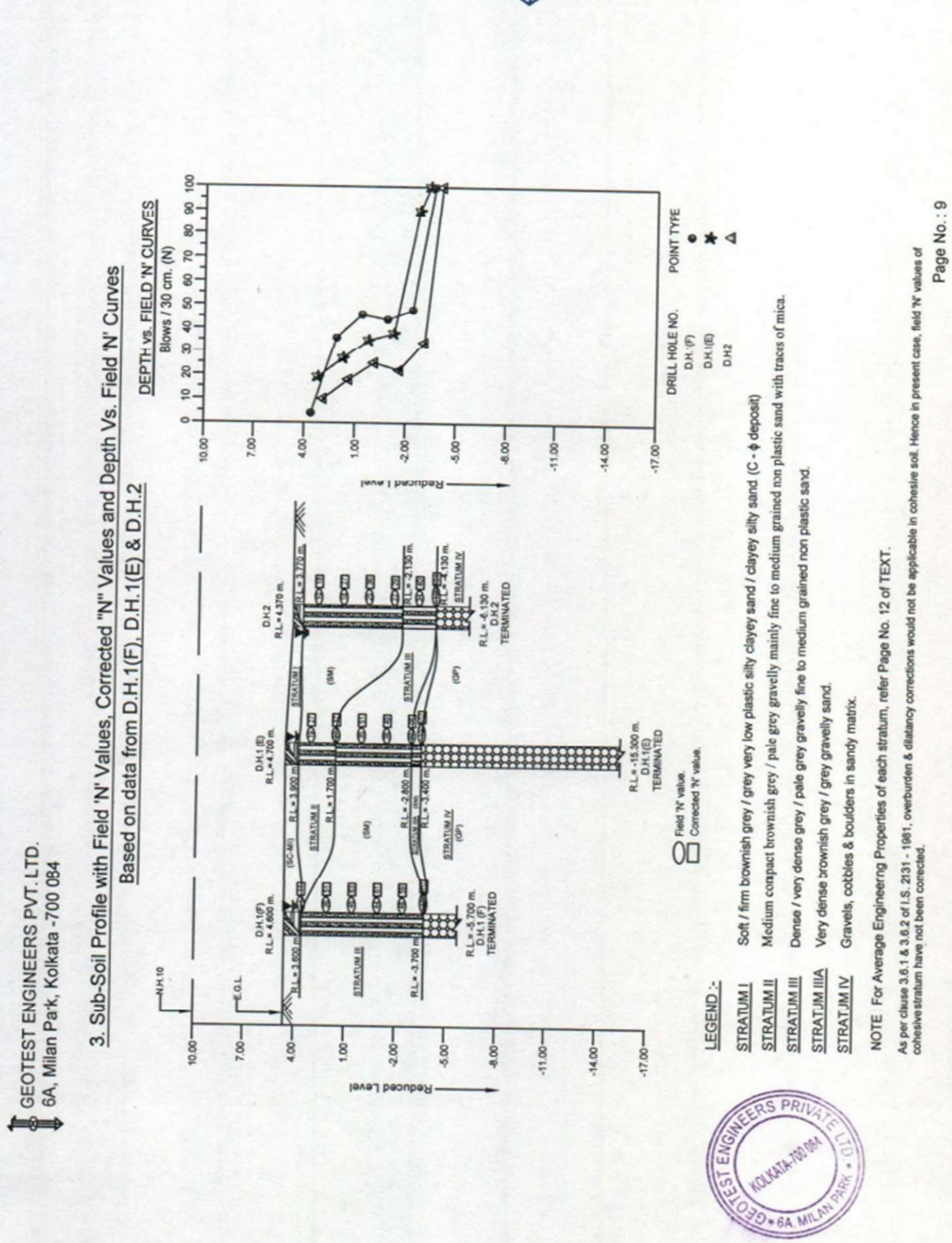

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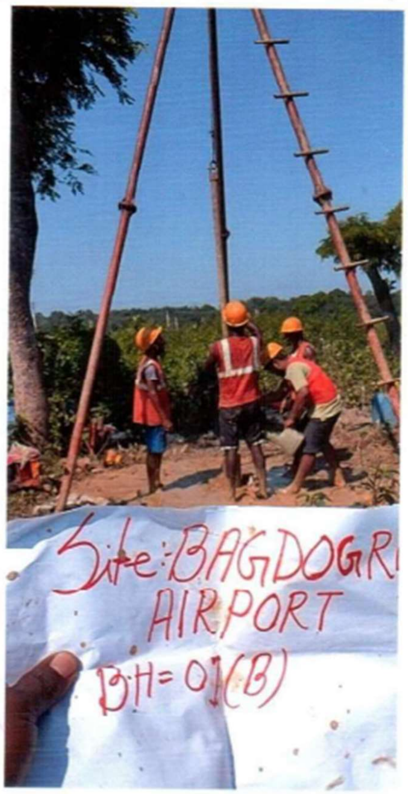

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::7::

2. Field Investigation Photograph

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TABLE - 2

D.H. No.	POSITION OF GROUND WATER TABLE BELOW E.G.L. (M.)																					
	27.05.2023	28.05.2023	29.05.2023	30.05.2023	31.05.2023	01.06.2023	02.06.2023	03.06.2023	04.06.2023	05.06.2023	06.06.2023	07.06.2023	08.06.2023	09.06.2023	10.06.2023	11.06.2023	12.06.2023	13.06.2023	14.06.2023	15.06.2023	16.06.2023	17.06.2023
1(A)	0.60	0.60	0.60	0.60	0.60	0.60	0.55	0.55	0.55	0.55	0.55	0.50	0.50	0.50	0.50	0.35	0.30	0.20	0.20	0.20	0.10	010
1(B)	-	-	-	-	-	-	-	-	-	-	1.50	1.50	1.50	1.47	1.47	1.45	1.45	1.40	1.40	1.40	1.35	135
1(C)	-	-	-	-	-	-	-	-	-	-	-	-	1.40	1.40	1.40	1.40	1.35	1.35	1.30	1.25	1.25	125
1(D)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.45	1.45	1.40	1.40	1.35	1.35	1.35	135
1(E)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.60	0.60	060
1(F)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	050
2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.70	0.50	0.50	0.40	0.40	040

Page No. - 6

For and on behalf of GEOTEST ENGINEERS PVT. LTD

[ALOK ROY]
B.E. (CIVIL), MCE (SOIL MECH. and FOUNDN. ENGG.)
MASCE, MIE, MIGS, M.I.P.H.E., M.A.C.I. (I), C. Eng. (I)
Chartered Engineer (I), Reg.No. M128469 – 4.
Director.

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7 (seven) numbers of drillholes were sunk during geotechnical investigation & ground water level observation was made during boring in the drillholes 24 hours of completion of boreholes.

During the period of field work from 21.05.2023 to 16.06.2023, the ground water levels were recorded and have been presented in Tabular form in the next page:

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: : 4 : :

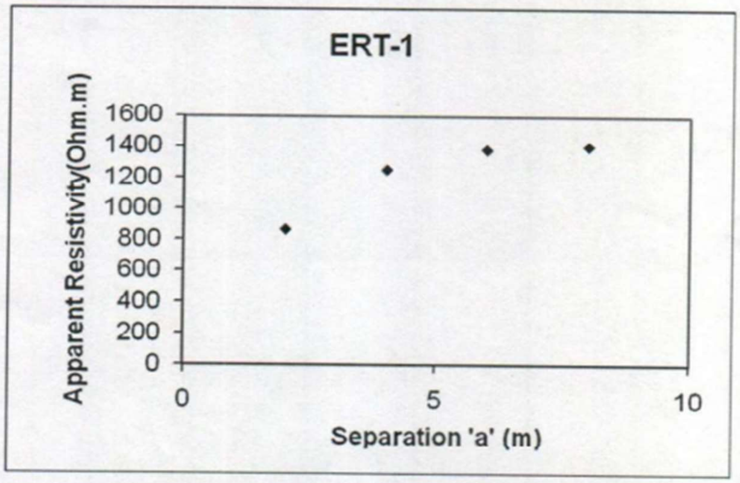
TABLE - 1

SUMMARIZED APPARENT RESISTIVITY VALUES AT BAGDOGRA AIRPORT

Location: ERT1 **DATE:** 14.6.2023

SL No	a (m)	Apparent Resistivity (ohm.m) N-S	Apparent Resistivity (ohm.m) E-W	Apparent Resistivity (ohm.m) NE-SW	Apparent Resistivity (ohm.m) NW-SE	Mean resistivity (ohm.m)
1.	2	847.95	879.19	868.59	851.97	861.93
2.	4	1241.53	1268.67	1257.0	1235.91	1250.78
3.	6	1375.31	1395.27	1391.68	1364.29	1381.64
4.	8	1390.98	1416.82	1413.04	1388.98	1402.46

Mean resistivity at the point is 1224.20 Ohm.m



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KOLKATA-700 084
6A, MILAN PARK

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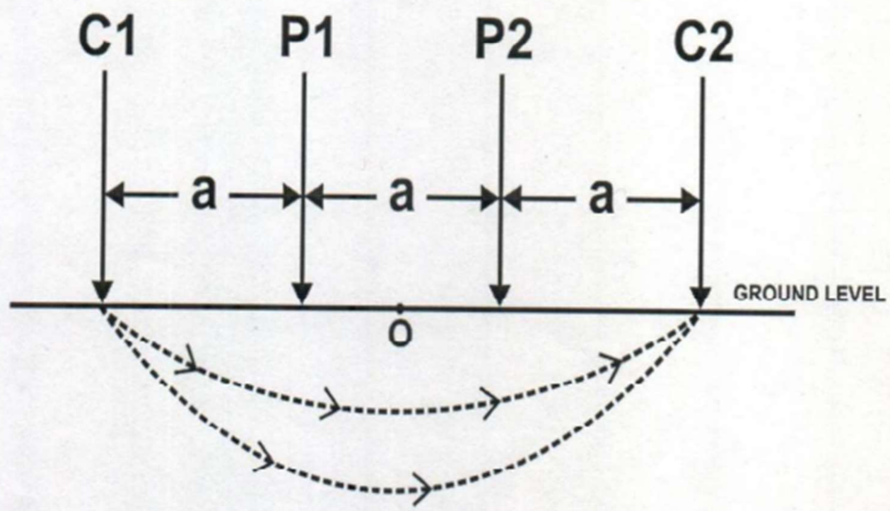
Soil Investigators & Land Surveyors
Ph. : 91-33-2430 3494 / 8103 / 9717

: : 3 : :

ELECTRODE CONFIGURATION IN WENNER METHOD



C1, C2 CURRENT ELECTRODES

P1, P2 POTENTIAL ELECTRODES

GEOTEST ENGINEERS PRIVATE LTD. KOLKATA-700 084 6A, MILAN PARK

REPORT SHEET
(An ISO 9001 : 2015 Certified Company with NABL accredited Soil Laboratory Certificate No. - TC-8297)

geotest ENGINEERS PVT. LTD.
Soil Investigators & Land Surveyors
Ph. : 91-33-2430 3494 / 8103 / 9717

::2::

1. Earth Resistivity Test Results, Curves & Data Sheets

Soil resistivity survey (ERT Test) was carried out on 14.6.23 in the Bagdogra airport site, Darjeeling district, West Bengal following IS code 3043(1987) and using a resistivity meter (model DDR3, GEOSENSORS make). The survey was carried out, using Indian Standards code with four electrodes following an arrangement commonly known as Wenner arrangement in Geophysical Resistivity Survey or Soil Resistivity Survey. In this method all four electrodes are placed on one line on the ground, the outer two electrodes are used for sending current, whereas the inner ones are used for measuring potential difference. The distances between each of the consecutive electrodes (a) is kept constant and is progressively varied to reach the depth at which resistivity information is wanted. Suitable electrode spacing determines the conductivity of the top soil as well as the various subsurface layers occurring in the area under study. At each location (centre point), 2 sets of observations are taken for each electrode spacing (a). In each of the E-W, N-S, NE-SW and NW-SE directions. four different electrode spicing, viz a = 2m, 4m, 6m, and 8m have been tried to know the nature of change of resistivity with depth.

The mean value of the apparent resistivity is determined by the formula
$\rho = 2\pi aR$ (= ρ_a, *in case of inhomogeneous medium)*
Where a = distance between the two consecutive electrodes &
ρ *(Apparent resistivity) corresponds to a point at the centre of electrode spread.*
R = Observed resistance.

GEOTEST ENGINEERS PRIVATE LTD. KOLKATA-700 084 6A, MILAN PARK

The mean value of the resistivity estimated was taken as the representative one. Summarized result of the resistivity measurements in the area is given in the following table.

It may be indicated here that in case of highly resistive formations, current penetrates much deeper into the earth than when the subsurface formations are conducting. Further, in the present investigation (as per IS code) only apparent resistivity is measured which may be taken (as a first approximation) as the weighted average of the true resistivity of the subsurface formations in which current lines flow.

ANNEXURE 11: GARBAGE DISPOSAL CONTRACT

भारतीय विमानपत्तन प्राधिकरण/AIRPORTS AUTHORITY OF INDIA
विमानपत्तन निदेशक का कार्यालय/OFFICE OF THE AIRPORT DIRECTOR
बागडोगरा कास्टम हवाई अड्डा/BAGDOGRA CUSTOMS AIRPORT
जिला: दार्जिलिंग/Dist-DARJEELING, पिन:734421/PIN-734421
Phone: 0353-2698431, Fax: 0353-2698317

Ref no. AAI/BD/COMML/GARBAGE DISPOSAL/AWARD/1842-1849 Date 14.09.2022

To,
M/s Madhwa Enterprises,
Avtar Marriage Lawn, Geeta Ashram,
Amousi Road,Sarojini Nagar,
Lucknow, Uttar Pradesh-226008.

Sub: Award of License for Garbage Disposal Contract at Bagdogra Airport.
Ref: E-bid no. 2022_AAI_124846_1 dated 05.08.2022.

Sir,

Reference may please be made to Tender Notice No. AAI/BD/COMML/GARBAGE DISPOSAL dated 05.08.2022 and E-bid no. 2022_AAI_124846_1 for the subject facility at Bagdogra Airport. The Competent Authority is pleased to award the license of Garbage Disposal Contract at Bagdogra Airport to **M/s Madhwa Enterprises** subject to following terms and conditions.

1. The period of licence shall be for **03 (three) years** from the date of commencement of contract or expiry of gestation period whichever is earlier. In case if required, the Airport Director/ In charge feel that due to expected construction activity within the existing building or plan for construction of new terminal has already been approved, then the time frame can be reduced suitably.

2. License fee for this contract is **Rs.18,551/- (Rupees Eighteen Thousand Five Hundred Fifty One only)** per month plus applicable taxes.

3. **Rate of Escalation:**

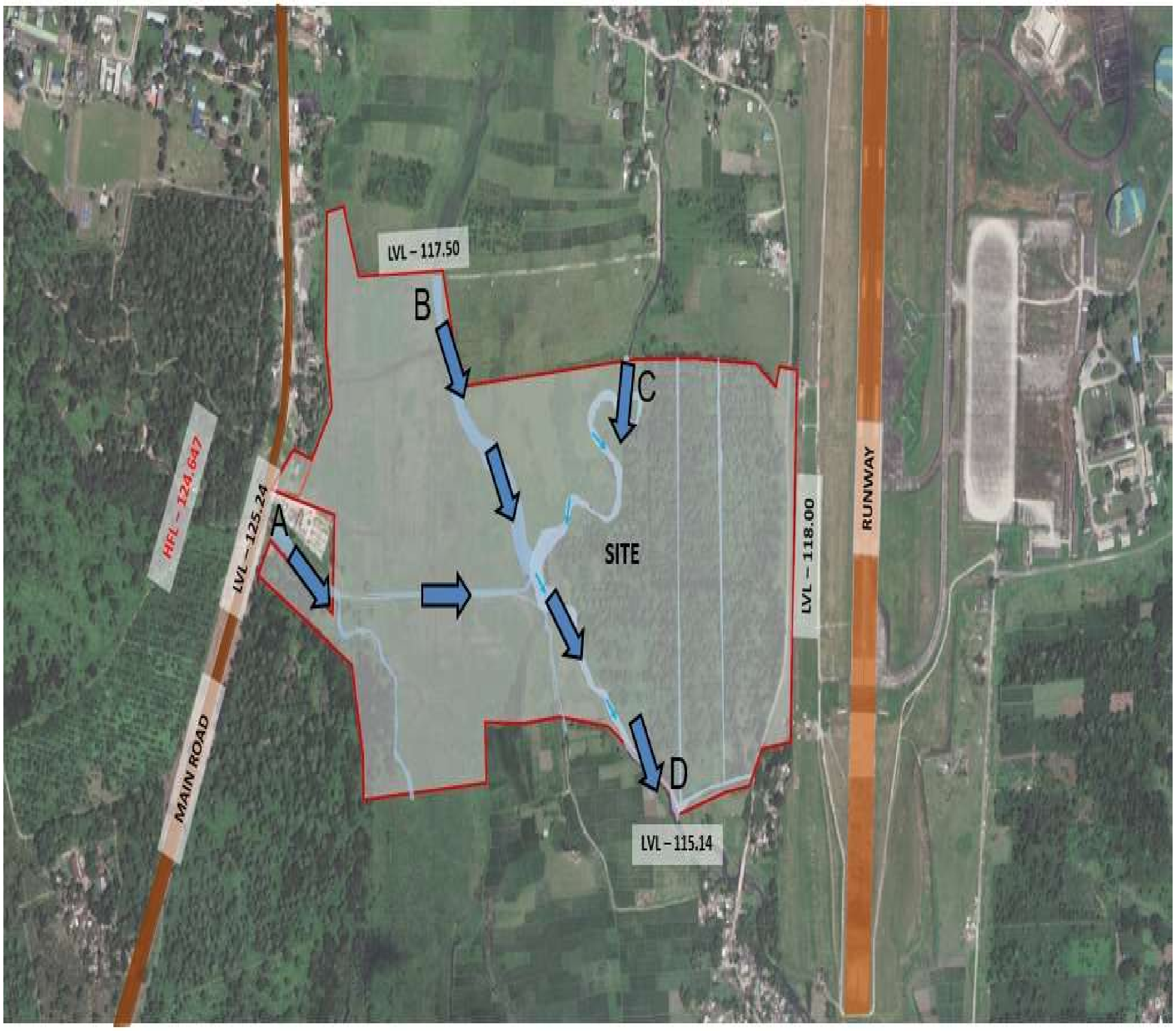
Sl. No.	Year	Licence fee per month.
1	1st year	**Rs.18,551/- per month plus applicable taxes.**
2	2nd year	**Rs.20,406/- per month plus applicable taxes**
3	3rd year	**Rs.22,447/- per month plus applicable taxes.**

4. AAI shall raise bill on or before 10th of every month. The concessionaire has to make payment of License Fees etc. by 25th of the same month, failing which interest on delayed payment at the rate of 9% per annum shall be charged from the due date for delay period of up to 30 days and if delay is for more than 30 days, then interest at the rate of 18% per annum shall be charged from the due date, for entire delay period.

5. Business incubation period shall mean a period of **15 days** from the date of issuance of LOIA to the selected bidder. The selected bidder will be under obligation to complete all the formalities/conditions of award as will be specified in the LOIA.

ANNEXURE 12: WATER CANAL RE-ORIENTATION

01. EXISTING SITE CONDITION



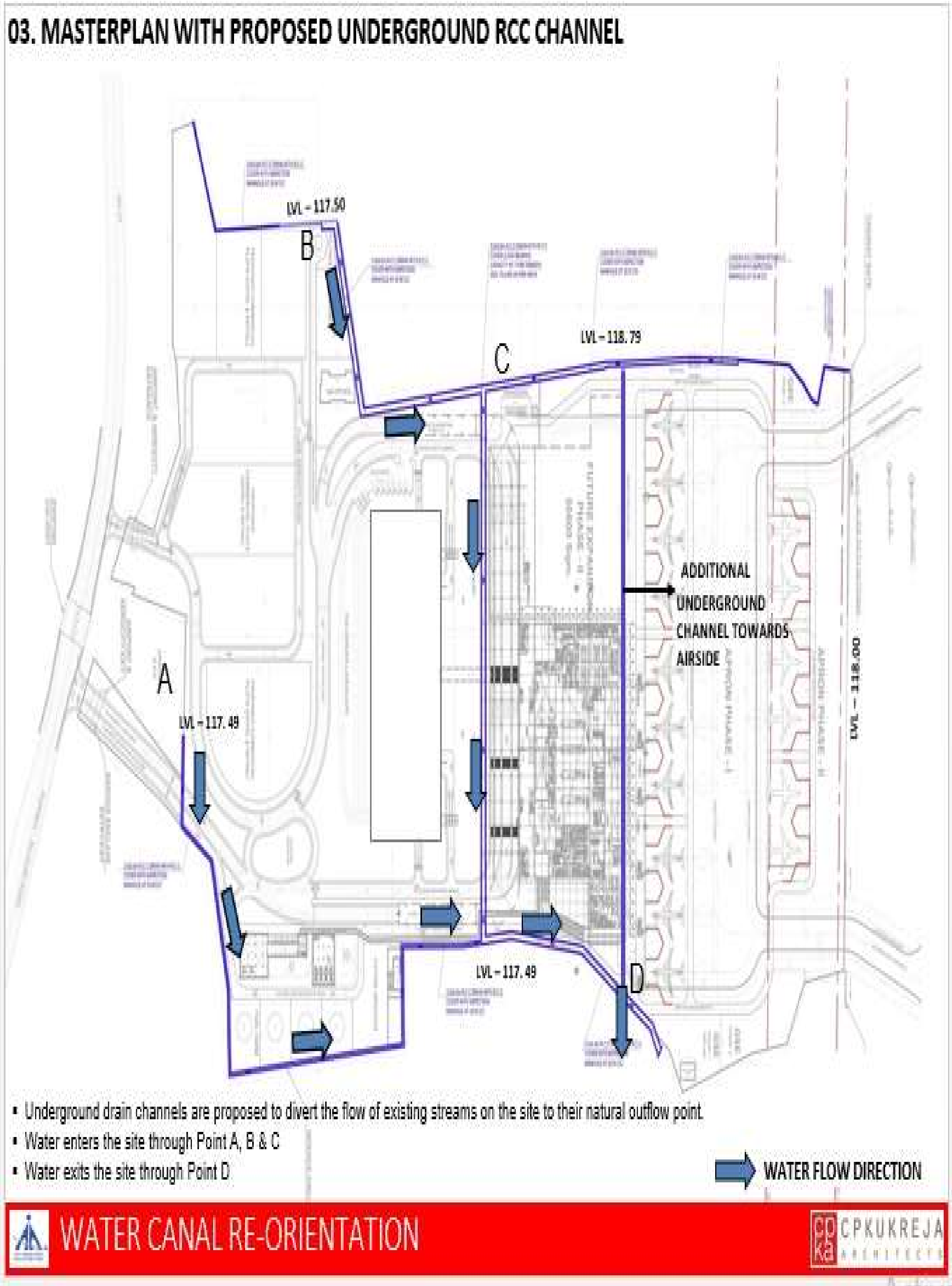
- Water enters the site through Point A, B & C
- Water exits the site through Point D

WATER FLOW DIRECTION

SITE BOUNDARY

WATER CANAL RE-ORIENTATION

CPKUKREJA ARCHITECTS


03. MASTERPLAN WITH PROPOSED UNDERGROUND RCC CHANNEL
LVL – 117.50
B
LVL – 118. 79
C
ADDITIONAL UNDERGROUND CHANNEL TOWARDS AIRSIDE
A
LVL – 117. 49
LVL – 117. 49
D
LVL – 118.00
▪ Underground drain channels are proposed to divert the flow of existing streams on the site to their natural outflow point.
▪ Water enters the site through Point A, B & C
▪ Water exits the site through Point D
WATER FLOW DIRECTION
WATER CANAL RE-ORIENTATION
CPKUKREJA ARCHITECTS

ANNEXURE 13: LANDSCAPE DESIGN