

# ENVIRONMENTAL CLEARANCE

{Cat. B1 under Item 7 (a)' Airports}

## ENVIRONMENTAL IMPACT ASSESSMENT

### Expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion of Terminal Building & Apron And Other Allied Works

**Baseline Data Collection :**

1<sup>st</sup> March to 31<sup>st</sup> May 2025



August 2025

**Project Proponent**



**Airports Authority of India  
Barapani Airport.  
Umroi, Shillong  
Meghalaya**

**NABET Accredited EIA Consultant**



**ABC Techno Labs India Private Limited**  
ABC Tower, #400, 13th Street, Godrej Rd, North  
Phase, Ambattur, Chennai, Tamil Nadu 600098  
+91 94442 60000, 9566187777  
[www.abctechnolab.com](http://www.abctechnolab.com)

**NABET Certificate : NABET/EIA/2225/RA 0290**

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### EIA Consultant Undertaking

[in compliance with MoEF Office Memorandum No. J-11013/41/2006-IA.II (I) dated 04.08.2009]

M/s. Airports Authority of India (AAI), proposes the Expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion of Terminal Building & Apron and Other Allied Works at Shillong, Meghalaya.

The Proposal requires prior EC under EIA Notification under Sl. No.7(a)-Category 'B1', as amended. Accordingly, the ToR Application has been submitted to SEIAA Meghalaya and the ToR vide File No. ML/SEAC/SEIAA/PP/RB/105/2025 dated 01.08.2025 has been awarded for the preparation of the EIA report.

The EIA Consultant, M/s. ABC Techno Labs India Private Limited, Chennai has been accredited for various Sectors including Sector-29 (Airport Projects) for Category 'A' by the National Accreditation Board for Education & Training (NABET), Quality Council of India vide Certificate NABET/EIA/2225/RA0290 dated 11.06.2023 with Validity till 16.11.2025. The ABC Techno Labs India Private Limited Laboratory is accredited by the National Accreditation Board for Testing and Calibration Laboratories (NABL) vide Certificate No. TC-5770 dated 03.04.2024 with validity till 02.04.2026.

The draft Environmental Impact Assessment (EIA) Report have been prepared in compliance with the awarded ToRs and as per the generic structure proposed in EIA Notification 2006 and submitted. The data submitted in the EIA Report are factually correct.

For ABC Techno Labs India Private Limited,-

Date : 06.08.2025

Place : Chennai

  
  
Authorized Signatory

### **ABC TECHNO LABS INDIA PRIVATE LIMITED**

(Accredited by NABET, NABL vide TC-5770, Approved by FSSAI, Recognised by MoEF&CC, BIS, APEDA, IOPEPC, Tea Board India)  
(An ISO : 9001, ISO : 14001, ISO : 45001 & ISO : 22000 Certified Company)

'ABC TOWER', #400, 13th Street, SIDCO Industrial Estate-North Phase,  
Ambattur, Chennai - 600 098. Tamil Nadu, INDIA.  
Ph : +91-44-2625 7788, 2625 7799

abc@abctechnolab.com  
www.abctechnolab.com  
Helpline : +91 94442 60000 / 95661 87777







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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 –

| S. No | Sector Description                                                                                                                               | Sector (as per) |           | Cat. |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------|------|
|       |                                                                                                                                                  | NABET           | MoEFCC    |      |
| 1     | Mining of minerals including opencast/ underground mining                                                                                        | 1               | 1 (a) (i) | A    |
| 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 (j)     | 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**  
**Dated: July 11, 2023**

**Certificate No.**  
**NABET/EIA/2225/RA 0290**

**Valid up to**  
**Nov 16, 2025**

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to the QCI-NABET website.



## DECLARATION OF EXPERTS

**Details as per Schedule of EIA Notification 2006, as amended till date**

**Name of the Project**                      *EIA for Expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion of Terminal Building & Apron And Other Allied Works*

**Schedule as per EIA notification 2006**    7 (a)

**Category**                                              B

**NABET Sector No.**                                29

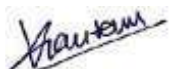
### **Declaration:**

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

### **EIA Coordinator (EC)**

Name : Vinod Kumar Gautam

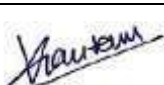
Signature

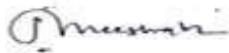
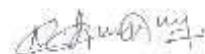
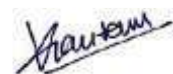


Period of involvement : March – November 2025

Contact information : [abc@abctechlab.com](mailto:abc@abctechlab.com)

### **FUNCTIONAL AREA EXPERTS:**

| S. No | Functional Areas | Name of the Expert/s | Involvement (Period) | Signature                                                                             |
|-------|------------------|----------------------|----------------------|---------------------------------------------------------------------------------------|
| 1.    | WP               | Vaishnavi Dhinakaran | March -Nov 2025      |  |
| 2.    | SHW              | Vinod Kumar Gautam   | March -Nov 2025      |  |
| 3.    | AP               | Abhik Saha           | March -Nov 2025      |  |
| 4.    | EB               |                      |                      |                                                                                       |
| 5.    | AQ               | Vinod Kumar Gautam   | March -Nov 2025      |  |
| 6.    | RH               | Vinod Kumar Gautam   | March -Nov 2025      |  |

|                                           |                      |                             |                 |                                                                                     |
|-------------------------------------------|----------------------|-----------------------------|-----------------|-------------------------------------------------------------------------------------|
| 7.                                        | HG                   | Dr.Veezhinathan Subramaniam | March -Nov 2025 |  |
| 8.                                        | NV                   | Haneesh KR                  | March -Nov 2025 |  |
| 9.                                        | LU                   | Dr. N Rama Krishnan         | March -Nov 2025 |  |
| 10.                                       | SE                   |                             |                 |                                                                                     |
| <b>EIA Coordinator</b> Vinod Kumar Gautam |                      |                             |                 |  |
| <b>Team Member – EIA Coordinator</b>      |                      |                             |                 |                                                                                     |
| 1.                                        | Vaishnavi Dhinakaran |                             |                 |  |

## **Point Wise Compliance of TOR in Tabular Chart with Index**

### **1. Compliance of Terms of Reference (TOR)**

AAI obtained Terms of Reference (ToR) from State Environmental Impact Assessment Authority (SEIAA), Meghalaya vide TOR I. No. TO25B2902ML5691923N (ML/SEAC/SEIAA/PP/RB/105/2025) dated 01/08/2025. The point wise compliance of Terms of Reference (TOR) is given below:

### **2. Standard Terms of Reference (TOR)**

The point wise compliance of Standard Terms of Reference (TOR) is given below:

| <b>S.No.</b> | <b>Description</b>                      | <b>Compliance Status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Index in EIA Report</b>                                                   |
|--------------|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| <b>1.</b>    | <b>Project Details</b>                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                              |
| 1.1          | Importance and benefits of the project. | <p><b>Safe Operation of Larger Aircraft:</b> The extension of runway at Barapani Airport will allow safe landing and take-off of large capacity aircraft like Airbus 320. The expansion of the Barapani Airport is needed to handle larger aircraft, enhance regional connectivity, fuel economic and tourism growth.</p> <p><b>Improved Connectivity:</b> Meghalaya, being a hilly and landlocked state in Northeast region of India, faces significant challenges in surface connectivity. Shillong Airport is essential to improve regional accessibility. Road and rail travel to Shillong from major cities of India is time-consuming. Air connectivity drastically reduces travel time, facilitating quicker and safer movement of people and goods.</p> <p><b>Tourism Development:</b> Meghalaya is known for its natural beauty, waterfalls, caves, and living root bridges. A well-functioning airport supports the</p> | Section 1.4 (Page 1-3) of Chapter 1 and Section 8.2 (Page 8-1) of Chapter 8. |

| S.N o. | Description                                                                                                                                                                                  | Compliance Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Index in EIA Report                 |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
|        |                                                                                                                                                                                              | <p>state's growing eco- and adventure-tourism potential.</p> <p><b>Economic Growth of Meghalaya:</b> Improved air connectivity can spur local economic development, trade, and investment in sectors such as agriculture, handicrafts, and services.</p> <p><b>Emergency &amp; Strategic Importance:</b> The airport plays a vital role in disaster response, medical evacuation, and national security, given the state's proximity to international borders.</p> <ul style="list-style-type: none"> <li>▪ For safe landing and take-off of larger aircrafts</li> <li>▪ Improved connectivity with various cities of India</li> <li>▪ Better infrastructure facilities for air passenger,</li> <li>▪ Promotion of tourism in the Meghalaya,</li> <li>▪ Increase in regional economy as it will boost tourism, trade and commercial activities in the region,</li> <li>▪ Generation of more revenue to the state, hence more development of the region,</li> <li>▪ Boost in religious tourism and more people to travel in the area,</li> <li>▪ Employment opportunity to people, and</li> <li>▪ More business and industrial opportunities.</li> </ul> |                                     |
| 1.2    | 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 | Barapani Airport is an operational airport. Area of existing passenger terminal building is 5000 sqm with a peak hour handling capacity of 200 passengers and 0.5 MPPA. Air passengers are increasing rapidly                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Section 5.2 (Page 5-1) of Chapter 5 |

| <b>S.No.</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                           | <b>Compliance Status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Index in EIA Report</b>                  |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
|              | <p>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.</p>                                                              | <p>at Barapani Airport. Therefore, there is urgent need for expansion terminal building. Further, existing runway 04/22 having dimension 1829m x 45m is suitable for the operation of ATR-72 type of aircraft. For operation of category C aircraft A 320, runway to be extended to 2400m. Therefore, AAI has decided for the expansion of Barapani (Shillong) airport. The 22 Acres encumbrance free land will be handed over by the Meghalaya State Govt to AAI for the expansion of Barapani Airport.</p> <p>Barapani Airport is operational airport and expansion activities will be located on the available 416.16 Acres land and additional 22 Acres land to be provided by government of Meghalaya. No alternative sites have been considered as the project under present proposal is expansion of Barapani airport.</p> |                                             |
| 1.3          | <p>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.</p> | <p>For the proposed project 1273976 cum cutting and 197136 cum filling will be required, which will be utilized at site and disposed in environmental sound manner. Surplus excavated earth will be spread over the airport site. Therefore, impact related to excavations and transportation of excavated materials will not appear from the project.</p> <p>Risk Assessment and Disaster Management Plan including</p>                                                                                                                                                                                                                                                                                                                                                                                                          | <p>Section 2.8 (Page 2-16) of Chapter 2</p> |

| <b>S.N o.</b> | <b>Description</b>                                                                                                                       | <b>Compliance Status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Index in EIA Report</b>                                                             |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
|               |                                                                                                                                          | emergency evacuation during natural and man-made disaster integrating with existing airport.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Chapter 7 of EIA Report                                                                |
| 1.4           | Details of man-power requirement (regular and contract).                                                                                 | During construction phase, 220 employment and during operation phase 165 employment will be generated. Indirect employment will be generated more than 2000 persons per day.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Section 2.19 (Page 2-26) of Chapter 2                                                  |
| 1.5           | The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out. | <p>The estimated project cost for expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion of Terminal Building &amp; Apron and Other Allied Works is estimated as Rs 489 Crores.</p> <p>Total budget of Rs 0.68 Crores and Rs 1.24 Crores has been kept for implementation of environmental management plan during construction and operation phases of the proposed expansion of Barapani Airport. Recurring Cost of Rs 0.35 Crores and Rs 0.69 Crores per annum has been kept for EMP implementation during construction and operation phases. Total budget of Rs 0.031 Crores and Rs 0.025 Crores (refer Chapter 6) has been kept for environmental monitoring during construction and operation phases.</p> | <p>Section 2.20 (Page 2.26) of Chapter 2</p> <p>Section 10.5 in Chapter 10 (10-85)</p> |
| 1.6           | Submit Layout plans of proposed project indicating runway, terminal building, parking, greenbelt area, utilities etc.                    | (i) Construction of Extended Runway from the existing length of 1829m x 45m to 2400m x 45m with provision of turn pads at both ends and strengthening of existing runway.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <p>Page 2-4 to 2-6</p> <p>Page 2-17 to 2-29 of Chapter 2</p>                           |

| <b>S.No.</b> | <b>Description</b>                                                                                                                                                                                                                                              | <b>Compliance Status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Index in EIA Report</b>                                                             |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
|              |                                                                                                                                                                                                                                                                 | <p>(ii) Expansion of Apron for parking of 5 nos. of Code - C Aircraft in power - in push - back configuration &amp; associated GSE area. Strengthening of existing apron, isolation bay and associated taxiways.</p> <p>(iii) Expansion of Existing Terminal Building by 5,550 sqm increasing the consolidated peak hour capacity to 1620 passengers (810 Arrival + 810 Departure) as per BCAS norms, with a provision of 2 nos. Passenger Boarding Bridge.</p> <p>(iv) Miscellaneous Works.</p> |                                                                                        |
| <b>2.</b>    | <b>Road And Traffic</b>                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                        |
| 2.1          | <p>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.</p> | <p>The Barapani (Shillong) Airport is situated nearly 60 km airily from LGB International airport Guwahati, 58 kms from Guwahati Railway station.</p> <p>The traffic study was carried out the following two highways:</p> <ul style="list-style-type: none"> <li>Shillong Bypass near Barapani Airport on 22 May 2025</li> <li>Guwahati–Shillong Section of NH 6 near Umiam on 26 May 2025</li> </ul>                                                                                           | <p>Section 2.18 page 2-25 of Chapter 2</p> <p>Section 4.4.8 page 4-38 of Chapter 4</p> |



| S.No. | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Compliance Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Index in EIA Report                     |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
|       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <p>The Level of Services (LOS) for Shillong Bypass and Guwahati – Shillong Section NH 6 are within B-C (Stable flow), hence capacity of both highways is well enough for passenger car traffic due to operation of Barapani (Shillong) Airport. Anticipated contribution of traffic due to Barapani (Shillong) Airport after expansion on the Shillong Bypass and Guwahati – Shillong Section NH 6 will be merely &lt;2 %. Therefore, there is no possibility of traffic jam due airport passengers’ vehicles on the Shillong Bypass and Guwahati – Shillong Section NH 6 due to operation of Barapani Airport after expansion.</p>                                                                                                                                           |                                         |
| 2.2   | <p>An assessment of the cumulative impact of all development and increased inhabitation being carried out or proposed to be carried out by the project or other agencies in the core area, shall be made for traffic densities and parking capabilities in a 05 kms radius from the site.</p> <p>A detailed traffic management and a traffic decongestion plan drawn up through an organization of repute and specializing in Transport Planning shall be submitted with the EIA. The Plan to be implemented to the satisfaction of the State Urban Development and Transport Departments shall also include the consent of all the concerned implementing agencies.</p> | <p>The traffic study was carried out the following two highways:</p> <ul style="list-style-type: none"> <li>• Shillong Bypass near Barapani Airport on 22 May 2025</li> <li>• Guwahati–Shillong Section of NH 6 near Umiam on 26 May 2025</li> </ul> <p>The Level of Services (LOS) for Shillong Bypass and Guwahati – Shillong Section NH 6 are within B-C (Stable flow), hence capacity of both highways is well enough for passenger car traffic due to operation of Barapani (Shillong) Airport. Anticipated contribution of traffic due to Barapani (Shillong) Airport after expansion on the Shillong Bypass and Guwahati – Shillong Section NH 6 will be merely &lt;2 %. Therefore, there is no possibility of traffic jam due airport passengers’ vehicles on the</p> | Section 4.4.8<br>page 4-38 of Chapter 4 |

| <b>S.N o.</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Compliance Status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Index in EIA Report</b>                                                                                                                    |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
|               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Shillong Bypass and Guwahati – Shillong Section NH 6 due to operation of Barapani Airport after expansion.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                               |
| <b>3.</b>     | <b>Land Environment</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                               |
| 3.1           | 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. | <p>Barapani (Shillong) Airport has an area of 416.16 Acres. 22 Acres of additional land (16 acres for Runway Extension by 571m and another 6 Acres of land for Relocation of Isolation Bay) would be handover by Meghalaya State Government for the proposed expansion.</p> <p>The study area dominated by Dense Jungle/Fairly Dense Jungle (83.46%) followed by Agriculture land (8.62 %), built-up area (6.21 %), river and other waterbody (1.68 %) and reserved forest (0.4 %). No forest land is involved in the project.</p> <p>There is no wildlife sanctuary/national park with 10 km radius distance from the Barapani Airport. There is no critically polluted area as identified by the CPCB. There is no inter-state boundaries and international boundaries within 10 km radius area.</p> | <p>Section 2.3.1<br/>Page 2-2 of Chapter 2</p> <p>Section 3.12<br/>(Page 3.55)<br/>in Chapter 3</p> <p>Table 1.1 of Chapter 1 at Page 1-5</p> |
| 3.2           | 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.                                                                                                                                                                                                                                                                                                                                                                                  | Barapani (Shillong) Airport has an area of 416.16 Acres. 22 Acres of additional land (16 acres for Runway Extension by 571m and another 6 Acres of land for Relocation of Isolation Bay) would be handover by Meghalaya State Government for the proposed expansion. No forest land is                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Section 2.3.1<br>Page 2-2 of Chapter 2                                                                                                        |

| <b>S.N o.</b> | <b>Description</b>                                                                                                                                                                          | <b>Compliance Status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Index in EIA Report</b>                                                                                                                              |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
|               |                                                                                                                                                                                             | involved in the project. The Site is not located in flood plain of river.                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                         |
| 3.3           | The details of excavations, its impacts and the impact of transport of excavated material. A detailed management plan shall be included in compliance with C&D Waste Management Rule, 2016. | For the proposed project 1273976 cum cutting and 197136 cum filling will be required, which will be utilized at site and disposed in environmental sound manner. Surplus excavated earth will be spread over the airport site. Therefore, impact related to excavations and transportation of excavated materials will not appear from the project.<br><br>At the Barapani airport, demolition of buildings is not planned. Additional 22 land will be provided incumbrance free by Govt of Meghalaya.             | Section 2.8 (Page 2-16) of Chapter 2                                                                                                                    |
| <b>4.</b>     | <b>Drainage</b>                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                         |
| 4.1           | 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 airport is located at an elevation of about 887 meters above mean sea level. Contour map for the project site is presented in Figure 3.3 (Page 3-4) of Chapter 3.<br><br>Umiam is river flowing at about 15 m the proposed expansion boundary of Barapani Airport. In the study area is drained by Umiam and other natural drainage channels. Umiam lake is about 8 km in WSW direction.<br><br>Drainage pattern of the study area has been described in Section 3.5.2 (Page 3-11) of Chapter 3 of EIA report. | Figure 3.2 and Figure 3.3 (Page 3.3 and 3.4) in Chapter 3.<br><br>Section 3.5.2 (Page 3-11) of Chapter 3.<br><br>Section 3.5.2 (Page 3-11) of Chapter 3 |
| <b>5.</b>     | <b>Water Environment</b>                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                         |
| 5.1           | Examine and submit the water bodies including the seasonal ones within the corridor of impacts                                                                                              | Umiam is river flowing at about 15 m the proposed expansion boundary of Barapani Airport. In                                                                                                                                                                                                                                                                                                                                                                                                                       | Section 3.5.2 (Page 3-11) of Chapter 3.                                                                                                                 |

| <b>S.No.</b> | <b>Description</b>                                                                                                                                             | <b>Compliance Status</b>                                                                                                                                                                                                                                                                                                                                         | <b>Index in EIA Report</b>                                                                                                     |
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|              | along with their status, volumetric capacity, quality likely impacts on them due to the project. Submit CRZ map in case the proposed site falls in CRZ region. | the study area is drained by Umiam and other natural drainage channels. Umiam lake is about 8 km in WSW direction.                                                                                                                                                                                                                                               |                                                                                                                                |
| <b>6.</b>    | <b>Land Acquisition And R&amp;R</b>                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                |
| 6.1          | Submit the present land use and permission required for any conversion such as forest, agriculture etc.                                                        | Barapani (Shillong) Airport has an area of 416.16 Acres. 22 Acres of additional land (16 acres for Runway Extension by 571m and another 6 Acres of land for Relocation of Isolation Bay) would be handover by Meghalaya State Government for the proposed expansion. No forest land is involved in the project. The Site is not located in flood plain of river. | Section 2.3.1<br>Page 2-2 of Chapter 2                                                                                         |
| 6.2          | Submit details regarding R&R involved in the project.                                                                                                          | For expansion of Barapani (Shillong) Airport, additional 22 Acres land will be handed over to AAI by Meghalaya State Government for the proposed expansion after paying compensation as per regulation.                                                                                                                                                          | Section 2.3.1<br>Page 2-2 of Chapter 2                                                                                         |
| 6.3          | Submit details of environmentally sensitive places, land acquisition status, rehabilitation of communities/ villages and present status of such activities.    | There is no wildlife sanctuary/national park with 10 km radius distance from the Barapani (Shillong) Airport.<br><br>For expansion of Barapani (Shillong) Airport, additional 22 Acres land will be handed over to AAI by Meghalaya State Government for the proposed expansion after paying compensation as per regulation.                                     | Table 1.1 of Chapter 1 at Page 1-5<br><br>Section 2.3.1<br>Page 2-2 of Chapter 2                                               |
| 6.4          | Examine baseline environmental quality along with projected incremental load due to the proposed project/activities.                                           | Baseline data was carried out for one season during summer season (from 1 <sup>st</sup> March to 31 <sup>th</sup> May 2025) for micro meteorology, air, water, soil, noise, etc were carried in the study area and presented in Chapter 3.<br><br>As per air pollution modelling maximum predicted incremental short term 24 hourly ground level                 | Section 3.4 at Page 3-6, Section 3.7 at Page 3-12, 3.8.3, Section 3.9 at Page 3-33 and Section 3.10 at Page 3-51 of Chapter 3. |

| <b>S.No.</b> | <b>Description</b>                                                                                                           | <b>Compliance Status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Index in EIA Report</b>                                       |
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|              |                                                                                                                              | <p>concentrations of, PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, and NO<sub>2</sub> likely to be encountered are 22.6 µg/m<sup>3</sup>, 3.5 µg/m<sup>3</sup>, 6.9 µg/m<sup>3</sup> and 11.9 µg/m<sup>3</sup> will be at will be within the airport site. The ground level concentration for CO is occurring at a distance of 0.16 km in east direction from Barapani (Shillong) Airport during operation.</p> <p>The noise levels from 70-90 dB(A) will be confined within the boundary of the Barapani (Shillong) Airport after expansion. The noise levels of 55 to 70 dB(A) cross the boundary and affect 4.73 km<sup>2</sup> of area outside boundary of Barapani (Shillong) Airport after expansion. The noise levels of 45-55 dB(A) cross the boundary and affect 11.8 km<sup>2</sup> of area outside the boundary of Barapani (Shillong) Airport after expansion. Boundary ball around the Barapani (Shillong) Airport after expansion and green belt development will significant attenuate noise levels from the Barapani (Shillong) Airport after expansion. The impact of noise levels due to the operation of the Barapani (Shillong) Airport after expansion will be within permissible levels. Further, noise mitigation measures to be implemented at and around the Barapani (Shillong) Airport after expansion will further reduce the noise levels in nearby settlements.</p> | Section 4.4.5 (Page 4-22) and Section 4.4.6 (4-34) of Chapter 4. |
| <b>7.</b>    | <b>Water Management</b>                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                  |
| 7.1          | Examine the details of water requirement, use of treated waste water and prepare a water balance chart. Source of water vis- | During operation phase, total fresh water requirement is estimated as 371 kld. 257 kld waste water will be generated from the Barapani                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Section 2.15 (Page 2-22) of Chapter 2                            |

| <b>S.No.</b> | <b>Description</b>                                                                                                                                      | <b>Compliance Status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Index in EIA Report</b>                |
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|              | à-vis waste water to be generated along with treatment facilities to be proposed.                                                                       | Airport, which will be treated in 275 kld capacity sewage treatment plant (STP). Water requirement will be met through ground water after obtaining permission from CGWA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                           |
| 7.2          | Rain water harvesting proposals should be made with due safeguards for ground water quality. Maximize recycling of water and utilization of rain water. | 26 rain water harvesting pits will be provided at the Barapani (Shillong) Airport as per CGWA guidelines.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Section 10.2.9 (Page 10-24) of Chapter 10 |
| <b>8.</b>    | <b>Waste Management</b>                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                           |
| 8.1          | Examine details of Solid waste generation (including de-plane waste and hazardous waste) treatment and its disposal.                                    | <p>Approx. 1240 kg per day solid waste will be generated during operation of the Barapani (Shillong) Airport after expansion, which will be collected, segregated and managed by external agency for disposal as per Solid Waste Management Rule, 2016. Hence, the impact on the soil will be insignificant as an organized solid waste collection and disposal practices will be followed at the Barapani Airport.</p> <p>From the Barapani Airport, about 200 liters used oil will be generated during the maintenance of DG sets. Used oil generated from the Barapani (Shillong) airport will be disposed to authorised used oil recyclers.</p> <p>About 250 kg per year e-wastes will be generated from the Barapani (Shillong), which will be disposed to authorised e-waste recyclers as per e-wastes management rules 2016.</p> | Section 10.2.3 (Page 10-11) of Chapter 10 |
| 8.2          | The impacts of demolition and the activities related thereto shall be examined and a management plan shall be prepared to conform to                    | Demolition of buildings is not proposed at the project site as incumbrance land will be provided by Govt of Meghalaya. Therefore,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Section 10.2.3 (Page 10-11) of Chapter 10 |

| <b>S.No.</b> | <b>Description</b>                                                                                                                        | <b>Compliance Status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Index in EIA Report</b>                                   |
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|              | the C&D Waste Management Rules.                                                                                                           | demolition waste management plan is not applicable.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                              |
| <b>9.</b>    | <b>Energy Management</b>                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                              |
| 9.1          | Requirement of power, with source of supply, status of approval                                                                           | Total power requirement is estimated as 1750 kW for the proposed terminal building and other facilities at the Barapani Airport. Power will be supplied by Meghalaya Power Distribution Corporation Limited (MPDCL). 2 DG sets of 380 kVA capacity are available at the Airport. During operation phase after expansion, two DG sets of 2x1000 kVA + 1 1000 kVA stand by capacity will be installed to meet the power during grid power failure.                                                                                                                                                                                                                                                                                                                                 | Section 2.13 (Page 2-22) of Chapter 2                        |
| 9.2          | Details shall be provided regarding the solar generation proposed and the extent of substitution, along with compliance to the ECBC rules | <p>To encourage reduction in carbon footprint at the Barapani Airport, the following measures will be taken:</p> <ul style="list-style-type: none"> <li>• GRIHA Rating 5 Star for Proposed Terminal Building</li> <li>• 150 kWp Grid Tied Ground Mounted SPVPP</li> <li>• LED lighting fixtures with inbuilt Harmonic suppression system</li> <li>• VFD on cooling tower fans</li> <li>• Variable frequency drive (VFD) for all AHU's</li> <li>• Demand Control Ventilation (DCV) System with indoor air quality sensors</li> <li>• Thermal Performance of glasses and construction materials to comply with ECBC-2017, Vertical Façade - U-value for glazing systems - 1.6 W/m<sup>2</sup>/K.</li> <li>• Transformers shall have no load losses/ full load losses as</li> </ul> | Section 10.2.7 and 10.2.8 of Chapter 10 (Pages 10-17, 10-20) |

| S.No. | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Compliance Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Index in EIA Report                                                 |
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|       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <p>per ECBC 2017/ GRIHA requirement</p> <ul style="list-style-type: none"> <li>Building management system for terminal building</li> </ul> <p>About 30% energy saving is planned after expansion of Barapani (Shillong) Airport.</p> <p>Details of reduction in carbon foot print, Energy conservation measures, solar power generation are given in the EIA report.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                     |
| 9.3   | <p>A note on appropriate process and materials to be used to encourage reduction in carbon foot print. Optimize use of energy systems in buildings that should maintain a specified indoor environment conducive to the functional requirements of the building by following mandatory compliance measures (for all applicable buildings) as recommended in the Energy Conservation Building Code (ECBC) 2017 of the Bureau of Energy Efficiency, Government of India. The energy system includes air conditioning systems, indoor lighting systems, water heaters, air heaters and air circulation devices</p> | <p>To encourage reduction in carbon footprint at the Barapani Airport, the following measures will be taken:</p> <ul style="list-style-type: none"> <li>GRIHA Rating 5 Star for Proposed Terminal Building</li> <li>150 kWp Grid Tied Ground Mounted SPVPP</li> <li>LED lighting fixtures with inbuilt Harmonic suppression system</li> <li>VFD on cooling tower fans</li> <li>Variable frequency drive (VFD) for all AHU's</li> <li>Demand Control Ventilation (DCV) System with indoor air quality sensors</li> <li>Thermal Performance of glasses and construction materials to comply with ECBC-2017, Vertical Façade - U-value for glazing systems - 1.6 W/m<sup>2</sup>/K.</li> <li>Transformers shall have no load losses/ full load losses as per ECBC 2017/ GRIHA requirement</li> <li>Building management system for terminal building</li> </ul> | <p>Section 10.2.7 and 10.2.8 of Chapter 10 (Pages 10-17, 10-20)</p> |



| S.N o.     | Description                                                                                                                                                             | Compliance Status                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Index in EIA Report                                                                                                                                                                 |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            |                                                                                                                                                                         | <p>About 30% energy saving is planned after expansion of Barapani (Shillong) Airport.</p> <p>Details of reduction in carbon foot print, Energy conservation measures, solar power generation are given in the EIA report.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                     |
| <b>10.</b> | <b>Environmental Monitoring and Management</b>                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                     |
| 10.1       | Examine separately the details for construction and operation phases both for Environmental Management Plan and Environmental Monitoring Plan with cost and parameters. | <p>Total budget of Rs 0.68 Crores and Rs 1.24 Crores has been kept for implementation of environmental management plan during construction and operation phases of the proposed expansion of Barapani Airport. Recurring Cost of Rs 0.35 Crores and Rs 0.69 Crores per annum has been kept for EMP implementation during construction and operation phases. Total budget of Rs 0.031 Crores and Rs 0.025 Crores (refer Chapter 6) has been kept for environmental monitoring during construction and operation phases.</p>                                                                                                                                                                      | Section 10.5 in Chapter 10 (10-85)                                                                                                                                                  |
| 10.2       | Examine baseline environmental quality along with projected incremental load due to the proposed project/activities.                                                    | <p>Baseline data was carried out for one season during summer season (from 1<sup>st</sup> March to 31<sup>th</sup> May 2025) for micro meteorology, air, water, soil, noise, etc were carried in the study area and presented in Chapter 3.</p> <p>As per air pollution modelling maximum predicted incremental short term 24 hourly ground level concentrations of, PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, and NO<sub>2</sub> likely to be encountered are 22.6 µg/m<sup>3</sup>, 3.5 µg/m<sup>3</sup>, 6.9 µg/m<sup>3</sup> and 11.9 µg/m<sup>3</sup> will be at will be within the airport site. The ground level concentration for CO is occurring at a distance of 0.16 km</p> | <p>Section 3.4 at Page 3-6, Section 3.7 at Page 3-12, 3.8.3, Section 3.9 at Page 3-33 and Section 3.10 at Page 3-51 of Chapter 3.</p> <p>Section 4.4.5 (4-22) and Section 4.4.6</p> |

| <b>S.No.</b> | <b>Description</b>                                                                                      | <b>Compliance Status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Index in EIA Report</b>                                                                        |
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|              |                                                                                                         | <p>in east direction from Barapani (Shillong) Airport during operation.</p> <p>The noise levels from 70-90 dB(A) will be confined within the boundary of the Barapani (Shillong) Airport after expansion. The noise levels of 55 to 70 dB(A) cross the boundary and affect 4.73 km<sup>2</sup> of area outside boundary of Barapani (Shillong) Airport after expansion. The noise levels of 45-55 dB(A) cross the boundary and affect 11.8 km<sup>2</sup> of area outside the boundary of Barapani (Shillong) Airport after expansion. Boundary ball around the Barapani (Shillong) Airport after expansion and green belt development will significant attenuate noise levels from the Barapani (Shillong) Airport after expansion. The impact of noise levels due to the operation of the Barapani (Shillong) Airport after expansion will be within permissible levels. Further, noise mitigation measures to be implemented at and around the Barapani (Shillong) Airport after expansion will further reduce the noise levels in nearby settlements.</p> | (4-34) of Chapter 4.                                                                              |
| 10.3         | The air quality monitoring should be carried out as per the notification issued on 16th November, 2009. | Baseline ambient air was carried out for one season during summer season (from 1 <sup>st</sup> March 2025 to 31 <sup>st</sup> May 2025) for micro meteorology, air, water, soil, noise, etc were carried in the study area and presented in Chapter 3. The results of ambient air quality monitoring of PM <sub>2.5</sub> , PM <sub>10</sub> , SO <sub>2</sub> , NO <sub>2</sub> , NH <sub>3</sub> , O <sub>3</sub> , C <sub>6</sub> H <sub>6</sub> , BaP, Pb, As, Ni and CO are presented in Table 3.17 to Table 3.24. The summary of Ambient Air Quality Monitoring                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Section 3-9 (Page 3-33) of Chapter 3. Table 3.17 to Table 3.25. of Chapter 3 (Page 3-41 to 3-49). |

| <b>S.N o.</b> | <b>Description</b>                                                                                                                                                          | <b>Compliance Status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Index in EIA Report</b>                                  |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|
|               |                                                                                                                                                                             | is given in Table 3.25 of Chapter 3 of EIA Report.<br><br>Air quality monitoring Reports are enclosed as in Annexure 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                             |
| 10.4          | A detailed draft EIA/EMP report should be prepared in accordance with the above additional TOR and should be submitted to the Ministry in accordance with the Notification. | EIA report has been prepared as per approved TOR by SEIAA, Meghalaya in compliance with EIA Notification 2006 and subsequent amendments.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Chapter 10 (Page 10-1 to 10-85)                             |
| 10.5          | Air quality modelling and noise modelling shall be carried out for the emissions from the various types of aircrafts.                                                       | As per air pollution modelling maximum predicted incremental short term 24 hourly ground level concentrations of, PM <sub>10</sub> , PM <sub>2.5</sub> , SO <sub>2</sub> , and NO <sub>2</sub> likely to be encountered are 22.6 µg/m <sup>3</sup> , 3.5 µg/m <sup>3</sup> , 6.9 µg/m <sup>3</sup> and 11.9 µg/m <sup>3</sup> will be at will be within the airport site. The ground level concentration for CO is occurring at a distance of 0.16 km in east direction from Barapani (Shillong) Airport during operation.<br><br>The noise levels from 70-90 dB(A) will be confined within the boundary of the Barapani (Shillong) Airport after expansion. The noise levels of 55 to 70 dB(A) cross the boundary and affect 4.73 km <sup>2</sup> of area outside boundary of Barapani (Shillong) Airport after expansion. The noise levels of 45-55 dB(A) cross the boundary and affect 11.8 km <sup>2</sup> of area outside the boundary of Barapani (Shillong) Airport after expansion. Boundary ball around the Barapani (Shillong) Airport after expansion and green belt development will significant attenuate noise levels from the | Section 4.4.5 (4-22) and Section 4.4.6 (4-34) of Chapter 4. |

| <b>S.N o.</b> | <b>Description</b>                                                                                                                                    | <b>Compliance Status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Index in EIA Report</b>                                   |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|
|               |                                                                                                                                                       | Barapani (Shillong) Airport after expansion. The impact of noise levels due to the operation of the Barapani (Shillong) Airport after expansion will be within permissible levels. Further, noise mitigation measures to be implemented at and around the Barapani (Shillong) Airport after expansion will further reduce the noise levels in nearby settlements.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                              |
| 10.6          | Possible carbon footprint contribution from each activities and mitigation measures proposed shall be included as part of Environment Management Plan | <p>To encourage reduction in carbon footprint at the Barapani Airport, the following measures will be taken:</p> <ul style="list-style-type: none"> <li>• GRIHA Rating 5 Star for Proposed Terminal Building</li> <li>• 150 kWp Grid Tied Ground Mounted SPVPP</li> <li>• LED lighting fixtures with inbuilt Harmonic suppression system</li> <li>• VFD on cooling tower fans</li> <li>• Variable frequency drive (VFD) for all AHU's</li> <li>• Demand Control Ventilation (DCV) System with indoor air quality sensors</li> <li>• Thermal Performance of glasses and construction materials to comply with ECBC-2017, Vertical Façade - U-value for glazing systems - 1.6 W/m<sup>2</sup>/K.</li> <li>• Transformers shall have no load losses/ full load losses as per ECBC 2017/ GRIHA requirement</li> <li>• Building management system for terminal building</li> </ul> <p>About 30% energy saving is planned after expansion of Barapani Airport. Details of reduction in carbon foot print, Energy conservation measures,</p> | Section 10.2.7 and 10.2.8 of Chapter 10 (Pages 10-17, 10-20) |

| <b>S.N o.</b> | <b>Description</b>                                                                                                                                           | <b>Compliance Status</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Index in EIA Report</b>               |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
|               |                                                                                                                                                              | solar power generation are given in the EIA report.                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                          |
| <b>11.</b>    | <b>Disaster Management Plan</b>                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                          |
| 11.2          | Submit details of a comprehensive Disaster Management Plan including emergency evacuation during natural and man-made disaster                               | Risk assessment and disaster management plan including emergency evacuation during natural and man-made disaster integrating with existing airport are given Chapter 7 of the EIA report.                                                                                                                                                                                                                                                                                                                                      | Chapter 7 (Pages 7-1 to 7-19)            |
| <b>12</b>     | <b>Socioeconomic Environment</b>                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                          |
| 12.1          | Examine the impact of proposed project on the nearest settlements.                                                                                           | Impact of the proposed expansion of Barapani (Shillong) Airport on the nearest settlements have been evaluated comprehensively in Chapter 4 of EIA Report. Impact of on ambient air quality and noise levels on nearby settlements will be insignificant. The project will have long term positive impacts on socio-economic conditions of the nearby area, employment opportunity, quality of life.                                                                                                                           | Section 4.4.12 (Page 4-43) of Chapter 4  |
| 12.2          | Submit details of corporate social responsibilities (CSR).                                                                                                   | AAI proposed to allocate Rs 3.67 Crores towards Corporate Environmental Responsibility (CER) within the study area for a period of 5 years (2027-2032). Every year consultation with District Administration and nearby Villages will be carried out to evaluate needs and CER activities will be finalised accordingly.<br><br>The Corporate Social Responsibility (CSR) Policy of the Airports Authority of India (AAI) is aligned with its overall commitment to maintaining the highest standards of business performance. | Section 10.4 (Page 10.83) of Chapter 10. |
| <b>13.</b>    | <b>Forest</b>                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                          |
| 13.1          | 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 | No tree cutting is required as Government of Meghalaya will handover encumbrances free 22 Acres land to AAI for the                                                                                                                                                                                                                                                                                                                                                                                                            | Section 4.3.10 (Page 4-15)               |

| <b>S.N o.</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                             | <b>Compliance Status</b>                                                                                                                                                                                                                                                                            | <b>Index in EIA Report</b>                 |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
|               | 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.                                                                                                                                                                    | expansion of Barapani (Shillong) Airport.                                                                                                                                                                                                                                                           |                                            |
| 13.2          | Submit status of permission to be obtained from concerned local authorities for the proposed tree cutting/pruning/transplantation                                                                                                                                                                                                              | No tree cutting is required as Government of Meghalaya will handover encumbrances free 22 Acres land to AAI for the expansion of Barapani (Shillong) Airport.                                                                                                                                       | Section 4.3.10 (Page 4-15)                 |
| 13.3          | 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. | Green area/landscaping is proposed on 8250 sqm (0.8 ha) area of city side of the Barapani Airport. 103 trees will be planted at the Barapani airport (@80 sqm for 1 tree). Treated waste water from STP will be used for irrigation of green belt. Indigenous trees/shrubs species will be planted. | Section 10.2.11 (Page 10.28) of Chapter 10 |
| <b>14.</b>    | <b>Court Cases</b>                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                     |                                            |
| 14.1          | Details of litigation pending against the project, if any, with direction/order passed by any Court of Law against the Project should be given.                                                                                                                                                                                                | PIL court case is pending in the Hon'ble High Court of Meghalaya vide PIL No.4/2021 with MC (PIL) No.2/2021 for providing 11.7 Acres land and early completion of proposed expansion of Barapani (Shillong) Airport.                                                                                | Section 2.1.2 of Chapter 2 (Page 2-2)      |
| <b>15.</b>    | <b>Miscellaneous</b>                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                     |                                            |
| 15.1          | 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 " <a href="http://moef.nic.in/Manual/Airport">http://moef.nic.in/Manual/Airport</a> "                                          | Same has been followed.                                                                                                                                                                                                                                                                             | —                                          |

## **CHAPTER – 1**

### **INTRODUCTION**

#### **1.1 Preamble**

Barapani (Shillong) Airport is the only operational airport in Meghalaya, serving Shillong. It's located in Umroi, about 30km from the Shillong city center. The airport is situated at an elevation of 887m above mean sea level, it has a single concrete runway (04/22), measuring 1,829m in length. Barapani (Shillong) Airport is an operational Airport, belonging to AAI, with an area of 416.16 acres. The Airport has a runway length of 1829 m x 45m and is suitable for ATR - 72 type of aircraft operation.

The Barapani airport has existing Passenger Terminal Building covering 5000 sqm and it handles 200 peak hour passengers. Existing apron is suitable for parking of 4 nos. ATR-72/Q - 400 type of aircraft with power - in and power - out configuration.

The existing Barapani Airport is operating with valid Environmental clearance obtained from Ministry of Environment, Forest and Climate Change (MOEF&CC) vide file no. 10-28/2018-IA-III dated 7<sup>th</sup> January 2020 (**Annexure I**). The certified copy of compliance report of conditions of Environmental Clearance by Regional Office of Ministry of Environment, Forest and Climate Change, Shillong is enclosed as **Annexure II**.

Airports Authority of India (AAI) has planned for expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion of Terminal Building & Apron And Other Allied Works. AAI has memorandum of understanding (MOU) with the Meghalaya State Government for providing incumbrance free 22 Acres land for the proposed runway extension and relocation of isolation pad. Under the proposed expansion of Barapani airport expansion of terminal building, runway extension, expansion of apron, relocation pad and associated facilities will be constructed.

The environment is indispensable to a nation's advancement. Recognizing this, the Ministry of Environment, Forest and Climate Change (MoEF&CC) of the Government of India has established comprehensive policies and guidelines to regulate industrial and developmental activities. These measures are designed to curb the unrestrained exploitation of natural resources and to ensure environmental considerations are embedded within development initiatives. To systematically identify and evaluate the potential environmental impacts during the design, construction, and operational phases of the proposed project, and to develop effective mitigation strategies alongside a robust Environmental Management Plan, an Environmental Impact Assessment (EIA) study has been conducted. This EIA was carried out in strict accordance with the approved Terms of Reference set by the State Environmental Impact Assessment Authority (SEIAA), following well-established standards, codes and regulations.

The Ministry of Environment, Forest and Climate Change (MoEF&CC) has made prior environmental clearance (EC) for Airport projects mandatory through its notification issued on 14th September 2006 and as amended on 20 April 2022. The expansion of Barapani Airport is covered under category 'B1' of item 7 (a) *i.e.* 'Airports' of the schedule to the EIA Notification, 2006 and its subsequent amendments on 20 April 2022, and requires appraisal at State level by State Expert Appraisal Committee (SEAC) and environmental clearance from state Environmental Impact Assessment Authority (SEIAA) Meghalaya. Airports Authority of India engaged NABET accredited Environmental Consultant M/s ABC Techno Labs India Pvt. Ltd. for carrying out environmental impact assessment and to obtain environmental clearance for Expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion of Terminal Building & Apron and Other Allied Works.

The proposal for grant of Terms of Reference (ToR) to the project 'Expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion of Terminal Building & Apron And Other Allied Works' by M/s Airports Authority of India, was considered by the State Expert Appraisal Committee in meeting (EC/AGENDA/SEAC/585272/6/2025) held on 20 June, 2025 and TOR was finalized vide TOR Identification no. TO25B2902ML5691923N (File No. ML/SEAC/SEIAA/PP/RB/105/2025) dated 01/08/2025. The copy of TOR issued by State Environmental Impact Assessment Authority (SEIAA) Meghalaya is enclosed as **Annexure 3**.

The compliance with the Terms of Reference (TOR) by SEIAA has been provided at the beginning of the EIA Report.

## **1.2 Need and Process of Environmental Clearance**

As per Environmental Impact Assessment Notification dated 14<sup>th</sup> September, 2006 and subsequent amendment dated 20<sup>th</sup> April 2022, the proposed project falls under category 'B' under project type 7(a) and required prior Environmental Clearance (EC) from State Environmental Impact Assessment Authority (SEIAA) Meghalaya.

As a part of obtaining environmental clearance for the proposed project, AAI obtained Terms of Reference (ToR) vide TOR Identification no. TO25B2902ML5691923N (File No. ML/SEAC/SEIAA/PP/RB/105/2025) dated 01/08/2025. Baseline data was collected from 1 March to 31 May 2025 and draft report was prepared for conducting public hearing as per approved TOR from SEIAA.

## **1.3 Identification of Project & Project Proponent**

### **1.3.1 Project Background**

Airports Authority of India (AAI) has planned for expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion of Terminal Building & Apron and Other Allied Works.



Total land available with Barapani Airport is 416.16 Acres. For proposed expansion, additional 22 Acres land is required, which will be acquired by Government of Meghalaya and encumbrance free land will be handed over to AAI as per MOU.

### **1.3.2 Project Proponent**

The proposed expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion of Terminal Building & Apron and Other Allied Works will be constructed and operated by the Airports Authority of India (AAI). Airports 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.

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.

AAI manages a total of 133 airports out of which 110 airports are operational while other 23 airports are non-operational. These operational airports include 28 civil enclaves and 8 airports under private control [2 JV Airports + 6 PPP Airports under long term lease]. 35 out of total 110 AAI operational airports have international operations.

## **1.4 Need for the Project and Its Importance**

### **1.4.1 Need for the Proposed Expansion**

**Safe Operation of Larger Aircraft:** The extension of runway at Barapani Airport will allow safe landing and take-off of large capacity aircraft like Airbus 320. The expansion of the Barapani Airport is needed to handle larger aircraft, enhance regional connectivity, fuel economic and tourism growth.

**Improved Connectivity:** Meghalaya, being a hilly and landlocked state in Northeast region of India, faces significant challenges in surface connectivity. Shillong Airport is essential to improve regional accessibility. Road and rail travel to Shillong from major cities of India is time-consuming. Air connectivity drastically reduces travel time, facilitating quicker and safer movement of people and goods.

**Tourism Development:** Meghalaya is known for its natural beauty, waterfalls, caves, and living root bridges. A well-functioning airport supports the state's growing eco- and adventure-tourism potential.

**Economic Growth of Meghalaya:** Improved air connectivity can spur local economic development, trade, and investment in sectors such as agriculture, handicrafts, and services.

**Emergency & Strategic Importance:** The airport plays a vital role in disaster response, medical evacuation, and national security, given the state's proximity to international borders.

#### **1.4.2 Importance of Expansion of Shillong Airport**

Importance of expansion of Shillong Airport is given below:

**Regional Connectivity:** Acts as a key node under the UDAN (Ude Desh ka Aam Naagrik) scheme, enhancing affordable air travel in underserved regions.

**Integration with National Network:** Connects Shillong with major Indian cities, integrating it into the broader economic and transportation network.

**Boost to North East Economy:** Strengthens the role of the Northeast as a gateway to Southeast Asia under India's "Act East Policy."

**Social Benefits** Enhances accessibility for education, healthcare, and employment opportunities, improving the quality of life for residents-

Summarily, the proposed expansion of Barapani (Shillong) airport including runway extension is needed for the following direct and indirect benefits:

- For safe landing and take-off of larger aircrafts
- Improved connectivity with various cities of India
- Better infrastructure facilities for air passenger,
- Promotion of tourism in the Meghalaya,
- Increase in regional economy as it will boost tourism, trade and commercial activities in the region,
- Generation of more revenue to the state, hence more development of the region,
- Boost in religious tourism and more people to travel in the area,
- Employment opportunity to people, and
- More business and industrial opportunities.

#### **1.5 Location of Proposed Expansion of Barapani Airport**

Barapani (Shillong) Airport is a domestic airport serving Shillong, the capital of Meghalaya, India. It is located at Umroi, situated 30 km from the city centre of Shillong. The Airport is located in Ri Bhoi district of Meghalaya state.

Airport Reference Point (ARP–WGS 84) is 25°42'12" N, 91°58' 41" E

Latitude and Longitude of corner points of Barapani (Shillong) Airport including proposed expansion area are given below:

| Points | Latitude      | Longitude     |
|--------|---------------|---------------|
| PT A   | 25°42'58.56"N | 91°59'11.38"E |
| PT B   | 25°42'51.12"N | 91°59'21.71"E |
| PT C   | 25°42'32.73"N | 91°58'40.31"E |
| PT D   | 25°41'32.60"N | 91°57'55.01"E |
| PT E   | 25°41'27.74"N | 91°58'1.62"E  |
| PT F   | 25°41'26.77"N | 91°58'7.76"E  |

**Figure 3.1** presents google earth map showing corner points of the proposed expansion of Barapani Airport.

### 1.5.1 Geographical Conditions of the Study Area

The 5 and 10 km radius study area has been considered for environmental impact assessment studies. The 5 and 10 km radius study area around the development of Barapani Airport on Google map are shown in **Figure 1.2** to **1.3**, respectively. There is no forest, national park or wildlife sanctuary within 10 km distance from the site for expansion of Barapani Airport.

### 1.6 Environmental Setting of the Study

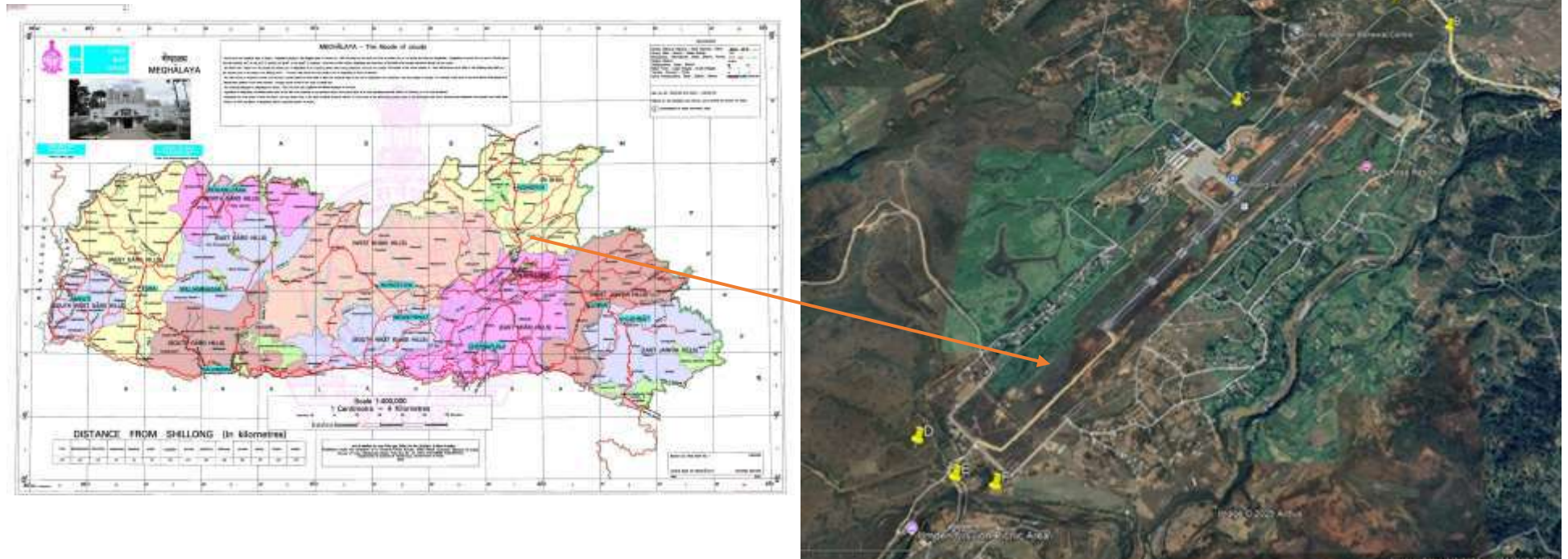
Environmental setting of the study area of 10 km radius around the Barapani Airport is tabulated in **Table 1.1**:

**Table 1.1: Environmental Setting of the Study Area**

| Sl. No. | Particulars          | Details                                                                                                                                                                                          |                 |                  |  |
|---------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|------------------|--|
| 1       | Project Location     | The site for expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion of Terminal Building & Apron and Other Allied Works in Umroi in Ri Bhoi District of Meghalaya State. |                 |                  |  |
| 2.      | Latitude & Longitude | <b>Points</b>                                                                                                                                                                                    | <b>Latitude</b> | <b>Longitude</b> |  |
|         |                      | PT A                                                                                                                                                                                             | 25°42'58.56"N   | 91°59'11.38"E    |  |
|         |                      | PT B                                                                                                                                                                                             | 25°42'51.12"N   | 91°59'21.71"E    |  |
|         |                      | PT C                                                                                                                                                                                             | 25°42'32.73"N   | 91°58'40.31"E    |  |
|         |                      | PT D                                                                                                                                                                                             | 25°41'32.60"N   | 91°57'55.01"E    |  |

| Sl. No. | Particulars               | Details                                                                                                                                                                                                                                                                                                                                                     |               |              |
|---------|---------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------|
|         |                           | PT E                                                                                                                                                                                                                                                                                                                                                        | 25°41'27.74"N | 91°58'1.62"E |
|         |                           | PT F                                                                                                                                                                                                                                                                                                                                                        | 25°41'26.77"N | 91°58'7.76"E |
| 3.      | Elevation above MSL       | At the site is at 8 86 m amsl                                                                                                                                                                                                                                                                                                                               |               |              |
| 4.      | Topography                | The airport is surrounded by gently undulating hills and plateaus, forming part of a broader highland system in the Eastern Himalayas.                                                                                                                                                                                                                      |               |              |
| 5.      | Climatic Conditions       | Tropical highland climate with mild summers and cool winters. Peak rainfall is received from June–August and area remains extremely wet. Humidity is especially highest in monsoon. Winds are low to moderate and visibility issues arise mainly from fog and rain. Annual rainfall at Barapani (Shillong) Airport at Umroi is approximately 3600 -3650 mm. |               |              |
| 6.      | Annual rainfall           | Annual rainfall at Barapani (Shillong) Airport at Umroi is approximately 3600 - 3650 mm.                                                                                                                                                                                                                                                                    |               |              |
| 7.      | Nearest Highway/Road      | Shillong Bypass Road-1.67 km towards NNE<br>SH-8: 5.68 km towards NW<br>NH-40 : 8.08 km towards SW<br>AH-2: 7.22 km towards WSW                                                                                                                                                                                                                             |               |              |
| 8.      | Nearest Railway station   | Kamrup Khetri RS : 48 km towards NNE<br>Guwahati RS : 58 km towards NNE                                                                                                                                                                                                                                                                                     |               |              |
| 9.      | Nearest Airport           | LGB International Airport Guwahati-59.50 km towards NW<br>Silchar Airport: 133.50 kms towards SE                                                                                                                                                                                                                                                            |               |              |
| 10.     | Nearest Habitation        | <ul style="list-style-type: none"> <li>• Umroi : 2.2 km towards NW</li> <li>• Umden : 1.20 km towards WSW</li> <li>• Umsning : 10.00 km towards NW</li> <li>• Shillong : 16.00 km towards SW</li> </ul>                                                                                                                                                     |               |              |
| 11.     | Reserve/Protected Forests | There is no forest land involved in the proposed expansion of Barapani Airport.                                                                                                                                                                                                                                                                             |               |              |
| 12.     | Nearest Waterbody         | <ul style="list-style-type: none"> <li>• Umaim Lake: 8.16 km towards WSW</li> <li>• Wah Umiam River: 0.015 km towards SE</li> <li>• However, there is no flooding at the airport due to Umiam River.</li> </ul>                                                                                                                                             |               |              |
| 13.     | Critically Polluted Area  | There is no critically polluted area as identified by the CPCB within 10 km from Barapani Airport.                                                                                                                                                                                                                                                          |               |              |

| <b>Sl. No.</b> | <b>Particulars</b>                                  | <b>Details</b>                                                                                                                                                |
|----------------|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14.            | Inter-state Boundaries and International Boundaries | There is no inter-state boundaries and international boundaries within 10 km radius area within 10 km from Barapani Airport.                                  |
| 15.            | Ecologically Sensitive Zones within 10-km distance  | There is no eco-sensitive area notified under Environmental (Protection) Act, 1986                                                                            |
| 16.            | National Parks/Wild Life Sanctuary                  | No national parks are present within 10 km radius from the Project site                                                                                       |
| 17.            | Historical/Archaeological Places                    | There is no historical/archaeological place within 10 km from the Barapani Airport.                                                                           |
| 18.            | Defense Installation                                | Defense installation in the vicinity of the airport.                                                                                                          |
| 19.            | Seismic Zone                                        | Zone V (The entire state of Meghalaya, including Barapani airport, falls under Seismic Zone V, the highest risk category according to the BIS IS 1893 (2002)) |



**Figure 1.1: Index Map of Proposed Expansion of Barapani Airport**



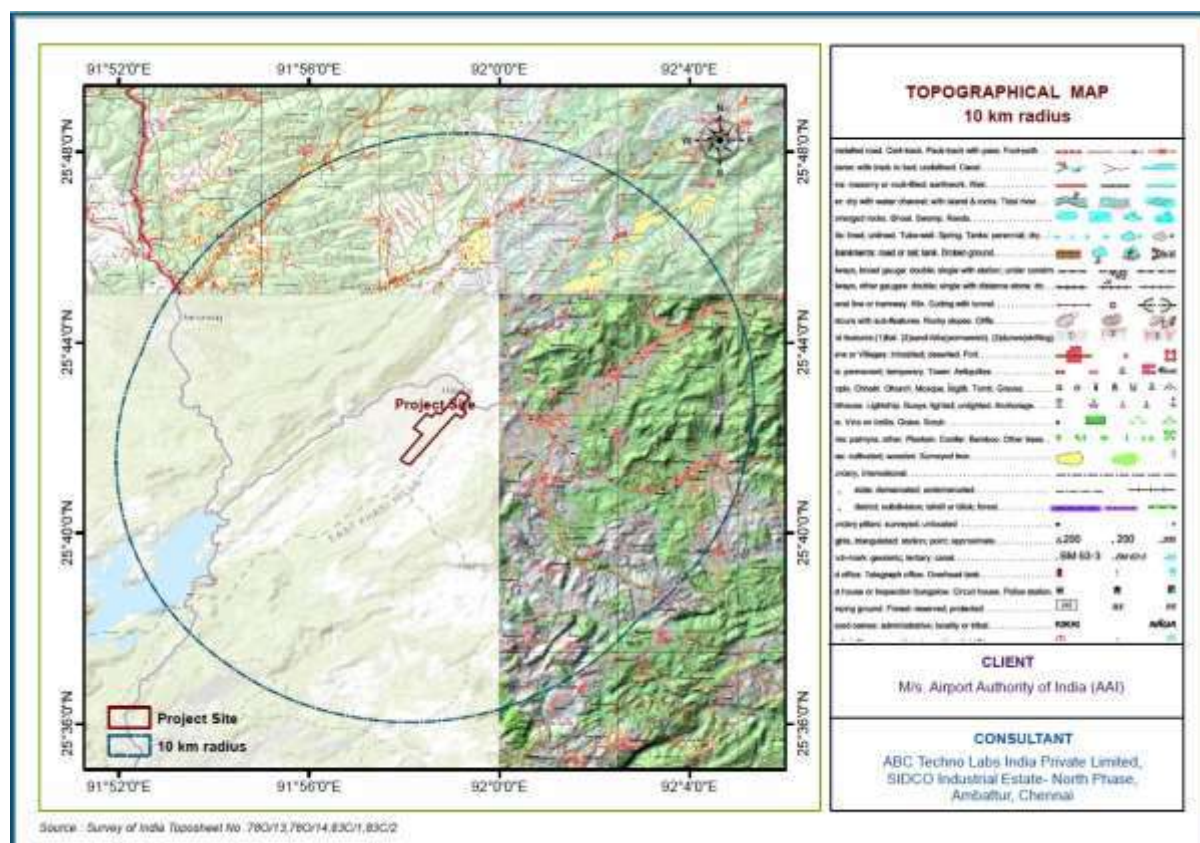


Figure 1.2: 10 Km Study Area on toposheet for Expansion of Barapani Airport

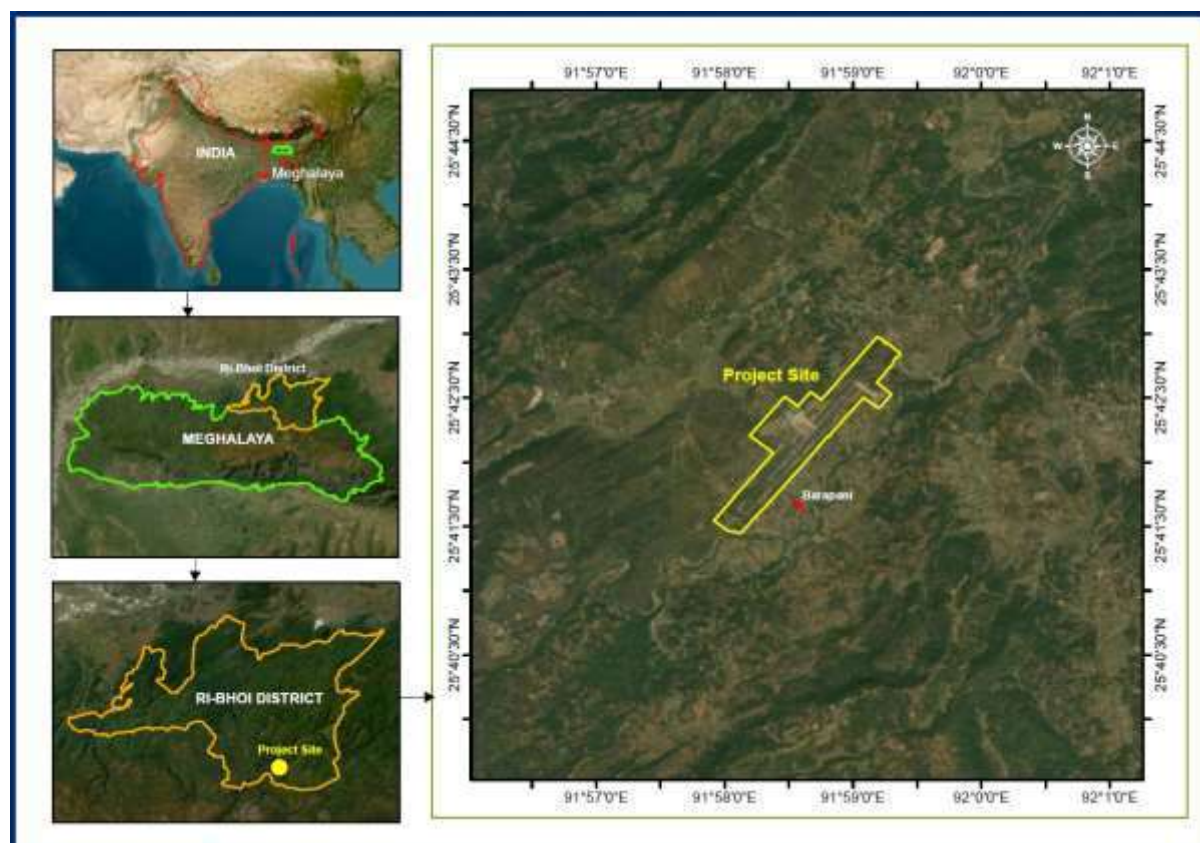


Figure 1.3: 10 Km Study Area for Expansion of Barapani Airport

## **1.7 Legal Aspects and Environmental Regulations**

The relevant environmental clearance and consents will be obtained from the statutory agencies under the following Environmental Acts, Rules and amendments for expansion of Barapani (Shillong) Airport including runway extension will adhere to the guidelines specified in.

During construction and operation of expansion of Barapani (Shillong) Airport 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:

- Environment (Protection) Act, 1986 & subsequent amendments till date
- EIA Notification, 2006 & subsequent amendments till date
- The Air (Prevention and Control of Pollution) Act, 1981 & subsequent amendments till date
- The Water (Prevention and Control of Pollution) Act, 1974 & subsequent amendments till date
- Manufacture, Storage and Import of Hazardous Chemicals Rules 2000(MSIHC Rules) & subsequent amendments till date
- Construction and Demolition Waste Management Rules 2016 & subsequent amendments till date
- Solid Waste Management Rules, 2016 & subsequent amendments till date
- Hazardous and Other Waste (Management and Transboundary Movement) Rules 2016 & subsequent amendments till date
- E-Waste (Management) Rules 2016 & subsequent amendments till date
- Plastic Waste Management Rules 2016 & subsequent amendments till date
- Bio-Medical waste Management Rules, 2016 & subsequent amendments till date
- The Noise Pollution (Regulation and Control) Rules, 2000 & subsequent amendments till date
- The Biological Diversity Act, 2002 & subsequent amendments till date
- Other Environmental and Occupational Health & Safety (OHS) regulations as applicable

## **1.8 Scope of the EIA Study**

Airports Authority of India appointed 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 environmental impacts of the proposed project and suggest suitable mitigation measures and environmental management plan for likely adverse impacts due to the activities. The EIA/EMP report has been prepared for the project following the generic structure specified in the EIA Notification, 2006 and subsequent regulations.



An EIA study is useful to understand and mitigate the impact of the proposed 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 project area. It also includes identification of the potential environmental impacts of the 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 project; and
- Delineation of post-study Environmental quality monitoring programme.

The scope also includes points given in the TORs prescribed by SEIAA Meghalaya for the airport. Baseline studies were carried out for a period of three months from 1<sup>st</sup> March to 31 May 2025, representing summer season.

### **1.8.1 Methodology**

Environment Impact Assessment report has been prepared with the following steps:

#### **Establishment of Baseline Environmental Status**

A comprehensive database on the baseline environmental status of the study area has been established through review, compilation & analysis of

- ❖ Existing published secondary data/literature/information, and
- ❖ Primary data generated/collected through initial site surveys and field study

The field monitoring has been carried out as per the guidelines of CPCB and requirement of the MoEF&CC for one complete season. Field study/monitoring has been conducted on:

- ❖ Ambient Air Quality;
- ❖ Noise Level;
- ❖ Metrological and Climatological Data Collection;
- ❖ Ground and Surface Water Quality;
- ❖ Soil Quality;
- ❖ Ecological and biodiversity Aspects;
- ❖ Land Use Pattern;
- ❖ Traffic Studies
- ❖ Socio- Economic Aspects;

## **Environmental Impact Assessment**

The project data/activities have been analysed & linked with the existing baseline environmental conditions in order to list out the affected environmental parameters and assess the likely impacts on such parameters. Compliance of the project with national standards has been duly checked.

## **Preparation of Environmental Management Plan**

Environmental Management Plan (EMP) is the key to ensure a safe and clean environment. The desired results from the environmental mitigation measures existing in the project may not be obtained without a management plan in order to assure its proper implementation & function. The EMP envisages the plans for the proper implementation of mitigation measures to reduce the adverse impacts arising out of the proposed project activities. EMP has been prepared addressing issues such as:

- ❖ Details of management plans.
- ❖ Pollution control / mitigation measures for abatement of the undesirable impacts caused during operational activities.
- ❖ Maintenance of water resources and water quality.
- ❖ Institutional set up identified/recommended for implementation of the EMP.
- ❖ Post project environmental monitoring programme.

## **1.9 Structure of Environmental Impact Assessment Report**

The Environmental Impact Assessment (EIA) Report has been prepared as per format described in the EIA Notification 2006 and the structure of EIA report is given below. The EIA report has been divided into 12 Chapters which are presented as follows:

## **Compliance of TORs**

**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 project details including master plan, layout plan, utility, power requirements, water requirement and sources pollution and its management, cost etc.

**Chapter 3 - Description of the Environment:** This chapter presents baseline environmental status within 10 Km radius i.e. study area including topography, geological, drainage pattern, water environment, climate & meteorology, ambient air quality, noise levels, ecology and biodiversity including 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 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.

**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. Public hearing and action taken report for issues raised during public hearing.

**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.

## **CHAPTER 2**

### **DESCRIPTION OF PROJECT**

#### **2.1 Introduction**

##### **2.1.1 Existing Airport Facilities**

The expansion of Barapani (Shillong) Airport including runway extension has following existing infrastructure:

##### **(i) Terminal Building**

Area of Existing Passenger Terminal Building is 5000 sqm with a peak hour handling capacity of 200 passengers and 0.5 MPPA,

##### **(ii) Runway**

Existing runway 04/22 having dimension 1829m x 45m is suitable for the operation of ATR-72 type of aircraft.

##### **(iii) Apron**

Existing apron is suitable for parking of 4 nos. ATR-72/Q - 400 type of aircraft with power - in and power - out configuration.

**Environmental Clearance** - Barapani (Shilong) Airport is operating with Environmental Clearance (File No. 10-28/2018-IA -III dated 7th January 2020) obtained from Ministry of Environment Forest and Climate Change (MOEF&CC).

**Certified Compliance Report**-Application submitted to Regional Office of MOEF&CC, Shillong for Certified compliance report for Environmental Clearance dated 7th January 2020.

**CTE and CTO** - Barapani (Shilong) Airport has CTE and application for CTO is with Meghalaya Pollution Control Board.

**Fire NoC** - Fire NoC for the Barapani (Shilong) Airport is available.

#### **Air Traffic at Barapani Airport**

Annual & Monthly Passenger and Flight Traffic

FY April 2024 – March 2025:

119,982 passengers handled — a 22.4% increase year-on-year.

2,626 aircraft movements (arrivals + departures) — up 31.6%

### **2.1.2 PIL Court Case for Early Completion of Proposed Expansion**

PIL court case is pending in the Hon'ble High Court of Meghalaya vide PIL No.4/2021 with MC (PIL) No.2/2021 for providing 11.7 Acres land and early completion of proposed expansion of Barapani (Shillong) Airport.

## **2.2 Proposed Expansion of Barapani (Shillong) Airport**

Under the proposed expansion, it is proposed to develop the following infrastructure at the existing Barapani (Shillong) airport considering A -320 as a critical aircraft for operations. The pavement strength has been considered with the potential for future upgrades to support A -321 operations.

(i) Construction of Extended Runway from the existing length of 1829m x 45m to 2400m x 45m with provision of turn pads at both ends and strengthening of existing runway.

(ii) Expansion of Apron for parking of 5 nos. of Code - C Aircraft in power - in push - back configuration & associated GSE area. Strengthening of existing apron, isolation bay and associated taxiways.

(iii) Expansion of Existing Terminal Building by 5,550 sqm increasing the consolidated peak hour capacity to 1620 passengers (810 Arrival + 810 Departure) as per BCAS norms, with a provision of 2 nos. Passenger Boarding Bridge.

(iv) Miscellaneous Works.

## **2.3 Size and Magnitude of Operation**

At the Barapani (Shillong) Airport, expansion of existing terminal building (5000 sqm) is proposed by 5550 sqm (total 10550 sqm) increasing the consolidated peak hour capacity to 1620 passengers (810 Arrival + 810 Departure) as per BCAS norms, with a provision of 2 nos. Passenger Boarding Bridge. The construction of extended runway is proposed from the existing length of 1829m x 45m to 2400m x 45m with provision of turn pads at both ends and strengthening of existing runway. The expansion of Apron is proposed for parking of 5 nos. of Code-C Aircraft in power-in push-back configuration & associated GSE area. Strengthening of existing apron, isolation bay and associated taxiways.

### **2.3.1 Land Requirement**

Barapani (Shillong) Airport has an area of 416.16 Acres. 22 Acres of additional land (16 acres for Runway Extension by 571m and another 6 Acres of land for Relocation of Isolation Bay) would be handover by Meghalaya State Government for the proposed expansion.

Out of 22 Acres additional land for proposed expansion, 10.3 Acres land will be taken from Defence by Meghalaya State Government by land swap and remaining 11.7 Acres of land will be given by Meghalaya State Govt.

## **2.4 Master Plan for Proposed Expansion of Barapani Airport**

The site master plan of the Expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion of Terminal Building & Apron and Other Allied Works is shown in **Figure 2.1** and extended terminal building proposal is shown in **Figure 2.2**. Expansion of existing apron is presented in **Figure 2.3**.

The project site is located in seismic zone V therefore design of various components will adhere to as per national standards for buildings to make it earthquake proof.

## **2.5 Scope for Proposed Expansion of Barapani Airport**

The scope of work for the proposed expansion of existing Barapani (Shillong) Airport is given below: W

### **1. Construction of Extended Runway from the existing length of 1829m x 45m to 2400m x 45m with provision of turn pads at both ends and strengthening of existing runway.**

#### **A. Civil Works**

(i) Obstacle survey to be undertaken before extension of runway to ensure full utilization of full length of runway.

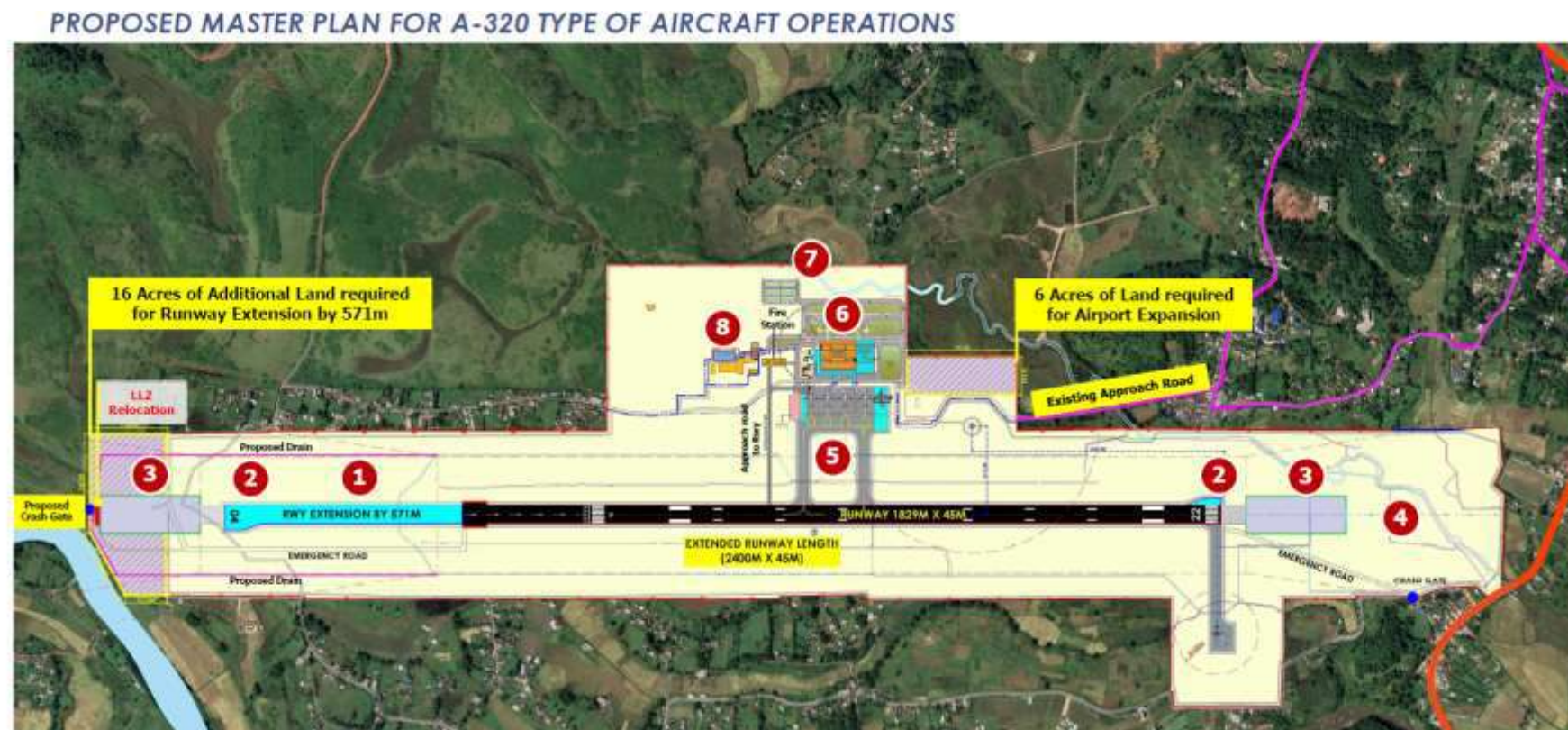
(ii) Extension of Runway by 571m at RWY 04, increasing the current runway length of 1829m x 45m to 2400m x 45m along with provision of turn pads at both ends as shown in the enclosed drawing (Annex-I) of strength suitable for A-321 type of aircraft.

(iii) Both longitudinal and transverse slopes are to be maintained for the complete runway length as specified in Annex-14/DGCA-CAR.

(iv) Strengthening of the existing runway 1829m x 45m to cater for the strength of A-321 type of aircraft.

(v) Provision of 7.5m wide shoulder on both sides of extended and existing runway pavement for provision of runway lights.

(vi) Strengthening & Grading of Runway strip (280m x 2520m) as specified in DGCA CAR. Taxiway strip and entire operational area to meet the ICAO slope criteria, wherever required.



**Figure 2.1: Master Plan for Barapani (Shillong) Airport Including Runway Extension, Expansion of Terminal Building & Apron and Other Allied Works**



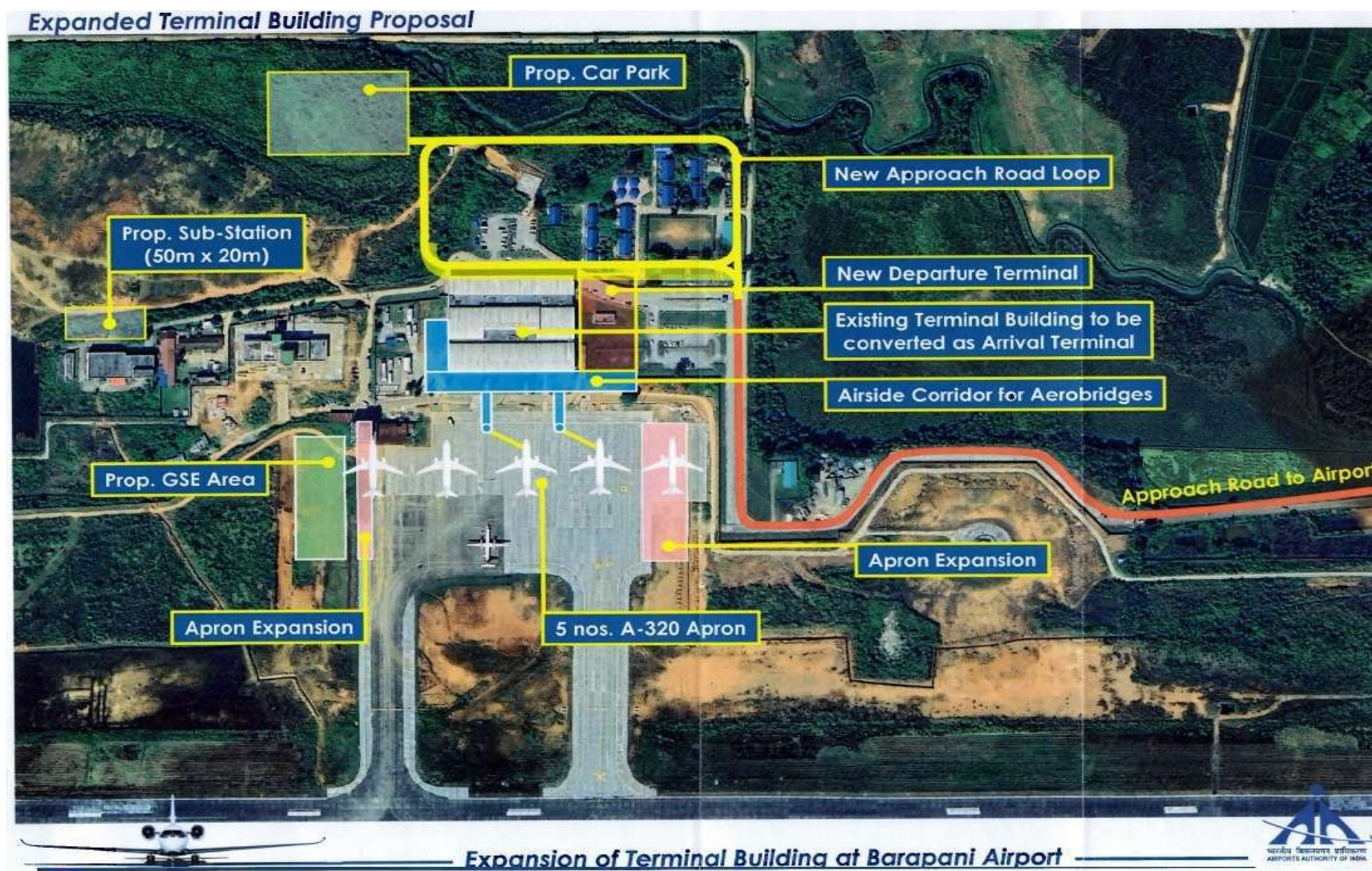


Figure 2.2: Extended Terminal Building Proposal



EIA for Expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion of Terminal Building & Apron And Other Allied Works  
Project Description

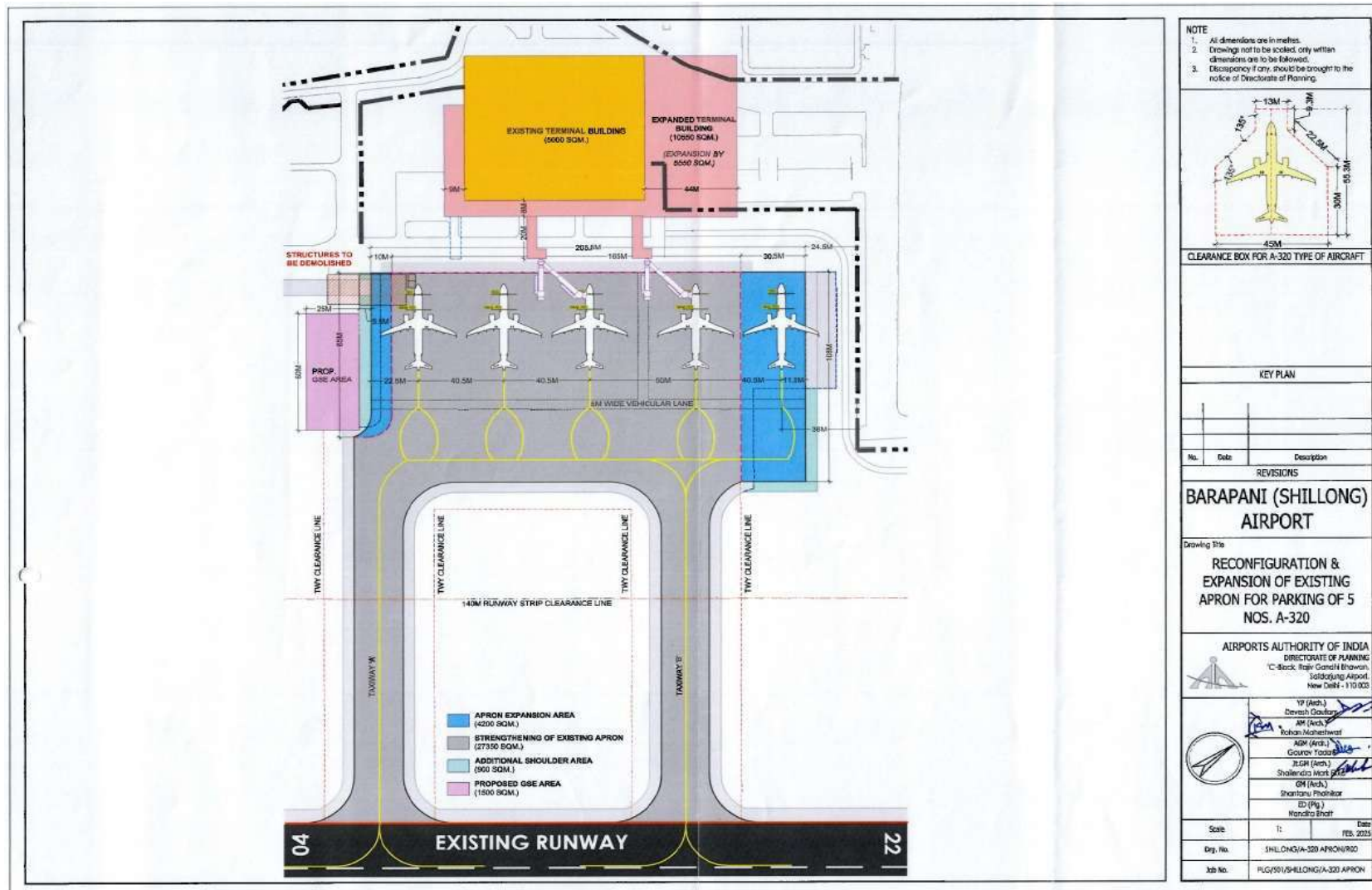


Figure 2.3: Extended Terminal Building Proposal

- (vii) Provision of storm water drainage system along the runway as per requirement.
- (viii) Provision of 60m x 60m Blast Pad at RWY-04.
- (ix) | Construction of 240m x 90m RESA at both ends of runway strip of Runway 04/22.
- (x) Technical evaluation and declaration of pavement strength after completion of work and prior to commissioning.
- (xi) Provision of Runway, Taxiway & Apron marking, mandatory instruction marking wherever required as per Annex-14 and Aerodrome design Manual Part-IV (Visual Aids).
- (xii) Paved surfaces of adequate dimensions should be provided in front of PAPI to prevent growth of grass and vegetation.
- (xiii) Provision of Emergency access road & Emergency Gate (Crash Gate) as per requirement.
- (xiv) Provision of civil work for Trans-installation of LLZ as per requirement.

## **B. Electrical Works**

- (i) Provision of Airfield Ground lighting (AGL) system comprising of LED Type Runway edge lighting system, Runway end light system, turnpad lights, Threshold lighting system, Threshold wing bar light, runway distance to Go Marker, Intermediate holding position light, ALCMS (Airfield Lighting Control & Monitoring System), Illuminated DIGMS (Digitally Illuminated Glowing Metallic Signboard), illuminated signage, PAPIs.
- (ii) Approach lighting system to be extended from 420m to 600m.
- (iii) AGL Substations i/c CCR halls (to be part of civil work), Sub Station Equipment, DG sets and associated system i/c air conditioning for CCR halls etc; Power Monitoring and Control System, Power supply (main and stand by) to NAVAIDS, MET & ancillary buildings, etc. inside operational area.
- (iv) Provision of Illuminated Wind direction indicator(s) and Landing direction indicator should be made as per DGCA CAR.
- (v) Provision of electrical work for Trans-installation of LLZ as per requirement.

## **2. Expansion of Apron for parking of 5 nos. of Code-C Aircraft in power-in push-back configuration & associated GSE area as per drawing attached as Annexure. Strengthening of existing apron, isolation bay and associated taxiways.**

### **A. Civil Works**

- (i) Construction of proposed apron expansion (rigid pavement) of 4200 sqm. (approx.) area for parking of 5 nos. of Code-C Aircraft
- (ii) Construction of GSE having an area of 1500 sqm. (approx.)

- (iii) Construction of additional shoulder having an area of 900 sqm. (approx.)
- (iv) Strengthening of existing apron having an area of 27350 sqm. (approx.);
- (v) The proposed Apron expansion should be rigid pavements with strength to cater to the operation of Code 'C' (A-321) type of aircraft.
- (vi) The apron markings will have to be redrawn as the existing parking stands have been redesigned.

## **B. General**

- (i) Augmentation and Provision of VDGS including Bay numbering for Parking Bays in the existing and extension of apron.
- (ii) Rerouting the existing drainage and / or provision of new drainage connecting the existing drainage system at appropriate location for protecting the extended portions of apron.
- (iii) Technical Evaluation & declaration of pavement strength after the completion of work and prior to commissioning.
- (iv) Provision of apron aircraft stand markings, apron edge marking, apron safety lines (including wing tip clearance lines & service road boundary lines as required by the parking configurations and ground facilities), mandatory instruction marking wherever required as per DGCA (CAR) and Aerodrome Design Manual Part-IV (Visual Aids).
- (v) Removal of obstructions, if any, in the portion of extension of apron.
- (vi) Slopes on an apron, including those on an aircraft stand taxi lane, shall be sufficient to prevent accumulation of water on the surface of the apron but shall be kept as level as drainage requirements permit. On an aircraft stand the maximum slope shall not exceed 1 percent.

## **C. Electrical Works**

- (i) Augmentation and Provision of apron edge lights and mandatory instruction signs and other illuminated information signs.
- (ii) Augmentation of power supply, if any.
- (iii) Augmentation and Provision of apron flood lights for the extended portions of the new Apron to meet the required illumination standards as per DGCA (CAR) and Aerodrome Design Manual Part-IV (Visual Aids).
- (iv) Rerouting of any electrical or communication cables in the areas of proposed extension of apron.

**3. Expansion of Existing Terminal Building by 5,550 sqm. increasing the consolidated peak hour capacity to 1620 passengers (810 Arrival + 810 Departure) as per BCAS norms, with a provision of 2 nos. Passenger Boarding Bridge.**

**A. Civil Works**

(i) Existing Terminal building having an area of 5,000 sq.m. shall be extended by 2,950 sqm (approx.) on the ground floor and 2,600 sqm (approx.) on first floor i.e. additional 5,550 sqm (excluding city side and air side kerb) to have total area of 10,550 sqm capable to handle 1620 peak hour passengers at any given time as per BCAS norms. Additional area of 900 sqm. for kerb and canopy expansion for an area of 570 sqm. at city side is also proposed.

(ii) 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 along with drinking water facility. Suitable number of ramps to be provided for entry and exit of differently-abled persons in Departure and Arrival area. Additional fixtures in the toilet to be provided for arrival passengers arriving together at one time.

(iii) Tactile pathway by using SS Studs & strips to be provided as per planning circular 1/2017 dated 17.10.17.

(iv) The design of Terminal building to include Media planning, Retail area planning, F & B plan, etc. Overall planning of Building to capture local architectural features and it to be part of design features of Terminal. The design should include the required arrangement for its regular maintenance to make it in-built part of execution. Solar power generation viz. solar lighting, solar roofing system, etc. shall be provided. Maintenance friendly roofing, false ceiling & building façade system including provision of regular cleaning with maintenance hoists, hooks, etc. including cat walk / rope suspended platform / gondola etc. to be provided on both inside and outside of terminal building.

(v) Use of solar panels on roof to be explored. mated baggage drop system etc.

(vi) Demolition of walls and partitions within the terminal Building as indicated in the drawing enclosed

• **Departure Area**

(i) The Terminal Building with provision for departure concourse, having 16 Nos. additional new check-in counters (in addition to existing 12 nos. counters) with Baggage Screening System, baggage conveyor belts, queuing space, segregation railing, back-up offices for Airlines, facilitation counters, weighing machines, counters, automated baggage drop system etc.

(ii) Security Offices.

- **Security Hold Area**

- (i) Security Hold area and bus lounge area with adequate seating arrangements isolated smoking area, child care room and wash rooms etc.
- (ii) Security check/passenger frisking area in security hold with adequate space for locating required number of DFMDs, X-ray machines, frisking platforms, Inspection Tables for manual checking of hand baggage and adequate space / room for security staff, etc.
- (iii) Security Hold to be planned on Ground and first floor to facilitate holding near the gates provided with 2 Nos. aerobridges and at ground floor for remote gates,
- (iv) Retail Area Creation of Retail Islands/ Shops, area for vehicle display without affecting the passenger movement.
- (v) Food & Beverage Area
- (vi) Office Space for regulatory agencies.

- **Arrival Area / Baggage Claim Area**

- (i) Baggage Claim area with additional 1 number of baggage conveyor belts of adequate size to be provided.
- (ii) Adequate space should be provided for required number of offices, Bank, space for storing of baggage trolleys, space for storage of mishandled baggage for airlines, segregation railing and associated passenger amenities.
- (iii) Office Space for regulatory agencies.
- (iv) Medical Room.

- **Other Requirements for Terminal Building**

- (i) Augmentation and 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, Conference Room and other facilities, infrastructure for advertisements and Art work at suitable locations.
- (ii) Adequate space for airline offices, CISF, AAI, etc. along with required staff toilet, concessionaire offices, and backup offices for GHS etc. is to be planned and provided.
- (iii) Construction of car park with all amenities for requisite nos. of cars and parking for VIP cars & buses, designated parking space for PWRM and separate car/scooter park area for AAI, and airlines staff at appropriate location.
- (iv) Provision of VIP/CIP lounges, with adequate number of chairs, furniture, furnishings etc. at suitable location both for arrival and departure passengers.

- (v) Augmentation and Provision of water supply system as per norms and as per site conditions.
- (vi) Horticulture-landscaping, drainage system, water supply, Rain Water Harvesting etc.
- (vii) Driver's rest room, canteen and toilet facility on the city side.
- (viii) Augmentation and Provision of acoustics for effective functioning of PA system.
- (ix) Providing city side compound wall depicting local architecture and with impressive entrance gates.
- (x) Building evacuation route and exit plan (level wise) leading to designated assembly point. Separate drawing to be prepared mentioning emergency exits and escape routes.
- (xi) Location of fire control room in airport terminal building to be earmarked
- (xii) The provision of the rooms in central location of the building at Ground Floor with air conditioners and adequate no. of Power points of 15 Amp and 3 phase power supply for UPS as mentioned below:

✓ **Equipment Room**

Minimum size - 5m x 7m

Purpose - Positioning of Rack for FIDS, CCTV and PA system to install servers/switches /Recorder of CCTV and other equipment.

✓ **UPS & Battery Room**

Minimum size - 3m x3m

Purpose - Housing Batteries & UPS for CCTV, FIDS, PA System and other equipment.

✓ **CCTV Monitoring Room**

Minimum size - 5m x 4m

Purpose - Housing CCTV video wall/monitors, PCs etc. and Monitoring/Surveillance of airport by security personnel through CCTV cameras.

✓ **Workshop/Maintenance Room**

Minimum size - 5m x 4m

Purpose - For repair and keeping spares of the equipment under this Dte. And maintenance and watch of all these sophisticated systems.

✓ **Aerodrome committee control room (ACCR)**

Provision for Aerodrome Committee control room (ACCR)

## **B. Electrical Works**

- (i) Augmentation and provision of Energy efficient Internal and external electrification for Terminal Building Complex, associated buildings, Car Park and roads i/c boom barriers etc. Lighting shall be of LED based.
- (ii) Augmentation of Sub-stations, A/C plant room, Fire & water pump Room and related service facilities. Provision to be made for backup Generators, UPS for essential services, etc.
- (iii) Augmentation and Energy efficient Central air-conditioning with provision of vertical air-conditioning concept & BMS i/c VRF/Split AC system as required.
- (iv) Augmentation and provision of BHS (Departure Check-in and Arrival Baggage Claim) with associated equipments i/c control rooms, equipments/panel rooms etc. as required.
- (v) Augmentation and Provision of Fire detection, alarm and protection system, firefighting hydrant, Sprinkler system, with Fire Control Room/panel and linking the same with Fire Station.
- (vi) Augmentation and Provision of automatic sliding doors at exit & entry points of Terminal Building.
- (vii) Augmentation and provision of escalators & elevators/walkalators with matching staircase.
- (viii) Augmentation and Provision of Passenger Boarding Bridges (PBB) i/c AVDGS as per the apron requirement.
- (ix) Augmentation and Provision of adequate number of LED Signages of world class standard, inside and outside the terminal building, car park area & City side approach road and air side area for guidance of passengers and visitors as per latest concept by signage consultant.
- (x) Augmentation and Provision of grid connected renewable energy generation system.
- (xi) Augmentation and Provision of pumps, compressors and associated electrical system for water supply, STP, water treatment systems.
- (xii) Augmentation and Provision of Air-curtains, Water cooler, hand driers etc.

## **C. Airports Systems**

- (i) Augmentation of Public address system and car calling system.
- (ii) Augmentation of 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.

(iii) Augmentation and Provision of Flight Information Display System (FIDS) with adequate number of Display Devices in departure, arrival and security hold area for passenger facilitation.

(iv) Augmentation and Provision of adequate number of X-ray machines for scanning Registered Baggage (RB) and Hand Baggage's (HB), including provision of required number of ETDs, DFMDs and HHMDs, as per BCAS norms.

(v) Augmentation and Provision of adequate no. of VHF FM Sets (Walkie-Talkie, Base Stations and Mobile Stations).

(vi) Augmentation and Provision of Telephone Exchange / digital EPABX/ IP EPABX system for Terminal Building including telephone/ intercom instruments, wiring etc.

#### **D. IT Systems**

(i) Passive & Active networking works at Airport Terminal

✓ The existing and extended Terminal Building to be integrated with Modern IT enabled passenger services to improve passenger convenience and throughput of the building. Latest IT enabled services should be integrated in a planned way.

✓ SITC of Active networking components such as Firewalls, Routers, Switches etc. and associated equipment as per the proposed solution architecture.

✓ SITC of Passive networking components such as UTP, OFC cabling, connectors, patch panels, I/O and associated equipment as per the proposed solution architecture.

✓ Provision of Raceways, Cable Trays and conduit shall be provided for the passive cabling works by Engg-Electrical as per requirement.

✓ SITC of Wireless Controller / Access Points and associated equipment as per the proposed solution architecture.

(ii) SITC of Server Room and associated works as per the proposed solution architecture.

(iii) SITC of Biometric Access Control Systems as per the latest technical specifications given by BCAS. The integration with existing Centralized BCAS system shall be in the scope of bidder.

(iv) Integration of all new IT Systems with IT Systems/ facilities of existing buildings.

#### **E. Commercial Works**

(i) Provision of CUTE/CUPPS and CUSS & BRS Systems

#### **4. Miscellaneous Works**

(i) Shifting and demolition of existing structures falling within the construction zone.



- (ii) Strengthening of all existing airside pavements for A-321 type of aircraft operations, as per requirement.
- (iii) | Provision of Bore wells, water storage and water supply, pump house for overhead water tanks and sump, etc. as per requirement, preferably by rainwater harvesting system.
- (iv) | Construction of Sewage System and Sewage treatment plant of adequate capacity (as per the requirement) with facility for future expansion.
- (v) Construction of electrical sub-station building for housing DG sets, stepping down the main power supply, transformers, etc., storage facilities for diesel, equipment, spare parts, etc., including Building for A/C Plant and water supply pump.
- (vi) Provision of gates to segregate airside and city side areas with security guard posts at the entry gate and additional security posts inside the operational area at an appropriate location in consultation with ATM and Security Dte.
- (vii) Construction of CCR and BMS room at an appropriate location.
- (viii) Provision of Battery-operated Buggies for Sr. Citizens and Differently Abled Persons as per requirement.
- (ix) Provision of covered drains and culvert (pipe/box) at appropriate locations in the operational/ non-operational area for the crossing of electrical and communication cables and draining of stormwater from the apron, terminal building, and car park areas. The strength of culverts, wherever required, must be designed for 'Code 4C type of aircraft'.
- (x) Construction of 2, 3, or 5-lane roads from the city main road up to the terminal building, and internal and perimeter roads with lighting as required for circulation.
- (xi) Provision of Boom Barrier as per requirement on city side and air side.
- (xii) Replacement/ Re-installation/ Re-routing of existing services (if any) to be done.
- (xiii) High-intensity Retro-reflective overhead signages and fascia signages of the Terminal Building.
- (xiv) Provision of property boundary wall and operational boundary wall (as per site condition) i/c lighting.
- (xv) Provision for Bollard, Tyre killer and BP Morcha as per standard.
- (xvi) Construction of boundary wall with embossed AAI logo of height as per letter no. PLG/507/TC/1/15/122 dated 09.02.2015. Construction of Watch Towers / Morcha as per requirement.
- (xvii) Provision of Perimeter Road (wherever required) of 4.8 m width with 1.2 m shoulder on both sides to facilitate quick movement of emergency vehicles/CFT and shall be capable of supporting Crash Fire Tender of 36.0 tonnes as per T.I. no.77 dated 27-04-2022.

(xviii) Watch tower as per site requirement next to perimeter road operational boundary wall i/c lighting.

(xix) Cutting and filling of ground to maintain the desired level.

(xx) Wall-to-wall grading for the operational area of the Airport.

(xxi) Provision for solid waste management system in order to comply with solid waste management rule 2016.

(xxii) Height Clearance for NOC for the proposed Terminal Building and associated infrastructure.

(xxii) Provision of approach road to fire pit, crash gates, apron, etc. as per operational and regulatory requirement.

(xxiv) The requirement of response time shall be met from fire station to both ends of runway and other location in maneuvering area without any obstructions and with minimum number of turns.

(xxv) Separate parking provision for electrical vehicles (EV) in a parking lot. Clearly marked and unobstructed parking spaces shall be reserved for EV charging at charging stations.

(xxvi) City side terminal buildings roads to be designed in such a manner for maneuvering of CFT and have proper turning radius.

(xxvii) As per DGCA CAR Section 4/B/I, Para 1.5.3 (applicable from 03rd Nov, 2022), Aerodrome stakeholders, particularly aircraft operators, shall be consulted in order to facilitate the master planning process using a consultative and collaborative approach.

(xxviii) Videography film - before & after the Development of the Airport

All the works are to be carried out as per DGCA CAR / ICAO / FAA documents and BCAS Norms. Any other work left out of the above and necessary to complete the project.

All system shall be complying with relevant international standard IS/NBC and sound engineering practices.

### **2.5.1 Passenger Terminal Building Expansion**

At the Barapani (Shillong) Airport, expansion of existing terminal building (5000 sqm) is proposed by 5550 sqm (total 10550 sqm) increasing the consolidated peak hour capacity to 1620 passengers (810 Arrival + 810 Departure) as per BCAS norms, with a provision of 2 nos. Passenger Boarding Bridge.

### **GRIHA V Rating for Proposed Terminal Building**

The domestic passenger terminal building at Barapani (Shillong) Airport will comply "Green

Rating for Integrated habitat Assessment (GRIHA) 5 star Rating. GRIHA is an acronym for Green Rating for Integrated Habitat Assessment. GRIHA is a rating tool that helps to assess the performance of their building against certain nationally acceptable benchmarks. It evaluates the environmental performance of a building holistically over its entire life cycle, thereby providing a definitive standard for what constitutes a 'green building'. The rating system, based on accepted energy and environmental principles, will seek to strike a balance between the established practices and emerging concepts, both national and international.

Ground floor plan of proposed terminal building, first floor plan of proposed terminal building, Roof Floor Plan of Proposed Terminal Building are presented in **Figure 2.4** to **2.6**, respectively.

## **2.6 Land for Proposed Development of Barapani (Shillong) Airport**

Barapani (Shillong) Airport has an area of 416.16 Acres. 22 Acres of additional land (16 acres for Runway Extension by 571m and another 6 Acres of land for Relocation of Isolation Bay) would be handover by Meghalaya State Government for the proposed expansion. Out of 22 Acres additional land for proposed expansion, 10.3 Acres land will be taken from Defence by Meghalaya State Government by land swap and remaining 11.7 Acres of land will be given by Meghalaya State Govt.

## **2.7 Contour Map for the Project Site**

The contour map for the project site is presented in **Figure 2.7**. The ground level at the proposed development site varies from 884 m to 914 m amsl.

## **2.8 Cutting & Filling**

For the proposed project 1273976 cum cutting and 197136 cum filling will be required, which will be utilized at site and disposed in environmental sound manner.

## **2.9 Construction Materials Requirement**

The construction materials requirement for the Proposed Expansion of Barapani (Shillong) Airport is as given below:

| <b>Construction Material</b> | <b>Quantity in MT</b> |
|------------------------------|-----------------------|
| Aggregates                   | 80000 MT              |
| Sand                         | 40000 MT              |
| Cement                       | 9000 MT               |
| Steel                        | 1500 MT               |
| Bitumen                      | 5200 MT               |

EIA for Expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion of Terminal Building & Apron And Other Allied Works  
Project Description

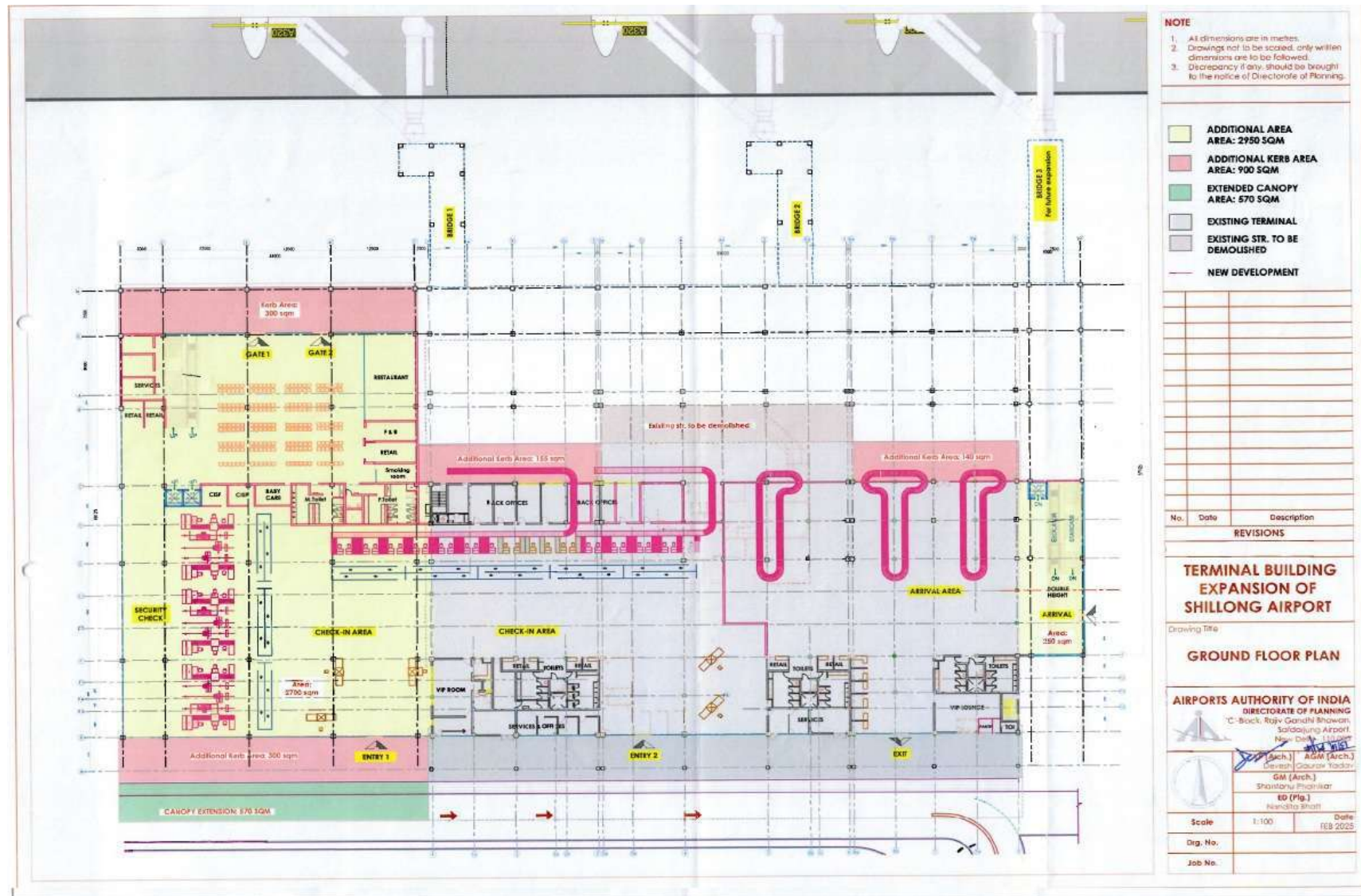


Figure 2.4: Ground Floor Plan of Proposed Terminal Building

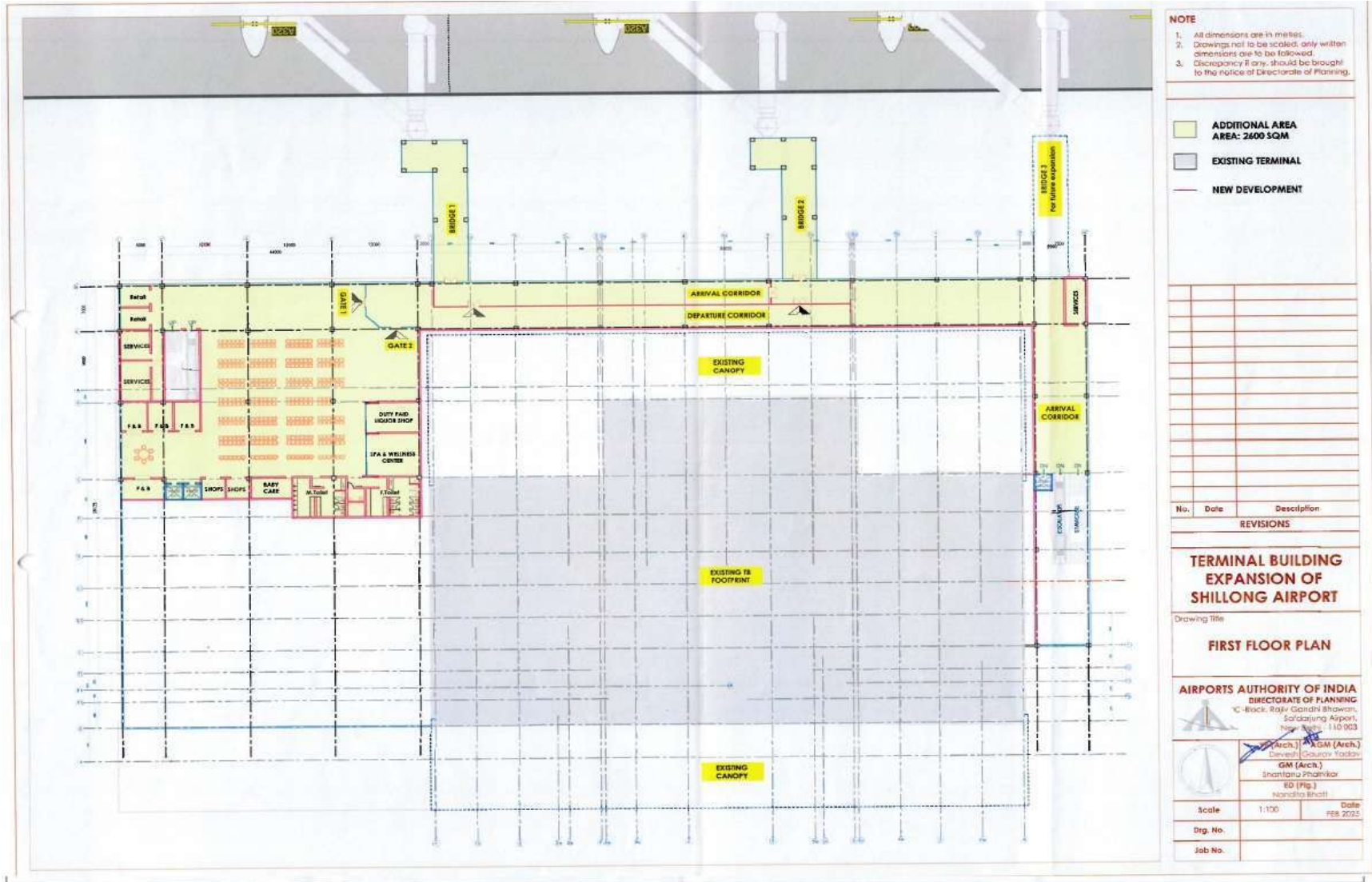


Figure 2.5: First Floor Plan of Proposed Terminal Building



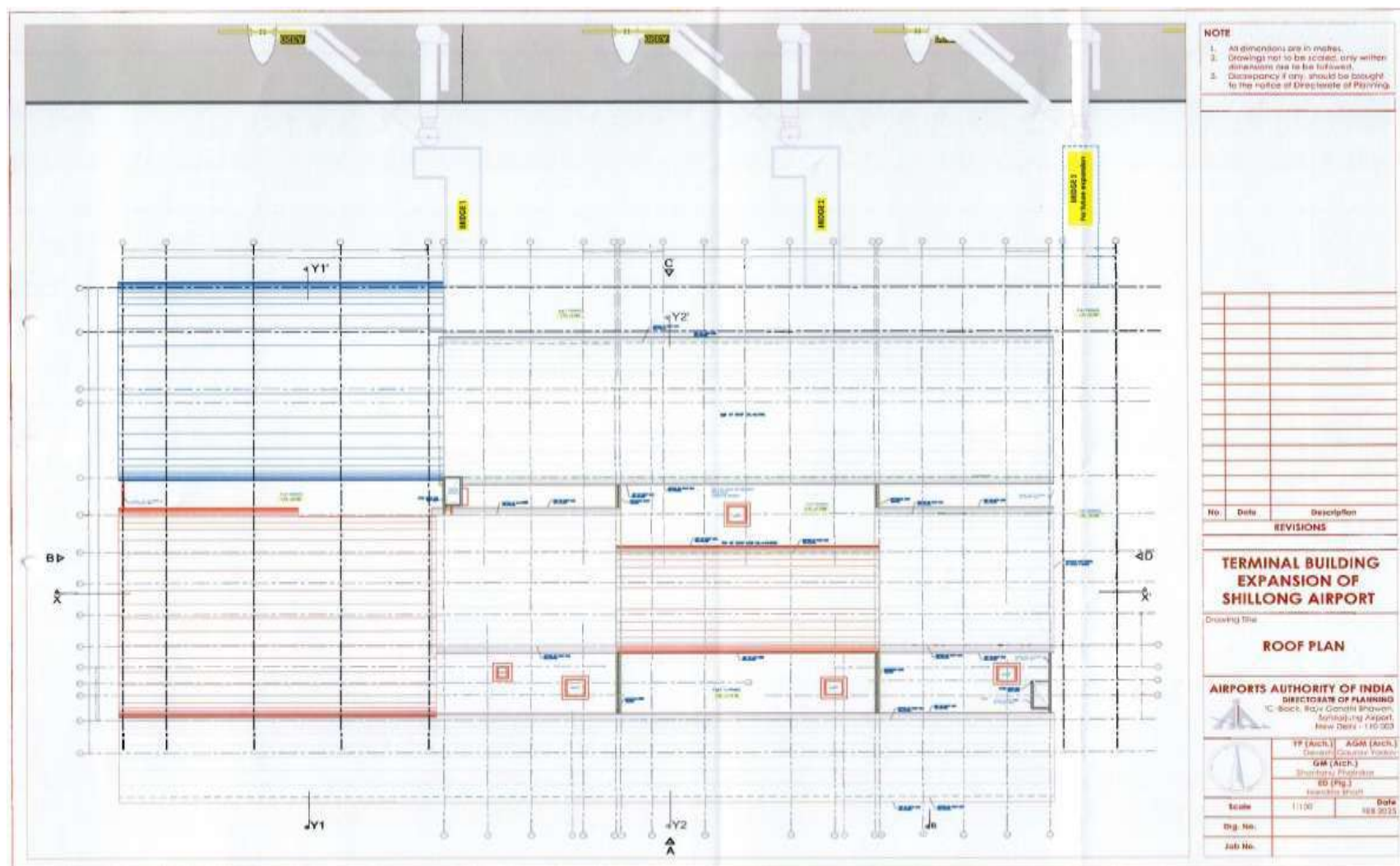


Figure 2.6: Roof Floor Plan of Proposed Terminal Building

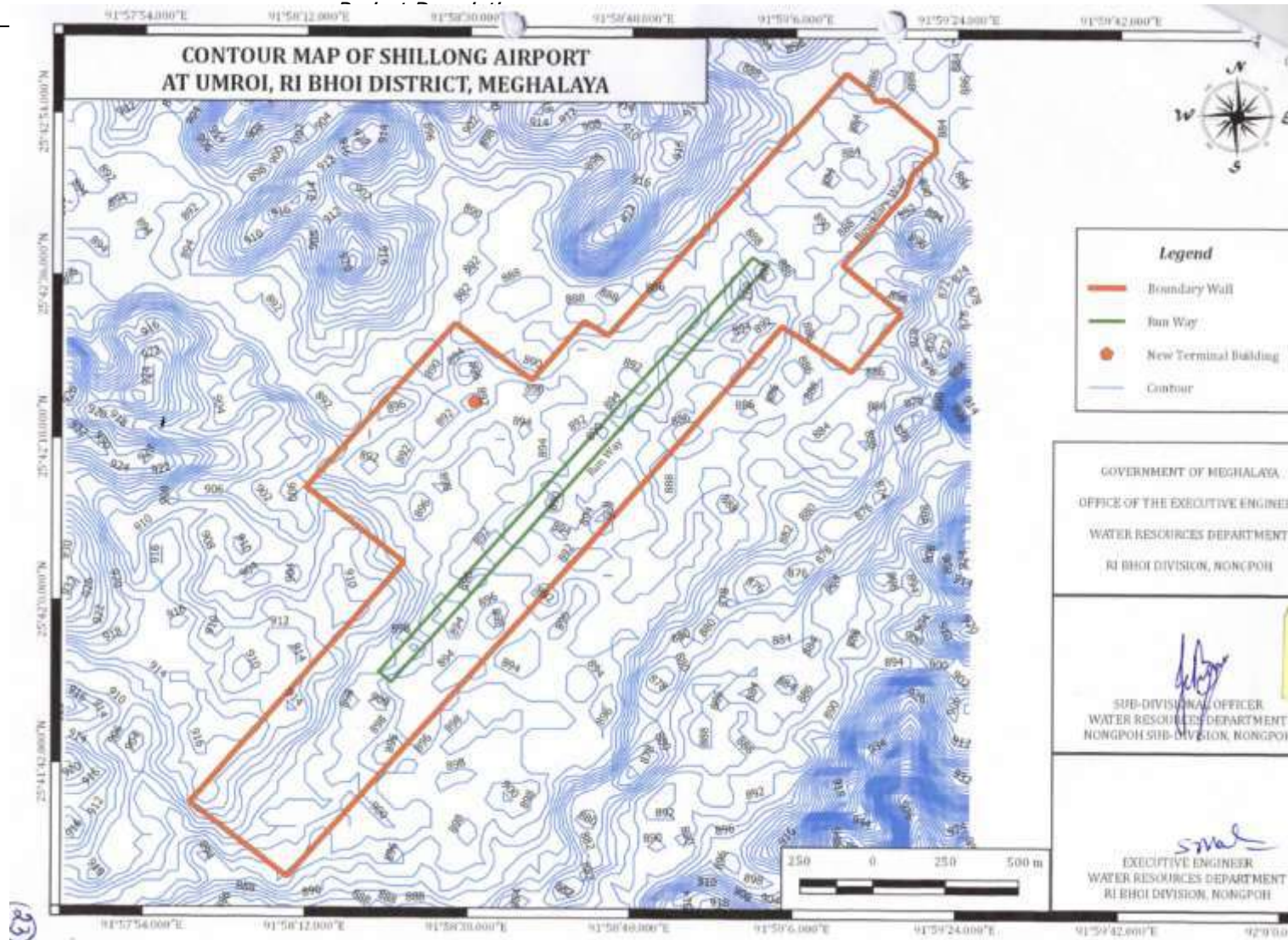
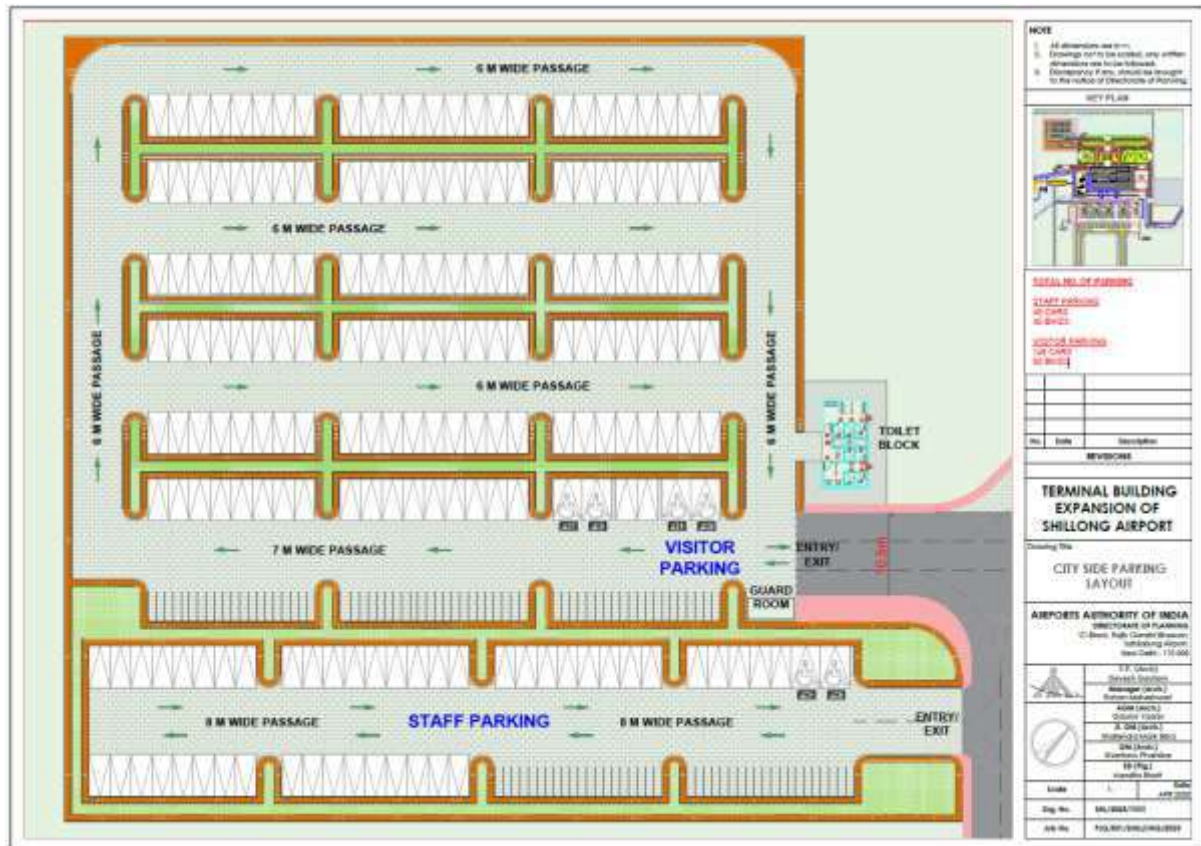


Figure 2.7: Contour Map of Barapani Airport and Surroundings



## 2.10 Parking Facilities and Traffic Circulation Plan

At the Barapani (Shillong) Airport, parking facilities will be provided for 148 cars and 60 bikes. In addition, airport staff parking will also be provided for 49 cars and 40 two wheelers. Parking plan are shown in **Figures 2.8.**



**Figure 2.8: Parking Plan of Barapani Airport**

## 2.11 Storm Water Management

The storm water management has been designed by providing storm water drains and culverts. Drains and culverts will meet the requirement of DGCA -CAR requirement.

## 2.12 Fire Fighting Facilities

At the proposed Barapani Airport, firefighting facilities will be provided as per guidelines and ICAO and CAR standards. Fire NOC is available for existing airport. After expansion also Fire NOC will be maintained.



## 2.13 Power Requirement & Supply /Sources

Total power requirement is estimated as 1750 kW after expansion of Barapani (Shillong) Airport including runway extension. Power will be supplied by Meghalaya Power Distribution Corporation Limited (MPDCL). Presently, 2 DG sets of 380 kVA capacity are available at the Airport. After expansion of Barapani airport 3 DG sets of 1000 kVA will be installed to meet the power requirement during grid power failure. Stack above building will be provided for DG sets to vent out exhaust gases into the atmosphere. All DG sets will be fitted with acoustic enclosure at the Barapani Airport.

### 2.13.1 Tank Farm for Fuel Storage

Barapani airport maintains 50 kL underground storage tank (UST) for HSD. Aircraft refueling at Shillong airport is carried by oil companies.

## 2.14 HVAC Requirement

After expansion 300 TR HVAC will be required at the Barapani Airport.

## 2.15 Water Requirement and Its Management

The expected population per day at the Barapani Airport is given below:

|                                   |   |      |
|-----------------------------------|---|------|
| Arriving and Departing Passengers | - | 4000 |
| Airport Staff (day time)          | - | 200  |
| Visitors                          | - | 200  |
| Residential accommodation         | - | 100  |

Water required as per National Building Code 2016 is given below.

|                           |   |                     |
|---------------------------|---|---------------------|
| Terminal Staff (day time) | - | 45 Litres/Head/Day  |
| Air Passenger             | - | 70 Litres/Head/Day  |
| Visitor                   | - | 15 Litres/Head/Day  |
| Residential               | - | 135 Litres/Head/Day |

### 2.15.1 Sources of Water

Total fresh water requirement will be 371 kld including domestic, fire testing and HVAC. Water requirement will be extracted through bore wells after obtaining permission from CGWA. Water requirement for flushing and horticulture will be met through treated waste water. Water requirement & waste water generation for Barapani (Shillong) Airport is given in **Table 2.1**.

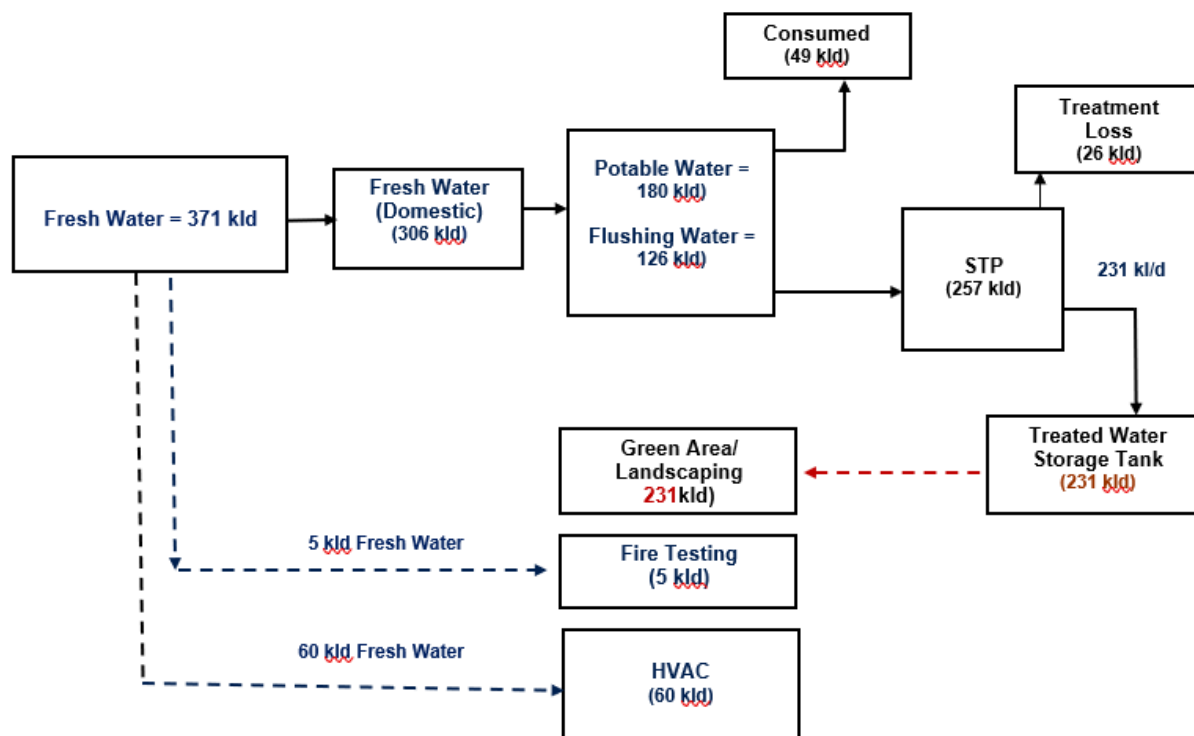
### 2.15.2 Total Water Required

Water requirement for the Barapani (Shillong) Airport is estimated as given **Table 2.1**:

**Table 2.1: Water Requirement for the Expansion of Barapani (Shillong) Airport**

| S.<br>No. | Description                                                                                                       | Total<br>Population<br>at Peak<br>hour | Daily<br>Population<br>(Considering<br>population<br>per day) | LPCD for<br>Potable water<br>(l) | LPCD for<br>Flushing<br>Water (l) | Potable<br>Water<br>Demand<br>(l/day) | Flushing<br>Water<br>Demand<br>(l/day) | Total<br>Water<br>Demand<br>(l/day) |
|-----------|-------------------------------------------------------------------------------------------------------------------|----------------------------------------|---------------------------------------------------------------|----------------------------------|-----------------------------------|---------------------------------------|----------------------------------------|-------------------------------------|
| 1.        | Terminal Building<br>(Passenger Load)                                                                             | 1620                                   | 4000                                                          | 40                               | 30                                | 1,60,000                              | 1,20,000                               | 2,80,000                            |
| 2.        | Staff (5% of Total Passengers) As<br>per clause 4.1 (b) Note-2 of NBC-<br>2016, Part-9, section-1 water supply    |                                        | 200                                                           | 25                               | 20                                | 5,000                                 | 4,000                                  | 9,000                               |
| 3.        | Visitors (5% of Total Passengers) As<br>per clause 4.1 (b) Note-2 of NBC-<br>2016, Part-9, section-1 water supply |                                        | 200                                                           | 5                                | 10                                | 1,000                                 | 2,000                                  | 3,000                               |
| 4.        | Residential Accommodation                                                                                         |                                        | 100                                                           | 135                              | 0                                 | 13,500                                | 0                                      | 13,500                              |
|           | Total Domestic Water in Litre/day                                                                                 |                                        |                                                               |                                  |                                   | 1,79,500                              | 1,26,000                               | 3,05,500                            |
|           | <b>Total Domestic Water in kld</b>                                                                                |                                        |                                                               |                                  |                                   | <b>180</b>                            | <b>126</b>                             | <b>306</b>                          |
|           |                                                                                                                   |                                        |                                                               |                                  |                                   |                                       |                                        |                                     |
| 5.        | Fire Testing                                                                                                      |                                        |                                                               |                                  |                                   |                                       |                                        | <b>5</b>                            |
|           |                                                                                                                   |                                        |                                                               |                                  |                                   |                                       |                                        |                                     |
| 6.        | <b>Soft Water Demand</b>                                                                                          |                                        |                                                               |                                  |                                   |                                       |                                        |                                     |
|           | <b>Water requirement for HVAC</b>                                                                                 |                                        |                                                               |                                  |                                   |                                       |                                        | 60000                               |
|           | <b>Say in (kld)</b>                                                                                               |                                        |                                                               |                                  |                                   |                                       |                                        | <b>60</b>                           |
|           |                                                                                                                   |                                        |                                                               |                                  |                                   |                                       |                                        |                                     |
| 7.        | <b>Horticulture / Landscaping</b>                                                                                 |                                        |                                                               |                                  |                                   |                                       |                                        |                                     |
|           | <b>Treated Water From STP for Landscaping (KLD)</b>                                                               |                                        |                                                               |                                  |                                   |                                       |                                        | <b>231</b>                          |
|           |                                                                                                                   |                                        |                                                               |                                  |                                   |                                       |                                        |                                     |
|           | <b>Fresh Water Requirement in kld</b>                                                                             |                                        |                                                               |                                  |                                   |                                       |                                        | <b>371</b>                          |

During operation phase, total fresh water requirement is estimated as 371 kld. 257 kld waste water will be generated from the Barapani Airport, which will be treated in 275 kld capacity sewage treatment plant (STP). The water balance diagram is shown in **Figure 2.9**.



# Source of fresh water supply from Ground Water.

**Figure 2.9: Water Balance Diagram for Barapani Airport**

## 2.16 Sources of Pollution and Its Control

At the proposed Barapani Airport, details of emissions, effluents, solid wastes and hazardous waste generation and their management are given below:

**Source of Emissions** – At the Barapani Airport, sources of emissions will be from Aircraft during taxing and at apron, vehicular emissions from vehicles engaged in ground operations, vehicular emissions from vehicles coming for drop and pick up of passengers and stack emission from DG sets operations during grid power failure. Details of estimation of emissions from various sources are given in Section 4.4.5 of Chapter 4.

**Effluents Generation and Disposal** - From the Barapani (Shillong) Airport, 257 kl sewage will be generated, which will be treated in SBR based sewage treatment plant of 275 kld capacity. 231 kld treated waste water from STP will be used for green area and landscaping development at the Barapani Airport.

**Solid Waste Generation and Its Management** - During construction phase small amount of construction waste will be generated, which will be reused at the site only for filling purpose.

Approx. 1240 kg per day municipal solid wastes will be generated from terminal building, residential area and from deplaning of aircraft. From the deplaning of aircraft approx. 300 kg per day waste is estimated to be generated. Solid wastes will be segregated and disposed as per Solid Waste Management Rules, 2016 by engaging third party. The composition of the solid wastes to be generated from the Barapani (Shillong) Airport:

| Types of Solid Wastes                  | Kg/day      |
|----------------------------------------|-------------|
| Recyclable Plastic Wastes              | 600         |
| Biodegradable Paper Wastes             | 120         |
| Recyclable Metal Waste (Tin cans, etc) | 140         |
| Biodegradable food wastes              | 360         |
| Non-Biodegradable Inert Wastes         | 20          |
| <b>Total Quantity</b>                  | <b>1240</b> |

**Hazardous Waste Management** - From the Barapani Airport, about 200 liters used oil will be generated during the maintenance of DG sets. Used oil generated from the Barapani (Shillong) airport will be disposed to authorised used oil recyclers.

**e-wastes Management** - About 250 kg per year e-wastes will be generated from the Barapani (Shillong), which will be disposed to authorised e-waste recyclers as per e-wastes management rules 2016.

## 2.17 Green Area and Landscape

At the Barapani Airport, green area and landscaping will be developed on 8250 sqm area city side.

## 2.18 Connectivity

The Barapani (Shillong) Airport is situated nearly 60 km airily from LGB International airport Guwahati, 58 kms from Guwahati Railway station.

| Particular                     | Details                                                                                                                                                                                             |
|--------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Nearest Highway/<br>Major Road | <ul style="list-style-type: none"> <li>Shillong Bypass Road-1.67 km towards NNE</li> <li>SH-8: 5.68 km towards NW</li> <li>NH-40 : 8.08 km towards SW</li> <li>AH-2: 7.22 km towards WSW</li> </ul> |
| Railway Station                | <ul style="list-style-type: none"> <li>Kamrup Khetri RS : 48 km towards NNE</li> </ul>                                                                                                              |

| Particular             | Details                                                                                                                                      |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
|                        | <ul style="list-style-type: none"> <li>Guwahati RS: 58 km towards NNW</li> </ul>                                                             |
| LGBI Airport, Guwahati | <ul style="list-style-type: none"> <li>59 km towards NW</li> </ul>                                                                           |
| Public Transport       | <ul style="list-style-type: none"> <li>Plenty of tourist buses, taxis and luxury coaches are available from Guwahati to Shillong.</li> </ul> |

## 2.19 Manpower Requirement

The total estimated manpower requirement for construction and operation phases of the development of Barapani Airport is given in **Table 2.2**:

**Table 2.2: Estimated Manpower for Development of Barapani Airport**

| Employment likely to be generated during construction phase (in two years) |   |                     |                 |              |
|----------------------------------------------------------------------------|---|---------------------|-----------------|--------------|
| Permanent employment                                                       |   |                     |                 |              |
| No. of permanent employment (Nos) [A]                                      | : | 20                  |                 |              |
| Period of employment (No. of days) [B]                                     | : | 730 (for two years) |                 |              |
| No. of man-days [X]=[A]*[B]                                                | : | 14600               |                 |              |
| Temporary / Contractual employment (No. of Man days) [Y]                   | : | 146000 (200*730)    |                 |              |
| Total [X] + [Y]                                                            | : | <b>160600</b>       |                 |              |
|                                                                            |   |                     |                 |              |
| Employment likely to be generated during operational phase (annually):     |   |                     |                 |              |
| Permanent employment (A)                                                   |   | <b>Existing</b>     | <b>Proposed</b> | <b>Total</b> |
| No. of permanent employment (No.s) [A]                                     |   | 15                  | 20              | 35           |
| Period of employment (No. of days) [B]                                     |   | 365                 | 365             | 365          |
| No. of man-days [X]=[A]*[B]                                                |   | <b>5475</b>         | <b>7300</b>     | <b>12775</b> |
| Temporary / Contractual employment                                         |   | 50                  | 80              | 130          |
| Temporary / Contractual employment (No. of Man days) [Y]                   | : | <b>18250</b>        | <b>29200</b>    | <b>47450</b> |
| Total [X] + [Y]                                                            | : | <b>23750</b>        | <b>36500</b>    | <b>60225</b> |

Indirect employment will be generated more than 2000 persons per day.

## 2.20 Project Cost and Time of Completion

The estimated project cost for expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion of Terminal Building & Apron and Other Allied Works is estimated as Rs 489 Crores.

The construction will be completed within 24 months' time from the start of the construction after obtaining environmental clearance.

## **CHAPTER – 3**

### **DESCRIPTION OF ENVIRONMENT**

#### **3.1 Introduction**

The reconnaissance survey of the area around the proposed expansion of Barapani (Shillong) Airport was carried out on 26<sup>th</sup> to 28<sup>th</sup> February 2025 and the field studies were carried out for one season during summer season (from 1<sup>st</sup> March to 31<sup>st</sup> May 2025) to collect baseline primary and secondary data for the baseline environmental scenario in the study area for the EIA study. The baseline monitoring results are given in **Annexure 4**.

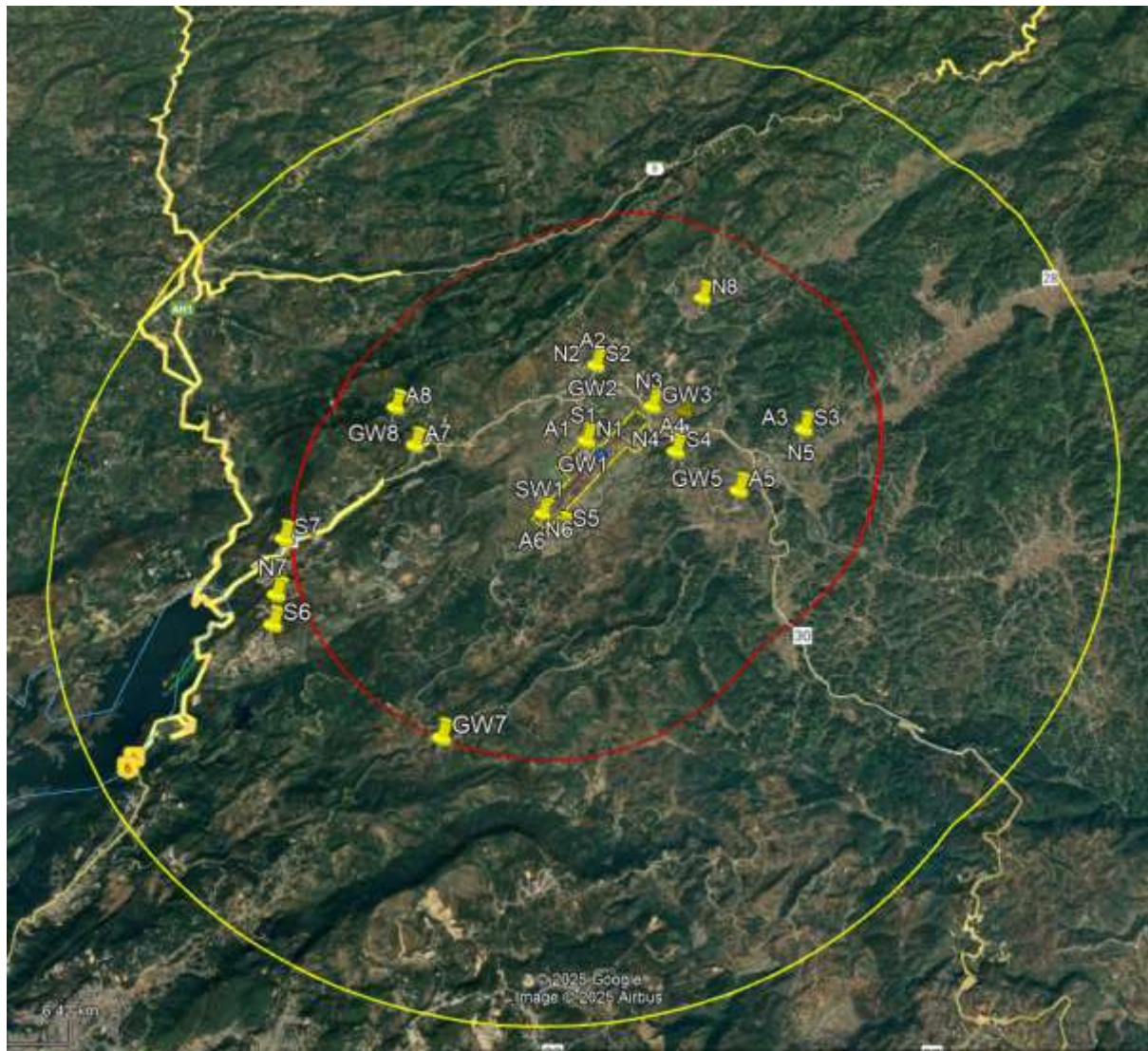
A comprehensive primary and secondary data collection program was undertaken to assess the status of baseline environment conditions within the study area for carrying out the EIA/EMP study for one season from 1<sup>st</sup> March to 31<sup>st</sup> May 2025 during summer season. The area covered by 10 km radius around the proposed expansion of Barapani (Shillong) Airport site has been considered for the study.

Land, surface and ground water, soil, meteorology, ambient air, ambient noise constitutes the physical environment, while flora and fauna constitute the biological environment of the study area. Demographic and socio-economic conditions of the study area were also studied during the study period. The environmental monitoring was carried out for ambient air quality, water quality, soil characteristics, noise levels, meteorology, etc. Physical, biological and socio-economic environmental conditions within 10 km radius study have been discussed in the following sections.

Soil sampling, ground and surface water sampling locations, ambient air quality monitoring locations and noise measurement locations are presented in **Figure 3.1**.

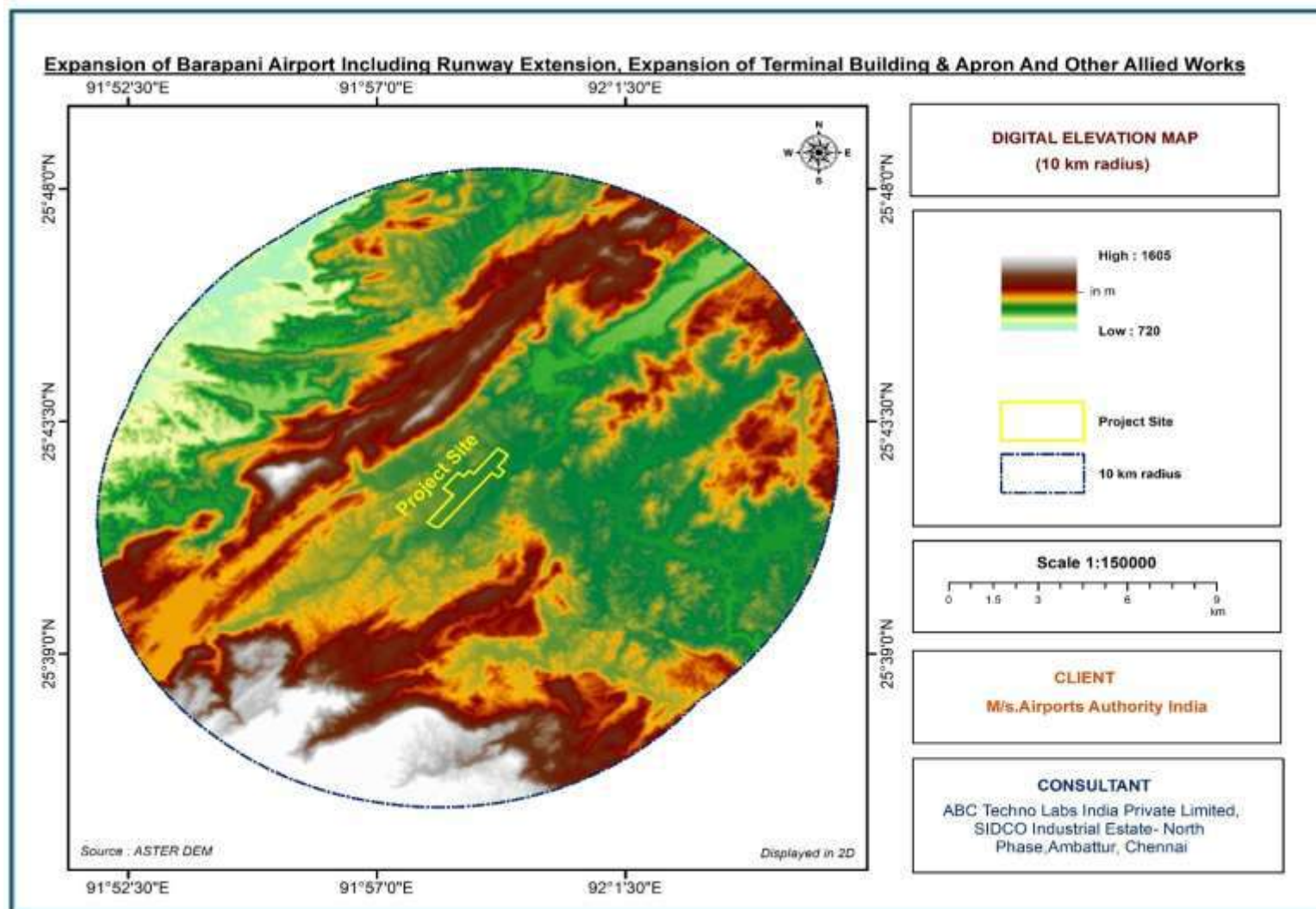
#### **3.2 Topography And Physiography**

The airport is situated in the Shillong Plateau, part of the Meghalaya Hills, which are an eastern extension of the Indian Peninsular Shield. The area features undulating terrain with moderate to steep slopes. The airport is located at an elevation of about 887 meters above mean sea level. The landscape of the includes low-lying valleys and isolated hillocks, which affect both wind flow patterns and visibility—important considerations for aviation. In the study area, rocky outcrops and lateritic soil are present, especially on elevated patches and ridges. The physiographic region includes seasonal streams and rivulets that drain the area, with the Umiam Lake (Barapani) located at distance of approximately 7 km from the airport. These contribute to local drainage patterns and humidity levels. The digital elevation model for the study area is shown in **Figure 3.2**. The contour map for the study area is shown in **Figure 3.3**.



**Figure 3.1: Sampling and Monitoring Locations in The Study Area**





**Figure 3.2: Digital Elevation Map of Study Area**



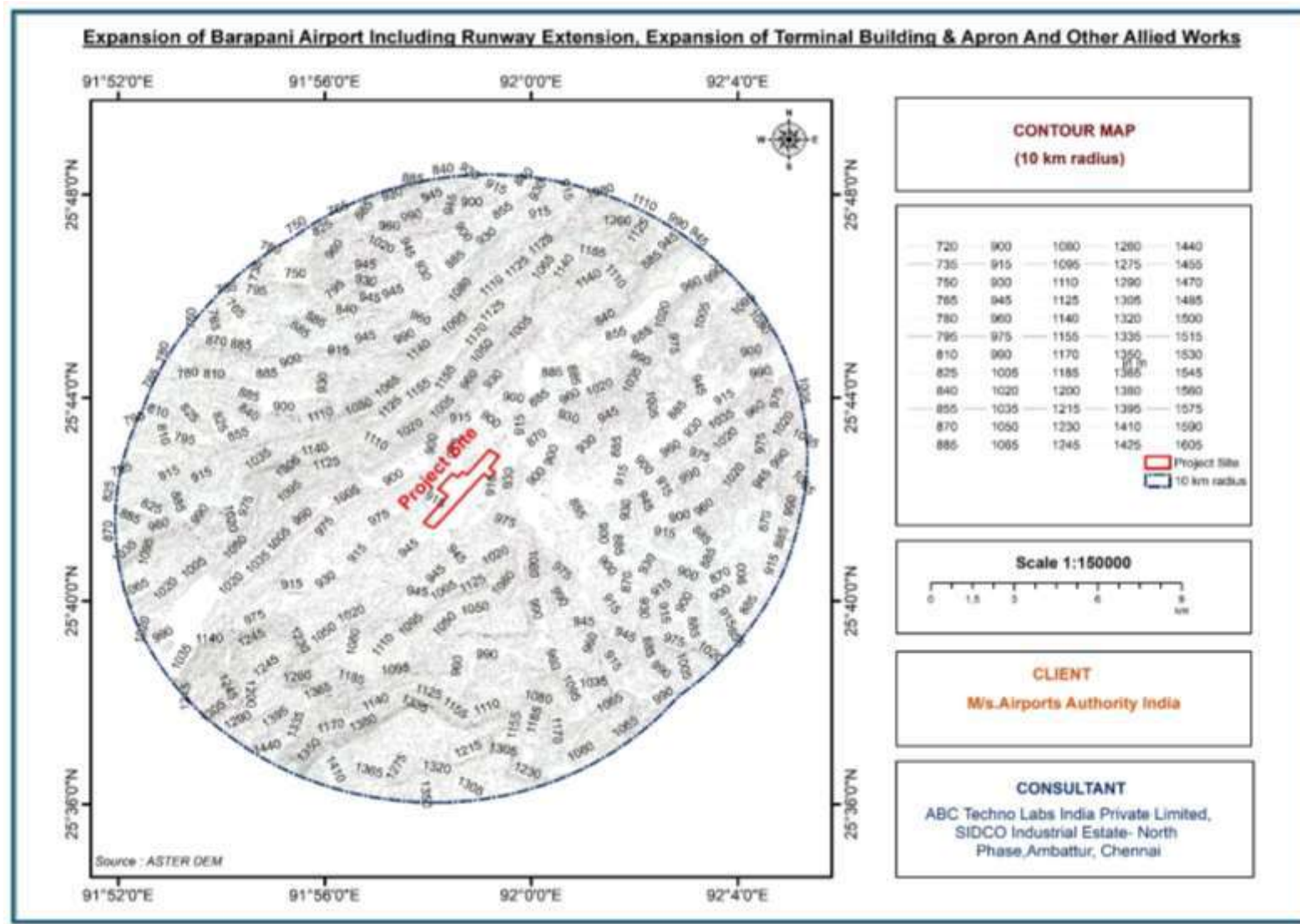


Figure 3.3: Contour Map for the Study Area

### 3.3 Geology of the Area

#### 3.3.1 Geomorphology

Geomorphologically, Ri-Bhoi district is a hilly one with intermontane valleys. The western and northern part of the district comprises of the denudational high hills with deep, narrow intermontane valleys covered with or without colluvium. Lithologically, the hills comprise Archaean Gneissic complex rocks, which are highly deformed, fractured and fissured in nature. These rocks also form highly dissected plateau with steep slopes and deep, narrow valleys exposed in the southwestern part of the district. In the central and eastern parts, denudational high hills with deep valleys are found to exist which comprise intrusive Granites. Further in the southeastern part, denudational low hills are found to occur with valleys and comprise granite with fracture zones. Large number of narrow intermontane valley occurs mostly in the southern part of the district, which are good recharge areas and have highly productive shallow aquifer zone.

Deeply dissected plateau comprising the Precambrian Shillong Group of quartzites and phyllites occurs as highly undulating terrain having more than 20 m deep valleys in the area. The quartzites are moderate to steeply dipping rocks having a trend in NE-SW direction. They are intruded by basic and ultramafic rocks, which occur as linear or curvilinear ridges.

#### Geological Set-up

The rocks of Gneissic Complex, comprising quartzo-feldspathic gneiss with enclaves of granites, amphibolites, schists etc., occupy major part of the district. Shillong group of rocks consisting of quartzite & phyllites are laid down as sedimentary deposits during Pre-Cambrian times and have been metamorphosed over time, are exposed in the south-eastern part of the district. These rocks were intruded by epidiorite rocks known as Khasi green stone. These metabasic rocks occur mostly as sills being concordant with the formations they intruded. Granite Plutons occur as porphyritic coarse granite, pegmatite, aplite / quartz vein traversed by epidiorite, dolerite and basalt dykes, occupy a large area in the central and eastern part of the district and are also encountered in the sub-surface. The Quaternary fluvial sediments occur in the extreme northern part of the district bordering Assam, forming part of Brahmaputra valley, with a thickness ranging between 3 to 20 metres.

Generalised geological succession of the area is given in **Table. 3.1.**

| Geological Age                        | Group              | Formation          | Rock Type                                                         |
|---------------------------------------|--------------------|--------------------|-------------------------------------------------------------------|
| Quaternary                            |                    |                    | Undifferentiated fluvial sediments                                |
| ~~~~~ Unconformity ~~~~~              |                    |                    |                                                                   |
| Neo-Proterozoic –<br>Lower Palaeozoic | Nongpoh<br>Granite | Granite<br>Plutons | Porphyritic coarse granite,<br>pegmatite, aplite/quartz vein etc. |
| Intrusive Contact                     |                    |                    |                                                                   |

| Geological Age                                 | Group                               | Formation      | Rock Type                                                                                 |
|------------------------------------------------|-------------------------------------|----------------|-------------------------------------------------------------------------------------------|
| Proterozoic (Undiff)                           | Khasi Basic-Ultrabasic intrusives   |                | Epidiorite, dolerite, Amphibolite and pyroxenite dykes and sills                          |
| Palaeo-Mesoproterozoic                         | Shillong Group                      | Upper Division | Mainly Quartzites intercalated with phyllites.                                            |
|                                                |                                     | Lower Division | Mainly schists with Calc Silicate rocks, carbonaceous phyllite and thin quartzite layers. |
| ~~~~~ Unconformity (Shared conglomerate) ~~~~~ |                                     |                |                                                                                           |
| Archaean(?)-Proterozoic (Undifferentiated)     | Gneissic Complex (Basement Complex) |                | Mainly quartzofeldspathic gneiss with enclaves of granites, amphibolites. schists etc.    |

### 3.4 Soil of the Study Area

Derived from gneissic (granite-like) parent rocks, soils of study area are mostly loamy to fine-loamy, with depths varying from around 50 cm to 2 m. The soil of study area are loamy to silt-loam, moderately deep. Soils are well drained; not waterlogged due to hillside slopes.

#### 3.4.1 Soil Characteristics

Total 8 locations in the study area were selected for soil sampling to understand the soil characteristics. The soil sampling locations are shown in **Figure 3.1**. Composite sampling of soil upto root depth (10 - 15 cm) was carried out at each location. Details of soil sampling locations is given in **Table 3.2**.

**Table 3.2: Soil Sampling Locations**

| Code | Locations                                   | Distance | Direction | Latitude      | Longitude     |
|------|---------------------------------------------|----------|-----------|---------------|---------------|
| S 1  | Project Site                                | -        |           | 25°42'21.05"N | 91°58'30.94"E |
| S 2  | Norgarh Umroi                               | 1.85 km  | N         | 25°43'20.98"N | 91°58'36.86"E |
| S 3  | Bhoriymbong                                 | 4.65 km  | ENE       | 25°42'33.29"N | 92° 1'17.93"E |
| S 4  | Umktieh                                     | 1.95 km  | E         | 25°42'13.57"N | 91°59'39.39"E |
| S 5  | Umed Umroi                                  | 2.15 km  | S         | 25°41'12.65"N | 91°58'14.59"E |
| S 6  | Umiam                                       | 7.55 km  | SW        | 25°40'0.18"N  | 91°54'47.44"E |
| S 7  | ICAR Research Complex for NEH region, Umiam | 6.65 km  | W         | 25°41'1.44"N  | 91°54'48.44"E |

The value of important physical and chemical parameters of these soil samples are given in **Table 3.3**. From the tabulated values, the following conclusions can be made about the physical and chemical characteristics of the soil samples.

**Texture:** Soil samples from all locations are clayey and Clay loam in texture.

**pH:** pH was determined by taking 1:5 ratio of soil and distilled water. pH of soil in the study area is found to be slightly alkaline in the range of 6.58 to 7.12.

**Bulk Density:** Bulk density of soil in the study area is found to be in the range from 1.21 to 1.31 g/cc.

**Water Holding Capacity:** Water holding capacity of soil in the study area is found to be in the range from 47.2 to 58.3 %.

**Electrical Conductivity:** Electrical conductivity of the soil in the study area is found to be in the range of 0.59 to 0.168 mS/cm.

**Available Nitrogen:** Available Nitrogen content of the soil samples in the study area ranges from 134 to 208 kg/ha.

**Available Phosphorous:** Available Phosphorous content of the soil samples in the study area ranges from 31.7 to 52.5 kg/ha.

**Available Potassium:** Available Potassium content of the soil samples in the study area ranges from 278 to 390 kg/ha.

**Exchangeable Calcium:** Exchangeable calcium content of the soil samples in the study area ranges from 14.7 to 17.5 meq/100g.

**Exchangeable Magnesium:** Exchangeable magnesium content of the soil samples in the study area ranges from 5.36 to 7.11 meq/100g.

**Exchangeable Sodium:** Exchangeable sodium content of the soil samples in the study area ranges from 0.97 to 1.45 meq/100g.

**Organic Matter:** Organic matter of the soil in the study area is found to be in the range from 0.92 to 1.31%.

**Sodium Absorption Ratio:** Sodium Absorption Ratio of the soil samples in the study area ranges from 0.96 to 1.37.

**Boron:** Boron of the soil in the study area is found to be in the range from 2.52 to 4.05 mg/kg.

**Iron:** Iron of the soil in the study area is found to be in the range from 698 to 1163 mg/kg.

**Copper:** Copper of the soil in the study area is found to be in the range from 10.7 to 16.8 mg/kg.

**Manganese:** Manganese of the soil in the study area is found to be in the range from 38.6 to 67.5 mg/kg.

**Zinc:** Zinc in the soil of the study area is found to be in the range from 13.5 to 26.7 mg/kg.

The concentrations of Molybdenum as Mo, Lead as Pb, Nickel as Ni, Chromium as Cr, Cadmium as Cd, Arsenic as As and Mercury as Hg were found below detection limit (BDL).

**Table 3.3: Soil Characteristics of the Study Area**

| Sn. | Parameters                             | S1         | S2         | S3         | S4         | S5        | S6         | S7         |
|-----|----------------------------------------|------------|------------|------------|------------|-----------|------------|------------|
| 1.  | pH                                     | 6.58       | 6.68       | 7.03       | 6.59       | 6.78      | 6.61       | 7.12       |
| 2.  | Bulk Density, g/cc                     | 1.23       | 1.28       | 1.24       | 1.30       | 1.21      | 1.25       | 1.31       |
| 3.  | Electrical Conductivity, mS/cm         | 0.059      | 0.095      | 0.118      | 0.086      | 0.120     | 0.077      | 0.168      |
| 4.  | Total Nitrogen as N, kg/ha             | 178        | 134        | 162        | 208        | 184       | 152        | 136        |
| 5.  | Available Phosphorous as P, kg/ha      | 35.1       | 42.8       | 31.7       | 46.4       | 52.5      | 44.1       | 39.7       |
| 6.  | Available Potassium as K, kg/ha        | 318        | 278        | 354        | 389        | 334       | 302        | 390        |
| 7.  | Exchangeable Calcium as Ca, meq/100g   | 16.2       | 14.5       | 17.3       | 15.6       | 17.5      | 16.8       | 14.7       |
| 8.  | Exchangeable Magnesium as Mg, meq/100g | 6.78       | 5.36       | 6.55       | 7.11       | 6.88      | 5.71       | 5.96       |
| 9.  | Exchangeable Sodium as Na, m.eq/100g   | 1.03       | 0.97       | 1.18       | 1.31       | 1.22      | 1.45       | 1.36       |
| 10. | Organic matter (%)                     | 0.92       | 1.14       | 1.31       | 1.26       | 1.13      | 1.27       | 0.95       |
| 11. | Sodium Absorption Ratio                | 0.96       | 0.97       | 1.08       | 1.23       | 1.10      | 1.37       | 1.34       |
| 12. | Boron as B, mg/kg                      | 3.14       | 2.52       | 4.05       | 2.56       | 3.05      | 2.62       | 3.79       |
| 13. | Iron as Fe, mg/kg                      | 914        | 1026       | 848        | 698        | 1163      | 904        | 1023       |
| 14. | Copper as Cu, mg/kg                    | 12.2       | 10.7       | 15.9       | 13.6       | 14.3      | 11.6       | 16.8       |
| 15. | Manganese as Mn, mg/kg                 | 51.4       | 38.6       | 55.4       | 44.8       | 67.5      | 43.8       | 55         |
| 16. | Zinc as Zn, mg/kg                      | 16.4       | 13.5       | 24.3       | 21.4       | 17.1      | 26.7       | 19.3       |
| 17. | Molybdenum as Mo , mg/kg               | 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)    |
| 19. | Nickel as Ni, mg/kg                    | 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)    |
| 21. | Cadmium as Cd, mg/kg                   | 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)    |
| 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) |
| 24. | Texture Classification                 | Clay       | Clay Loam  | Clay       | Clay Loam  | Clay      | Clay       | Clay Loam  |
| 25. | Sand (%)                               | 25.6       | 36.2       | 23.8       | 37.2       | 25.1      | 22.8       | 34.6       |
| 26. | Clay (%)                               | 64.2       | 35.5       | 62.5       | 33.7       | 60.9      | 66.1       | 36.4       |
| 27. | Silt (%)                               | 10.2       | 28.3       | 13.7       | 29.1       | 14        | 11.1       | 29         |
| 28. | Water Holding Capacity,%               | 52.6       | 48.7       | 53.6       | 47.2       | 55.7      | 58.3       | 47.9       |

### **3.5 Hydrogeology of the Study Area**

#### **3.5.1 Hydrogeological Set-up**

Ground water in the study area occurs under both unconfined & semi-confined conditions in the hard rocks controlled mostly by topography & secondary porosities of weathered residuum and in joints & fractures. Depth to water level vary from 3 to 6 m bgl.

#### **Occurrence of Ground Water in Gneissic Formation**

The gneissic rocks are exposed in the north, central and southern parts of the area. The occurrence of ground water in this formation is largely controlled either by weathering and or by fractures patterns. In fractured rocks, ground water movement mainly takes place along the fractures and their openings. Groundwater in these formations occurs under phreatic conditions in weathered mantle and under semi-confined conditions in the fractured rocks, which is governed by topography and drainage. The rocks are weathered and the degree of weathering is found to be higher in the topographic depressions. In the hard and massive rocks the structural plane of weakness such as joints, fractures etc, act as storage of ground water and the inter-connected joints and fractures, act as conduits for the movement of water. In the gneissic formation, majority of the well-recorded depth to water level in the range of 2 m bgl to 4 mbgl.

#### **Occurrence of Ground Water in Granite Pluton**

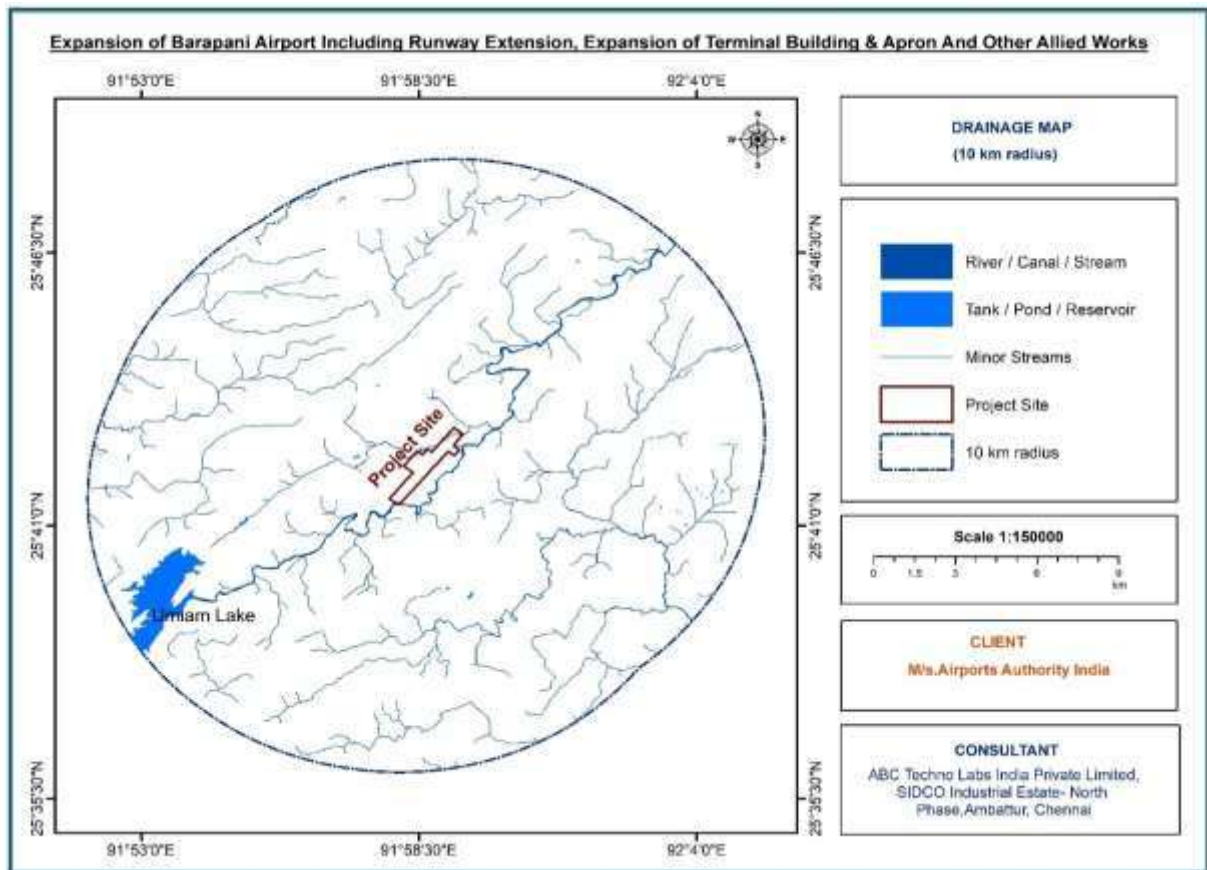
There are two major granitic plutons, (i) The Kyrdem granite in the southeast and (ii) Nongpoh granite in the northeastern part. Ground water occurs in these formations under unconfined and semi-confined conditions. It can be seen that majority of the dug well in the formation recorded depth to water level within the range of 0 to 1 m. The deepest and shallowest water levels were recorded at Bhoilynbong and Nongpoh key wells having 3.3 mbgl (May & June 2006) and 0.40 mbgl (May & June 2006) respectively. The maximum water level fluctuation was recorded at Bhoilymbong having 0.76 m and minimum fluctuation at Umsiang of 0.01m respectively.

#### **Occurrence of Ground Water Condition in Quartzite formation**

The Quartzite and Phyllites are exposed trending NE-SW in the southern parts of the district. Ground water occurs in the area under water-table conditions in the top weathered quartzite and in semi-confined to confined condition in the interconnected joints, fractures etc of the underlying hard quartzite. The deepest water level was recorded at Umbang (5m bgl) during May & June and shallowest at Barapani (0.5m bgl) during November and January respectively. The water level fluctuation in the formation ranges between 2.5 m and 0.6 m.

### 3.5.2 Drainage Pattern

Umiyam is river flowing at about 15 m the proposed expansion boundary of Barapani Airport. In the study area is drained by Umiyam and other natural drainage channels. Umiyam lake is about 8 km in WSW direction. The drainage network of the study area and their respective areas are shown in **Figure 3.4**.



**Figure 3.4: Drainage Map for the Study Area**

### 3.6 Water Resources

Water resources of the study area are classified into the following categories:

- Surface Water Resources: Umiyam river, Umiyam lake and other natural drainage channels, etc.
- Ground Water Resources: Accumulation of water in deeper strata of ground.



### 3.6.1 Surface Water Resources

Surface water resources in the study area are Umiam river, Umiam lake and other natural drainage channels, etc. The source of recharging for surface water in the area are from the atmospheric precipitation, which is in the form of rainfall.

### 3.6.2 Ground Water Resources

In the area groundwater is drawn for domestic purpose and for agricultural purpose. Details of ground water exploration in the study area are given below:

| Sr. No. | Location      | Depth Drilled (m) | Aquifer type    | Aquifer zones tapped (m. bgl)           | DTW (m.bgl) | Discharge (m <sup>3</sup> /hr) |
|---------|---------------|-------------------|-----------------|-----------------------------------------|-------------|--------------------------------|
| 1.      | ICAR Barapani | 180.8             | Quartzite       | 74.1-92.4, 92.4-180.8                   | Free flow   | 66.78                          |
| 2.      | Umroi         | 167.07            | Granitic gneiss | 12.3-87.77, 93.87-124.37, 130.47-160.97 | 3           | 56.53                          |

## 3.7 Ground and Surface Water Quality in Study Area

### 3.7.1 Ground Water Quality in Study Area

The quality of ground and surface water is affected by both surface and sub-surface environmental conditions. Additionally, the quantity and quality of water infiltrating into the subsurface play a crucial role in determining the overall groundwater quality.

Water quality in the study area has been assessed to evaluate the existing water environment and anticipate potential impacts of the proposed expansion of Barapani Airport. Based on a reconnaissance survey, sampling locations were selected using the following criteria:

- drainage pattern;
- location of residential areas representing different activities/likely impact areas; and
- likely areas which can represent baseline conditions.

### A. Water Sampling Locations

Ground water samples were collected from 8 locations from the study area, i.e. at Project Site, Norgarh Umroi(Presbyterian Church), Bangla, Bhorymbong, Habitation, Umed Umroi, Umbang Addab and Umeit for assessing the ground water quality in the study area. Surface water sample was collected from Umiam River Up-stream and down stream. The samples were collected and analyzed as per the procedures specified in 'Standard Methods for the Examination of Water and Wastewater' published by American Public Health Association (APHA). The details of ground and surface water sampling locations are given in **Table 3.4** are shown in **Figure 3.1**.

**Table 3.4: Ground and Surface Water Sampling Locations**

| Sr No.                  | Locations                          | Distance | Latitude       | Longitude      |
|-------------------------|------------------------------------|----------|----------------|----------------|
| <b>I. Ground Water</b>  |                                    |          |                |                |
| 1.                      | Project Site                       | -        | 25°42'21.05"N  | 91°58'30.94"E  |
| 2.                      | Norgarh Umroi(Presbyterian Church) | 1.85 km  | 25°43'20.98"N  | 91°58'36.86"E  |
| 3.                      | Bangla                             | 1.65 km  | 25°42'49.17"N  | 91°59'21.13"E  |
| 4.                      | Bhoriymbong                        | 4.65 km  | 25°42'33.29"N  | 92° 1'17.93"E  |
| 5.                      | Habitation                         | 3.45 km  | 25°41'45.08"N  | 92° 0'26.77"E  |
| 6.                      | Umed Umroi                         | 2.15 km  | 25°41'12.65"N  | 91°58'14.59"E  |
| 7.                      | Umbang Addab                       | 7.15 km  | 25°38'45.09"N  | 91°56'54.91"E  |
| 8.                      | Umeit                              | 3.65 km  | 25°42'13.70"N  | 91°56'20.42"E  |
| <b>II Surface Water</b> |                                    |          |                |                |
| 1.                      | Umiam River Up-stream              | 0.08 km  | 25° 41' 26.01" | 91° 57' 59.64" |
| 2.                      | Umiam River Down -stream           | 0.7 km   | 25° 42' 47.12" | 91° 59' 46.57" |

Samples for chemical analysis were collected in polyethylene carboys. Samples collected for metal content were acidified with 1 ml HNO<sub>3</sub>. Samples for bacteriological analysis are collected in sterilized glass bottles. Selected physico-chemical parameters have been analyzed for projecting the existing water quality status in the study area.

## **B. Characteristics of Ground Water Samples**

The collected water samples were analyzed for organoleptic & physical and chemical parameters as parameters described in IS:10500:2012. These surface water samples were analyzed as IS:2296. **Table 3.5** gives desirable and permissible limits prescribed for potable water in IS:10500: 2012.

**Table 3.5: Indian Standard Specification for Drinking Water**

| Sl. No.   | Characteristic                                                                   | Requirement (Acceptable Limit) | Permissible Limit in the Absence of Alternate Source | Protocol           |
|-----------|----------------------------------------------------------------------------------|--------------------------------|------------------------------------------------------|--------------------|
| <b>I</b>  | <b>Organoleptic and Physical Parameters</b>                                      |                                |                                                      |                    |
| i)        | Colour, Hazen units, <i>Max</i>                                                  | 5                              | 15                                                   | IS 3025 (Part 4)   |
| ii)       | Odour                                                                            | Agreeable                      | Agreeable                                            | IS 3025 (Part 5a)  |
| iii)      | pH value                                                                         | 6.5-8.5                        | No relaxation                                        | IS 3025 (Part 11)  |
| iv)       | Taste                                                                            | Agreeable                      | Agreeable                                            | IS 3025 (Part 7&8) |
| v)        | Turbidity, NTU, <i>Max</i>                                                       | 1                              | 5                                                    | IS 3025 (Part 10)  |
| vi)       | Total dissolved solids, mg/l, <i>Max</i>                                         | 500                            | 2000                                                 | IS 3025 (Part 16)  |
| <b>II</b> | <b>General Parameters Concerning Substances Undesirable in Excessive Amounts</b> |                                |                                                      |                    |
| i)        | Aluminium (as Al), mg/l, <i>Max</i>                                              | 0.03                           | 0.2                                                  | IS 3025 (Part 55)  |
| ii)       | Ammonia (as total ammonia-N), mg/l, <i>Max</i>                                   | 0.5                            | No relaxation                                        | IS 3025 (Part 34)  |
| iii)      | Anionic detergents (as MBAS) mg/l, <i>Max</i>                                    | 0.2                            | 1.0                                                  | IS 13428           |
| iv)       | Barium (as Ba), mg/l, <i>Max</i>                                                 | 0.7                            | No relaxation                                        | IS 15302           |
| v)        | Boron (as B), mg/l, <i>Max</i>                                                   | 0.5                            | 1.0                                                  | IS 3025 (Part 57)  |
| vi)       | Calcium (as Ca), mg/l, <i>Max</i>                                                | 75                             | 200                                                  | IS 3025 (Part 40)  |
| vii)      | Chloramines (as Cl <sub>2</sub> ), mg/l, <i>Max</i>                              | 4.0                            | No relaxation                                        | IS 3025 (Part 26)  |
| viii)     | Chloride (as Cl), mg/l, <i>Max</i>                                               | 250                            | 1000                                                 | IS 3025 (Part 32)  |
| ix)       | Copper (as Cu), mg/l, <i>Max</i>                                                 | 0.05                           | 1.5                                                  | IS 3025 (Part 42)  |
| x)        | Fluoride (as F) mg/l, <i>Max</i>                                                 | 1.0                            | 1.5                                                  | IS 3025 (Part 60)  |
| xi)       | Free residual chlorine, mg/l, <i>Min</i>                                         | 0.2                            | 1                                                    | IS 3025 (Part 26)  |
| xii)      | Iron (as Fe), mg/l, <i>Max</i>                                                   | 0.3                            | No relaxation                                        | IS 3025 (Part 53)  |
| xiii)     | Magnesium (as Mg), mg/l, <i>Max</i>                                              | 30                             | 100                                                  | IS 3025 (Part 46)  |
| xiv)      | Manganese (as Mn), mg/l, <i>Max</i>                                              | 0.1                            | 0.3                                                  | IS 3025 (Part 59)  |
| xv)       | Mineral oil, mg/l, <i>Max</i>                                                    | 0.5                            | No relaxation                                        | IS 3025 (Part 39)  |
| xvi)      | Nitrate (as NO <sub>3</sub> ), mg/l, <i>Max</i>                                  | 45                             | No relaxation                                        | IS 3025 (Part 34)  |
| xvii)     | Phenolic compounds (as C <sub>6</sub> H <sub>5</sub> OH), mg/l, <i>Max</i>       | 0.001                          | 0.002                                                | IS 3025 (Part 43)  |
| xviii)    | Selenium (as Se), mg/l, <i>Max</i>                                               | 0.01                           | No relaxation                                        | IS 3025 (Part 56)  |
| xix)      | Silver (as Ag), mg/l, <i>Max</i>                                                 | 0.1                            | No relaxation                                        | IS 13428           |
| xx)       | Sulphate (as SO <sub>4</sub> ) mg/l, <i>Max</i>                                  | 200                            | 400                                                  | IS 3025 (Part 24)  |

| Sl. No.    | Characteristic                                                                                         | Requirement (Acceptable Limit)               | Permissible Limit in the Absence of Alternate Source | Protocol                    |
|------------|--------------------------------------------------------------------------------------------------------|----------------------------------------------|------------------------------------------------------|-----------------------------|
| xxi)       | Sulphide (as H <sub>2</sub> S), mg/l, <i>Max</i>                                                       | 0.05                                         | No relaxation                                        | IS 3025 (Part 29)           |
| xxii)      | Total alkalinity as Calcium, mg/l, <i>Max</i>                                                          | 200                                          | 600                                                  | IS 3025 (Part 23)           |
| xxiii)     | Total hardness (as CaCO <sub>3</sub> ), mg/l, <i>Max</i>                                               | 200                                          | 600                                                  | IS 3025 (Part 21)           |
| xxiv)      | Zinc (as Zn), mg/l, <i>Max</i>                                                                         | 5                                            | 15                                                   | IS 3025 (Part 49)           |
| <b>III</b> | <b>Parameters Concerning Toxic Substances</b>                                                          |                                              |                                                      |                             |
| i)         | Cadmium (as Cd), mg/l, <i>Max</i>                                                                      | 0.003                                        | No relaxation                                        | IS 3025 (Part 41)           |
| ii)        | Cyanide (as CN), mg/l, <i>Max</i>                                                                      | 0.05                                         | No relaxation                                        | IS 3025 (Part 27)           |
| iii)       | Lead (as Pb), mg/l, <i>Max</i>                                                                         | 0.01                                         | No relaxation                                        | IS 3025 (Part 47)           |
| iv)        | Mercury (as Hg), mg/l, <i>Max</i>                                                                      | 0.001                                        | No relaxation                                        | IS 3025 (Part 48)           |
| v)         | Molybdenum (as Mo), mg/l, <i>Max</i>                                                                   | 0.07                                         | No relaxation                                        | IS 3025 (Part 2)            |
| vi)        | Nickel (as Ni), mg/l, <i>Max</i>                                                                       | 0.02                                         | No relaxation                                        | IS 3025 (Part 54)           |
| vii)       | Polychlorinated biphenyls, mg/l, <i>Max</i>                                                            | 0.0005                                       | No relaxation                                        | APHA 6630                   |
| viii)      | Polynuclear aromatic hydrocarbons (as PAH), mg/l, <i>Max</i>                                           | 0.0001                                       | No relaxation                                        | APHA 6630                   |
| ix)        | Total Arsenic (as As), mg/l, <i>Max</i>                                                                | 0.01                                         | 0.05                                                 | IS 3025 (Part 37)           |
| x)         | Total chromium (as Cr), mg/l, <i>Max</i>                                                               | 0.05                                         | No relaxation                                        | IS 3025 (Part 52)           |
| xi)        | Trihalomethanes                                                                                        |                                              |                                                      |                             |
| a)         | Bromoform, mg/l, <i>Max</i>                                                                            | 0.1                                          | No relaxation                                        | ASTM D 3973-85 or APHA 6232 |
| b)         | Dibromochloromethane, mg/l, <i>Max</i>                                                                 | 0.1                                          | No relaxation                                        | ASTM D 3973-85 or APHA 6232 |
| c)         | Bromodichloromethane, mg/l, <i>Max</i>                                                                 | 0.06                                         | No relaxation                                        | ASTM D 3973-85 or APHA 6232 |
| d)         | Chloroform, mg/l, <i>Max</i>                                                                           | 0.2                                          | No relaxation                                        | ASTM D 3973-85 or APHA 6232 |
| <b>IV</b>  | <b>Bacteriological Quality of Drinking Water</b>                                                       |                                              |                                                      |                             |
| i          | <i>All water intended for drinking,</i><br>a) <i>E. coli</i> or thermotolerant coliform bacteria (TCB) | Shall not be detectable in any 100 ml sample |                                                      |                             |

Source: Bureau of Indian Standard Code IS: 10500:2012

The analysis results of ground water samples collected during the study period are given in **Table 3.6**.

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

**Odour:** The odour in ground water samples was Agreeable and meets the acceptable limit for drinking water standards.

**Turbidity:** The turbidity of water samples was found <1 NTU unit and meets acceptable limit at all the ground water sampling locations.

**pH:** The pH value of all ground water samples ranges from 6.69 to 7.05 and meets the acceptable drinking water standards.

**Total Dissolved Solids (TDS):** The TDS in ground water samples range from 148 to 275 mg/l and meet acceptable limit of 500 mg/l in all the ground water sampling locations.

**Total Alkalinity:** Total alkalinity in ground water samples ranges from 54 mg/l to 93 mg/l. Total alkalinity values in all the ground water samples is within the acceptable limit of 200 mg/l.

**Total Hardness:** The total hardness of ground water samples range between 74 mg/l to 118 mg/l and meets acceptable limit of 200 mg/l in all the ground water sampling locations.

**Calcium:** The calcium content in ground water samples range from 21 mg/l to 37 mg/l and is within the acceptable limit of 75 mg/l of all the ground water.

**Magnesium:** The Magnesium content in ground water samples range from 3.3 mg/l to 7.5 mg/l, which within acceptable limit of 30 mg/l in all ground water samples.

**Iron:** The iron content in all ground water samples ranges from BDL to 0.12 mg/l and meets acceptable limits of 0.3 mg/l in all the ground water sampling locations.

**Chloride:** The chloride content in ground water samples range from 47 mg/l to 96 mg/l and meets acceptable limit of 250 mg/l at all the ground water sampling locations.

**Sulphate:** Sulphate content in ground water samples ranges from 10 to 28 mg/l and meets the acceptable limit of 200 mg/l at all the ground water sampling locations.

**Nitrate:** Nitrate content in ground water samples ranges from 1 mg/l to 2 mg/l and meet the acceptable limit of 45 mg/l at all the ground water sampling locations.

**Fluoride:** Fluoride content in ground water samples ranges from 0.14 mg/l to 0.29 at all locations meets acceptable limit of 1 mg/l at all the ground water sampling locations.

**Zinc:** Zinc content in ground water samples ranges from 0.02 mg/l to 0.05 at all locations meets acceptable limit of 1 mg/l at all the ground water sampling locations.

**Total Coliforms -** Total coliforms were absent in all water ground samples.

**E.coli :** E.coli were absent in all water ground samples.

**Other Parameters:** Manganese (Mn), Barium (Ba), Copper (Cu), Residual Free Chlorine, Aluminium (Al), Cadmium (Cd), Lead (Pb), Copper (Cu), Total Chromium (Cr), Arsenic (As), Cyanide (CN), Selenium (Se), Mercury (Hg), Anionic Surfactants (MBAS), Phenolic compounds contents were found below detection limit (BDL) in ground water samples.

**Table 3.6: Ground Water Quality in the Study Area During Study Period**

| S. No | Parameters                            | Unit  | Acceptable Limit IS 10500: 2012 | Permissible Limit in the Absence of Alternate Source IS 10500: 2012 | GW 1              | GW 2              | GW 3              | GW 4              | GW 5              | GW 6              | GW 7              | GW 8              |
|-------|---------------------------------------|-------|---------------------------------|---------------------------------------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| 1     | Colour                                | Hazen | 5                               | 15                                                                  | <1                | <1                | <1                | <1                | <1                | <1                | <11               | <1                |
| 2     | Odour                                 | -     | Agreeable                       | 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                               | 5                                                                   | BDL (<0.5)        | BDL (<0.5)        | BDL (<0.5)        | BDL (<0.5)        | BDL (<0.5)        | BDL (<0.5)        | 0.5               | BDL (<0.5)        |
| 4     | pH at 25 °C                           | -     | 6.5-8.5                         | No relaxation                                                       | 6.89              | 6.75              | 7.05              | 6.98              | 6.78              | 6.90              | 7.01              | 6.69              |
| 5     | Conductivity at 25°C                  | µS/cm | Not Specified                   | Not Specified                                                       | 370               | 312               | 452               | 466               | 373               | 345               | 259               | 284               |
| 6     | Total dissolved solids                | mg/l  | 500                             | 2000                                                                | 219               | 178               | 243               | 275               | 213               | 197               | 148               | 162               |
| 7     | Total Suspended solids                | mg/l  | Not Specified                   | Not Specified                                                       | <2                | <2                | <2                | <2                | <2                | <2                | <2                | <2                |
| 8     | Total Alkalinity as CaCO <sub>3</sub> | mg /l | 200                             | 600                                                                 | 66                | 60                | 80                | 93                | 78                | 66                | 54                | 63                |
| 9     | Total Hardness as CaCO <sub>3</sub>   | mg/l  | 200                             | 600                                                                 | 94                | 78                | 108               | 118               | 86                | 74                | 67                | 75                |
| 10    | Calcium as Ca                         | mg/l  | 75                              | 200                                                                 | 29                | 24                | 32                | 37                | 22                | 25                | 21                | 23                |
| 11    | Magnesium as Mg                       | mg/l  | 30                              | 100                                                                 | 5.2               | 4.4               | 6.8               | 6.1               | 7.5               | 3.3               | 3.5               | 4.3               |
| 12    | Chloride as Cl <sup>-</sup>           | mg/l  | 250                             | 1000                                                                | 78                | 58                | 87                | 96                | 65                | 71                | 47                | 51                |
| 13    | Sulphate as SO <sub>4</sub>           | mg/l  | 200                             | 400                                                                 | 22                | 14                | 28                | 23                | 19                | 13                | 12                | 10                |
| 14    | Nitrate as NO <sub>3</sub>            | mg/l  | 45                              | No relaxation                                                       | 1                 | 2                 | 1                 | 2                 | 2                 | 1                 | 1                 | 2                 |
| 15    | Iron as Fe                            | mg/l  | 0.3                             | No relaxation                                                       | 0.12              | 0.10              | 0.05              | 0.08              | BDL (<0.05)       | BDL (<0.05)       | 0.05              | BDL (<0.05)       |
| 16    | Manganese as Mn                       | mg/l  | 0.1                             | 0.3                                                                 | BDL (<0.01)       | BDL (<0.01)       | BDL (<0.01)       | BDL (<0.01)       | BDL (<0.01)       | BDL (<0.01)       | BDL (<0.01)       | BDL (<0.01)       |
| 17    | Fluoride as F                         | mg/l  | 1.0                             | 1.5                                                                 | 0.27              | 0.29              | 0.23              | 0.26              | 0.25              | 0.17              | 0.14              | 0.18              |

| S. No | Parameters                  | Unit | Acceptable Limit IS 10500: 2012 | Permissible Limit in the Absence of Alternate Source IS 10500: 2012 | GW 1         | GW 2         | GW 3         | GW 4         | GW 5         | GW 6         | GW 7         | GW 8         |
|-------|-----------------------------|------|---------------------------------|---------------------------------------------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| 18    | Sodium as Na                | mg/l | Not Specified                   | Not Specified                                                       | 47           | 38           | 52           | 59           | 43           | 52           | 28           | 33           |
| 19    | Potassium as K              | mg/l | Not Specified                   | Not Specified                                                       | 2.7          | 2.3          | 3.2          | 3.1          | 3.3          | 1.6          | 1.2          | 1.6          |
| 20    | Barium as Ba                | mg/l | 0.7                             | No relaxation                                                       | 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                             | 1                                                                   | 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                            | 0.2                                                                 | 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                           | No relaxation                                                       | 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                            | No relaxation                                                       | 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                            | 1.5                                                                 | 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                               | 15                                                                  | 0.03         | 0.02         | 0.03         | 0.05         | 0.03         | 0.03         | 0.05         | 0.05         |
| 27    | Total Chromium as Cr        | mg/l | 0.05                            | No relaxation                                                       | 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                            | 0.05                                                                | 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                            | No relaxation                                                       | 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                            | No relaxation                                                       | 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                           | No relaxation                                                       | 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                             | 1.0                                                                 | BDL (<0.025) | BDL (<0.025) | BDL (<0.025) | BDL (<0.025) | BDL (<0.025) | BDL (<0.025) | BDL (<0.025) | BDL (<0.025) |



| <b>S. No</b> | <b>Parameters</b>            | <b>Unit</b> | <b>Acceptable Limit IS 10500: 2012</b> | <b>Permissible Limit in the Absence of Alternate Source IS 10500: 2012</b> | <b>GW 1</b>  | <b>GW 2</b>  | <b>GW 3</b>  | <b>GW 4</b>  | <b>GW 5</b>  | <b>GW 6</b>  | <b>GW 7</b>  | <b>GW 8</b>  |
|--------------|------------------------------|-------------|----------------------------------------|----------------------------------------------------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| 33           | Phenolic Compounds as Phenol | mg/l        | 0.001                                  | 0.002                                                                      | 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                                 | No relaxation                                                              | Absent       | Absent       | Absent       | Absent       | Absent       | Absent       | Absent       | Absent       |
| 35           | Total Coliforms              | MPN/100ml   | Absent /100ml                          | No relaxation                                                              | Absent       | Absent       | Absent       | Absent       | Absent       | Absent       | Absent       | Absent       |
| 36           | E.coli                       | MPN/100ml   | Absent /100ml                          | No relaxation                                                              | Absent       | Absent       | Absent       | Absent       | Absent       | Absent       | Absent       | Absent       |

*Note: BDL - Below Detection Limit*

### III. Conclusions

The results of ground water samples were compared to Indian Standard Specification of drinking water IS: 10500:2012. All the analysed parameters meet acceptable limit. The ground water resources in the study area were found fit for drinking purpose.

#### 3.7.2 Surface Water Quality in Study Area

During the study period, surface water sample were collected and analysed from Umiam River up-stream and down-stream. Surface water quality standards as per IS: 2296 and CPCB Water Quality Criteria are presented below:

#### Surface Water Quality Standards (as per IS: 2296)

Class A – Drinking water without conventional treatment but after disinfection. Class B – Water for outdoor bathing. Class C – Drinking water with conventional treatment followed by disinfection. Class D – Water for fish culture and wild life propagation. Class E – Water for irrigation, industrial cooling and controlled waste disposal. (Unobj = Unobjectionable).

| Sl | Parameter and Unit                          | A     | B   | C    | D    | E    |
|----|---------------------------------------------|-------|-----|------|------|------|
| 1  | Taste                                       | None  | --  | --   | --   | --   |
| 2  | Odour                                       | Unobj | --  | --   | --   | --   |
| 3  | Colour (True) (Hazen unit)                  | 10    | 300 | 300  | --   | --   |
| 4  | pH (max) (min : 6.5)                        | 8.5   | 8.5 | 8.5  | 8.5  | 8.5  |
| 5  | Conductivity (25oC) uS/cm                   | --    | --  | --   | 1000 | 2250 |
| 6  | DO (mg/L) (minimum)                         | 6     | 5   | 4    | 4    | --   |
| 7  | BOD (3d, 27oC) (mg/L)                       | 2     | 3   | 3    | --   | --   |
| 8  | Total Coliforms (MPN/100 mL)                | 50    | 500 | 5000 | --   | --   |
| 9  | TDS (mg/L)                                  | 500   | --  | 1500 | --   | 2100 |
| 10 | Oil and Grease (mg/L)                       | --    | --  | 0.1  | 0.1  | --   |
| 11 | Mineral oil (mg/L)                          | 0.01  | --  | --   | --   | --   |
| 12 | Total Hardness (mg/L as CaCO <sub>3</sub> ) | 300   | --  | --   | --   | --   |
| 13 | Chlorides (mg/L as Cl)                      | 250   | --  | 600  | --   | 600  |
| 14 | Sulfates (mg/L as SO <sub>4</sub> )         | 400   | --  | 400  | --   | 1000 |
| 15 | Nitrates (mg/L as NO <sub>3</sub> )         | 20    | --  | 50   | --   | --   |
| 16 | Free CO <sub>2</sub> (mg/L )                | --    | --  | --   | 6    | --   |
| 17 | Free NH <sub>3</sub> (mg/L as N)            | --    | --  | --   | 1.2  | --   |
| 18 | Fluorides (mg/L as F)                       | 1.5   | 1.5 | 1.5  | --   | --   |
| 19 | Calcium (mg/L)                              | 80.10 | --  | --   | --   | --   |
| 20 | Magnesium (mg/L)                            | 24.28 | --  | --   | --   | --   |
| 21 | Copper (mg/L)                               | 1.5   | --  | 1.5  | --   | --   |
| 22 | Iron (mg/L)                                 | 0.3   | --  | 50   | --   | --   |
| 23 | Manganese (mg/L)                            | 0.5   | --  | --   | --   | --   |
| 24 | Zinc (mg/L)                                 | 15    | --  | 15   | --   | --   |
| 25 | Boron (mg/L as B)                           | --    | --  | --   | --   | 2    |

| SI | Parameter and Unit                | A     | B     | C     | D     | E     |
|----|-----------------------------------|-------|-------|-------|-------|-------|
| 26 | Barium (mg/L)                     | 1     | --    | --    | --    | --    |
| 27 | Silver (mg/L)                     | 0.05  | --    | --    | --    | --    |
| 28 | Arsenic Total (mg/L)              | 0.05  | 0.2   | 0.2   | --    | --    |
| 29 | Mercury (mg/L)                    | 0.001 | --    | --    | --    | --    |
| 30 | Lead (mg/L)                       | 0.1   | --    | 0.1   | --    | --    |
| 31 | Cadmium (mg/L)                    | 0.01  | --    | 0.01  | --    | --    |
| 32 | Chromium (VI) (mg/L)              | 0.05  | 0.05  | 0.05  | --    | --    |
| 33 | Selenium (mg/L)                   | 0.01  | --    | 0.05  | --    | --    |
| 34 | Cyanide (mg/L as CN)              | 0.05  | 0.05  | 0.05  | --    | --    |
| 35 | Phenols (mg/L)                    | 0.002 | 0.005 | 0.005 | --    | --    |
| 36 | Anionic detergents (mg/L as MBAS) | 0.2   | 1     | 1     | --    | --    |
| 37 | PAH (mg/L)                        | 0.2   | --    | --    | --    | --    |
| 38 | Pesticides (ug/L)                 | 0     | --    | --    | --    | --    |
| 39 | Insecticides (ug/L)               | --    | --    | 0     | --    | --    |
| 40 | Alpha emitters (10-6uCi/mL)       | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| 41 | Beta emitters (10-6uCi/mL)        | 0.01  | 0.01  | 0.01  | 0.01  | 0.01  |
| 42 | Percent Sodium (%)                | --    | --    | --    | --    | 60    |
| 43 | Sodium Absorption Ratio           | --    | --    | --    | --    | 26    |

### CPCB Water Quality Criteria

| Designated-Best-Use                                                         | Class of Water | Criteria                                                                                                                                                                                                                                       |
|-----------------------------------------------------------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Drinking Water Source without conventional treatment but after disinfection | A              | <ul style="list-style-type: none"> <li>Total Coliforms Organism MPN/100ml shall be 50 or less</li> <li>pH between 6.5 and 8.5</li> <li>Dissolved Oxygen 6mg/l or more</li> <li>Biochemical Oxygen Demand 5 days 20 °C 2mg/l or less</li> </ul> |
| Outdoor Bathing (Organised)                                                 | B              | <ul style="list-style-type: none"> <li>Total Coliforms Organism MPN/100ml shall be 500 or less pH between 6.5 and 8.5</li> <li>Dissolved Oxygen 5mg/l or more</li> <li>Biochemical Oxygen Demand 5 days 20 °C 3mg/l or less</li> </ul>         |
| Drinking water source after conventional treatment and disinfection         | C              | <ul style="list-style-type: none"> <li>Total Coliforms Organism MPN/100ml shall be 5000 or less pH between 6 to 9</li> <li>Dissolved Oxygen 4mg/l or more</li> <li>Biochemical Oxygen Demand 5 days 20C 3mg/l or less</li> </ul>               |
| Propagation of Wild life and Fisheries                                      | D              | <ul style="list-style-type: none"> <li>pH between 6.5 to 8.5</li> <li>Dissolved Oxygen 4mg/l or more</li> <li>Free Ammonia (as N) 1.2 mg/l or less</li> </ul>                                                                                  |
| Irrigation, Industrial Cooling, Controlled Waste disposal                   | E              | <ul style="list-style-type: none"> <li>pH between 6.0 to 8.5</li> <li>Electrical Conductivity at 25C micro mhos/cm Max.2250</li> <li>Sodium absorption Ratio Max. 26</li> </ul>                                                                |

|  |         |                                                                                             |
|--|---------|---------------------------------------------------------------------------------------------|
|  |         | <ul style="list-style-type: none"> <li>• Boron Max. 2mg/l</li> </ul>                        |
|  | Below-E | <ul style="list-style-type: none"> <li>• Not Meeting A, B, C, D &amp; E Criteria</li> </ul> |

The analysis results for surface water sample are given in **Table 3.7**. The characteristics of surface water samples are described below:

**Colour:** The colour of surface water samples was found 10 and 60 hazen unit in upstream and down-stream of Umiam River, which with within the tolerance limits IS: 2296-1982 (Class C).

**Odour:** No odour was observed in the surface water in up-stream and down-stream of Umiam River.

**pH:** pH of surface water samples was found 7.41 and 7.54, which with within the tolerance limits IS: 2296-1982 (Class C).

**Electrical Conductivity:** Electrical conductivity of surface water samples was found 354 and 479, which with within the tolerance limits IS: 2296-1982 (Class C).

**Turbidity:** Turbidity of surface water samples was found 1.2 and 13.5 NTU. No limit has been stipulated for turbidity as per IS: 2296-1982 and CPCB Water Quality Criteria (Class C).

**Total Hardness:** Total hardness of surface water sample was found 82 and 130 mg/l. No limit has been stipulated for total hardness as per IS: 2296-1982 and CPCB Water Quality Criteria (Class C).

**Total Dissolved Solids (TDS):** TDS of surface water samples was found 202 and 278 mg/l. 1500 mg/l limit has been stipulated for TDS as per IS: 2296-1982.

**Total Suspended Solid (TSS):** Total suspended solids in surface water sample were found 2 and 6 mg/l. No limit has been stipulated for total suspended solid (TSS) as per IS: 2296-1982 and CPCB Water Quality Criteria (Class C).

**Total Alkalinity:** Total alkalinity of surface water sample was found 78 and 110 mg/l. No limit has been stipulated for total alkalinity as per IS: 2296-1982 and CPCB Water Quality Criteria (Class C).

**Iron:** Iron in surface water sample was found 0.25 and 0.29 mg/l. 50 mg/l limit has been stipulated for Iron as per IS: 2296-1982.

**Chloride:** Chloride content of surface water sample was found 56 and 77 mg/l. 60 mg/l limit has been stipulated for Chloride as per IS: 2296-1982.

**Calcium:** Calcium content of surface water sample was found 26 and 31 mg/l. No limit has been stipulated for Calcium as per IS: 2296-1982 and CPCB Water Quality Criteria (Class C).

**Magnesium:** Magnesium content of surface water sample was found 4.1 and 12.7mg/l. No limit has been stipulated for Magnesium as per IS: 2296-1982 and CPCB Water Quality Criteria (Class C).

**Sulphate:** Sulphate content of surface water sample was found 14 and 16 mg/l. 60 mg/l limit has been stipulated for Sulphate as per IS: 2296-1982.

**Nitrate:** Nitrate content of surface water sample was found 3 and 10 mg/l. 50 mg/l limit has been stipulated for Nitrate as per IS: 2296-1982.

**Fluoride:** Fluoride content of surface water sample was found 0.11 and 0.15 mg/l. 1.5 mg/l limit has been stipulated for Fluoride as per IS: 2296-1982.

**Dissolved Oxygen (DO):** Dissolved Oxygen in surface water sample was found 6.3 and 5.8 mg/l. No limit has been stipulated for dissolved oxygen as per IS: 2296-1982 and CPCB Water Quality Criteria (Class C).

**Biological Oxygen Demand (BOD):** Biological Oxygen Demand in surface water sample was found BDL to 2.2 mg/l. 3 mg/l limit has been stipulated for BOD as per IS: 2296-1982 and CPCB Water Quality Criteria (Class C).

**Chemical Oxygen Demand (CDO):** Chemical Oxygen Demand (COD) in surface water sample was found 15 and 22 mg/l. No limit has been stipulated for COD as per IS: 2296-1982 and CPCB Water Quality Criteria (Class C).

**Total Coliform:** Total coliform in surface water sample was found 1100 and <1600 MPN/100 ml. 5000 mg/l limit has been stipulated for total coliform as per IS: 2296-1982 and CPCB Water Quality Criteria (Class C).

**Faecal Coliform:** Faecal Coliform in surface water sample was found 14 and 40 MPN/100 ml. No limit has been stipulated for total coliform as per IS: 2296-1982 and CPCB Water Quality Criteria (Class C).

Surface water samples from in upstream and down-stream of Umiam River are meeting Class of Water - C as per IS: 2296-1982 and CBCB Criteria for designated use.

**Table 3.7: Analysis Results of Surface Water Sample**

| S. No | Parameters                                             | Unit  | SW 1              | SW 2              | Tolerance Limits IS: 2296-1982 (Class C) | CPCB Water Quality Criteria (Class C) |
|-------|--------------------------------------------------------|-------|-------------------|-------------------|------------------------------------------|---------------------------------------|
| 1.    | Temperature                                            | °C    | 26.4              | 27.1              | --                                       | --                                    |
| 2.    | Colour                                                 | Hazen | 10                | 60                | 300                                      | --                                    |
| 3.    | Odour                                                  | -     | No Odour Observed | No Odour Observed | --                                       | --                                    |
| 4.    | pH at 25°C                                             | -     | 7.41              | 7.54              | 6.5-8.5                                  | --                                    |
| 5.    | Electrical Conductivity                                | µS/cm | 354               | 479               | --                                       | --                                    |
| 6.    | Turbidity                                              | NTU   | 1.2               | 13.5              | --                                       | --                                    |
| 7.    | Total Dissolved Solids                                 | mg/l  | 202               | 278               | 1500                                     | --                                    |
| 8.    | Total Hardness as CaCO <sub>3</sub>                    | mg/l  | 82                | 130               | --                                       | --                                    |
| 9.    | Total Alkalinity as CaCO <sub>3</sub>                  | mg/l  | 78                | 110               | --                                       | --                                    |
| 10.   | Chloride as Cl                                         | mg/l  | 56                | 77                | 600                                      | --                                    |
| 11.   | Sulphate as SO <sub>4</sub>                            | mg/l  | 14                | 16                | 400                                      | --                                    |
| 12.   | Fluoride as F                                          | mg/l  | 0.11              | 0.15              | 1.5                                      | --                                    |
| 13.   | Nitrate as NO <sub>3</sub>                             | mg/l  | 3                 | 11                | 50                                       | --                                    |
| 14.   | Ammonia as NH <sub>3</sub>                             | mg/l  | 0.14              | 0.52              | --                                       | --                                    |
| 15.   | Phosphate as PO <sub>4</sub>                           | mg/l  | 0.32              | 0.41              | --                                       | --                                    |
| 16.   | Sodium as Na                                           | mg/l  | 37                | 48                | --                                       | --                                    |
| 17.   | Potassium as K                                         | mg/l  | 4.5               | 6.6               | --                                       | --                                    |
| 18.   | Calcium as Ca                                          | mg/l  | 26                | 31                | --                                       | --                                    |
| 19.   | Magnesium as Mg                                        | mg/l  | 4.1               | 12.7              | --                                       | --                                    |
| 20.   | Iron as Fe                                             | mg/l  | 0.25              | 0.29              | 50                                       | --                                    |
| 21.   | Manganese as Mn                                        | mg/l  | 0.02              | 0.15              | --                                       | --                                    |
| 22.   | Anionic Surfactants as MBAS                            | mg/l  | BDL (<0.025)      | BDL (<0.025)      | --                                       | --                                    |
| 23.   | Total Suspended Solids                                 | mg/l  | 2                 | 6                 | --                                       | --                                    |
| 24.   | Dissolved Oxygen as O <sub>2</sub>                     | mg/l  | 6.3               | 5.8               | --                                       | --                                    |
| 25.   | Chemical Oxygen Demand                                 | mg/l  | 15                | 22                | --                                       |                                       |
| 26.   | Bio-Chemical Oxygen Demand @ 27°C for 3 days           | mg/l  | BDL (<2)          | 2.2               | 3                                        | 3                                     |
| 27.   | Phenolic compounds as C <sub>6</sub> H <sub>5</sub> OH | mg/l  | BDL (<0.001)      | BDL (<0.001)      | --                                       | --                                    |
| 28.   | Copper as Cu                                           | mg/l  | BDL (<0.03)       | BDL (<0.03)       | 1.5                                      | --                                    |
| 29.   | Mercury as Hg                                          | mg/l  | BDL (<0.001)      | BDL (<0.001)      |                                          | --                                    |
| 30.   | Cadmium as Cd                                          | mg/l  | BDL (<0.003)      | BDL (<0.003)      | 0.01                                     | --                                    |

| <b>S. No</b> | <b>Parameters</b>    | <b>Unit</b> | <b>SW 1</b> | <b>SW 2</b> | <b>Tolerance Limits IS: 2296-1982 (Class C)</b> | <b>CPCB Water Quality Criteria (Class C)</b> |
|--------------|----------------------|-------------|-------------|-------------|-------------------------------------------------|----------------------------------------------|
| 31.          | Selenium as Se       | mg/l        | BDL (<0.01) | BDL (<0.01) | 0.05                                            | --                                           |
| 32.          | Total Arsenic as As  | mg/l        | BDL (<0.01) | BDL (<0.01) | 0.2                                             | --                                           |
| 33.          | Cyanide as CN        | mg/l        | BDL (<0.02) | BDL (<0.02) | 0.05                                            | --                                           |
| 34.          | Lead as Pb           | mg/l        | BDL (<0.01) | BDL (<0.01) | 0.1                                             | --                                           |
| 35.          | Zinc as Zn           | mg/l        | 0.03        | 0.13        | 15                                              | --                                           |
| 36.          | Total Chromium as Cr | mg/l        | BDL (<0.03) | BDL (<0.03) | 0.01                                            | --                                           |
| 37.          | Nickel as Ni         | mg/l        | BDL (<0.02) | BDL (<0.02) | --                                              | --                                           |
| 38.          | Oil & Grease         | mg/l        | BDL(<1)     | BDL(<1)     | 0.1                                             | --                                           |
| 39.          | Total Coliform       | MPN/ 100 ml | 1100        | >1600       | 5000                                            | 5000                                         |
| 40.          | Faecal Coliform      | MPN/ 100 ml | 14          | 40          | --                                              | --                                           |

*Note: BDL- Below Detection Limit*

### **3.8 Climatology and Meteorology**

#### **3.8.1 Introduction**

#### **3.8.2 Climatology**

Climatological (long-term) data was obtained from the nearest Indian Meteorological Department (IMD) station or another nearby station with over ten years of meteorological records. The climatological data for the proposed site is presented and discussed in the following subsections.

##### **A. Seasons**

The study experiences a subtropical highland climate, influenced by its elevation and the southwest monsoon. The state enjoys three main seasons:

|         |   |                                                                                                                                                          |
|---------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Summer  | : | March to May, Pleasant and moderately warm. Pre-monsoon thunderstorms and occasional hailstorms are common.                                              |
| Monsoon | : | July to September, with heavy rainfall Temperatures drop slightly during this time. Overcast skies, high humidity, and frequent rain throughout the day. |
| Winter  | : | October to February, Cool and dry with clear skies. mornings and evenings can be chilly, especially in hill regions like Shillong                        |

##### **B. Temperature**

The study area has a subtropical highland climate, with three distinct seasons: summer season from March to May, and a monsoon season from June to September and Winter season from October to February. In the summer months, temperatures range from 4 °C to 32 °C. In the winter, they range from 0.3 to 30 °C.

April and May months constitute the hottest part of the year. The maximum temperature in April is 32 °C. The minimum temperature in April is 9.5 °C and maximum temperature rises up to 32 °C or over. The January is the coldest month with maximum temperature at 23.4 °C and minimum temperature at 0.3 °C.

**Table 3.8** gives the temperatures at Barapani IMD Station which is the located at Barapani Airport.



**Table 3.8: Highest and Lowest Temperatures in the Area**

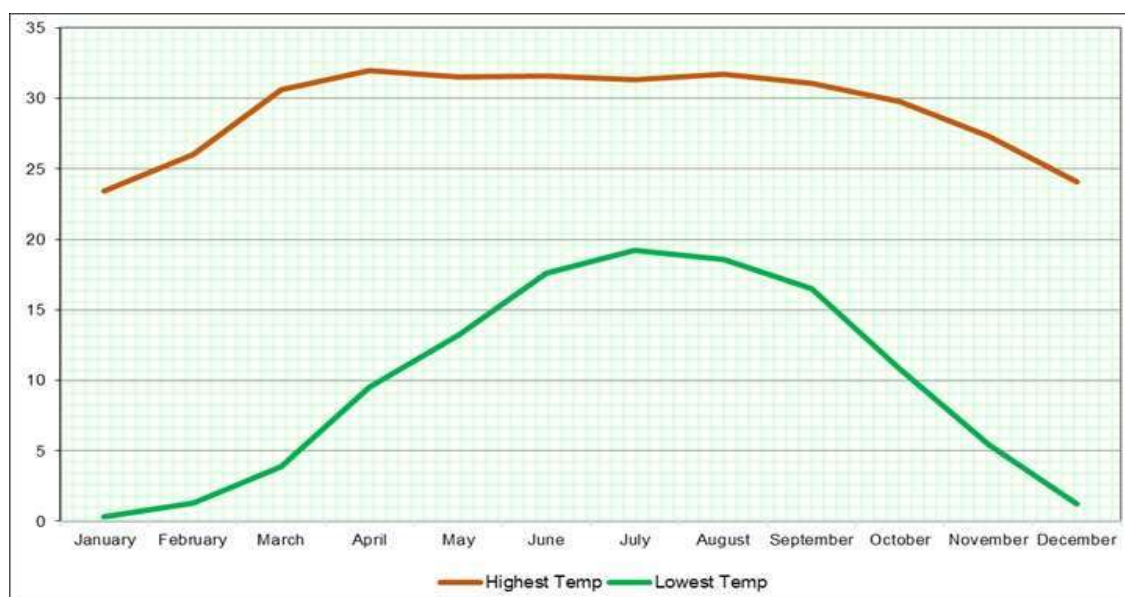
| Month     | Highest Temperature (°C) | Lowest Temperature (°C) | Relative Humidity |
|-----------|--------------------------|-------------------------|-------------------|
| January   | 23.4                     | 0.3                     | 86                |
| February  | 26                       | 1.3                     | 74                |
| March     | 30.6                     | 3.9                     | 60                |
| April     | 32                       | 9.5                     | 64                |
| May       | 31.5                     | 13.2                    | 73                |
| June      | 31.6                     | 17.6                    | 80                |
| July      | 31.3                     | 19.2                    | 82                |
| August    | 31.7                     | 18.6                    | 82                |
| September | 31.1                     | 16.5                    | 82                |
| October   | 29.8                     | 10.8                    | 81                |
| November  | 27.3                     | 5.4                     | 82                |
| December  | 24.1                     | 1.2                     | 85                |

Source: IMD Station, Barapani

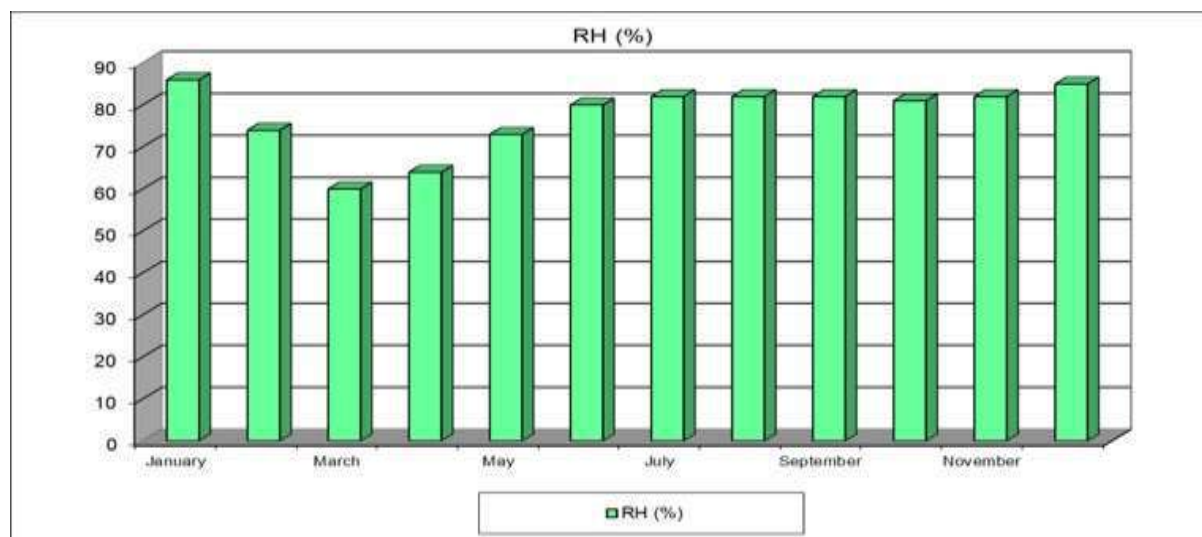
### C. Humidity

**Table 3.8** also gives the relative humidity (RH) data at IMD station Barapani. The air is very humid during December and January when relative humidity are 80 to 82 %. Relative humidity decreases progressively during 60 to 64%.

The highest and lowest temperatures and monthly relative humidity are given in **Figures 3.5** and **3.6**, respectively.



**Figure 3.5: Monthly Highest and Lowest Temperatures**



**Figure 3.6: Monthly Relative Humidity during Morning & Evening**

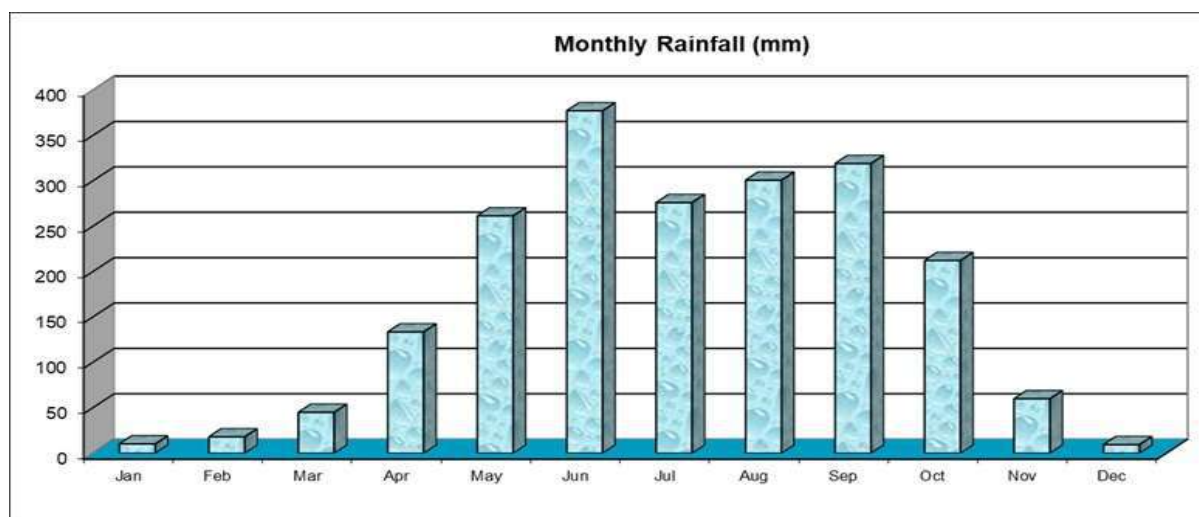
#### D. Rainfall

Rainfall data for Barapani IMD station is given **Table 3.9**. The values given parenthesis are rainy days. The study area receives 2124.4 mm rainfall annually. There are on average 120.8 rainy-day in a year. June to September are wettest months. Graphical presentation of monthly rainfall in the study area is shown in **Figure 3.7** and rainy days in the study area are shown in **Figure 3.8**.

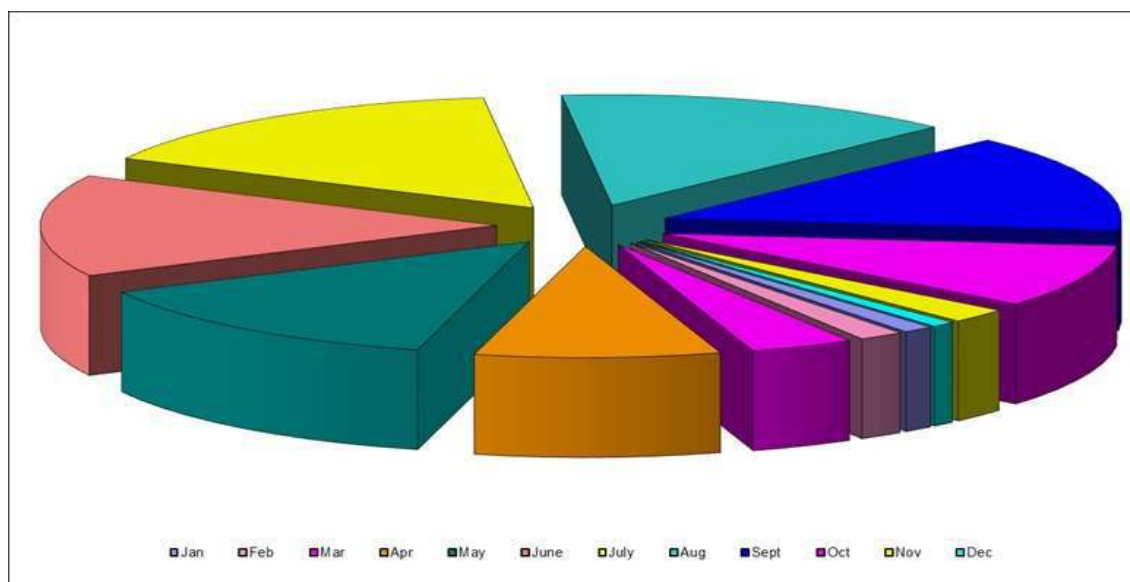
**Table 3.9: Rainfall data for The Area**

| Jan   | Feb   | Mar   | Apr    | May    | Jun    | Jul   | Aug    | Sep    | Oct   | Nov   | Dec | Annual         |
|-------|-------|-------|--------|--------|--------|-------|--------|--------|-------|-------|-----|----------------|
| 10.2  | 18    | 45    | 133.6  | 261.5  | 377.3  | 276.1 | 300.8  | 319.2  | 212.3 | 60    | 9.4 | <b>2124.4</b>  |
| (1.3) | (1.9) | (4.4) | (10.4) | (16.3) | (17.8) | (19)  | (17.1) | (17.1) | (11)  | (2.5) | (1) | <b>(120.8)</b> |

Source: IMD Station, Barapani



**Figure 3.7: Monthly Rainfall in the Study Area**



**Figure 3.8: Rainy days in the Study Area**

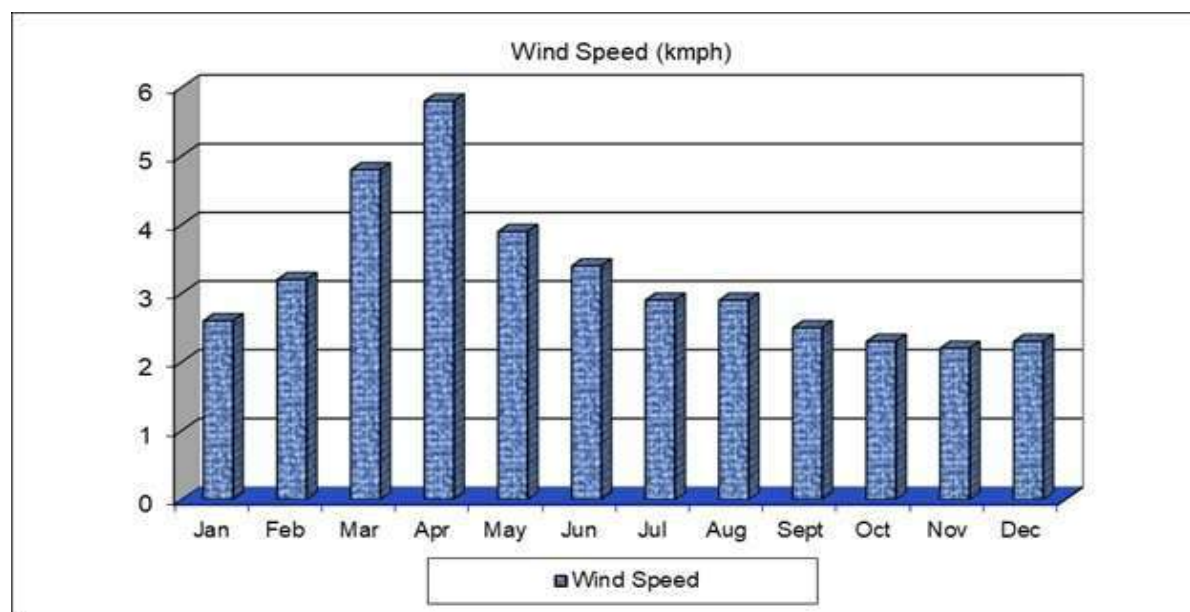
## E. Wind Speed

Mean wind speed at Barapani IMD station is given **Table 3.10** and shown in **Figure 3.9**. In the area, annual average wind speed is 3.2 kmph. Highest average monthly wind speed is observed in April month (5.8 kmph) while lowest (2.2 kmph) in November month.

**Table 3.10: Wind Speed in the Area (kmph)**

| Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--------|
| 2.6 | 3.2 | 4.8 | 5.8 | 3.9 | 3.4 | 2.9 | 2.9 | 2.5 | 2.3 | 2.2 | 2.3 | 3.2    |

Source: IMD Station, Barapani



**Figure 3.9: Monthly Wind Speed**

## F. Wind Direction

The prevailing winds blow from NE-E sector towards SW-W sector through out the year. Monthly wind direction for Barapani IMD station are also given in **Table 3.19**.

## G. Cloudiness

The skies are generally moderately to heavily cloud during the monsoon season. The skies are mainly clear or lightly clouded during the non-monsoon months.

**Table 3.11: Wind Direction in the Area**

| Sn  | Months        | N        | NE       | E         | SE       | S        | SW       | W        | NW       | Calm      |
|-----|---------------|----------|----------|-----------|----------|----------|----------|----------|----------|-----------|
| 1.  | January       | 1        | 4        | 8         | 1        | 1        | 0        | 1        | 1        | 83        |
| 2.  | February      | 2        | 4        | 10        | 2        | 1        | 1        | 5        | 5        | 70        |
| 3.  | March         | 4        | 7        | 9         | 1        | 1        | 4        | 15       | 9        | 50        |
| 4.  | April         | 4        | 6        | 10        | 3        | 1        | 8        | 17       | 10       | 41        |
| 5.  | May           | 5        | 8        | 12        | 4        | 1        | 4        | 9        | 7        | 50        |
| 6.  | June          | 2        | 7        | 17        | 6        | 2        | 2        | 4        | 4        | 56        |
| 7.  | July          | 1        | 8        | 17        | 5        | 1        | 1        | 2        | 1        | 64        |
| 8.  | August        | 2        | 9        | 19        | 5        | 2        | 0        | 1        | 1        | 61        |
| 9.  | September     | 3        | 7        | 19        | 4        | 2        | 1        | 2        | 2        | 60        |
| 10. | October       | 2        | 9        | 15        | 3        | 2        | 1        | 1        | 1        | 66        |
| 11. | November      | 2        | 8        | 16        | 3        | 1        | 0        | 1        | 0        | 69        |
| 12. | December      | 1        | 6        | 13        | 2        | 1        | 0        | 0        | 1        | 76        |
|     | <b>Annual</b> | <b>3</b> | <b>7</b> | <b>14</b> | <b>3</b> | <b>1</b> | <b>2</b> | <b>5</b> | <b>3</b> | <b>62</b> |

Source: IMD Station, Barapani

## H. Special Weather Phenomenon

Special weather phenomena are given in **Table 3.12** for the area. Thunder occurs on an average 30.4 day in a year. Fog occurs occasionally for about 48.4 days in a year. More than 0.3 mm precipitation is occurred on 159.1 days in a year. Dust storm, Hail and squall are rare in the area.

**Table 3.12: Special Weather Phenomena in the Area**

| Months        | PPT 0.3 mm or more | Hail       | Thunder     | Fog         | Dust Storm | Squall   |
|---------------|--------------------|------------|-------------|-------------|------------|----------|
| January       | 2.4                | 0          | 0           | 11.2        | 0          | 0        |
| February      | 3.3                | 0          | 0.4         | 6.3         | 0          | 0        |
| March         | 6.3                | 0          | 1.5         | 2.7         | 0.1        | 0        |
| April         | 13.3               | 0          | 3.9         | 0.4         | 0          | 0        |
| May           | 20                 | 0.1        | 4.6         | 0.4         | 0          | 0        |
| June          | 22.                | 2 0        | 4.8         | 0.3         | 0          | 0        |
| July          | 24.1               | 0          | 3.1         | 0           | 0          | 0        |
| August        | 23                 | 0          | 4.4         | 0.2         | 0          | 0        |
| September     | 20.8               | 0          | 4.3         | 0.4         | 0          | 0        |
| October       | 15.1               | 0          | 2.7         | 6.2         | 0          | 0        |
| November      | 6                  | 0          | 0.7         | 8.8         | 0          | 0        |
| December      | 2.6                | 0          | 0           | 11.4        | 0          | 0        |
| <b>Annual</b> | <b>159.1</b>       | <b>0.1</b> | <b>30.4</b> | <b>48.4</b> | <b>0.1</b> | <b>0</b> |

Source : IMD Station, Barapani

### 3.8.3 Micro Meteorological Data for The Project Site

Micrometeorology data changes after a few kilometers due to changes in local topography. Furthermore, IMD data recorded only at 8:30 AM for only eight wind directions with wind speeds over widely spaced ranges is not of much use in dispersion modelling. Because of these limitations, micrometeorological data was collected near site round the clock.

The meteorological data, such as, wind speed and direction, ambient temperature, and relative humidity was collected near the site and is presented in **Table 3.13** for summer season.

**Table 3.13: Summary of Micro Meteorological Conditions for the Site**

| Parameter                | Summar Season<br>(1 <sup>st</sup> March to 31 May 2025) |
|--------------------------|---------------------------------------------------------|
| <b>Temperature</b>       |                                                         |
| Max (°C)                 | 32.8                                                    |
| Min (°C)                 | 4.2                                                     |
| Mean (°C)                | 28.1                                                    |
| <b>Relative Humidity</b> |                                                         |
| Max (%)                  | 76.4                                                    |
| Min (%)                  | 57.1                                                    |
| Mean (°C)                | 61.2                                                    |
| <b>Wind Speed</b>        |                                                         |
| Max (kmph)               | 6.6                                                     |
| Min (kmph)               | 5.1                                                     |

| <b>Parameter</b>           | <b>Summar Season<br/>(1<sup>st</sup> March to 31 May 2025)</b> |
|----------------------------|----------------------------------------------------------------|
| Mean (kmph)                | 5.3                                                            |
| Predominant Wind Direction | From NE-E towards SW-W Sector                                  |
| Solar Radiation            | 6.2 kWh/m <sup>2</sup> /day                                    |
| Cloud Cover (OKTAS)        | 3                                                              |

### **A. Temperature**

The maximum ambient temperature recorded near the site during the study period was 32.8 °C, while minimum temperature was recorded as 4.2 °C.

### **B. Relative Humidity**

During the study period, maximum relative humidity recorded near site was 76.4 % while minimum humidity was recorded as 57.1%.

### **C. Wind Speed**

During the study period, maximum wind speed recorded near the site was 6.6 kmph while minimum wind speed was recorded as 5.1 kmph. Mean wind speed during the study period recorded as 5.3 kmph.

### **D. Wind Pattern**

During the study period, predominant wind direction was recorded from NE-E towards SW-E direction. Wind rose diagram for Day time and Night Time for study period are shown in **Figure 3.10**.

## **3.9 Ambient Air Quality**

### **3.9.1 Introduction**

To study, the baseline air quality scenario in the study area, eight ambient air quality monitoring (AAQM) stations were selected in the study area in different directions and at different distances from the proposed expansion of Barapani airport site keeping in view of the guidelines of the Ministry of Environment, Forest and Climate Change (MOEF&CC), Government of India.

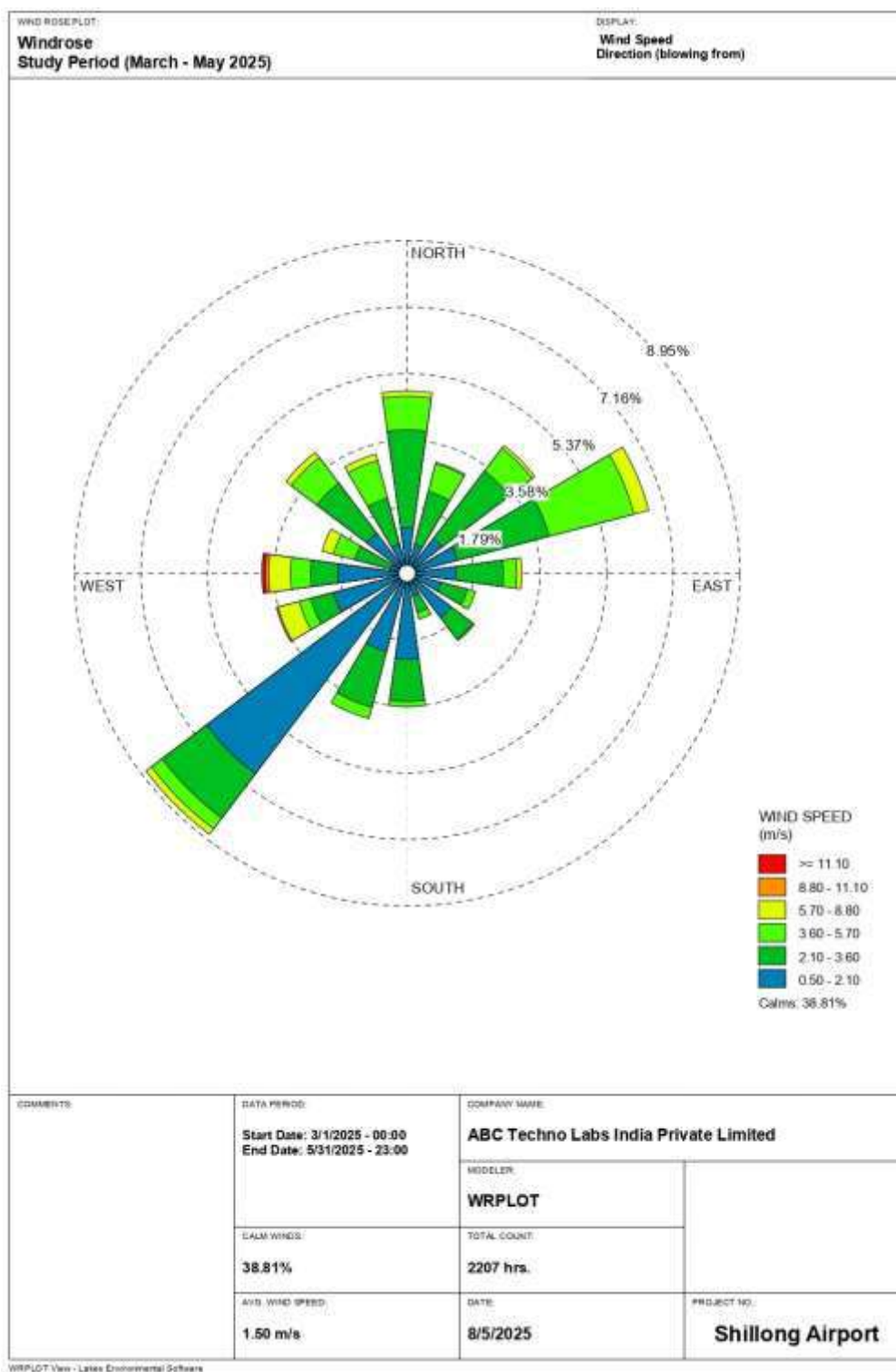


Figure 3.10: Windrose Diagram Near Project Site

### **3.9.2 Methodology of Monitoring and Analysis**

Envirotech APM Respirable Dust Sampler (RDS) and Sampler (Envirotech APM) fine particulate matter were deployed for ambient air quality monitoring.

The baseline ambient air quality was monitored for the following parameters:

- Particulate Matter (PM<sub>2.5</sub>);
- Particulate Matter (PM<sub>10</sub>);
- Sulphur dioxide (SO<sub>2</sub>);
- Nitrogen Dioxide (NO<sub>2</sub>);
- Ozone (O<sub>3</sub>);
- Lead (Pb);
- Carbon Monoxide (CO);
- Ammonia (NH<sub>3</sub>);
- Benzene (C<sub>6</sub>H<sub>6</sub>);
- Benzo (a) Pyrene (BaP);
- Arsenic (As); and
- Nickel (Ni).

### **Sampling and Analytical Techniques**

PM<sub>2.5</sub> and PM<sub>10</sub> have been estimated by gravimetric method. Modified West and Gaeke method (IS-5182 part-II, 1969) have been adopted for estimation of SO<sub>2</sub>. Jacobs-Hochheiser method (IS-5182 part-IV, 1975) has been adopted for the estimation of NO<sub>2</sub>.

Samples for carbon monoxide were analyzed using NDIR techniques. The techniques adopted for sampling and analysis are given in **Table 3.14** along with the minimum detection limits for each parameter.



**Table 3.14: Techniques Used for Ambient Air Quality Monitoring**

| S. No. | Parameter                                | Technique                                                            | Detectable Limit ( $\mu\text{g}/\text{m}^3$ ) |
|--------|------------------------------------------|----------------------------------------------------------------------|-----------------------------------------------|
| 1.     | Particulate Matter ( $\text{PM}_{10}$ )  | Gravimetric [EPA-40 (CFR Part 50)]                                   | 2.0                                           |
| 2.     | Particulate Matter ( $\text{PM}_{2.5}$ ) | Gravimetric [EPA-40 (CFR Part 50)]                                   | 2.0                                           |
| 3.     | Sulphur Dioxide ( $\text{SO}_2$ )        | Improved West and Gaeke                                              | 5.0                                           |
| 4.     | Nitrogen Dioxide ( $\text{NO}_2$ )       | Modified Jacob & Hochheiser                                          | 5.0                                           |
| 5.     | Carbon Monoxide (CO)                     | NDIR [IS 13270: 1992]                                                | 0.1                                           |
| 6.     | Ammonia ( $\text{NH}_3$ )                | Nessler's Method (APHA)                                              | 20                                            |
| 7.     | Ozone ( $\text{O}_3$ )                   | KI Absorption Method                                                 | 5.0                                           |
| 8.     | Lead (Pb)                                | AAS Method [IS 5182 (Part 22): 2004]                                 | 0.1                                           |
| 9.     | Arsenic (As)                             | AAS Method [IS 5182 (Part 22): 2004]                                 | 0.001                                         |
| 10.    | Nickel (Ni)                              | AAS Method [IS 5182 (Part 22): 2004]                                 | 0.001                                         |
| 11.    | Benzene ( $\text{C}_6\text{H}_6$ )       | Adsorption & Desorption followed by GC [IS 5182 (Part 11): 2006]     | 0.01                                          |
| 12.    | Benzo (a) pyrene (BaP)                   | Solvent Extraction followed by GC Analysis [IS 5282 (Part 12): 1991] | 0.001                                         |

### 3.9.3 National Ambient Air Quality Standards

The national ambient air quality standards are given in **Table 3.15**. Monitored values for study have been compared with the National Ambient Air Quality Standards.

**Table 3.15: National Ambient Air Quality Standards**

| S. No | Pollutant                                                                                                | Time Weighted Average | Concentration in Ambient Air                |                                                              |
|-------|----------------------------------------------------------------------------------------------------------|-----------------------|---------------------------------------------|--------------------------------------------------------------|
|       |                                                                                                          |                       | Industrial Residential, Rural & Other Areas | Ecologically Sensitive Area (Notified by Central Government) |
| 1.    | Sulphur Dioxide ( $\text{SO}_2$ ) ( $\mu\text{g}/\text{m}^3$ )                                           | Annual Average*       | 50                                          | 20                                                           |
|       |                                                                                                          | 24 Hours**            | 80                                          | 80                                                           |
| 2.    | Nitrogen Dioxide ( $\text{NO}_2$ ) ( $\mu\text{g}/\text{m}^3$ )                                          | Annual Average*       | 40                                          | 30                                                           |
|       |                                                                                                          | 24 Hours**            | 80                                          | 80                                                           |
| 3.    | Particulate Matter (Size Less Than $10 \mu\text{m}$ ) or $\text{PM}_{10}$ ( $\mu\text{g}/\text{m}^3$ )   | Annual Average*       | 60                                          | 60                                                           |
|       |                                                                                                          | 24 Hours**            | 100                                         | 100                                                          |
| 4.    | Particulate Matter (Size Less Than $2.5 \mu\text{m}$ ) or $\text{PM}_{2.5}$ ( $\mu\text{g}/\text{m}^3$ ) | Annual Average*       | 40                                          | 40                                                           |
|       |                                                                                                          | 24 Hours**            | 60                                          | 60                                                           |
| 5.    |                                                                                                          | 8 Hours*              | 100                                         | 100                                                          |

| S. No | Pollutant                                                          | Time Weighted Average | Concentration in Ambient Air                |                                                              |
|-------|--------------------------------------------------------------------|-----------------------|---------------------------------------------|--------------------------------------------------------------|
|       |                                                                    |                       | Industrial Residential, Rural & Other Areas | Ecologically Sensitive Area (Notified by Central Government) |
|       | Ozone O <sub>3</sub> (µg/m <sup>3</sup> )                          | 1 Hours**             | 80                                          | 80                                                           |
| 6.    | Lead (Pb) (µg/m <sup>3</sup> )                                     | Annual Average*       | 0.5                                         | 0.5                                                          |
|       |                                                                    | 24 Hours**            | 1.0                                         | 1.0                                                          |
| 7.    | Carbon monoxide (CO) (mg/m <sup>3</sup> )                          | Annual Average*       | 2                                           | 2                                                            |
|       |                                                                    | 24 Hours**            | 4                                           | 4                                                            |
| 8.    | Ammonia (NH <sub>3</sub> ) (µg/m <sup>3</sup> )                    | Annual Average*       | 100                                         | 100                                                          |
|       |                                                                    | 24 Hours**            | 400                                         | 400                                                          |
| 9.    | Benzene (C <sub>6</sub> H <sub>6</sub> ) (µg/m <sup>3</sup> )      | Annual*               | 5                                           | 5                                                            |
| 10.   | Benzo (a) Pyrene (BaP) particulate phase only (ng/m <sup>3</sup> ) | Annual*               | 1                                           | 1                                                            |
| 11.   | Arsenic (As) (µg/m <sup>3</sup> )                                  | Annual*               | 6                                           | 6                                                            |
| 12.   | Nickel (Ni) (ng/m <sup>3</sup> )                                   | Annual*               | 20                                          | 20                                                           |

**Note:**

\* Annual arithmetic means 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.

### 3.9.4 Ambient Air Quality Monitoring Locations

Eight locations namely Project site, Norgarh Umroi(Presbyterian Church), Bhorilymbong, Umktieh, Habitation, Umed Umroi, Umeit and Habitation were selected for ambient air quality monitoring based as per guidelines of CPCB.

#### Ambient Air Quality Monitoring Locations

The eight (8) ambient air quality monitoring locations were selected for ambient air quality monitoring based as per guidelines of CPCB. Ambient quality monitoring locations are presented in **Table 3.16** and **Figure 3.1**.

**Table 3.16: Ambient Air Quality Monitoring Stations in the Study Area**

| Sr No. | Locations                           | Distance | Direction | Latitude      | Longitude     |
|--------|-------------------------------------|----------|-----------|---------------|---------------|
| 1.     | Project Site                        | -        |           | 25°42'21.05"N | 91°58'30.94"E |
| 2.     | Norgarh Umroi (Presbyterian Church) | 1.85 km  | N         | 25°43'20.98"N | 91°58'36.86"E |

| Sr No. | Locations   | Distance | Direction | Latitude      | Longitude     |
|--------|-------------|----------|-----------|---------------|---------------|
| 3.     | Bhoriymbong | 4.65 km  | ENE       | 25°42'33.29"N | 92° 1'17.93"E |
| 4.     | Umktieh     | 1.95 km  | E         | 25°42'13.57"N | 91°59'39.39"E |
| 5.     | Habitation  | 3.5 km   | S         | 25°41'45.08"N | 92° 0'26.77"E |
| 6.     | Umed Umroi  | 2.15 km  | SW        | 25°41'12.65"N | 91°58'14.59"E |
| 7.     | Umeit       | 3.65 km  | W         | 25°42'13.70"N | 91°56'20.42"E |
| 8.     | Habitation  | 4.15 km  | N         | 25°42'39.96"N | 91°56'4.15"E  |

### 3.9.5 Results of Ambient Air Quality Monitoring

The results of ambient air quality monitoring of PM<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub>, NO<sub>2</sub>, NH<sub>3</sub>, O<sub>3</sub>, C<sub>6</sub>H<sub>6</sub>, BaP, Pb, As, Ni and CO are presented in **Table 3.17** to **Table 3.24**. The summary of Ambient Air Quality Monitoring is given in **Table 3.25**.

On the basis of tabulated data, the following observations can be made:

#### Fine Particulate Matter (PM<sub>2.5</sub>)

The 24-hourly PM<sub>2.5</sub> concentrations during the study period vary in the range of 16 to 26 µg/m<sup>3</sup>. The maximum PM<sub>2.5</sub> concentration was found 26 µg/m<sup>3</sup> while minimum PM<sub>2.5</sub> concentration was 16 µg/m<sup>3</sup>. The mean PM<sub>2.5</sub> concentration was 20 µg/m<sup>3</sup> and 98% tile value of PM<sub>2.5</sub> concentration was found 25 µg/m<sup>3</sup>.

#### Particulate Matter (PM<sub>10</sub>)

The 24-hourly PM<sub>10</sub> concentrations during study period vary in the range of 34 µg/m<sup>3</sup> to 55 µg/m<sup>3</sup>. The maximum PM<sub>10</sub> concentration was found 55 µg/m<sup>3</sup> while minimum PM<sub>10</sub> concentration was 34 µg/m<sup>3</sup>. The mean PM<sub>10</sub> concentration was 42 µg/m<sup>3</sup> and 98%tile value of PM<sub>10</sub> concentration was 52 µg/m<sup>3</sup>.

#### Sulphur Dioxide (SO<sub>2</sub>)

The 24-hourly SO<sub>2</sub> concentrations during study period vary in the range of 4.9 to 7.8 µg/m<sup>3</sup>. The maximum SO<sub>2</sub> concentration was found 7.8 µg/m<sup>3</sup> while minimum SO<sub>2</sub> concentration was 4.9 µg/m<sup>3</sup>. The mean SO<sub>2</sub> concentration was 6.1 µg/m<sup>3</sup> and 98%tile value of SO<sub>2</sub> concentration was 7.5 µg/m<sup>3</sup>.

### **Nitrogen Oxide (NO<sub>2</sub>)**

The 24-hourly NO<sub>2</sub> concentrations during study period vary in the range of 9.6 to 16.9 µg/m<sup>3</sup>. The maximum NO<sub>2</sub> concentration was found as 16.9 µg/m<sup>3</sup> and minimum NO<sub>2</sub> concentration was 9.6 µg/m<sup>3</sup>. The mean NO<sub>2</sub> concentration was 13.0 µg/m<sup>3</sup> and 98%tile value of NO<sub>2</sub> concentration was 16.4 µg/m<sup>3</sup>.

### **Carbon Monoxide (CO)**

The CO concentrations during study period vary in the range of 0.1 to 0.2 mg/m<sup>3</sup>. The maximum CO concentration was found as 0.2 mg/m<sup>3</sup> and minimum CO concentration was 0.1 mg/m<sup>3</sup>. The mean CO concentration was 0.10 mg/m<sup>3</sup> and 98%tile value of CO concentration was 0.2 mg/m<sup>3</sup>.

### **Ozone (O<sub>3</sub>)**

The CO concentrations during study period vary in the range of 8.1 to 14.7 mg/m<sup>3</sup>. The maximum CO concentration was found as 14.7 mg/m<sup>3</sup> and minimum CO concentration was 8.1 mg/m<sup>3</sup>. The mean CO concentration was 11.0 mg/m<sup>3</sup> and 98%tile value of CO concentration was 13.9 mg/m<sup>3</sup>.

### **Ammonia (NH<sub>3</sub>)**

The NH<sub>3</sub> concentrations were found below detectable limit (BDL) during the study period.

### **Lead (Pb)**

The Lead (Pb) concentrations were found below detectable limit (BDL) during the study period.

### **Benzene (C<sub>6</sub>H<sub>6</sub>)**

The Benzene (C<sub>6</sub>H<sub>6</sub>) concentrations were found below detectable limit (BDL) during the study period.

### **Benzo (a) Pyrene (BaP)**

The Benzo (a) Pyrene (BaP) concentrations were found below detectable limit (BDL) during the study period.

### **Arsenic (As)**

The Arsenic concentrations were found below detectable limit (BDL) during the study period.

### **Nickel (Ni)**

The Arsenic concentrations were found below detectable limit (BDL) during the study period.

### **3.9.6 Ambient Air Quality Status**

National ambient air quality standards are given in **Table 3.15**. National ambient air quality standards for industrial, residential, rural & other areas are met for all monitored parameters at all AAQM locations during the study period.

**Table 3.17: Ambient Air Quality at Project Airport (AAQM 1)**

| Date            | PM <sub>2.5</sub><br>µg/m <sup>3</sup> | PM<br>µg/m <sup>3</sup> | SO <sub>2</sub><br>µg/m <sup>3</sup> | NO <sub>2</sub><br>µg/m <sup>3</sup> | CO<br>mg/m <sup>3</sup> | O <sub>3</sub><br>µg/m <sup>3</sup> | NH <sub>3</sub><br>µg/m <sup>3</sup> | Lead<br>µg/m <sup>3</sup> | Benzene<br>µg/m <sup>3</sup> | B[a]P<br>ng/m <sup>3</sup> | Ni<br>ng/m <sup>3</sup> | As<br>ng/m <sup>3</sup> |
|-----------------|----------------------------------------|-------------------------|--------------------------------------|--------------------------------------|-------------------------|-------------------------------------|--------------------------------------|---------------------------|------------------------------|----------------------------|-------------------------|-------------------------|
| 03.03.2025      | 22                                     | 45                      | 6.9                                  | 14.8                                 | 0.17                    | 12.1                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 06.03.2025      | 24                                     | 49                      | 5.8                                  | 16.3                                 | 0.13                    | 13.3                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 10.03.2025      | 26                                     | 53                      | 7.1                                  | 15.5                                 | 0.18                    | 13.1                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 13.03.2025      | 24                                     | 51                      | 6.9                                  | 13.9                                 | 0.16                    | 11.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 17.03.2025      | 23                                     | 47                      | 7.3                                  | 15.9                                 | 0.13                    | 12.8                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 21.03.2025      | 20                                     | 42                      | 5.4                                  | 16.4                                 | 0.17                    | 13.3                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 24.03.2025      | 23                                     | 48                      | 5.3                                  | 16.7                                 | 0.12                    | 13.1                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 27.03.2025      | 24                                     | 50                      | 6.5                                  | 15.1                                 | 0.13                    | 12.9                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 01.04.2025      | 26                                     | 55                      | 7.2                                  | 14.8                                 | 0.16                    | 12.2                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 04.04.2025      | 23                                     | 48                      | 6.9                                  | 16.9                                 | 0.17                    | 13.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 07.04.2025      | 24                                     | 51                      | 7.7                                  | 13.5                                 | 0.12                    | 11.7                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 10.04.2025      | 22                                     | 47                      | 7.1                                  | 15.7                                 | 0.11                    | 12.1                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 14.04.2025      | 20                                     | 43                      | 5.9                                  | 16.8                                 | 0.16                    | 14.1                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 17.04.2025      | 22                                     | 46                      | 6.8                                  | 13.6                                 | 0.17                    | 10.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 22.04.2025      | 25                                     | 52                      | 6.2                                  | 14.8                                 | 0.13                    | 12.5                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 25.04.2025      | 23                                     | 49                      | 6.5                                  | 13.1                                 | 0.11                    | 11.1                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 05.05.2025      | 25                                     | 51                      | 7.8                                  | 15.8                                 | 0.18                    | 12.7                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 08.05.2025      | 20                                     | 42                      | 6.7                                  | 16.3                                 | 0.13                    | 14.2                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 12.05.2025      | 22                                     | 47                      | 7.3                                  | 13.4                                 | 0.17                    | 11.3                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 15.05.2025      | 25                                     | 53                      | 5.8                                  | 14.6                                 | 0.12                    | 12.4                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 19.05.2025      | 21                                     | 45                      | 6.4                                  | 13.1                                 | 0.11                    | 10.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 22.05.2025      | 19                                     | 41                      | 6.9                                  | 14.9                                 | 0.15                    | 12.5                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 26.05.2025      | 23                                     | 49                      | 5.5                                  | 16.6                                 | 0.17                    | 13.9                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 29.05.2025      | 25                                     | 52                      | 7.3                                  | 13.3                                 | 0.13                    | 11.2                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| <b>Minimum</b>  | <b>19</b>                              | <b>41</b>               | <b>5.3</b>                           | <b>13.1</b>                          | <b>0.11</b>             | <b>10.6</b>                         | <b>BDL(&lt;5)</b>                    | <b>BDL(&lt;5)</b>         | <b>BDL(&lt;5)</b>            | <b>BDL(&lt;5)</b>          | <b>BDL(&lt;5)</b>       | <b>BDL(&lt;5)</b>       |
| <b>Maximum</b>  | <b>26</b>                              | <b>55</b>               | <b>7.8</b>                           | <b>16.9</b>                          | <b>0.18</b>             | <b>14.2</b>                         | <b>BDL(&lt;5)</b>                    | <b>BDL(&lt;5)</b>         | <b>BDL(&lt;5)</b>            | <b>BDL(&lt;5)</b>          | <b>BDL(&lt;5)</b>       | <b>BDL(&lt;5)</b>       |
| <b>Average</b>  | <b>23.0</b>                            | <b>48</b>               | <b>6.6</b>                           | <b>15.1</b>                          | <b>0.15</b>             | <b>12.5</b>                         | <b>BDL(&lt;5)</b>                    | <b>BDL(&lt;5)</b>         | <b>BDL(&lt;5)</b>            | <b>BDL(&lt;5)</b>          | <b>BDL(&lt;5)</b>       | <b>BDL(&lt;5)</b>       |
| <b>98 %tile</b> | <b>26.0</b>                            | <b>54</b>               | <b>7.8</b>                           | <b>16.9</b>                          | <b>0.18</b>             | <b>14.2</b>                         | <b>BDL(&lt;5)</b>                    | <b>BDL(&lt;5)</b>         | <b>BDL(&lt;5)</b>            | <b>BDL(&lt;5)</b>          | <b>BDL(&lt;5)</b>       | <b>BDL(&lt;5)</b>       |

**Table 3.18: Ambient Air Quality at Norgarh Umroi (Presbyterian Church) (AAQM 2)**

| Date            | PM <sub>2.5</sub><br>µg/m <sup>3</sup> | PM<br>µg/m <sup>3</sup> | SO <sub>2</sub><br>µg/m <sup>3</sup> | NO <sub>2</sub><br>µg/m <sup>3</sup> | CO<br>mg/m <sup>3</sup> | O <sub>3</sub><br>µg/m <sup>3</sup> | NH <sub>3</sub><br>µg/m <sup>3</sup> | Lead<br>µg/m <sup>3</sup> | Benzene<br>µg/m <sup>3</sup> | B[a]P<br>ng/m <sup>3</sup> | Ni<br>ng/m <sup>3</sup> | As<br>ng/m <sup>3</sup> |
|-----------------|----------------------------------------|-------------------------|--------------------------------------|--------------------------------------|-------------------------|-------------------------------------|--------------------------------------|---------------------------|------------------------------|----------------------------|-------------------------|-------------------------|
| 03.03.2025      | 23                                     | 48                      | 5.9                                  | 12.9                                 | 0.13                    | 10.7                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 06.03.2025      | 19                                     | 40                      | 5.1                                  | 14.8                                 | 0.11                    | 12.1                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 10.03.2025      | 22                                     | 45                      | 5.6                                  | 13.6                                 | 0.12                    | 11.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 13.03.2025      | 19                                     | 41                      | 6.3                                  | 14.7                                 | 0.16                    | 12.8                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 17.03.2025      | 22                                     | 46                      | 6.1                                  | 15.5                                 | 0.14                    | 13.1                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 21.03.2025      | 23                                     | 49                      | 5.7                                  | 13.2                                 | 0.11                    | 11.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 24.03.2025      | 19                                     | 41                      | 5.2                                  | 14.7                                 | 0.16                    | 12.5                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 27.03.2025      | 18                                     | 38                      | 5.6                                  | 15.9                                 | 0.17                    | 13.1                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 01.04.2025      | 21                                     | 45                      | 5.4                                  | 13.6                                 | 0.16                    | 11.5                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 04.04.2025      | 23                                     | 47                      | 6.8                                  | 15.8                                 | 0.11                    | 12.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 07.04.2025      | 20                                     | 41                      | 5.7                                  | 12.7                                 | 0.17                    | 10.4                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 10.04.2025      | 21                                     | 43                      | 6.1                                  | 13.6                                 | 0.16                    | 11.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 14.04.2025      | 23                                     | 49                      | 5.9                                  | 12.9                                 | 0.13                    | 10.7                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 17.04.2025      | 19                                     | 40                      | 6.4                                  | 15.5                                 | 0.17                    | 13.1                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 22.04.2025      | 21                                     | 45                      | 5.2                                  | 14.6                                 | 0.12                    | 12.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 25.04.2025      | 18                                     | 38                      | 5.8                                  | 12.6                                 | 0.14                    | 10.5                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 05.05.2025      | 22                                     | 46                      | 6.6                                  | 13.9                                 | 0.11                    | 10.9                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 08.05.2025      | 19                                     | 40                      | 7.1                                  | 12.8                                 | 0.13                    | 11.2                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 12.05.2025      | 22                                     | 47                      | 6.7                                  | 14.4                                 | 0.15                    | 12.3                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 15.05.2025      | 18                                     | 37                      | 5.9                                  | 13.6                                 | 0.12                    | 12.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 19.05.2025      | 20                                     | 42                      | 6.3                                  | 14.1                                 | 0.17                    | 11.1                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 22.05.2025      | 22                                     | 48                      | 5.8                                  | 12.7                                 | 0.11                    | 10.5                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 26.05.2025      | 19                                     | 41                      | 6.4                                  | 13.3                                 | 0.16                    | 11.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 29.05.2025      | 23                                     | 47                      | 5.9                                  | 14.1                                 | 0.14                    | 12.4                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| <b>Minimum</b>  | <b>18</b>                              | <b>37</b>               | <b>5.1</b>                           | <b>12.6</b>                          | <b>0.11</b>             | <b>10.40</b>                        | -                                    | -                         | -                            | -                          | -                       | -                       |
| <b>Maximum</b>  | <b>23</b>                              | <b>49</b>               | <b>7.1</b>                           | <b>15.9</b>                          | <b>0.17</b>             | <b>13.10</b>                        | -                                    | -                         | -                            | -                          | -                       | -                       |
| <b>Average</b>  | <b>20.7</b>                            | <b>43.5</b>             | <b>6.0</b>                           | <b>14.0</b>                          | <b>0.14</b>             | <b>11.80</b>                        | -                                    | -                         | -                            | -                          | -                       | -                       |
| <b>98 %tile</b> | <b>23.0</b>                            | <b>49.0</b>             | <b>7.0</b>                           | <b>15.9</b>                          | <b>0.17</b>             | <b>13.10</b>                        | -                                    | -                         | -                            | -                          | -                       | -                       |

**Table 3.19: Ambient Air Quality at Bhoirymbong (AAQM 3)**

| Date            | PM <sub>2.5</sub><br>µg/m <sup>3</sup> | PM<br>µg/m <sup>3</sup> | SO <sub>2</sub><br>µg/m <sup>3</sup> | NO <sub>2</sub><br>µg/m <sup>3</sup> | CO<br>mg/m <sup>3</sup> | O <sub>3</sub><br>µg/m <sup>3</sup> | NH <sub>3</sub><br>µg/m <sup>3</sup> | Lead<br>µg/m <sup>3</sup> | Benzene<br>µg/m <sup>3</sup> | B[a]P<br>ng/m <sup>3</sup> | Ni<br>ng/m <sup>3</sup> | As<br>ng/m <sup>3</sup> |
|-----------------|----------------------------------------|-------------------------|--------------------------------------|--------------------------------------|-------------------------|-------------------------------------|--------------------------------------|---------------------------|------------------------------|----------------------------|-------------------------|-------------------------|
| 03.03.2025      | 19                                     | 41                      | 5.9                                  | 12.3                                 | BDL(<0.1)               | 10.1                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 06.03.2025      | 17                                     | 37                      | 5.8                                  | 12.9                                 | BDL(<0.1)               | 10.3                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 10.03.2025      | 22                                     | 46                      | 5.5                                  | 13.3                                 | BDL(<0.1)               | 11.1                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 13.03.2025      | 20                                     | 42                      | 5.6                                  | 11.8                                 | BDL(<0.1)               | 9.6                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 17.03.2025      | 23                                     | 48                      | 5.7                                  | 12.5                                 | BDL(<0.1)               | 10.2                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 21.03.2025      | 21                                     | 43                      | 5.1                                  | 13.3                                 | BDL(<0.1)               | 11.3                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 24.03.2025      | 19                                     | 40                      | 6.4                                  | 14.2                                 | BDL(<0.1)               | 12.5                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 27.03.2025      | 18                                     | 38                      | 5.8                                  | 13.5                                 | BDL(<0.1)               | 11.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 01.04.2025      | 22                                     | 46                      | 6.1                                  | 12.9                                 | BDL(<0.1)               | 10.5                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 04.04.2025      | 19                                     | 41                      | 5.9                                  | 13.6                                 | BDL(<0.1)               | 10.8                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 07.04.2025      | 23                                     | 47                      | 6.3                                  | 11.7                                 | BDL(<0.1)               | 9.5                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 10.04.2025      | 17                                     | 38                      | 6.7                                  | 12.9                                 | BDL(<0.1)               | 10.4                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 14.04.2025      | 21                                     | 43                      | 5.2                                  | 13.5                                 | BDL(<0.1)               | 11.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 17.04.2025      | 19                                     | 40                      | 5.4                                  | 13.1                                 | BDL(<0.1)               | 11.2                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 22.04.2025      | 18                                     | 38                      | 5.9                                  | 12.5                                 | BDL(<0.1)               | 10.8                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 25.04.2025      | 21                                     | 46                      | 6.1                                  | 11.7                                 | BDL(<0.1)               | 9.7                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 05.05.2025      | 19                                     | 40                      | 5.2                                  | 13.3                                 | BDL(<0.1)               | 11.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 08.05.2025      | 17                                     | 38                      | 5.9                                  | 12.9                                 | BDL(<0.1)               | 10.4                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 12.05.2025      | 20                                     | 41                      | 5.7                                  | 14.4                                 | BDL(<0.1)               | 12.2                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 15.05.2025      | 18                                     | 39                      | 6.4                                  | 11.9                                 | BDL(<0.1)               | 9.6                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 19.05.2025      | 21                                     | 44                      | 6.1                                  | 14.0                                 | BDL(<0.1)               | 11.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 22.05.2025      | 19                                     | 40                      | 5.1                                  | 12.3                                 | BDL(<0.1)               | 10.5                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 26.05.2025      | 22                                     | 47                      | 5.8                                  | 13.5                                 | BDL(<0.1)               | 11.8                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 29.05.2025      | 18                                     | 38                      | 5.4                                  | 12.2                                 | BDL(<0.1)               | 10.5                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| <b>Minimum</b>  | <b>17</b>                              | <b>37</b>               | <b>5.1</b>                           | <b>11.7</b>                          | -                       | <b>9.50</b>                         | -                                    | -                         | -                            | -                          | -                       | -                       |
| <b>Maximum</b>  | <b>23</b>                              | <b>48</b>               | <b>6.7</b>                           | <b>14.4</b>                          | -                       | <b>12.50</b>                        | -                                    | -                         | -                            | -                          | -                       | -                       |
| <b>Average</b>  | <b>19.7</b>                            | <b>41.7</b>             | <b>5.8</b>                           | <b>12.9</b>                          | -                       | <b>10.81</b>                        | -                                    | -                         | -                            | -                          | -                       | -                       |
| <b>98 %tile</b> | <b>23.0</b>                            | <b>47.5</b>             | <b>6.6</b>                           | <b>14.3</b>                          | -                       | <b>12.36</b>                        | -                                    | -                         | -                            | -                          | -                       | -                       |



**Table 3.20: Ambient Air Quality at Umktieh (AAQM 4)**

| Date            | PM <sub>2.5</sub><br>µg/m <sup>3</sup> | PM<br>µg/m <sup>3</sup> | SO <sub>2</sub><br>µg/m <sup>3</sup> | NO <sub>2</sub><br>µg/m <sup>3</sup> | CO<br>mg/m <sup>3</sup> | O <sub>3</sub><br>µg/m <sup>3</sup> | NH <sub>3</sub><br>µg/m <sup>3</sup> | Lead<br>µg/m <sup>3</sup> | Benzene<br>µg/m <sup>3</sup> | B[a]P<br>ng/m <sup>3</sup> | Ni<br>ng/m <sup>3</sup> | As<br>ng/m <sup>3</sup> |
|-----------------|----------------------------------------|-------------------------|--------------------------------------|--------------------------------------|-------------------------|-------------------------------------|--------------------------------------|---------------------------|------------------------------|----------------------------|-------------------------|-------------------------|
| 03.03.2025      | 16                                     | 34                      | 6.5                                  | 11.4                                 | BDL(<0.1)               | 9.5                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 06.03.2025      | 18                                     | 39                      | 7.4                                  | 10.8                                 | BDL(<0.1)               | 8.8                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 10.03.2025      | 16                                     | 35                      | 6.1                                  | 12.3                                 | BDL(<0.1)               | 10.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 13.03.2025      | 18                                     | 37                      | 7.3                                  | 11.4                                 | BDL(<0.1)               | 9.1                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 17.03.2025      | 19                                     | 40                      | 6.6                                  | 13.1                                 | BDL(<0.1)               | 11.3                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 21.03.2025      | 16                                     | 34                      | 7.7                                  | 10.7                                 | BDL(<0.1)               | 8.9                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 24.03.2025      | 18                                     | 39                      | 6.6                                  | 12.5                                 | BDL(<0.1)               | 10.2                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 27.03.2025      | 20                                     | 41                      | 7.4                                  | 11.4                                 | BDL(<0.1)               | 9.4                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 01.04.2025      | 17                                     | 35                      | 6.2                                  | 12.9                                 | BDL(<0.1)               | 10.3                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 04.04.2025      | 19                                     | 40                      | 6.4                                  | 11.3                                 | BDL(<0.1)               | 9.4                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 07.04.2025      | 18                                     | 38                      | 7.1                                  | 11.8                                 | BDL(<0.1)               | 8.8                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 10.04.2025      | 16                                     | 34                      | 5.5                                  | 10.6                                 | BDL(<0.1)               | 9.3                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 14.04.2025      | 19                                     | 39                      | 5.7                                  | 13.0                                 | BDL(<0.1)               | 11.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 17.04.2025      | 20                                     | 41                      | 7.3                                  | 12.4                                 | BDL(<0.1)               | 10.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 22.04.2025      | 17                                     | 38                      | 6.4                                  | 11.9                                 | BDL(<0.1)               | 9.5                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 25.04.2025      | 16                                     | 36                      | 5.7                                  | 12.5                                 | BDL(<0.1)               | 10.2                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 05.05.2025      | 19                                     | 40                      | 7.1                                  | 10.7                                 | BDL(<0.1)               | 8.8                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 08.05.2025      | 17                                     | 38                      | 6.6                                  | 11.6                                 | BDL(<0.1)               | 9.6                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 12.05.2025      | 20                                     | 40                      | 5.8                                  | 12.4                                 | BDL(<0.1)               | 10.5                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 15.05.2025      | 16                                     | 35                      | 5.1                                  | 10.9                                 | BDL(<0.1)               | 9.7                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 19.05.2025      | 19                                     | 39                      | 6.6                                  | 12.8                                 | BDL(<0.1)               | 8.6                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 22.05.2025      | 16                                     | 34                      | 6.1                                  | 11.1                                 | BDL(<0.1)               | 9.7                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 26.05.2025      | 20                                     | 41                      | 7.5                                  | 12.3                                 | BDL(<0.1)               | 10.5                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 29.05.2025      | 16                                     | 35                      | 5.1                                  | 10.9                                 | BDL(<0.1)               | 8.8                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| <b>Minimum</b>  | <b>16</b>                              | <b>34</b>               | <b>5.1</b>                           | <b>10.6</b>                          | <b>-</b>                | <b>8.60</b>                         | <b>-</b>                             | <b>-</b>                  | <b>-</b>                     | <b>-</b>                   | <b>-</b>                | <b>-</b>                |
| <b>Maximum</b>  | <b>20</b>                              | <b>41</b>               | <b>7.7</b>                           | <b>13.1</b>                          | <b>-</b>                | <b>11.60</b>                        | <b>-</b>                             | <b>-</b>                  | <b>-</b>                     | <b>-</b>                   | <b>-</b>                | <b>-</b>                |
| <b>Average</b>  | <b>17.8</b>                            | <b>37.6</b>             | <b>6.5</b>                           | <b>11.8</b>                          | <b>-</b>                | <b>9.74</b>                         | <b>-</b>                             | <b>-</b>                  | <b>-</b>                     | <b>-</b>                   | <b>-</b>                | <b>-</b>                |
| <b>98 %tile</b> | <b>20.0</b>                            | <b>41.0</b>             | <b>7.6</b>                           | <b>13.1</b>                          | <b>-</b>                | <b>11.46</b>                        | <b>-</b>                             | <b>-</b>                  | <b>-</b>                     | <b>-</b>                   | <b>-</b>                | <b>-</b>                |

**Table 3.21: Ambient Air Quality at Nanglakhit (AAQM 5)**

| Date            | PM <sub>2.5</sub><br>µg/m <sup>3</sup> | PM<br>µg/m <sup>3</sup> | SO <sub>2</sub><br>µg/m <sup>3</sup> | NO <sub>2</sub><br>µg/m <sup>3</sup> | CO<br>mg/m <sup>3</sup> | O <sub>3</sub><br>µg/m <sup>3</sup> | NH <sub>3</sub><br>µg/m <sup>3</sup> | Lead<br>µg/m <sup>3</sup> | Benzene<br>µg/m <sup>3</sup> | B[a]P<br>ng/m <sup>3</sup> | Ni<br>ng/m <sup>3</sup> | As<br>ng/m <sup>3</sup> |
|-----------------|----------------------------------------|-------------------------|--------------------------------------|--------------------------------------|-------------------------|-------------------------------------|--------------------------------------|---------------------------|------------------------------|----------------------------|-------------------------|-------------------------|
| 03.03.2025      | 19                                     | 41                      | 6.3                                  | 12.2                                 | BDL(<0.1)               | 10.3                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 06.03.2025      | 21                                     | 44                      | 5.8                                  | 11.6                                 | BDL(<0.1)               | 9.9                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 10.03.2025      | 19                                     | 39                      | 5.1                                  | 13.3                                 | BDL(<0.1)               | 11.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 13.03.2025      | 22                                     | 46                      | 5.9                                  | 12.7                                 | BDL(<0.1)               | 10.8                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 17.03.2025      | 19                                     | 40                      | 5.4                                  | 12.2                                 | BDL(<0.1)               | 10.1                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 21.03.2025      | 17                                     | 38                      | 5.1                                  | 11.9                                 | BDL(<0.1)               | 9.2                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 24.03.2025      | 22                                     | 46                      | 5.9                                  | 13.5                                 | BDL(<0.1)               | 11.3                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 27.03.2025      | 19                                     | 40                      | 6.1                                  | 14.0                                 | BDL(<0.1)               | 12                                  | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 01.04.2025      | 22                                     | 47                      | 5.8                                  | 12.6                                 | BDL(<0.1)               | 10.3                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 04.04.2025      | 19                                     | 39                      | 5.4                                  | 12.1                                 | BDL(<0.1)               | 9.9                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 07.04.2025      | 21                                     | 45                      | 5.6                                  | 13.9                                 | BDL(<0.1)               | 11.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 10.04.2025      | 18                                     | 37                      | 5.3                                  | 12.5                                 | BDL(<0.1)               | 10.2                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 14.04.2025      | 22                                     | 46                      | 6.4                                  | 14.2                                 | BDL(<0.1)               | 12.1                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 17.04.2025      | 19                                     | 40                      | 5.7                                  | 13.5                                 | BDL(<0.1)               | 11.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 22.04.2025      | 18                                     | 38                      | 5.9                                  | 12.8                                 | BDL(<0.1)               | 10.7                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 25.04.2025      | 21                                     | 44                      | 5.1                                  | 11.4                                 | BDL(<0.1)               | 9.6                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 05.05.2025      | 19                                     | 41                      | 5.3                                  | 10.9                                 | BDL(<0.1)               | 8.9                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 08.05.2025      | 18                                     | 39                      | 6.6                                  | 12.5                                 | BDL(<0.1)               | 10.5                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 12.05.2025      | 22                                     | 45                      | 6.1                                  | 11.3                                 | BDL(<0.1)               | 9.5                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 15.05.2025      | 18                                     | 38                      | 5.8                                  | 13.2                                 | BDL(<0.1)               | 11.6                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 19.05.2025      | 20                                     | 42                      | 6.1                                  | 12.8                                 | BDL(<0.1)               | 9.4                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 22.05.2025      | 22                                     | 46                      | 5.7                                  | 11.6                                 | BDL(<0.1)               | 10.3                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 26.05.2025      | 18                                     | 38                      | 5.1                                  | 12.1                                 | BDL(<0.1)               | 9.7                                 | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| 29.05.2025      | 21                                     | 43                      | 5.5                                  | 13.0                                 | BDL(<0.1)               | 10.8                                | BDL(<5)                              | BDL(<0.1)                 | BDL(<0.1)                    | BDL(<0.1)                  | BDL(<1)                 | BDL(<1)                 |
| <b>Minimum</b>  | <b>17</b>                              | <b>37</b>               | <b>5.1</b>                           | <b>10.9</b>                          | -                       | <b>8.90</b>                         | -                                    | -                         | -                            | -                          | -                       | -                       |
| <b>Maximum</b>  | <b>22</b>                              | <b>47</b>               | <b>6.6</b>                           | <b>14.2</b>                          | -                       | <b>12.1</b>                         | -                                    | -                         | -                            | -                          | -                       | -                       |
| <b>Average</b>  | <b>19.8</b>                            | <b>41.8</b>             | <b>5.7</b>                           | <b>12.6</b>                          | -                       | <b>10.5</b>                         | -                                    | -                         | -                            | -                          | -                       | -                       |
| <b>98 %tile</b> | <b>22.0</b>                            | <b>46.5</b>             | <b>6.5</b>                           | <b>14.1</b>                          | -                       | <b>12.1</b>                         | -                                    | -                         | -                            | -                          | -                       | -                       |

**Table 3.22: Ambient Air Quality at Umed Umroi (AAQM 6)**

| Date            | PM <sub>2.5</sub> | PM                | SO <sub>2</sub>   | NO <sub>2</sub>   | CO                | O <sub>3</sub>    | NH <sub>3</sub>   | Lead              | Benzen<br>e       | B[a]P             | Ni                | As                |
|-----------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|                 | µg/m <sup>3</sup> | µg/m <sup>3</sup> | µg/m <sup>3</sup> | µg/m <sup>3</sup> | mg/m <sup>3</sup> | µg/m <sup>3</sup> | µg/m <sup>3</sup> | µg/m <sup>3</sup> | µg/m <sup>3</sup> | ng/m <sup>3</sup> | ng/m <sup>3</sup> | ng/m <sup>3</sup> |
| 03.03.2025      | 18                | 37                | 6.2               | 10.5              | BDL(<0.1)         | 9.4               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 06.03.2025      | 21                | 43                | 5.7               | 12.6              | BDL(<0.1)         | 10.6              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 10.03.2025      | 19                | 40                | 6.6               | 11.7              | BDL(<0.1)         | 9.1               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 13.03.2025      | 22                | 46                | 6.2               | 12.3              | BDL(<0.1)         | 10.3              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 17.03.2025      | 17                | 38                | 5.3               | 10.9              | BDL(<0.1)         | 9.4               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 21.03.2025      | 21                | 43                | 6.2               | 12.4              | BDL(<0.1)         | 11.1              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 24.03.2025      | 18                | 40                | 5.8               | 11.6              | BDL(<0.1)         | 10.1              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 27.03.2025      | 22                | 46                | 5.4               | 13.0              | BDL(<0.1)         | 11.6              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 01.04.2025      | 16                | 37                | 6.5               | 12.5              | BDL(<0.1)         | 11.2              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 04.04.2025      | 20                | 42                | 7.3               | 11.4              | BDL(<0.1)         | 10.1              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 07.04.2025      | 17                | 38                | 5.3               | 10.8              | BDL(<0.1)         | 9.6               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 10.04.2025      | 20                | 42                | 5.1               | 10.4              | BDL(<0.1)         | 8.9               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 14.04.2025      | 17                | 36                | 6.5               | 11.6              | BDL(<0.1)         | 9.5               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 17.04.2025      | 19                | 41                | 7.3               | 12.8              | BDL(<0.1)         | 11.1              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 22.04.2025      | 21                | 45                | 6.4               | 13.3              | BDL(<0.1)         | 11.6              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 25.04.2025      | 16                | 37                | 6.7               | 10.7              | BDL(<0.1)         | 8.6               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 05.05.2025      | 19                | 42                | 5.2               | 12.6              | BDL(<0.1)         | 11.2              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 08.05.2025      | 21                | 44                | 6.6               | 12.1              | BDL(<0.1)         | 10.9              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 12.05.2025      | 17                | 36                | 7.5               | 13.1              | BDL(<0.1)         | 11.3              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 15.05.2025      | 23                | 49                | 6.7               | 12.5              | BDL(<0.1)         | 10.8              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 19.05.2025      | 21                | 43                | 6.3               | 11.4              | BDL(<0.1)         | 9.4               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 22.05.2025      | 18                | 38                | 5.1               | 10.9              | BDL(<0.1)         | 8.4               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 26.05.2025      | 20                | 41                | 6.2               | 11.7              | BDL(<0.1)         | 9.3               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 29.05.2025      | 17                | 38                | 5.5               | 10.1              | BDL(<0.1)         | 8.8               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| <b>Minimum</b>  | <b>16</b>         | <b>36</b>         | <b>5.1</b>        | <b>10.1</b>       | -                 | <b>8.40</b>       | -                 | -                 | -                 | -                 | -                 | -                 |
| <b>Maximum</b>  | <b>23</b>         | <b>49</b>         | <b>7.5</b>        | <b>13.3</b>       | -                 | <b>11.60</b>      | -                 | -                 | -                 | -                 | -                 | -                 |
| <b>Average</b>  | <b>19.2</b>       | <b>40.9</b>       | <b>6.2</b>        | <b>11.8</b>       | -                 | <b>10.10</b>      | -                 | -                 | -                 | -                 | -                 | -                 |
| <b>98 %tile</b> | <b>22.5</b>       | <b>47.6</b>       | <b>7.4</b>        | <b>13.2</b>       | -                 | <b>11.60</b>      | -                 | -                 | -                 | -                 | -                 | -                 |

**Table 3.23: Ambient Air Quality at Umeit (AAQM 7)**

| Date            | PM <sub>2.5</sub> | PM                | SO <sub>2</sub>   | NO <sub>2</sub>   | CO                | O <sub>3</sub>    | NH <sub>3</sub>   | Lead              | Benzen<br>e       | B[a]P             | Ni                | As                |
|-----------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|                 | µg/m <sup>3</sup> | µg/m <sup>3</sup> | µg/m <sup>3</sup> | µg/m <sup>3</sup> | mg/m <sup>3</sup> | µg/m <sup>3</sup> | µg/m <sup>3</sup> | µg/m <sup>3</sup> | µg/m <sup>3</sup> | ng/m <sup>3</sup> | ng/m <sup>3</sup> | ng/m <sup>3</sup> |
| 03.03.2025      | 16                | 35                | 5.3               | 9.9               | BDL(<0.1)         | 8.5               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 06.03.2025      | 19                | 39                | 6.1               | 10.4              | BDL(<0.1)         | 9.1               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 10.03.2025      | 18                | 37                | 5.8               | 11.5              | BDL(<0.1)         | 10.3              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 13.03.2025      | 20                | 41                | 6.7               | 11.1              | BDL(<0.1)         | 9.4               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 17.03.2025      | 21                | 43                | 5.1               | 12.6              | BDL(<0.1)         | 10.6              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 21.03.2025      | 18                | 40                | 6.5               | 13.1              | BDL(<0.1)         | 11.3              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 24.03.2025      | 17                | 38                | 5.3               | 10.5              | BDL(<0.1)         | 9.8               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 27.03.2025      | 21                | 42                | 5.9               | 10.9              | BDL(<0.1)         | 8.9               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 01.04.2025      | 17                | 36                | 6.7               | 11.4              | BDL(<0.1)         | 9.7               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 04.04.2025      | 19                | 39                | 5.6               | 9.9               | BDL(<0.1)         | 8.1               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 07.04.2025      | 21                | 44                | 5.2               | 10.5              | BDL(<0.1)         | 9.4               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 10.04.2025      | 18                | 40                | 5.3               | 10.1              | BDL(<0.1)         | 9.9               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 14.04.2025      | 16                | 37                | 5.1               | 11.7              | BDL(<0.1)         | 10.2              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 17.04.2025      | 18                | 36                | 6.5               | 12.2              | BDL(<0.1)         | 11.3              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 22.04.2025      | 19                | 39                | 6.2               | 12.8              | BDL(<0.1)         | 11.7              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 25.04.2025      | 21                | 42                | 5.3               | 11.1              | BDL(<0.1)         | 9.6               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 05.05.2025      | 19                | 40                | 4.9               | 12.3              | BDL(<0.1)         | 10.5              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 08.05.2025      | 16                | 37                | 5.2               | 10.9              | BDL(<0.1)         | 9.1               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 12.05.2025      | 21                | 44                | 5.7               | 10.2              | BDL(<0.1)         | 8.6               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 15.05.2025      | 17                | 35                | 5.1               | 9.6               | BDL(<0.1)         | 8.2               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 19.05.2025      | 20                | 41                | 6.8               | 11.2              | BDL(<0.1)         | 10.6              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 22.05.2025      | 18                | 36                | 5.7               | 10.4              | BDL(<0.1)         | 9.4               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 26.05.2025      | 21                | 44                | 6.2               | 12.6              | BDL(<0.1)         | 10.2              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 29.05.2025      | 18                | 38                | 5.1               | 11.2              | BDL(<0.1)         | 9.6               | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| <b>Minimum</b>  | <b>16</b>         | <b>35</b>         | <b>4.9</b>        | <b>9.6</b>        | -                 | <b>8.10</b>       | -                 | -                 | -                 | -                 | -                 | -                 |
| <b>Maximum</b>  | <b>21</b>         | <b>44</b>         | <b>6.8</b>        | <b>13.1</b>       | -                 | <b>11.70</b>      | -                 | -                 | -                 | -                 | -                 | -                 |
| <b>Average</b>  | <b>18.7</b>       | <b>39.3</b>       | <b>5.7</b>        | <b>11.2</b>       | -                 | <b>9.75</b>       | -                 | -                 | -                 | -                 | -                 | -                 |
| <b>98 %tile</b> | <b>21.0</b>       | <b>44.0</b>       | <b>6.8</b>        | <b>13.0</b>       | -                 | <b>11.52</b>      | -                 | -                 | -                 | -                 | -                 | -                 |

**Table 3.24: Ambient Air Quality at Habitation (AAQM 8)**

| Date            | PM <sub>2.5</sub> | PM                | SO <sub>2</sub>   | NO <sub>2</sub>   | CO                | O <sub>3</sub>    | NH <sub>3</sub>   | Lead              | Benzen<br>e       | B[a]P             | Ni                | As                |
|-----------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|                 | µg/m <sup>3</sup> | µg/m <sup>3</sup> | µg/m <sup>3</sup> | µg/m <sup>3</sup> | mg/m <sup>3</sup> | µg/m <sup>3</sup> | µg/m <sup>3</sup> | µg/m <sup>3</sup> | µg/m <sup>3</sup> | ng/m <sup>3</sup> | ng/m <sup>3</sup> | ng/m <sup>3</sup> |
| 03.03.2025      | 23                | 48                | 5.9               | 15.6              | 0.16              | 13.1              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 06.03.2025      | 21                | 43                | 6.1               | 13.9              | 0.13              | 12.2              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 10.03.2025      | 24                | 51                | 5.5               | 14.4              | 0.12              | 12.6              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 13.03.2025      | 21                | 44                | 5.2               | 12.9              | 0.17              | 11.2              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 17.03.2025      | 20                | 43                | 6.8               | 13.9              | 0.21              | 11.8              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 21.03.2025      | 19                | 39                | 7.1               | 15.8              | 0.14              | 12.9              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 24.03.2025      | 22                | 46                | 6.9               | 16.1              | 0.16              | 13.6              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 27.03.2025      | 20                | 40                | 7.4               | 14.4              | 0.11              | 12.7              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 01.04.2025      | 21                | 43                | 6.2               | 13.5              | 0.16              | 11.8              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 04.04.2025      | 19                | 38                | 5.9               | 14.7              | 0.19              | 12.5              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 07.04.2025      | 23                | 49                | 6.3               | 15.2              | 0.14              | 13.1              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 10.04.2025      | 22                | 48                | 6.8               | 14.6              | 0.13              | 12.6              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 14.04.2025      | 21                | 46                | 7.1               | 16.2              | 0.17              | 14.7              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 17.04.2025      | 19                | 39                | 6.9               | 14.7              | 0.13              | 12.6              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 22.04.2025      | 20                | 42                | 7.5               | 15.5              | 0.15              | 13.5              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 25.04.2025      | 23                | 47                | 7.1               | 13.9              | 0.18              | 11.5              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 05.05.2025      | 19                | 40                | 6.6               | 14.8              | 0.16              | 12.8              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 08.05.2025      | 22                | 46                | 6.1               | 16.3              | 0.14              | 14.2              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 12.05.2025      | 21                | 42                | 7.8               | 13.7              | 0.15              | 11.6              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 15.05.2025      | 19                | 39                | 6.3               | 14.3              | 0.19              | 12.2              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 19.05.2025      | 22                | 45                | 5.9               | 15.3              | 0.11              | 13.4              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 22.05.2025      | 24                | 48                | 7.4               | 13.7              | 0.18              | 11.8              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 26.05.2025      | 21                | 45                | 6.8               | 15.2              | 0.13              | 12.7              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| 29.05.2025      | 20                | 42                | 7.4               | 14.4              | 0.15              | 12.1              | BDL(<5)           | BDL(<0.1)         | BDL(<0.1)         | BDL(<0.1)         | BDL(<1)           | BDL(<1)           |
| <b>Minimum</b>  | <b>19</b>         | <b>38</b>         | <b>5.2</b>        | <b>12.9</b>       | <b>0.11</b>       | <b>11.2</b>       | -                 | -                 | -                 | -                 | -                 | -                 |
| <b>Maximum</b>  | <b>24</b>         | <b>51</b>         | <b>7.8</b>        | <b>16.3</b>       | <b>0.21</b>       | <b>14.7</b>       | -                 | -                 | -                 | -                 | -                 | -                 |
| <b>Average</b>  | <b>21.1</b>       | <b>43.9</b>       | <b>6.6</b>        | <b>14.7</b>       | <b>0.15</b>       | <b>12.6</b>       | -                 | -                 | -                 | -                 | -                 | -                 |
| <b>98 %tile</b> | <b>24.0</b>       | <b>50.1</b>       | <b>7.7</b>        | <b>16.3</b>       | <b>0.20</b>       | <b>14.5</b>       | -                 | -                 | -                 | -                 | -                 | -                 |

**Table 3.25: Summary of Ambient Air Quality for The Study Area**

| Sl. No. | Sampling Locations |          | PM <sub>2.5</sub><br>µg/m <sup>3</sup> | PM<br>µg/m <sup>3</sup> | SO <sub>2</sub><br>µg/m <sup>3</sup> | NO <sub>2</sub><br>µg/m <sup>3</sup> | CO<br>mg/m <sup>3</sup> | O <sub>3</sub><br>µg/m <sup>3</sup> | NH <sub>3</sub><br>µg/m <sup>3</sup> | Lead<br>µg/m <sup>3</sup> | Benzene<br>µg/m <sup>3</sup> | B[a]P<br>ng/m <sup>3</sup> | Ni<br>ng/m <sup>3</sup> | As<br>ng/m <sup>3</sup> |
|---------|--------------------|----------|----------------------------------------|-------------------------|--------------------------------------|--------------------------------------|-------------------------|-------------------------------------|--------------------------------------|---------------------------|------------------------------|----------------------------|-------------------------|-------------------------|
| 1.      | Project Airpor     | Minimum  | 19                                     | 41                      | 5.3                                  | 13.1                                 | 0.11                    | 10.6                                | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | Maximum  | 26                                     | 55                      | 7.8                                  | 16.9                                 | 0.18                    | 14.2                                | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | Average  | 23                                     | 48                      | 6.6                                  | 15.1                                 | 0.15                    | 12.5                                | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | 98 %tile | 26                                     | 54                      | 7.8                                  | 16.9                                 | 0.18                    | 14.2                                | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
| 2.      | Norgarh Umroi      | Minimum  | 18                                     | 37                      | 5.1                                  | 12.6                                 | 0.11                    | 10.40                               | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | Maximum  | 23                                     | 49                      | 7.1                                  | 15.9                                 | 0.17                    | 13.10                               | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | Average  | 20.7                                   | 43.5                    | 6.0                                  | 14.0                                 | 0.14                    | 11.80                               | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | 98 %tile | 23.0                                   | 49.0                    | 7.0                                  | 15.9                                 | 0.17                    | 13.10                               | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
| 3.      | Bhoriymbong        | Minimum  | 17                                     | 37                      | 5.1                                  | 11.7                                 | BDL(<5)                 | 9.50                                | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | Maximum  | 23                                     | 48                      | 6.7                                  | 14.4                                 | BDL(<5)                 | 12.50                               | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | Average  | 19.7                                   | 41.7                    | 5.8                                  | 12.9                                 | BDL(<5)                 | 10.81                               | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | 98 %tile | 23.0                                   | 47.5                    | 6.6                                  | 14.3                                 | BDL(<5)                 | 12.36                               | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
| 4.      | Umktieh            | Minimum  | 16                                     | 34                      | 5.1                                  | 10.6                                 | BDL(<5)                 | 8.60                                | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | Maximum  | 20                                     | 41                      | 7.7                                  | 13.1                                 | BDL(<5)                 | 11.60                               | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | Average  | 17.8                                   | 37.6                    | 6.5                                  | 11.8                                 | BDL(<5)                 | 9.74                                | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | 98 %tile | 20.0                                   | 41.0                    | 7.6                                  | 13.1                                 | BDL(<5)                 | 11.46                               | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
| 5.      | Nanglakhit         | Minimum  | 17                                     | 37                      | 5.1                                  | 10.9                                 | BDL(<5)                 | 8.90                                | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | Maximum  | 22                                     | 47                      | 6.6                                  | 14.2                                 | BDL(<5)                 | 12.1                                | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | Average  | 19.8                                   | 41.8                    | 5.7                                  | 12.6                                 | BDL(<5)                 | 10.5                                | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | 98 %tile | 22.0                                   | 46.5                    | 6.5                                  | 14.1                                 | BDL(<5)                 | 12.1                                | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
| 6.      | Umed Umroi         | Minimum  | 16                                     | 36                      | 5.1                                  | 10.1                                 | BDL(<5)                 | 8.40                                | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | Maximum  | 23                                     | 49                      | 7.5                                  | 13.3                                 | BDL(<5)                 | 11.60                               | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | Average  | 19.2                                   | 40.9                    | 6.2                                  | 11.8                                 | BDL(<5)                 | 10.10                               | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | 98 %tile | 22.5                                   | 47.6                    | 7.4                                  | 13.2                                 | BDL(<5)                 | 11.60                               | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
| 7.      | Umeit              | Minimum  | 16                                     | 35                      | 4.9                                  | 9.6                                  | BDL(<5)                 | 8.10                                | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | Maximum  | 21                                     | 44                      | 6.8                                  | 13.1                                 | BDL(<5)                 | 11.70                               | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | Average  | 18.7                                   | 39.3                    | 5.7                                  | 11.2                                 | BDL(<5)                 | 9.75                                | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | 98 %tile | 21.0                                   | 44.0                    | 6.8                                  | 13.0                                 | BDL(<5)                 | 11.52                               | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
| 8.      | Habitation         | Minimum  | 19                                     | 38                      | 5.2                                  | 12.9                                 | 0.11                    | 11.2                                | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | Maximum  | 24                                     | 51                      | 7.8                                  | 16.3                                 | 0.21                    | 14.7                                | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | Average  | 21.1                                   | 43.9                    | 6.6                                  | 14.7                                 | 0.15                    | 12.6                                | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |
|         |                    | 98 %tile | 24.0                                   | 50.1                    | 7.7                                  | 16.3                                 | 0.20                    | 14.5                                | BDL(<5)                              | BDL(<5)                   | BDL(<5)                      | BDL(<5)                    | BDL(<5)                 | BDL(<5)                 |

| Sl. No. | Sampling Locations |          | PM <sub>2.5</sub> | PM                | SO <sub>2</sub>   | NO <sub>2</sub>   | CO                | O <sub>3</sub>    | NH <sub>3</sub>   | Lead              | Benzene           | B[a]P             | Ni                | As                |
|---------|--------------------|----------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
|         |                    |          | µg/m <sup>3</sup> | µg/m <sup>3</sup> | µg/m <sup>3</sup> | µg/m <sup>3</sup> | mg/m <sup>3</sup> | µg/m <sup>3</sup> | µg/m <sup>3</sup> | µg/m <sup>3</sup> | µg/m <sup>3</sup> | ng/m <sup>3</sup> | ng/m <sup>3</sup> | ng/m <sup>3</sup> |
|         | Total Study Area   | Minimum  | 16                | 34                | 4.9               | 9.6               | 0.1               | 8.1               | BDL(<5)           | BDL(<5)           | BDL(<5)           | BDL(<5)           | BDL(<5)           | BDL(<5)           |
|         |                    | Maximum  | 26                | 55                | 7.8               | 16.9              | 0.2               | 14.7              | BDL(<5)           | BDL(<5)           | BDL(<5)           | BDL(<5)           | BDL(<5)           | BDL(<5)           |
|         |                    | Average  | 20                | 42                | 6.1               | 13.0              | 0.1               | 11.0              | BDL(<5)           | BDL(<5)           | BDL(<5)           | BDL(<5)           | BDL(<5)           | BDL(<5)           |
|         |                    | 98 %tile | 25                | 52                | 7.5               | 16.4              | 0.2               | 13.9              | BDL(<5)           | BDL(<5)           | BDL(<5)           | BDL(<5)           | BDL(<5)           | BDL(<5)           |

### 3.10 Ambient Noise Levels

#### 3.10.1 Introduction

Noise can be defined as an unwanted sound. It interferes with speech and hearing and is intense enough to damage hearing or is otherwise annoying. The definition of noise as unwanted sound implies that it has an adverse effect on human beings and their environment. Noise can also disturb wildlife and ecological system.

#### 3.10.2 Methodology

To understand the noise environment in the study area, noise survey was conducted using Sound Level Meter 2031 manufactured by Cygnet Systems. Noise measurements were carried out at the same location where ambient air quality was monitored. The 24-hourly sound levels were measured at each location once during the study period.

#### 3.10.3 Equivalent Sound Energy Level or Leq

In most of the acoustic environments, the sound pressure level fluctuates with time due to changes in noise generation sources. The fluctuating noise levels are reported as equivalent sound energy level or Leq. It is defined as the steady sound pressure levels which would have given the same total energy as the actual time varying sound pressure level over the given time period.

By recorded noise levels, Leq was computed using the following statistical relationship:

$$Leq = L_{50} + [(L_{10} - L_{90})^2 / 60]$$

Where  $L_{90}$  = the noise levels exceed 90 percent of the time

$L_{50}$  = the noise levels exceed 50 percent of the time

$L_{10}$  = the noise levels exceed 10 percent of the time

It may be noted here that  $L_{10}$ ,  $L_{50}$  and  $L_{90}$  values can be considered as peak, average and background sound pressure levels at each of the locations, respectively.

The details noise levels monitoring locations in the study area are given in **Table 3.26** and **Figure 3.16**.

**Table 3.26: Noise Levels Monitoring Stations in the Study Area**

| Sr No. | Locations                           | Distance | Direction | Latitude      | Longitude     |
|--------|-------------------------------------|----------|-----------|---------------|---------------|
| 1.     | Project Site                        | --       | --        | 25°42'21.05"N | 91°58'30.94"E |
| 2.     | Norgarh Umroi (Presbyterian Church) | 1.85 km  | N         | 25°43'20.98"N | 91°58'36.86"E |
| 3.     | Bhoriymbong                         | 4.65 km  | ENE       | 25°42'33.29"N | 92° 1'17.93"E |



| Sr No. | Locations  | Distance | Direction | Latitude      | Longitude     |
|--------|------------|----------|-----------|---------------|---------------|
| 4.     | Umktieh    | 1.95 km  | E         | 25°42'13.57"N | 91°59'39.39"E |
| 5.     | Habitation | 3.5 km   | S         | 25°41'45.08"N | 92° 0'26.77"E |
| 6.     | Umed Umroi | 2.15 km  | SW        | 25°41'12.65"N | 91°58'14.59"E |
| 7.     | Umeit      | 3.65 km  | W         | 25°42'13.70"N | 91°56'20.42"E |
| 8.     | Habitation | 4.15 km  | N         | 25°42'39.96"N | 91°56'4.15"E  |

### 3.10.4 Day and Night Time Leq Noise levels

Day and night time Leq for ambient noise levels for the study area are given in **Table 3.27** and shown in **Figure 3.1**. Tabulated results indicate that measured Leq noise levels are within the limit stipulated for commercial and residential areas at all the locations.

**Table 3.27: Day and Night time Leq for Ambient Noise Levels**

| Location Code | Monitoring Locations | Landuse     | Lday [dB(A)] | Lnight [dB(A)] | Leq [dB(A)] | Prescribed Standards dB(A) |            |
|---------------|----------------------|-------------|--------------|----------------|-------------|----------------------------|------------|
|               |                      |             |              |                |             | Day Time                   | Night Time |
| N1            | Project Site         | Commercial  | 61.1         | 53.8           | 59.7        | 65                         | 55         |
| N2            | Norgarh Umroi        | Residential | 52.9         | 41.1           | 51.3        | 55                         | 45         |
| N3            | Bhoriymbong          | Residential | 49.7         | 43.5           | 48.4        | 55                         | 45         |
| N4            | Umktieh              | Residential | 45.1         | 39.1           | 43.9        | 55                         | 45         |
| N5            | Habitation           | Residential | 48.2         | 40.8           | 46.8        | 55                         | 45         |
| N6            | Umed Umroi           | Residential | 51.9         | 39.6           | 50.3        | 55                         | 45         |
| N7            | Umeit                | Residential | 48.6         | 42.8           | 47.4        | 55                         | 45         |
| N8            | Habitation           | Residential | 50.8         | 40.3           | 49.2        | 55                         | 45         |

### 3.11 Natural Hazards and Disaster Risk

The project site is located in seismic zone V and has most earthquake-prone zone, classified as having the highest severity and intensity of seismic activity. The study area lies in the most active and highest risk zone as shown in **Figure 3.11**.

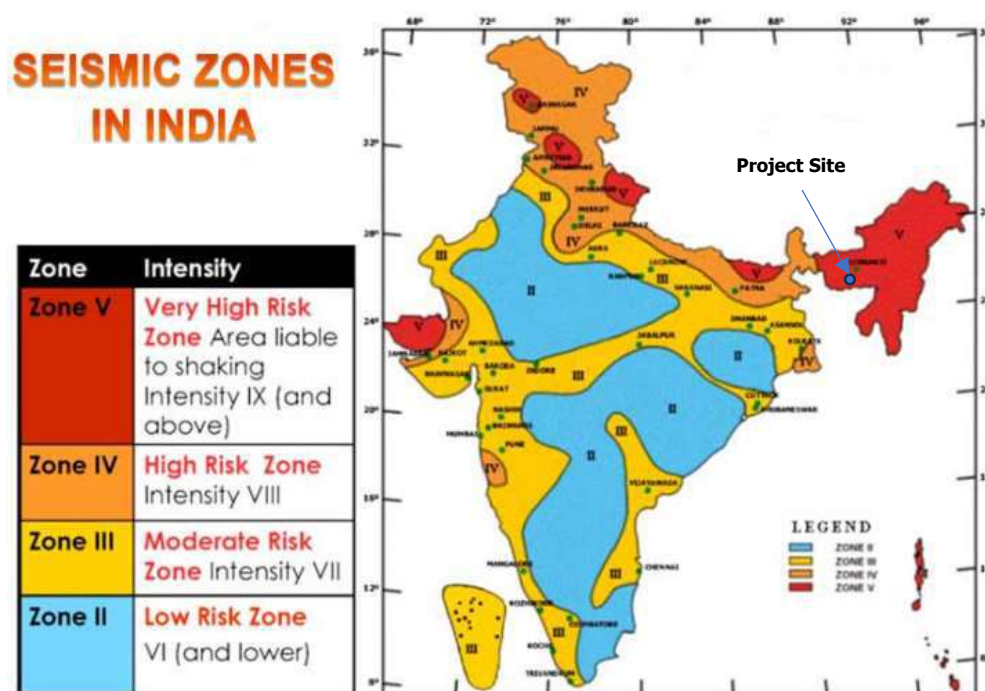


Figure 3.11: Seismic Zone of the Project Site

### 3.12 Landuse & Land Cover through Satellite Imagery Interpretation

Landuse and land cover for the 10 km study area have been prepared using False Colour Composite (FCC) scene of IRS P-4 LISS-III. The percentage area of different categories of land use/ land covers within the 10 km radius study area is as given in **Table 3.28**. The study area dominated by Dense Jungle/Fairly Dense Jungle (Forest) (83.46%) followed by Agriculture land (8.62 %), built-up area (6.21 %), river and other waterbody (1.68 %) and reserved forest (0.4 %).

Table 3.28: Landuse and Land Cover for 10 km Study Area

| Sn. | Category of Landuse                       | Area sqkm | %age  |
|-----|-------------------------------------------|-----------|-------|
| 1.  | Built-up Land                             | 25.31     | 6.21  |
| 2.  | Agriculture land                          | 34.95     | 8.62  |
| 3.  | Dense Jungle/Fairly Dense Jungle (Forest) | 338.18    | 83.46 |
| 5.  | Protected Forest                          | 0.15      | 0.4   |
| 6.  | River and Other water Bodies              | 6.8       | 1.68  |

Barapani (Shillong) Airport has an area of 416.16 Acres. 22 Acres of additional land (16 acres for Runway Extension by 571m and another 6 Acres of land for Relocation of Isolation Bay) would be handover by Meghalaya State Government for the proposed expansion. No forest land is involved in the project.

FCC and Landuse and land cover of the study area through satellite imagery is shown in **Figures 3.12** and **3.13**, respectively.

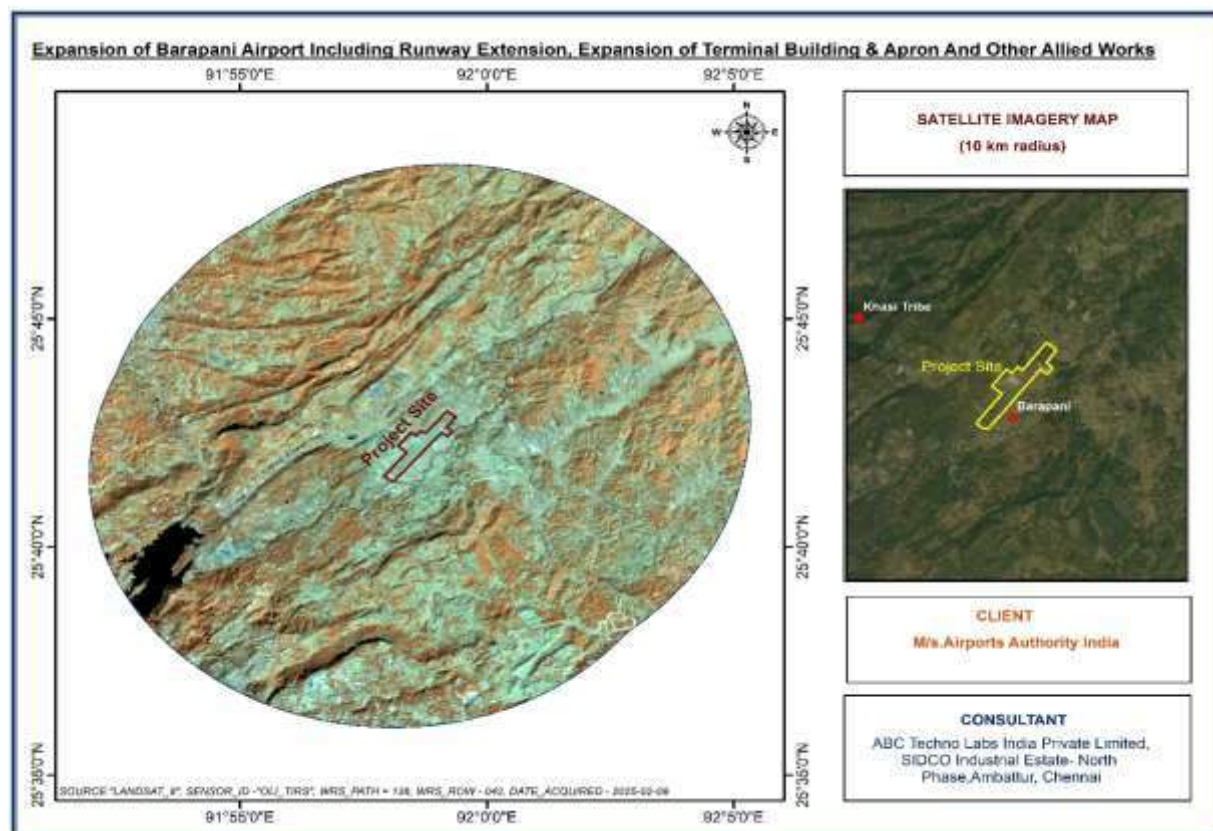


Figure 3.12: FCC for the Study Area

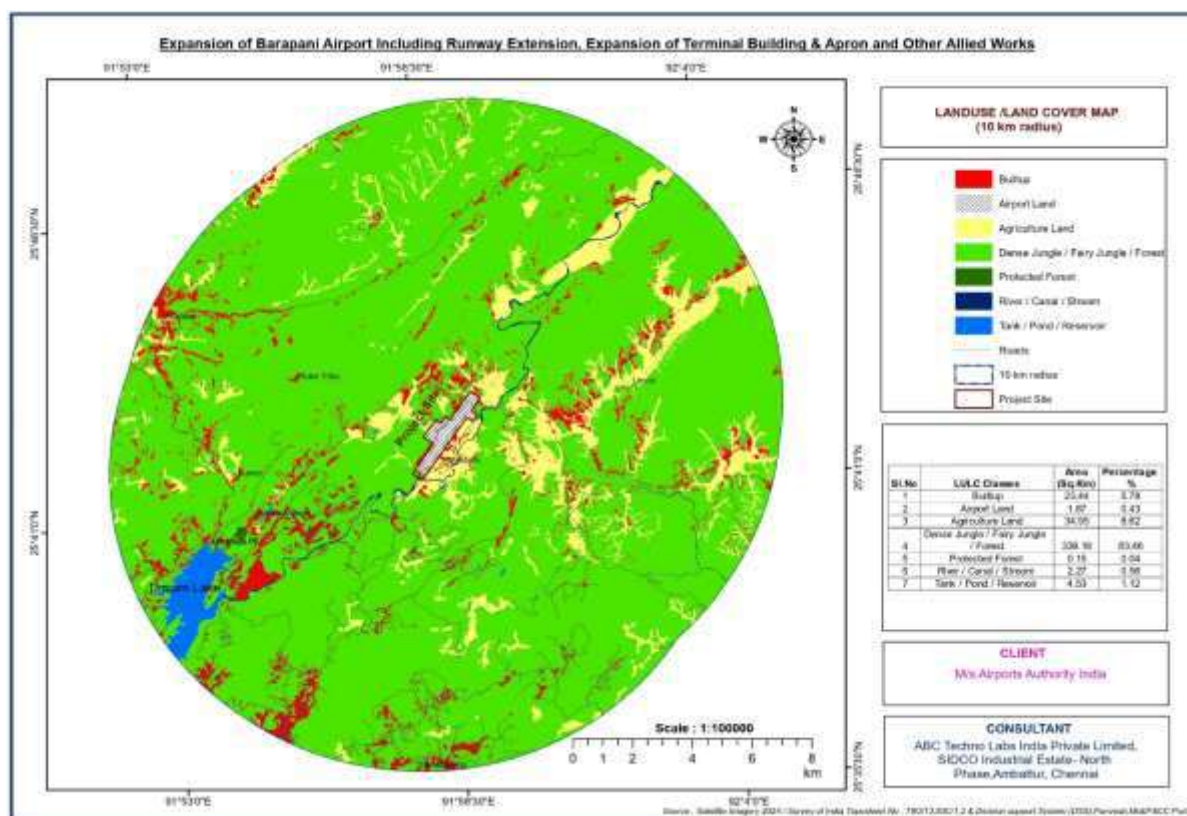


Figure 3.13: Landuse & Land Cover of Study Area Through Satellite Imagery

### **3.13 Biological Environment**

#### **3.13.1 Introduction**

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. Generally, biological communities are good indicators of climatic and edaphic factors because of their strong relationships with them. 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.

The proposed project "Expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion of Terminal Building & Apron and Other Allied Works", belonging to 'Airports Authority of India' (AAI). Barapani (Shillong) Airport may have direct or indirect adverse or beneficial impacts on the ecology and biodiversity of the area. As a part of EIA study, baseline data for ecology and biodiversity have been collected through field studies and from secondary sources.

#### **3.13.2 Objectives of Ecological Studies**

The objectives of ecological study during the study period of EIA study are outlined as follows:

- To characterize the environmental components like land, water, flora and fauna;
- To understand their present status;
- To understand carrying capacity of the ecosystem;
- To assess present biodiversity; and
- To identify susceptible and sensitive areas.

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

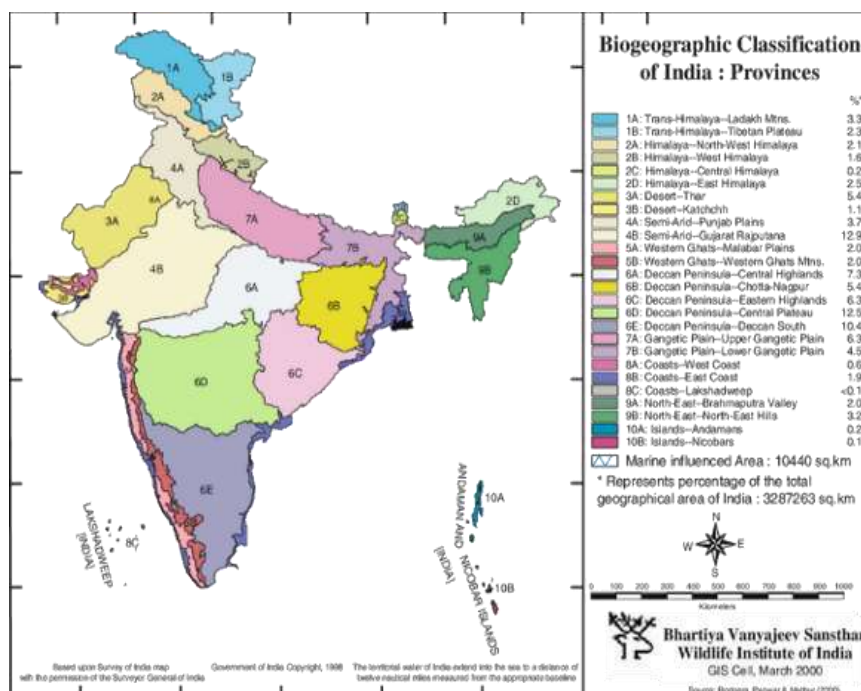
- To establish the present status of ecological conditions surrounding the project location;
- To study the existing anthropogenic stresses on the prevailing ecosystem.
- To identify and predict the likely impacts on the local ecosystem from the proposed activities;
- To list out floral species, terrestrial vertebrate and aquatic flora and fauna present within the study area, and significance status under The Wildlife (Protection) Amendment Act, 2022;
- To define ecological/conservation status of each species as per IUCN categories (Red Data List).
- To formulate migratory 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 environmentally sensitive areas within the study area;
- Assessment of migratory route of wildlife (if any);

### 3.13.3 Biogeographic zone, province and Forest type

The study area falls under **9B- North East Hills.** category as far as the Indian biogeographical zones (Rodger, Panwar, Mathur 2000) are concerned. The study area has primary forest area and agricultural land as the main land use feature of the study area. Umium lake is situated within study area towards South Western side. Bio-geographic Provinces of India are shown in **Figure 3.14.**



Source: WII

**Figure 3.14: Map showing the Bio-geographic Provinces of India**

The region has been Physiographically influenced by the course of the Umium River and streams. The study area situated in East Khasi hills districts comprises of:

- Agricultural land,
- Forest land

#### 3.13.3.1 Regional Biodiversity

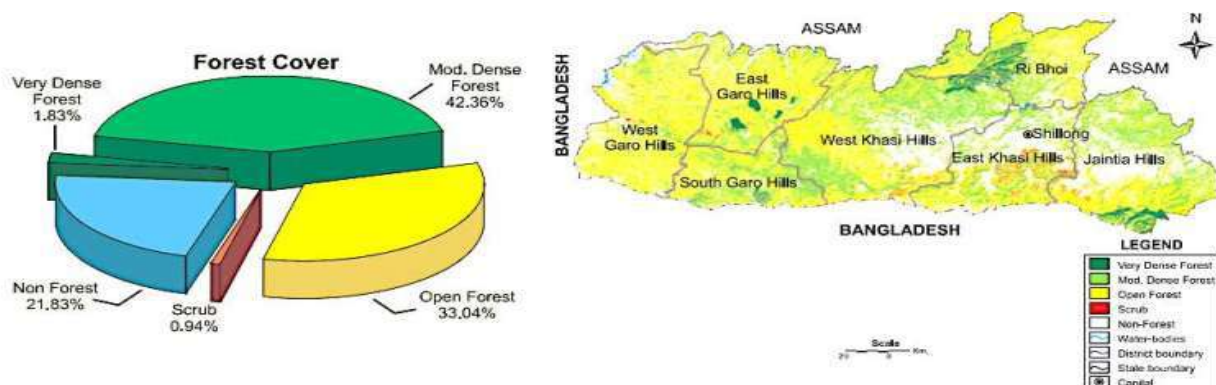
The East Khasi Hill district falls within the Indo-Burma Biodiversity Hotspot Region as delineated by the International Union for Conservation of Nature & Natural Resources (IUCN) and the area as whole has been accorded international status in terms of conservation of biodiversity. It has the richest reservoir of plant diversity in India and is one of the "biodiversity hotspot" of the world supporting about 50% of India's biodiversity. All type vegetation like grassland, meadows, marshes,



swamps, scrub forest, temperate and alpine are found here the region exhibits the richest diversity in orchids, zingibers, yams, rhododendrons, bamboos, canes and wild relatives of cultivated plants. It is also considered as cradle of „angiosperms“ as primitive plant families such as *Magnoliaceae*, *Lauraceae*, *Hamamelidaceae*, *Degeneriaceae*, *Tetracentraceae* and *Lardizabalaceae* are well represented here.

As per the Forest Survey of India report, Meghalaya rank seventh amongst the Indian states in respect of percentage of geographical area under forest cover. The forests of Meghalaya are rich in biodiversity and endowed with rare species of orchids and medicinal plants. The forest types in Meghalaya are Subtropical Pine, Subtropical Broadleaf, Tropical Wet Evergreen, Tropical Semi Evergreen, and Tropical Moist Deciduous Forests. Sacred groves mostly located in the Khasi and the Jaintia Hills represent the climax vegetation of the area. According to Haridasan and Rao (1985), the forest vegetation of Meghalaya consists of Tropical Evergreen Forest in the low-lying areas with high rainfall; Tropical Semi-Evergreen Forest up to the elevation of about 1,200 m with annual rainfall between 1,500 to 2,000 mm; Tropical Moist Deciduous Forest in the areas with less than 1,500 mm rainfall; Grassland on the tops of Khasi, the Jaintia and the Garo Hills; isolated patches of Temperate Forest along the southern slopes of the Khasi and Jaintia Hills; and Subtropical Pine Forest with pure stands of *Pinus Kesiya* confined to the Higher reaches of the Shillong Plateau. Bamboo and canes are found in undisturbed forests. Meghalaya has many endemic plant species, the most famous being the carnivore pitcher plant *Nepenthes khasiana*.

The Forest and Tree cover in the State is 79.37 % covering 17,803 Sq.km. Out of total forest area of 17,146 sq km (76.44% of the state's geographical area) only 1145.19 sq km of Forest areas (5.10 % of geographical area) comes directly under the control of the State Forest Department in the form of reserved forest, protected forest, national parks, wildlife sanctuaries and parks & gardens. The rest of the forest areas belong to communities, clan and private people and District Councils. There are three Autonomous District Councils (ADCs) i.e., Khasi Hills Autonomous District Councils, Jaintia Hills Autonomous District Councils and Garo Hills Autonomous District Councils, which have been set up under the provisions of the Sixth Schedule to the Constitution of India. These ADCs have the power to make laws with respect to, among others, the management of any forest not being a reserved forest.



Source: GoM, Department of Forest and Environment

**Figure 3.15: Forest cover type in Meghalaya**

The total forest land under East Khasi Hill district is 35.34% of the total geographical area of the district. The land use map based on Toposheet and satellite imagery of the study area (10 km

around the proposed landfill site) shows that 109.88 sq km (34.97% under total study area) is under unclassified forest, 11.20 sq. km is Reserved Forest and 6.8727 sq km is Protected Forest. Riat Khawan R.F and Laitkor Protected Forest (P.F), Short Round P.F & Shyrwat P.F. are located within the study area.

### 3.13.4 Forest Type and Density

The forests of Meghalaya can broadly be grouped under the tropical type and the temperate type, mainly based on the altitude, rainfall and dominant species composition.

- **Tropical Forests:** These forests are met within areas upto an elevation of 1200m and with an average rainfall of about 100-250cm. There are numerous subtypes within this category such as evergreen, semi-evergreen, moist and dry deciduous forest, etc.
- **Tropical evergreen forests:** These forests usually occur in high rainfall areas as well as near catchment areas. They seldom form continuous belts due to various exogenous factors. But still, they harbour very rich species diversity, where nature is at its extravaganza forming a closed evergreen canopy. The trees exhibit clear zonation with dense and impenetrable herbaceous undergrowth.
- **Tropical semi-evergreen forests:** This category of forests occupies the north-eastern and northern slopes of the State, typically upto elevations of 1200m, where annual rainfall is 150-200cm with a comparatively cooler winter. The numbers of species here are fewer than the evergreen zone. There are also a few species in these forests which are deciduous in nature, such as *Careya arborea*, *Dillenia pentagyna* and *Callicarpa arborea*. Again, there is a clear stratification of the trees in these forests.
- **Tropical moist and dry deciduous forests:** This type of forests occurs where annual rainfall is below 150cm and at comparatively low elevations. Typical natural deciduous forests do not occur anywhere in Meghalaya but are only subclimax or man-made forests. These forests are characterised by seasonal leaf shedding and profuse flowering of the trees. Recurrent forest fires are a common phenomenon here. Deciduous forests are much more extensive in their distribution in the State and include a host of economically important trees like *Shorea robusta*, *Tectona grandis*, *Terminalia myriocarpa*, *Sterculia villosa*, *Logerstroemia flosreginae*, *L. Porviflora*, *Morus laevigatus*, *Artocarpus chaplasha*, and *Gmelina arborea* both as natural and as plantations. *Schima wallichii*, *Artocarpus gameziana*, *Tetrameles nudiflora*, *Lannea coromandelica*, *Salmaalial malabarica* *Erythrina stricta*, *Premna milliflora*, *Vitex peduncularis*, *Albizia lebbbeck*. *Lucida*, *Terminalia bellirica* etc is also in abundance. These trees of the deciduous canopy are always lofty and straight bole and with spreading crown.
- **Grass and Savannas:** Grasslands of Meghalaya are also not a climax type but are only as a result of removal of original forest cover. The rolling grasslands covering large areas can be seen throughout the Shillong plateau, around Riango, Ranikor, Weiloi, Mawphlang, Mawsynram, Cherrapunji, Shillong, Jowai, Jarain, and Sutnga in Khasi and Jaintia Hills and major parts of west Garo Hills.
- **Temperate Forests:** The temperate forests occupy the higher elevations about 1000m, mostly along the southern slope of Khasi and Jaintia Hills. The rainfall here is very high 200-500cm with a severe winter during November to March. Ground frost is also common during December to January.
- **Sacred Groves:** The scared groves of Meghalaya largely fall under the temperate type and are the relic type evolved through millions of years. These are rich storehouse of vegetation

wealth incomparable to any other type of forests in the State. These isolated pockets are untouched due to the religious beliefs and myths attributed to them. Many of the endangered species of the State are presently confined to these pockets only. Fagaceae members dominate over others in these sacred forests. Epiphytic flora is quite abundant and again dominated over by ferns and orchids.

#### **3.13.4.1 Methodology Adopted for the Study**

A desktop review (published documents etc.) was conducted to determine the forest area, land use, water bodies, settlements etc (through Satellite imagery), vegetation type (*Champion and Seth, 1962*), floral and faunal assemblage in the study area. Terrestrial investigations for flora and fauna records were collected by random field survey using checklist. During field survey, discussions with the local people were also 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 and forest working plans was referred from State Forest Department.
- Site Verification and finalization in consultation with local inhabitants.
- Vegetation analysis through quadrature method using sampling plots.

#### **□ Protocol for Sampling through Quadrature 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. Quadrature 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 was 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 x 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).

$$IVI = \text{Relative frequency} + \text{Relative density} + \text{Relative dominance}$$

### C. Faunal Study

Ground surveys are carried out by trekking the study area for identification of important faunal groups such as birds, mammals and reptiles for sampling of fauna 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 species as per the schedule of The Wildlife (Protection) Amendment Act, 2022.

The emphasis is given to identify avifauna and mammals to determine the presence and absence of Schedule-1 species, listed in The Wildlife (Protection) Amendment Act, 2022, as well as in Red List of IUCN. Various methods used for study of wildlife are as follows:

1. **Point Survey Method:** Observations were made at each site for 15-30 min duration.
2. **Road Side Counts:** The observer travelled by motor vehicles from site to site and all sightings were recorded.

### Sampling Locations

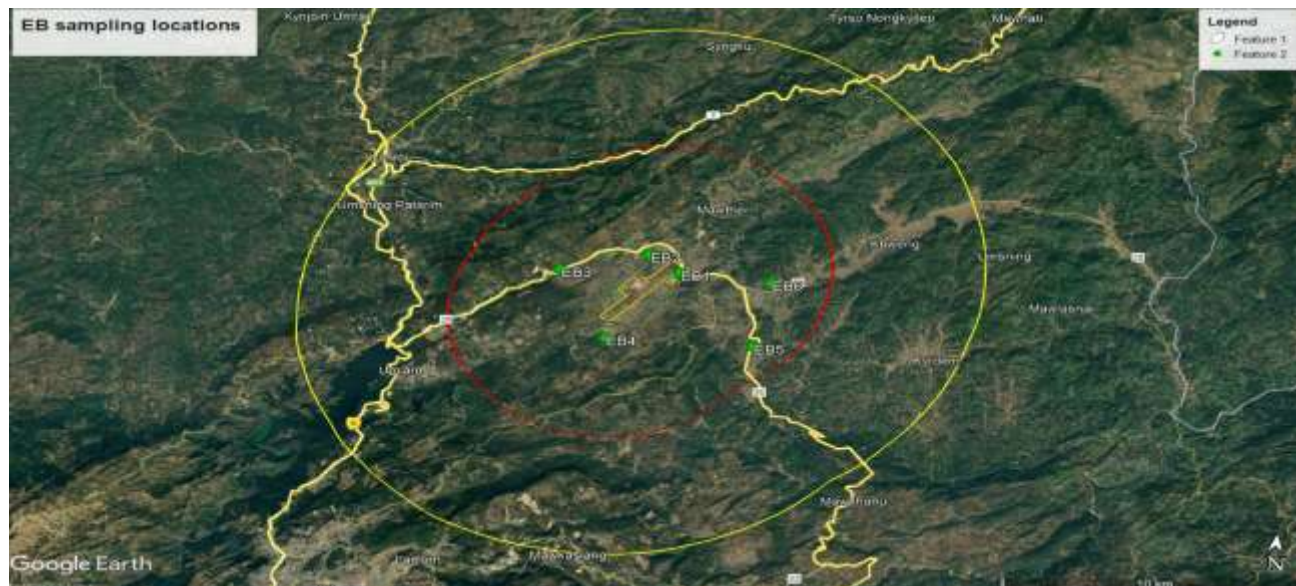
The ecology and diversity survey were conducted in 6 sampling locations within the study area. It is observed that human settlements present within the study area. The locations covered during the present survey were Near airport road, Near Nongrah Umroi, Near Shillong bypass, Near Umden Umroi, Near Umtung, Near Bhoirymbo. The details of locations for plot surveys are given in **Table 3.29**.

**Table 3.29: Details of Locations for Plot Survey**

| Sl.No. | Name of village   | Plot No. | Lattitude     | Longitude     | Direction | Distance (Km) |
|--------|-------------------|----------|---------------|---------------|-----------|---------------|
| 1      | Near airport road | EB1      | 25°42'42.44"N | 91°59'21.93"E | NE        | 0.5           |

|   |                      |     |               |               |    |     |
|---|----------------------|-----|---------------|---------------|----|-----|
| 2 | Near Nongrah Umroi   | EB2 | 25°43'4.43"N  | 91°58'43.22"E | NW | 1   |
| 3 | Near Shillong bypass | EB3 | 25°42'33.88"N | 91°57'1.19"E  | W  | 2.2 |
| 4 | Near Umden Umroi     | EB4 | 25°41'2.78"N  | 91°58'4.81"E  | S  | 0.7 |
| 5 | Near Umtung          | EB5 | 25°41'7.68"N  | 92° 1'0.44"E  | SE | 4.1 |
| 6 | Near Bhoirymbo       | EB6 | 25°42'38.53"N | 92° 1'10.90"E | E  | 3.3 |

Source: ABC Techno Labs India Pvt. Ltd.



Source: ABC Techno Labs India Pvt. Ltd.

**Figure 3.16: Locations of Sampling for Plot survey**

### 3.13.5 Terrestrial Ecology

#### Floral Diversity

The structure and type of vegetation depends on climatic conditions and physiography as well as the requirements of the local inhabitants of an area. Climate of the study area is well suited for the growth of all types of vegetation. The existing airport site at Barapani is not located in the demarcated forest land i.e. Reserved Forest or Protected Forest. The vegetation in the adjoining area of airport mainly consists of *Albizia lebbeck*, *Betula alnoides*, *Pinus kesiya*, *Quercus dealbata*, *Shorea robusta*, *Schima khasiana*, *Prunus undulata*, *Artocarpus chaplasha* etc. There are also some grasses and other shrubs, like *Lantana camara*, *Alpinia spp.*, *Euphorbia monocot*, *Clerodendrum serratum*, *Myrica nagi*.

During the terrestrial plant survey, 108 plant species were recorded and reported, which includes 52 species of trees, 18 species of shrubs, 25 species of herbs, 6 species of climbers, 4 genera of bamboo, 3 genus of ferns within the study area. The natural vegetation of the area has been completely altered by anthropogenic activity in long past.

The study area has sparse vegetation, though it includes timber, fruit, avenue and ornamental trees and shrubs. Herbaceous vegetation includes crops, pulses, vegetables and grasses of economic importance. Open agricultural land and field bunds are used most of time for plantation of some tree species.

During the primary quadrat survey, about 63 floral species observed. The most dominant tree species in the entire study area was dominated *Albizia lebbeck*, *Careya arborea*, *Betula alnoides*,

*Pinus kesiya*, *Quercus dealbata*, *Shorea robusta*, *Schima khasiana*, *Schima wallichii*, *Manglietia insignis*, *Prunus undulata*, *Artocarpus chaplasha*. Most dominant shrubs observed within the study area were *Lantana camara*, *Alpinia spp.*, *Euphorbia monocot*, *Clerodendrum serratum*, *Myrica nagi* etc. Among the herb species observed are *Cynodon dactylon*, *Thysanolaena maxima*, *Sida cordifolia*, *Xanthium strumarium*, *Mimosa pudica*, *Ageratum conyzoides* etc.

The list of flora observed in the entire study area is given in **Table 3.30**:

**Table 3.30 : Floristic Diversity in the Buffer Zone Study Area**

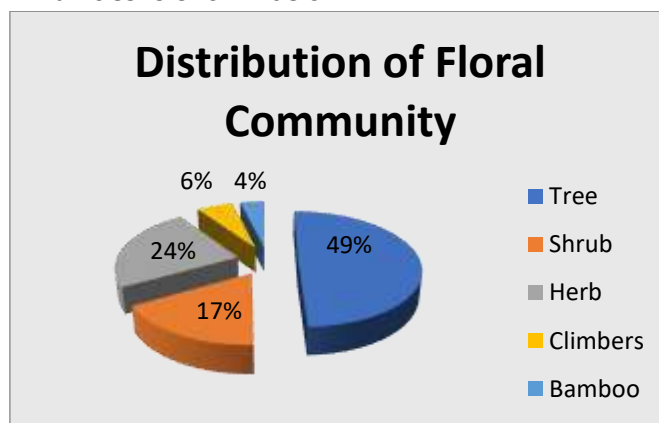
| Sl.No       | Scientific Name                 | Local name/Common name  | Family           | IUCN Conservation Status |
|-------------|---------------------------------|-------------------------|------------------|--------------------------|
| <b>Tree</b> |                                 |                         |                  |                          |
| 1           | <i>Albizia lebbek</i>           | Kothia koro             | Fabaceae         | Least Concerned          |
| 2           | <i>Careya arborea</i>           | Kum                     | Lecythidaceae    | Not Assessed             |
| 3           | <i>Betula alnoides</i>          | Himalayan Birch         | Betulaceae       | Least Concerned          |
| 4           | <i>Pinus kesiya</i>             | Khasi Pine              | Pinaceae         | Least Concerned          |
| 5           | <i>Quercus dealbata</i>         | White oak               | Fagaceae         | Least Concerned          |
| 6           | <i>Shorea robusta</i>           | Sal                     | Dipterocarpaceae | Least Concerned          |
| 7           | <i>Adina cordifolia</i>         | Laupatia                | Rubiaceae        | Least Concerned          |
| 8           | <i>Terminalia myriocarpa</i>    | Hollock                 | Combretaceae     | Not Assessed             |
| 9           | <i>Schima khasiana</i>          | Khasi Schima            | Theaceae         | Least Concerned          |
| 10          | <i>Schima wallichii</i>         | Makrisal                | Theaceae         | Least Concerned          |
| 11          | <i>Albizia procera</i>          | Korai                   | Fabaceae         | Least Concerned          |
| 12          | <i>Manglietia insignis</i>      | Dieng-rhi-basaw         | Magnoliaceae     | Least Concerned          |
| 13          | <i>Prunus undulata</i>          | Himalayan Cherry        | Rosaceae         | Least Concerned          |
| 14          | <i>Artocarpus chaplasha</i>     | Chaplash                | Moraceae         | Not Assessed             |
| 15          | <i>Cordia dichotoma</i>         | Boal                    | Boraginaceae     | Least Concerned          |
| 16          | <i>Stereospermum spp.</i>       | Paroli                  | Bignoniaceae     | Not Assessed             |
| 17          | <i>Bauhinia purpurea</i>        | Kanchan                 | Fabaceae         | Least Concerned          |
| 18          | <i>Clerodendrum arborea</i>     | East Indian Glory Bower | Lamiaceae        | Not Assessed             |
| 19          | <i>Ficus hispida</i>            | Dimoru                  | Moraceae         | Least Concerned          |
| 20          | <i>Erythrina spicata</i>        | Indian Coral Tree       | Fabaceae         | Not Assessed             |
| 21          | <i>Tectona grandis</i>          | Teak                    | Lamiaceae        | Endangered               |
| 22          | <i>Dillenia indica</i>          | Outenga                 | Dilleniaceae     | Least Concerned          |
| 23          | <i>Carpinus indicum</i>         | Himalayan Hornbeam      | Betulaceae       | Not Assessed             |
| 24          | <i>Pterospermum acerifolium</i> | Hatipolia               | Sterculiaceae    | Least Concerned          |
| 25          | <i>Syzygium jambos</i>          | Jam                     | Myrtaceae        | Least Concerned          |
| 26          | <i>Trewia nudiflora</i>         | Bhura                   | Euphorbiaceae    | Least Concerned          |
| 27          | <i>Carpinus spp.</i>            | Hornbeam                | Betulaceae       | Not Assessed             |
| 28          | <i>Alencuim chinensis</i>       | Marli                   | Cornaceae        | Not Assessed             |
| 29          | <i>Anacardium occidentale</i>   | Kaju                    | Anacardiaceae    | Least Concerned          |
| 30          | <i>Castanopsis indica</i>       | Soh-ot-rit              | Fagaceae         | Least Concerned          |
| 31          | <i>Itea macrophylla</i>         | Dieng-lamethel          | Iteaceae         | Not Assessed             |
| 32          | <i>Semecarpus anacardium</i>    | Bhelatuki               | Anacardiaceae    | Least Concerned          |
| 33          | <i>Myrica esculenta</i>         | Sohphie                 | Myricaceae       | Not Assessed             |
| 34          | <i>Gmelina arborea</i>          | Gamari                  | Lamiaceae        | Least Concerned          |
| 35          | <i>Terminalia bellirica</i>     | Baheda                  | Combretaceae     | Least Concerned          |
| 36          | <i>Premna milleflora</i>        | Khasi Premna            | Lamiaceae        | Vulnerable               |
| 37          | <i>Bombax ceiba</i>             | Simul                   | Bombacaceae      | Least Concerned          |

| Sl.No                     | Scientific Name                    | Local name/Common name | Family          | IUCN Conservation Status |
|---------------------------|------------------------------------|------------------------|-----------------|--------------------------|
| 38                        | <i>Macaranga denticulata</i>       | Blister Macaranga      | Euphorbiaceae   | Least Concerned          |
| 39                        | <i>Medinilla rubicunda</i>         | Boghi-tenga            | Melastomataceae | Not Assessed             |
| 40                        | <i>Eugenia spp.</i>                | Jamun                  | Myrtaceae       | Not Assessed             |
| 41                        | <i>Lindera pulcherrima</i>         | Himalayan Spicebush    | Lauraceae       | Least Concerned          |
| 42                        | <i>Litsea salicifolia</i>          | Dighloti               | Lauraceae       | Least Concerned          |
| 43                        | <i>Eurya acuminata</i>             | Edible Leaf Eurya      | Theaceae        | Least Concerned          |
| 44                        | <i>Michelia champaca</i>           | Champ                  | Magnoliaceae    | Least Concerned          |
| 45                        | <i>Ligustrum robustum</i>          | Eastern Wild Privet    | Oleaceae        | Least Concerned          |
| 46                        | <i>Rhus semialata</i>              | Naga-tenga             | Anacardiaceae   | Not Assessed             |
| 47                        | <i>Symplocos spicata</i>           | Ashila                 | Symplocaceae    | Not Assessed             |
| 48                        | <i>Ficus hirta</i>                 | Hairy Fig              | Moraceae        | Least Concerned          |
| 49                        | <i>Glochidion spp.</i>             | Cheese tree            | Phyllanthaceae  | Not Assessed             |
| 50                        | <i>Sterculia villosa</i>           | Hairy sterculia        | Malvaceae       | Least Concerned          |
| 51                        | <i>Lagerstroemia parviflora</i>    | Dhauli                 | Lythraceae      | Least Concerned          |
| 52                        | <i>Morus laevigata</i>             | Indian white mulberry  | Moraceae        | Not Assessed             |
| <b>Shrub</b>              |                                    |                        |                 |                          |
| 1                         | <i>Lantana camara</i>              | Samballei              | Verbenaceae     | Not Assessed             |
| 2                         | <i>Alpinia spp.</i>                | Sying Khlaw            | Zingiberaceae   | Not Assessed             |
| 3                         | <i>Croton variegatum</i>           | Garden Croton          | Euphorbiaceae   | Not Assessed             |
| 4                         | <i>Artemisia vulgaris</i>          | Dieng tlio             | Asteraceae      | Not Assessed             |
| 5                         | <i>Euphorbia monocot</i>           | Dieng soh ramdieng     | Euphorbiaceae   | Not Assessed             |
| 6                         | <i>Clerodendrum serratum</i>       | Nangal Bhanga          | Lamiaceae       | Not Assessed             |
| 7                         | <i>Clerodendrum infortunatum</i>   | Bhat                   | Lamiaceae       | Least Concerned          |
| 8                         | <i>Clerodendrum colebrookianum</i> | Sla jarem              | Lamiaceae       | Not Assessed             |
| 9                         | <i>Inula cappa</i>                 | Gaaitihaare            | Asteraceae      | Not Assessed             |
| 10                        | <i>Myrica nagi</i>                 | Soh-phi                | Myricaceae      | Near Threatened          |
| 11                        | <i>Prunus nepalensis</i>           | Sohiong                | Rosaceae        | Not Assessed             |
| 12                        | <i>Elaeagnus khasianum</i>         | Soh-shang              | Elaeagnaceae    | Not Assessed             |
| 13                        | <i>Polygala arillata</i>           | Marcha                 | Polygalaceae    | Least Concerned          |
| 14                        | <i>Mahonia pycnophylla</i>         | Ningmat                | Berberidaceae   | Not Assessed             |
| 15                        | <i>Daphne papyracea</i>            | Ka dieng baiong        | Thymelaeaceae   | Not Assessed             |
| 16                        | <i>Phyllanthus reticulatus</i>     | Panjuli                | Phyllanthaceae  | Least Concerned          |
| 17                        | <i>Styrax serrulata</i>            | Snowbell               | Styracaceae     | Not Assessed             |
| 18                        | <i>Amaranthus racemosus</i>        | Laising                | Amaranthaceae   | Not Assessed             |
| <b>Herb &amp; Grasses</b> |                                    |                        |                 |                          |
| 1                         | <i>Cynodon dactylon</i>            | Durba                  | Poaceae         | Not Assessed             |
| 2                         | <i>Sida cordifolia</i>             | Bariyar                | Malvaceae       | Not Assessed             |
| 3                         | <i>Xanthium strumarium</i>         | Jati dhenki            | Asteraceae      | Not Assessed             |
| 4                         | <i>Tridax procumbens</i>           | Bikhalyakarani         | Asteraceae      | Not Assessed             |
| 5                         | <i>Mimosa pudica</i>               | Lajukilata             | Fabaceae        | Least Concerned          |
| 6                         | <i>Ageratum conyzoides</i>         | Bat proi               | Asteraceae      | Not Assessed             |
| 7                         | <i>Trifolium repens</i>            | White Clover           | Fabaceae        | Not Assessed             |
| 8                         | <i>Achyranthes aspera</i>          | Dikge                  | Amaranthaceae   | Not Assessed             |
| 9                         | <i>Sida acuta</i>                  | Khingkhiih             | Malvaceae       | Not Assessed             |
| 10                        | <i>Polygonum orientale</i>         | Bara Pani Mirch        | Polygonaceae    | Not Assessed             |
| 11                        | <i>Thysanolaena maxima</i>         | Broom Grass            | Poaceae         | Not Assessed             |

| Sl.No           | Scientific Name                    | Local name/Common name | Family         | IUCN Conservation Status |
|-----------------|------------------------------------|------------------------|----------------|--------------------------|
| 12              | <i>Arisaema spp.</i>               | Cobra Lilies/Dhei      | Araceae        | Not Assessed             |
| 13              | <i>Euphorbia lutea</i>             | Sohphie                | Euphorbiaceae  | Not Assessed             |
| 14              | <i>Amaranthus viridis</i>          | Langkhen               | Amaranthaceae  | Not Assessed             |
| 15              | <i>Hypochoeris radicata</i>        | Catsear                | Asteraceae     | Not Assessed             |
| 16              | <i>Lindera spp.</i>                | Himalayan Spicebush    | Lauraceae      | Not Assessed             |
| 17              | <i>Desmodium laxiflorum</i>        | Kuro Jhar              | Fabaceae       | Not Assessed             |
| 18              | <i>Vinca rosea</i>                 | Sadabahar              | Apocynaceae    | Not Assessed             |
| 19              | <i>Sonchus asper</i>               | Prickly Sow-Thistle    | Asteraceae     | Not Assessed             |
| 20              | <i>Pouzolzia hirta</i>             | Memsleh                | Urticaceae     | Not Assessed             |
| 21              | <i>Asparagus racemosus</i>         | Satavari               | Asparagaceae   | Not Assessed             |
| 22              | <i>Oxalis corniculata</i>          | Jabuit                 | Oxalidaceae    | Not Assessed             |
| 23              | <i>Carex filicina</i>              | Sedge                  | Cyperaceae     | Least Concerned          |
| 24              | <i>Cyperus griffithii</i>          | Griffith's Flatsedge   | Cyperaceae     | Not Assessed             |
| 25              | <i>Imperata cylindrica</i>         | Di                     | Poaceae        | Not Assessed             |
| <b>Climbers</b> |                                    |                        |                |                          |
| 1               | <i>Avodia spinosa</i>              | Meyna                  | Malvaceae      | Not Assessed             |
| 2               | <i>Hedera helix</i>                | English Ivy            | Araliaceae     | Not Assessed             |
| 3               | <i>Vitis spp</i>                   | Wild grape             | Vitaceae       | Not Assessed             |
| 4               | <i>Rubus monogynous</i>            | Soh-shiah              | Rosaceae       | Not Assessed             |
| 5               | <i>Zanthoxylum candied</i>         | Jaiur                  | Rutaceae       | Not Assessed             |
| 6               | <i>Hedyotis seamdams</i>           | Jyrmi Skie             | Rubiaceae      | Not Assessed             |
| <b>Bamboos</b>  |                                    |                        |                |                          |
| 1               | <i>Calamus sp</i>                  | Raidang bet            | Poaceae        | Not Assessed             |
| 2               | <i>Bambusa pallida</i>             | Tenang                 | Poaceae        | Not Assessed             |
| 3               | <i>Chimonobambusa griffithiana</i> | Spar                   | Poaceae        | Not Assessed             |
| 4               | <i>Melocanna bambusoides</i>       | U Sylli                | Poaceae        | Not Assessed             |
| <b>Fern</b>     |                                    |                        |                |                          |
| 1               | <i>Lemmaphyllum spp</i>            | Japanese Beard Fern    | Polypodiaceae  | Not Assessed             |
| 2               | <i>Asplenium spp</i>               | Spleenworts            | Aspleniaceae   | Not Assessed             |
| 3               | <i>Dicranopteris spp.</i>          | Tlew-rakot             | Gleicheniaceae | Not Assessed             |

Source: ABC Techno Labs India Pvt. Ltd.

Tree species found to be abundant (49%) within the study area while less number of shrub species (17%) and climbers (6%). Herbaceous species found to be about 24% observed during field study. Distribution of floral communities is shown below.



#### □ **Phytosociological Analysis**

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 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 of 10 km radius. 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 3.31**.



**Table 3.31: 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          |
|---------------------|------------------------------|-------------------|-----------|----------------------------|-------------------|---------|------------------|-------------|--------------------|-----------|--------------------|--------------|
| <b>Tree Species</b> |                              |                   |           |                            |                   |         |                  |             |                    |           |                    |              |
| 1                   | <i>Albizia lebbbeck</i>      | Kothia koroi      | 6         | 6                          | 6                 | 1.00    | 7.50             | 100.0       | 7.6                | 1.00      | 7.50               | 22.59        |
| 2                   | <i>Careya arborea</i>        | Kum               | 4         | 4                          | 6                 | 0.67    | <b>5.00</b>      | 66.7        | <b>5.1</b>         | 1.00      | 5.00               | <b>15.06</b> |
| 3                   | <i>Betula alnoides</i>       | Himalayan Birch   | 5         | 5                          | 6                 | 0.83    | 6.25             | 83.3        | 6.3                | 1.00      | 6.25               | 18.83        |
| 4                   | <i>Pinus kesiya</i>          | Khasi Pine        | 5         | 5                          | 6                 | 0.83    | 6.25             | 83.3        | 6.3                | 1.00      | 6.25               | 18.83        |
| 5                   | <i>Quercus dealbata</i>      | White oak         | 3         | 3                          | 6                 | 0.50    | 3.75             | 50.0        | 3.8                | 1.00      | 3.75               | 11.30        |
| 6                   | <i>Shorea robusta</i>        | Sal               | 4         | 4                          | 6                 | 0.67    | 5.00             | 66.7        | 5.1                | 1.00      | 5.00               | 15.06        |
| 7                   | <i>Adina cordifolia</i>      | Laupatia          | 2         | 2                          | 6                 | 0.33    | 2.50             | 33.3        | 2.5                | 1.00      | 2.50               | 7.53         |
| 8                   | <i>Terminalia myriocarpa</i> | Hollock           | 4         | 4                          | 6                 | 0.67    | 5.00             | 66.7        | 5.1                | 1.00      | 5.00               | 15.06        |
| 9                   | <i>Schima khasiana</i>       | Khasi Schima      | 4         | 4                          | 6                 | 0.67    | 5.00             | 66.7        | 5.1                | 1.00      | 5.00               | 15.06        |
| 10                  | <i>Schima wallichii</i>      | Makrisal          | 5         | 5                          | 6                 | 0.83    | 6.25             | 83.3        | 6.3                | 1.00      | 6.25               | 18.83        |
| 11                  | <i>Albizia procera</i>       | Korai             | 3         | 3                          | 6                 | 0.50    | 3.75             | 50.0        | 3.8                | 1.00      | 3.75               | 11.30        |
| 12                  | <i>Manglietia insignis</i>   | Dieng-rhi-basaw   | 4         | 4                          | 6                 | 0.67    | 5.00             | 66.7        | 5.1                | 1.00      | 5.00               | 15.06        |
| 13                  | <i>Prunus undulata</i>       | Himalayan Cherry  | 3         | 3                          | 6                 | 0.50    | 3.75             | 50.0        | 3.8                | 1.00      | 3.75               | 11.30        |
| 14                  | <i>Artocarpus chaplasha</i>  | Chaplash          | 3         | 3                          | 6                 | 0.50    | 3.75             | 50.0        | 3.8                | 1.00      | 3.75               | 11.30        |
| 15                  | <i>Cordia dichotoma</i>      | Boal              | 2         | 2                          | 6                 | 0.33    | 2.50             | 33.3        | 2.5                | 1.00      | 2.50               | 7.53         |
| 16                  | <i>Stereospermum spp.</i>    | Paroli            | 3         | 3                          | 6                 | 0.50    | 3.75             | 50.0        | 3.8                | 1.00      | 3.75               | 11.30        |
| 17                  | <i>Bauhinia purpurea</i>     | Kanchan           | 2         | 2                          | 6                 | 0.33    | 2.50             | 33.3        | 2.5                | 1.00      | 2.50               | 7.53         |
| 18                  | <i>Ficus hispida</i>         | Dimoru            | 2         | 2                          | 6                 | 0.33    | 2.50             | 33.3        | 2.5                | 1.00      | 2.50               | 7.53         |
| 19                  | <i>Erythrina spicata</i>     | Indian Coral Tree | 3         | 2                          | 6                 | 0.50    | 3.75             | 33.3        | 2.5                | 1.50      | 3.75               | 10.03        |
| 20                  | <i>Tectona grandis</i>       | Teak              | 1         | 1                          | 6                 | 0.17    | 1.25             | 16.7        | 1.3                | 1.00      | 1.25               | 3.77         |
| 21                  | <i>Syzygium jambos</i>       | Jam               | 2         | 2                          | 6                 | 0.33    | 2.50             | 33.3        | 2.5                | 1.00      | 2.50               | 7.53         |
| 22                  | <i>Gmelina arborea</i>       | Gamari            | 2         | 2                          | 6                 | 0.33    | 2.50             | 33.3        | 2.5                | 1.00      | 2.50               | 7.53         |
| 23                  | <i>Bombax ceiba</i>          | Simul             | 2         | 2                          | 6                 | 0.33    | 2.50             | 33.3        | 2.5                | 1.00      | 2.50               | 7.53         |
| 24                  | <i>Ficus hirta</i>           | Hairy Fig         | 2         | 2                          | 6                 | 0.33    | 2.50             | 33.3        | 2.5                | 1.00      | 2.50               | 7.53         |

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Description of Environment

| 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   |
|----------------------|---------------------------------|-----------------------|-----------|----------------------------|-------------------|---------|------------------|-------------|--------------------|-----------|--------------------|-------|
| 25                   | <i>Lagerstroemia parviflora</i> | Dhauli                | 2         | 2                          | 6                 | 0.33    | 2.50             | 33.3        | 2.5                | 1.00      | 2.50               | 7.53  |
| 26                   | <i>Morus laevigata</i>          | Indian white mulberry | 2         | 2                          | 6                 | 0.33    | 2.50             | 33.3        | 2.5                | 1.00      | 2.50               | 7.53  |
|                      | <b>Total</b>                    |                       | <b>80</b> | <b>79</b>                  | <b>156</b>        |         |                  |             |                    |           |                    |       |
| <b>Shrub Species</b> |                                 |                       |           |                            |                   |         |                  |             |                    |           |                    |       |
| 1                    | <i>Lantana camara</i>           | Samballei             | 10        | 6                          | 6                 | 1.67    | 18.87            | 100.0       | 13.0               | 1.67      | 18.87              | 50.78 |
| 2                    | <i>Alpinia spp.</i>             | Sying Khlaw           | 6         | 5                          | 6                 | 1.00    | 11.32            | 83.3        | 10.9               | 1.20      | 11.32              | 33.51 |
| 3                    | <i>Croton variegatum</i>        | Garden Croton         | 4         | 4                          | 6                 | 0.67    | 7.55             | 66.7        | 8.7                | 1.00      | 7.55               | 23.79 |
| 4                    | <i>Artemisia vulgaris</i>       | Dieng tlio            | 2         | 2                          | 6                 | 0.33    | 3.77             | 33.3        | 4.3                | 1.00      | 3.77               | 11.89 |
| 5                    | <i>Euphorbia monocot</i>        | Dieng soh ramdieng    | 5         | 5                          | 6                 | 0.83    | 9.43             | 83.3        | 10.9               | 1.00      | 9.43               | 29.74 |
| 6                    | <i>Clerodendrum serratum</i>    | Nangal Bhanga         | 4         | 4                          | 6                 | 0.67    | 7.55             | 66.7        | 8.7                | 1.00      | 7.55               | 23.79 |
| 7                    | <i>Myrica nagi</i>              | Soh-phi               | 4         | 3                          | 6                 | 0.67    | 7.55             | 50.0        | 6.5                | 1.33      | 7.55               | 21.62 |
| 8                    | <i>Prunus nepalensis</i>        | Sohiong               | 2         | 2                          | 6                 | 0.33    | 3.77             | 33.3        | 4.3                | 1.00      | 3.77               | 11.89 |
| 9                    | <i>Polygala arillata</i>        | Marcha                | 4         | 4                          | 6                 | 0.67    | 7.55             | 66.7        | 8.7                | 1.00      | 7.55               | 23.79 |
| 10                   | <i>Mahonia pycnophylla</i>      | Ningmat               | 2         | 2                          | 6                 | 0.33    | 3.77             | 33.3        | 4.3                | 1.00      | 3.77               | 11.89 |
| 11                   | <i>Phyllanthus reticulatus</i>  | Panjuli               | 3         | 3                          | 6                 | 0.50    | 5.66             | 50.0        | 6.5                | 1.00      | 5.66               | 17.84 |
| 12                   | <i>Styrax serrulata</i>         | Snowbell              | 3         | 3                          | 6                 | 0.50    | 5.66             | 50.0        | 6.5                | 1.00      | 5.66               | 17.84 |
| 13                   | <i>Amaranthus racemosus</i>     | Laising               | 4         | 3                          | 6                 | 0.67    | 7.55             | 50.0        | 6.5                | 1.33      | 7.55               | 21.62 |
|                      | <b>Total</b>                    |                       | <b>53</b> | <b>46</b>                  | <b>78</b>         |         |                  |             |                    |           |                    |       |
| <b>Herb Species</b>  |                                 |                       |           |                            |                   |         |                  |             |                    |           |                    |       |
| 1                    | <i>Cynodon dactylon</i>         | Durba                 | 18        | 6                          | 6                 | 3.00    | 15.25            | 100.0       | 7.1                | 3.00      | 15.25              | 37.57 |
| 2                    | <i>Sida cordifolia</i>          | Bariyar               | 7         | 6                          | 6                 | 1.17    | 5.93             | 100.0       | 7.1                | 1.17      | 5.93               | 18.92 |
| 3                    | <i>Xanthium strumarium</i>      | Jati dhenki           | 7         | 6                          | 6                 | 1.17    | 5.93             | 100.0       | 7.1                | 1.17      | 5.93               | 18.92 |
| 4                    | <i>Tridax procumbens</i>        | Bikhalyakarani        | 4         | 3                          | 6                 | 0.67    | 3.39             | 50.0        | 3.5                | 1.33      | 3.39               | 10.31 |
| 5                    | <i>Mimosa pudica</i>            | Lajukilata            | 7         | 4                          | 6                 | 1.17    | 5.93             | 66.7        | 4.7                | 1.75      | 5.93               | 16.57 |
| 6                    | <i>Ageratum conyzoides</i>      | Bat proi              | 5         | 4                          | 6                 | 0.83    | 4.24             | 66.7        | 4.7                | 1.25      | 4.24               | 13.18 |



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|-------|-----------------------------|----------------------|------------|----------------------------|-------------------|---------|------------------|-------------|--------------------|-----------|--------------------|-------|
| 7     | <i>Trifolium repens</i>     | White Clover         | 3          | 3                          | 6                 | 0.50    | 2.54             | 50.0        | 3.5                | 1.00      | 2.54               | 8.61  |
| 8     | <i>Achyranthes aspera</i>   | Dikge                | 6          | 4                          | 6                 | 1.00    | 5.08             | 66.7        | 4.7                | 1.50      | 5.08               | 14.88 |
| 9     | <i>Sida acuta</i>           | Khingkhoh            | 6          | 4                          | 6                 | 1.00    | 5.08             | 66.7        | 4.7                | 1.50      | 5.08               | 14.88 |
| 10    | <i>Polygonum orientale</i>  | Bara Pani Mirch      | 3          | 3                          | 6                 | 0.50    | 2.54             | 50.0        | 3.5                | 1.00      | 2.54               | 8.61  |
| 11    | <i>Thysanolaena maxima</i>  | Broom Grass          | 10         | 5                          | 6                 | 1.67    | 8.47             | 83.3        | 5.9                | 2.00      | 8.47               | 22.83 |
| 12    | <i>Arisaema spp.</i>        | Cobra Lilies/Dhei    | 2          | 2                          | 6                 | 0.33    | 1.69             | 33.3        | 2.4                | 1.00      | 1.69               | 5.74  |
| 13    | <i>Euphorbia lutea</i>      | Sohphie              | 3          | 2                          | 6                 | 0.50    | 2.54             | 33.3        | 2.4                | 1.50      | 2.54               | 7.44  |
| 14    | <i>Amaranthus viridis</i>   | Langkhen             | 5          | 5                          | 6                 | 0.83    | 4.24             | 83.3        | 5.9                | 1.00      | 4.24               | 14.36 |
| 15    | <i>Hypochaeris radicata</i> | Catsear              | 2          | 2                          | 6                 | 0.33    | 1.69             | 33.3        | 2.4                | 1.00      | 1.69               | 5.74  |
| 16    | <i>Lindera spp.</i>         | Himalayan Spicebush  | 2          | 2                          | 6                 | 0.33    | 1.69             | 33.3        | 2.4                | 1.00      | 1.69               | 5.74  |
| 17    | <i>Desmodium laxiflorum</i> | Kuro Jhar            | 3          | 3                          | 6                 | 0.50    | 2.54             | 50.0        | 3.5                | 1.00      | 2.54               | 8.61  |
| 18    | <i>Vinca rosea</i>          | Sadabahr             | 6          | 5                          | 6                 | 1.00    | 5.08             | 83.3        | 5.9                | 1.20      | 5.08               | 16.05 |
| 19    | <i>Sonchus asper</i>        | Prickly Sow-Thistle  | 4          | 3                          | 6                 | 0.67    | 3.39             | 50.0        | 3.5                | 1.33      | 3.39               | 10.31 |
| 20    | <i>Pouzolzia hirta</i>      | Memsleh              | 3          | 3                          | 6                 | 0.50    | 2.54             | 50.0        | 3.5                | 1.00      | 2.54               | 8.61  |
| 21    | <i>Oxalis corniculata</i>   | Jabuit               | 3          | 3                          | 6                 | 0.50    | 2.54             | 50.0        | 3.5                | 1.00      | 2.54               | 8.61  |
| 22    | <i>Carex filicina</i>       | Sedge                | 6          | 4                          | 6                 | 1.00    | 5.08             | 66.7        | 4.7                | 1.50      | 5.08               | 14.88 |
| 23    | <i>Cyperus griffithii</i>   | Griffith's Flatsedge | 1          | 1                          | 6                 | 0.17    | 0.85             | 16.7        | 1.2                | 1.00      | 0.85               | 2.87  |
| 24    | <i>Imperata cylindrica</i>  | Di                   | 2          | 2                          | 6                 | 0.33    | 1.69             | 33.3        | 2.4                | 1.00      | 1.69               | 5.74  |
|       | <b>Total</b>                |                      | <b>118</b> | <b>85</b>                  | <b>144</b>        |         |                  |             |                    |           |                    |       |

Source: ABC Techno Labs India Pvt. Ltd.

The interpretation vegetation study results of the study area are presented in the following **Table 3.32.**

**Table 3.32: Interpretation of Vegetation Results in the Study Area**

|                                     |                                                                                 |                                                                                                 |
|-------------------------------------|---------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| <i>Relative density</i>             | Relative density is found to be maximum for <i>Albizia lebbeck</i> about 7.5.   | Density of the primary species is found to be much higher in comparison with the other species. |
| <i>Relative frequency</i>           | Maximum RF found to be 7.6 in case of <i>Albizia lebbeck</i> .                  | Vegetation community is heterogenous in nature                                                  |
| <i>Relative Abundance</i>           | Maximum value observed in case of <i>Albizia lebbeck</i> about 7.5.             | <i>Albizia lebbeck</i> the most common species found in the area.                               |
| <i>Importance Value Index (IVI)</i> | The maximum IVI value observed in case of <i>Albizia lebbeck</i> is about 22.59 | The dominant species is <i>Albizia lebbeck</i>                                                  |

Source: ABC Techno Labs India Pvt. Ltd.

#### □ Biodiversity Indices

Biodiversity index is a quantitative measure that reflects how many different types of species, there are in a dataset, and simultaneously considers 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 is equally abundant. Interpretation of Vegetation results in the study area is given in **Table 3.33.**

**Table 3.33 Interpretation of Vegetation Results in the Study Area**

| Community | Biodiversity indices     |                               |                  |
|-----------|--------------------------|-------------------------------|------------------|
|           | Shannon-Wiener Index (H) | Simpson Diversity Index (1/D) | Species Evenness |
| Tree      | 3.18                     | 0.97                          | 0.37             |
| Shrub     | 1.90                     | 0.92                          | 0.44             |
| Herbs     | 3.82                     | 0.95                          | 0.52             |

Source: ABC Techno Labs India Pvt. Ltd.

From **Table 3.33**, it can be interpreted that herb community has higher 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. High herb species diversity is often an indicator of a healthy and complex ecosystem, suggesting good environmental conditions and a wide range of species interactions.

#### □ Economically Important Flora of the Study Area

**Agricultural crops:** Major food crops include rice, maize, and millets. Horticulture plays a significant role, with oranges, pineapples, pears, peaches, plums, and various local fruits being cultivated. Additionally, vegetables like potatoes, sweet potatoes, ginger, and garlic are also grown.

**Orchids:** Meghalaya is the storehouse of richly varied and colourful orchid. The east Khasi hill alone are endowed with 75 orchid genera represented by 275 sp. Orchid species found in this area are *Calanthe manni*, *Corybas purpureus* etc.

**Medicinal plant species:** The East Khasi Hills region of Meghalaya, India, is rich in medicinal plants used traditionally by the Khasi tribe. Some prominent examples include *Cinnamomum tamala* (Tejpat), *Costus speciosus* (Gokarek), *Curcuma longa* (Haridra), and *Cymbopogon citratus* (Jwarankusha). These plants are utilized for a variety of ailments, from gastric problems and kidney issues to coughs, colds, and skin diseases.

**Bamboo:** Bamboo is an important forest component of East Khasi hill district. Some of the species found in this district includes *Bambusa pallida*, *Chimnobambusa griffithiana*, *Melocanna bambusoides* etc. Cane (*Calamus sp*) is a woody climber which often twins around trees and is commonly known as rattan palm. The state Government as well as the district councils collect royalty for different species of cane.

**Broom-grass:** Broom-grass (*Thysanolaena maxima*) is the important forest produce used as raw material in the paper industries and small-scale cottage industries for making mats. About 30% of the total produce of broom-grass comes from Khasi hill division.

**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 area.

**Exotic Plants:** Many exotic plant species is found in this area which grows luxuriantly in home gardens, crop fields, degraded land, road sides etc. Rao and Dam(1979) reported as many as 144 species of exotic plants from Shillong and its neighbourhood. Some of them are, *Acacia dealbata*, *Albizia lebbek*, *Ambrosia artemisfolia*, *Apodites benthamiana*, *Psidium guajava*, *Riparium adenopharum*, *Brugmansia suaveolen* etc.

**Rare and endangered floral species:** There are about 200 taxa of plants in Meghalaya which are listed under different categories in the Red Data Book (Lain and Sastry, 1990). Rao and Haridasan (1983) have reported 54 rare and threatened plants from Meghalaya. However, no such rare, endangered or threatened species are reported in the study area.

## Faunal Communities

During field survey, both direct (sighting) and indirect (evidences) observations methods were used to survey the faunal species in 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:** During the field survey, common mammalian species were directly sighted in the study area. Dialogue with local villagers located in the study area also could confirm presence of certain wild animal in the study area. As per information obtained Monkey, Common Indian Mongoose, Himalayan Squirrels, Mole rat, Indian Field Mouse, Bandicoot Rat, Bamboo Rat, Shortnosed Fruit Bat, Black-naped hare, Small Indian Civet, Malayan Giant Squirrel, Indian Giant Squirrel etc were observed during primary survey.

**Avifauna:** Since birds are 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 study area and surrounding areas. From the primary survey, a total of 54 species of avifauna were identified and recorded in the study area. The diversity of avifauna from this region was found to be quite high and encouraging. The list of fauna species found in the study area is mentioned in **Table 3.34**. The Water lizard, Khasi Hill Rock Toad are also seen. Variety of butterflies (like Common tiger, Plain tiger, Common Blue Jay, Common Mormon, Common crow, Small Grass Yellow, Lime Butterfly, Common sailor, Common Grass Yellow, Common Emigrant, Common Jezebel) is spotted in abundance in the study zone.

**Table 3.34 Fauna Recorded from the Primary Survey in the Study Area and their Conservation Status**

| Sl.No          | Scientific name                   | English Name           | Schedule of Wildlife Protection Act, 2002 | Status as per IUCN Red Data List | Method |
|----------------|-----------------------------------|------------------------|-------------------------------------------|----------------------------------|--------|
| <b>Mammals</b> |                                   |                        |                                           |                                  |        |
| 1              | <i>Macaca mulatta</i>             | Monkey                 | II                                        | Least Concern                    | DS     |
| 2              | <i>Herpestes edwardsii</i>        | Common Indian Mongoose | I                                         | Least Concern                    | DS     |
| 3              | <i>Hylobates hoolock</i>          | Hoolock Gibbon         | I                                         | Endangered                       | NS     |
| 4              | <i>Scotophilus heathi</i>         | Common yellow Bat      | II                                        | Least Concern                    | NS     |
| 5              | <i>Dremomys lokriah</i>           | Himalayan Squirrels    | II                                        | Least Concern                    | DS     |
| 6              | <i>Bandicota bengalensis</i>      | Mole rat               | NL                                        | Least Concern                    | DS     |
| 7              | <i>Mus booduga</i>                | Indian Field Mouse     | NL                                        | Least Concern                    | DS     |
| 8              | <i>Bandicota indica</i>           | Bandicoot Rat          | NL                                        | Least Concern                    | DS     |
| 9              | <i>Cannomys badius</i>            | Bamboo Rat             | NL                                        | Least Concern                    | DS     |
| 10             | <i>Cynopterus sphinx</i>          | Short nosed Fruit Bat  | NL                                        | Least Concern                    | DS     |
| 11             | <i>Lepus nigricollis</i>          | Black-naped hare       | II                                        | Least Concern                    | DS     |
| 12             | <i>Vulpes bengalensis</i>         | Indian Fox             | I                                         | Least Concern                    | NS     |
| 13             | <i>Hystrix indica</i>             | Indian Porcupine       | I                                         | Least Concern                    | NS     |
| 14             | <i>Paradoxurus hermaphroditus</i> | Asian Palm civet       | II                                        | Least Concern                    | NS     |
| 15             | <i>Prionodon pardicolor</i>       | Spotted Linsang        | I                                         | Least Concern                    | NS     |
| 16             | <i>Viverricula indica</i>         | Small Indian Civet     | II                                        | Least Concern                    | DS     |
| 17             | <i>Nycticebus coucang</i>         | Slow loris             | I                                         | Endangered                       | NS     |
| 18             | <i>Ratufa bicolor</i>             | Malayan Giant Squirrel | II                                        | Near Threatened                  | DS     |

| Sl.No        | Scientific name              | English Name                  | Schedule of Wildlife Protection Act, 2002 | Status as per IUCN Red Data List | Method |
|--------------|------------------------------|-------------------------------|-------------------------------------------|----------------------------------|--------|
| 19           | <i>Felis bengalensis</i>     | Leopard Cat                   | I                                         | Least Concern                    | NS     |
| 20           | <i>Viverra zibetha</i>       | Large Indian Civet            | II                                        | Least Concern                    | NS     |
| 21           | <i>Felis chaus</i>           | Jungle Cat                    | II                                        | Least Concern                    | NS     |
| 22           | <i>Ratufa indica</i>         | Indian Giant Squirrel         | II                                        | Least Concern                    | DS     |
| 23           | <i>Hystrix hodgsoni</i>      | Himalayan Crestless porcupine | I                                         | Not assessed                     | NS     |
| 24           | <i>Caprolagus hispidus</i>   | Hispid hare                   | I                                         | Endangered                       | NS     |
| 25           | <i>Paguma larvata</i>        | Himalayan Palm Civet          | I                                         | Least Concern                    | NS     |
| 26           | <i>Arctictis binturong</i>   | Binturong                     | I                                         | Vulnerable                       | NS     |
| <b>Birds</b> |                              |                               |                                           |                                  |        |
| 1            | <i>Corvus splendens</i>      | House crow                    | NL                                        | Least Concern                    | DS     |
| 2            | <i>Acridotheres tristis</i>  | Common myna                   | II                                        | Least Concern                    | DS     |
| 3            | <i>Pycnonotus cafer</i>      | Red-vented bulbul             | II                                        | Least Concern                    | DS     |
| 4            | <i>Arborophila torqueola</i> | Common Hill Partridge         | II                                        | Least Concern                    | DS     |
| 5            | <i>Anas crecca</i>           | Common teal                   | II                                        | Least Concern                    | DS     |
| 6            | <i>Eudynamys scolopacea</i>  | Koel                          | II                                        | Least Concern                    | DS     |
| 7            | <i>Spilopelia chinensis</i>  | Spotted dove                  | II                                        | Least Concern                    | DS     |
| 8            | <i>Dicrurus macrocercus</i>  | Black drongo                  | II                                        | Least Concern                    | DS     |
| 9            | <i>Lanius vittatus</i>       | Bay backed shrike             | II                                        | Least Concern                    | DS     |
| 10           | <i>Columba livia</i>         | Blue rock pigeon              | II                                        | Least Concern                    | DS     |
| 11           | <i>Rhipidura albicollis</i>  | White-throated Fantail        | II                                        | Least Concern                    | DS     |
| 12           | <i>Motacilla cinerea</i>     | Grey wagtail                  | II                                        | Least Concern                    | DS     |
| 13           | <i>Acridotheres fuscus</i>   | Jungle Mynah                  | II                                        | Least Concern                    | DS     |
| 14           | <i>Motacilla alba</i>        | White wagtail                 | II                                        | Least Concern                    | DS     |
| 15           | <i>Gracula religiosa</i>     | Hill Myna                     | I                                         | Least Concern                    | DS     |
| 16           | <i>Passer domesticus</i>     | House Sparrow                 | II                                        | Least Concern                    | DS     |
| 17           | <i>Corvus macrorhynchos</i>  | Indian jungle crow            | NL                                        | Least Concern                    | DS     |
| 18           | <i>Upupa epops</i>           | Common hoopoe                 | II                                        | Least Concern                    | DS     |
| 19           | <i>Coracias benghalensis</i> | Indian roller                 | II                                        | Least Concern                    | DS     |
| 20           | <i>Dendrocitta vagabunda</i> | Tree Pie                      | II                                        | Least Concern                    | DS     |
| 21           | <i>Copsychus saularis</i>    | Magpie robin                  | II                                        | Least Concern                    | DS     |
| 22           | <i>Surniculus lugubris</i>   | Drongo Cuckoo                 | II                                        | Least Concern                    | DS     |
| 23           | <i>Ceryle lugubris</i>       | Crested Kingfisher            | II                                        | Not assessed                     | DS     |
| 24           | <i>Pericrocotus flammeus</i> | Scarlet minivet               | II                                        | Least Concern                    | DS     |
| 25           | <i>Cinnyris asiaticus</i>    | Purple Sunbird                | II                                        | Least Concern                    | DS     |
| 26           | <i>Merops orientalis</i>     | Small green bee-eater         | II                                        | Least Concern                    | DS     |
| 27           | <i>Lonchura punctulata</i>   | Spotted Munia                 | II                                        | Least Concern                    | DS     |
| 28           | <i>Argya caudata</i>         | Common Babbler                | II                                        | Least Concern                    | DS     |
| 29           | <i>Apus affinis</i>          | Indian House Swift            | II                                        | Least Concern                    | DS     |
| 30           | <i>Haliastur Indus</i>       | Brahminy Kite                 | II                                        | Least Concern                    | NS     |
| 31           | <i>Psittacula krameri</i>    | Rose-ringed parakeet          | II                                        | Least Concern                    | DS     |
| 32           | <i>Hierococcyx varius</i>    | Common Hawk Cuckoo            | II                                        | Least Concern                    | DS     |
| 33           | <i>Orthotomus sutorius</i>   | Common tailorbird             | II                                        | Least Concern                    | DS     |

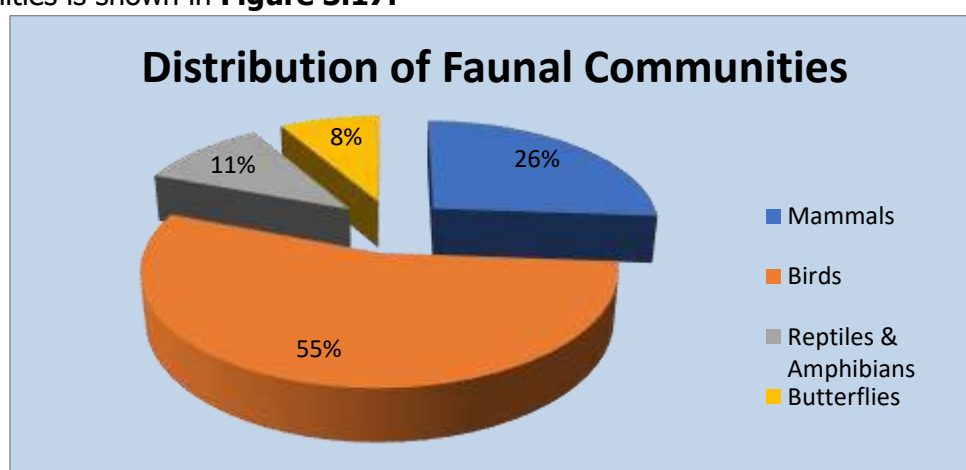
| Sl.No                            | Scientific name                  | English Name              | Schedule of Wildlife Protection Act, 2002 | Status as per IUCN Red Data List | Method |
|----------------------------------|----------------------------------|---------------------------|-------------------------------------------|----------------------------------|--------|
| 34                               | <i>Zosterops palpebrosus</i>     | Oriental White-eye        | II                                        | Least Concern                    | DS     |
| 35                               | <i>Elanus caeruleus</i>          | Black-winged Kite         | II                                        | Least Concern                    | DS     |
| 36                               | <i>Halcyon smyrnensis</i>        | White-breasted kingfisher | II                                        | Least Concern                    | DS     |
| 37                               | <i>Amaurornis phoenicurus</i>    | White-breasted waterhen   | II                                        | Least Concern                    | DS     |
| 38                               | <i>Actitis hypoleucos</i>        | Common Sandpiper          | II                                        | Least Concern                    | NS     |
| 39                               | <i>Pericrocotus ethologus</i>    | Long-tailed Minivet       | II                                        | Least Concern                    | DS     |
| 40                               | <i>Ardeola grayii</i>            | Indian Pond Heron         | II                                        | Least Concern                    | DS     |
| 41                               | <i>Saxicoloides fulicata</i>     | Indian robin              | II                                        | Least Concern                    | DS     |
| 42                               | <i>Egretta garzetta</i>          | Little egret              | II                                        | Least Concern                    | DS     |
| 43                               | <i>Dinopium benghalense</i>      | Goldenbacked Woodpecker   | II                                        | Least Concern                    | DS     |
| 44                               | <i>Acridotheres ginginianus</i>  | Bank myna                 | II                                        | Least Concern                    | DS     |
| 45                               | <i>Turdoides striata</i>         | Jungle babbler            | II                                        | Least Concern                    | DS     |
| 46                               | <i>Bubulcus ibis</i>             | Cattle egret              | II                                        | Least Concern                    | DS     |
| 47                               | <i>Garrulax monileger</i>        | Necklaced Laughing Thrush | II                                        | Least Concern                    | DS     |
| 48                               | <i>Milvus migrans</i>            | Common pariah kite        | II                                        | Least Concern                    | DS     |
| 49                               | <i>Ploceus philippinus</i>       | Baya Weaver               | II                                        | Least Concern                    | DS     |
| 50                               | <i>Prinia socialis</i>           | Ashy Prinia               | II                                        | Least Concern                    | DS     |
| 51                               | <i>Ardea alba</i>                | Great Egret               | II                                        | Least Concern                    | DS     |
| 52                               | <i>Eumyias thalassinus</i>       | Verditer Flycatcher       | II                                        | Least Concern                    | DS     |
| 53                               | <i>Anthus rufulus</i>            | Paddyfield Pipit          | II                                        | Least Concern                    | DS     |
| 54                               | <i>Oriolus oriolus</i>           | Golden oriole             | II                                        | Least Concern                    | DS     |
| <b>Reptiles &amp; Amphibians</b> |                                  |                           |                                           |                                  |        |
| 1                                | <i>Ptyas mucosus</i>             | Yellow Rat Snake          | I                                         | Not assessed                     | DS     |
| 2                                | <i>Bungarus caeruleus</i>        | Common Krait              | II                                        | Least Concern                    | DS     |
| 3                                | <i>Naja naja</i>                 | Cobra                     | I                                         | Least Concern                    | NS     |
| 4                                | <i>Varanus salvator</i>          | Water lizard              | II                                        | Least Concern                    | DS     |
| 5                                | <i>Bufoides meghalayanus</i>     | Khasi Hill Rock Toad      | II                                        | Critically Endangered            | DS     |
| 6                                | <i>Trimeresurus gramineus</i>    | Green Vipors              | II                                        | Least Concern                    | NS     |
| 7                                | <i>Varanus bengalensis</i>       | Monitor lizard            | I                                         | Near Threatened                  | DS     |
| 8                                | <i>Rana limnocharis</i>          | Rice field frog           | NL                                        | Least Concern                    | DS     |
| 9                                | <i>Calotes versicolor</i>        | Common garden lizard      | NL                                        | Not assessed                     | DS     |
| 10                               | <i>Hemidactylus flaviviridis</i> | House lizard              | II                                        | Not assessed                     | DS     |
| 11                               | <i>Varanus varanus</i>           | Tree lizard               | II                                        | Not assessed                     | DS     |
| <b>Butterflies</b>               |                                  |                           |                                           |                                  |        |
| 3                                | <i>Danaus genutia</i>            | Common tiger              | NL                                        | Not assessed                     | DS     |
| 2                                | <i>Danaus chrysippus</i>         | Plain tiger               | NL                                        | Least Concern                    | DS     |
| 6                                | <i>Graphium doson</i>            | Common Blue Jay           | NL                                        | Not assessed                     | DS     |
| 20                               | <i>Papilio polytes</i>           | Common Mormon             | NL                                        | Not assessed                     | DS     |
| 21                               | <i>Euploea core</i>              | Common crow               | NL                                        | Least Concern                    | DS     |

| Sl.No | Scientific name          | English Name        | Schedule of Wildlife Protection Act, 2022 | Status as per IUCN Red Data List | Method |
|-------|--------------------------|---------------------|-------------------------------------------|----------------------------------|--------|
| 22    | <i>Eurema brigitta</i>   | Small Grass Yellow  | NL                                        | Not assessed                     | DS     |
| 23    | <i>Papilio deneoleus</i> | Lime Butterfly      | NL                                        | Not assessed                     | DS     |
| 14    | <i>Neptis hylas</i>      | Common sailor       | NL                                        | Not assessed                     | DS     |
| 15    | <i>Eurema hecabe</i>     | Common Grass Yellow | NL                                        | Not assessed                     | DS     |
| 16    | <i>Catopsilia pomona</i> | Common Emigrant     | NL                                        | Not assessed                     | DS     |
| 17    | <i>Delias eucharis</i>   | Common Jezebel      | NL                                        | 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.

Avifauna found to be abundant (55%) within the study area while less number of mammals (26%) and reptiles/amphibians (11%) observed during field study. Distribution of faunal communities is shown in **Figure 3.17**.



**Figure 3.17 Distribution of Faunal Communities**

Livestock like cattle, goats, sheep, pigs, and poultry being common and are reared for dairy products, meat and egg. Majority of cattle and buffalo are of local variety. Poultry farming, including both layers and broilers, is also a significant activity.

With reference to the Wildlife (Protection) Amendment Act, 2022, total number of wildlife tabulated in this study can be characterized as given in the **Table 3.35**.

**Table 3.35 Characterization of Fauna in the Study Area (As Per The Wildlife (Protection) Amendment Act, 2022)**

| Sl.No. | Schedule of Wildlife (Protection) Amendment Act, 2022 | No. of species | Remark |
|--------|-------------------------------------------------------|----------------|--------|
| 1      | Schedule I                                            | 15             | -      |
| 2      | Schedule II                                           | 67             | -      |

Source: ABC Techno Labs India Pvt. Ltd.

Conservation plan is prepared for the 15 Schedule I species as per **Wildlife (Protection) Amendment Act, 2022**.

The detailed interpretation of flora and fauna identified within 10 km radius of the project site are tabulated In **Table 3.36**.

**Table 3.36: Description of Fauna**

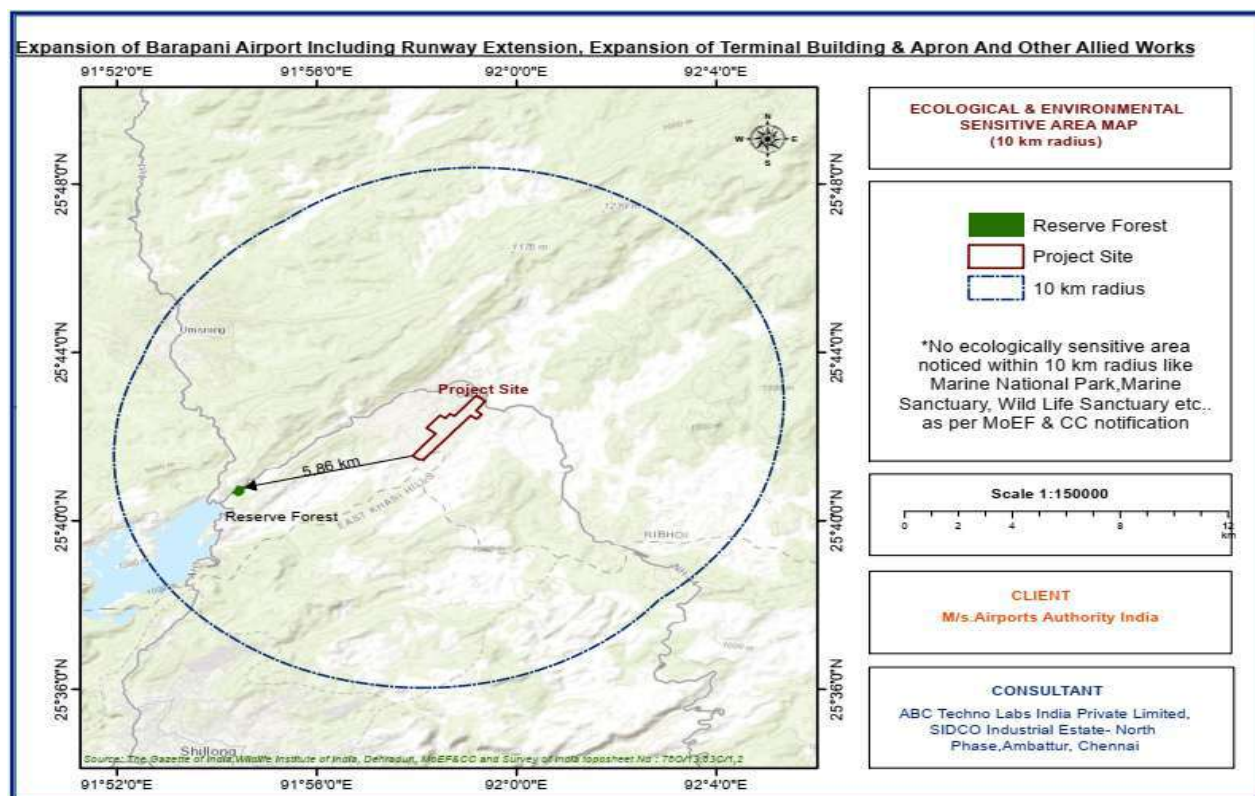
| Sl.No.       | Type of Species                    | Scientific Name              | Common Name            | Type of species |
|--------------|------------------------------------|------------------------------|------------------------|-----------------|
| <b>Fauna</b> |                                    |                              |                        |                 |
| 1            | Critically Endangered species      | <i>Bufoides meghalayanus</i> | Khasi Hill Rock Toad   | Amphibian       |
| 2            | Endangered species                 | <i>Hylobates hoolock</i>     | Hooloek Gibbon         | Mammal          |
|              |                                    | <i>Nycticebus coucang</i>    | Slow loris             | Mammal          |
|              |                                    | <i>Caprolagus hispidus</i>   | Hispid hare            | Mammal          |
| 3            | Threatened species                 | None                         | -                      | -               |
| 4            | Near Threatened species            | <i>Ratufa bicolor</i>        | Malayan Giant Squirrel | Mammal          |
| 5            | Vulnerable species                 | <i>Arctictis binturong</i>   | Binturong              | Mammal          |
| 6            | Migratory Corridors & Flight Paths | -                            |                        |                 |
| 7            | Breeding & Spawning grounds        | -                            |                        |                 |

Source: ABC Techno Labs India Pvt. Ltd.

### 3.13.6 National Park and Wildlife Sanctuary

There is no ecologically sensitive wildlife habitat like National Park, Wildlife Sanctuary, Biosphere Reserve, Elephant Reserve, Tiger Reserve, Ramsar Sites in the entire study area of the airport site. As per Meghalaya State Biodiversity Action Plan, there are no biodiversity conservation hotspots within the Shillong Master Plan area.





**Figure 3.18: Environmental Sensitivity Map of study area**

### 3.13.7 Aquatic Ecology

Evaluation of the biological impulses on study area is an integral part of an environmental impact assessment as the consequences of perturbations in the environment ultimately may affect the habitat. The proposed expansion of Shillong Airport does not effect on intense breeding/nursery grounds of economically important living resources is not anticipated. Though organisms have evolved to withstand the change within certain limits, they may not be well adapted to manmade stresses. Thus, the monitoring programme should sufficiently target the entire potential at risk. An essential pre requisite for the successful solution to these problems is to evaluate ecological impacts from the baseline information and undertake effective management plan. So, the objective of aquatic ecological study may be outlined as follows:

- To characterize water bodies like fresh waters;
- To understand their present biological status;
- To characterize water bodies with the help of biota;
- To understand the impact of industrial and urbanization activities; and
- To suggest recommendations to counter adverse impacts, if any on the ecosystem.

To meet these objectives the following methods were followed:

- Generating data by actual field sampling and analysis in these areas through field visits during study period; and

- Discussion with local people to get the information for aquatic plants and aquatic animals.

Several samples were investigated for enumeration of aquatic flora & fauna. In order to study aquatic flora and faunal life one time survey was conducted during the winter season. Major component of the aquatic life under the study area are listed below:

- *Aquatic macrophytes*
- *Aquatic vertebrates like fish, amphibians etc.*

While considering assessment of aquatic pollution and its implications, it must be realized that, despite many changes in the physico-chemical properties of the water body, the ultimate consequences of pollutants may be reflected inevitably on the biological system. Hence, the investigations of an ecosystem and particularly of its communities constitute an integral part of any ecological assessment. This can be achieved by selecting a few reliable parameters from a complex community structure. The parameters considered have phytoplankton, zooplankton and status of fishery. The first two reflect the productivity of a water column at the primary and secondary levels, respectively. Information on larval stages of fishes was used to evaluate probable occurrence of spawning and breeding grounds of economically important species.

**Riverine Habitat:** The major rivers in the block are Wah Umiam River and Umkhen River. There are also numbers of streams and seasonal rivers. All these rivers and nalas are forms the riverine ecosystem. There is large reservoir namely Umiam Reservoir in the study area. Adjacent to the rivers riparian vegetation was also recorded. The riverine ecosystem is also suitable habitat for fresh water fishes.

To assess the planktonic profile of Phytoplankton and Zooplankton, 2 water samples from Umiam River and Umkhen River were collected at sub surface level. The aquatic ecological study was conducted in different water bodies of the study area and the flora and fauna was recorded.

#### □ **Macrophytes**

The following macrophytes observed within the study area:

| Sl.No. | Scientific name               | Common name            |
|--------|-------------------------------|------------------------|
| 1      | <i>Hydrilla verticillata</i>  | Hydrilla               |
| 2      | <i>Ipomea aquatica</i>        | Water Morning Glory    |
| 3      | <i>Phragmites karka</i>       | Tropical Reed          |
| 4      | <i>Alternanthera sessilis</i> | Dwarf Copperleaf       |
| 5      | <i>Cyperus iria</i>           | Rice flat sedge        |
| 6      | <i>Nymphoides cristata</i>    | Crested floating heart |
| 7      | <i>Eichhornia crassipes</i>   | Common water hyacinth  |
| 8      | <i>Najas indica</i>           | Waternymph             |
| 9      | <i>Lemna sp.</i>              | Common duckweed        |

| Sl.No. | Scientific name              | Common name     |
|--------|------------------------------|-----------------|
| 10     | <i>Polygonum barbatum</i>    | Knot gras       |
| 11     | <i>Enhydra fluctuans</i>     | Water Cress     |
| 12     | <i>Typha angustifolia</i>    | Lesser Bulrush  |
| 13     | <i>Hygrophila auriculata</i> | Marsh Barbel    |
| 14     | <i>Nymphaea pubescens</i>    | Pink Water Lily |
| 15     | <i>Nelumbo nucifera</i>      | Lotus           |
| 16     | <i>Pistia stratiotis</i>     | Water cabbage   |

Source: ABC Techno Labs India Pvt. Ltd.

#### ❑ Fish Species in the Study Area

The fish species reported in the study area are tabulated in **Table** below:

| Sl.No | Scientific name                     | English Name              |
|-------|-------------------------------------|---------------------------|
| 1     | <i>Cyprinus carpio</i>              | Common carp               |
| 2     | <i>Channa punctatus</i>             | Lata                      |
| 3     | <i>Channa gachua</i>                | Dwarf snakehead           |
| 4     | <i>Labeo gonius</i>                 | Kuria labeo               |
| 5     | <i>Labeo dero</i>                   | Kalabans                  |
| 6     | <i>Labeo calbasu</i>                | Calbasu                   |
| 7     | <i>Cirrhinus mrigala</i>            | Mrigal                    |
| 8     | <i>Cirrhinus reba</i>               | Reba carp                 |
| 9     | <i>Neolissochilus hexagonolepis</i> | Copper mahseer            |
| 10    | <i>Lepidocephalichthys guntea</i>   | Peppered loach            |
| 11    | <i>Acanthocobitis botia</i>         | Mottled loach             |
| 12    | <i>Botia dario</i>                  | Bengal loach              |
| 13    | <i>Parambassis baculis</i>          | Himalayan Glassy Perchlet |
| 14    | <i>Mystus bleekeri</i>              | Gulsha Tengra             |
| 15    | <i>Amblyceps apangi</i>             | Indian Torrent Catfish    |
| 16    | <i>Badis badis</i>                  | Blue perch                |
| 17    | <i>Tor putitora</i>                 | Golden mahseer            |

Source: ABC Techno Labs India Pvt. Ltd.

Wilderness fishes like chanda, ghute etc., are now rare due to the indiscriminate use of organochlorine pesticides which contaminate the run-off from agricultural fields and flow into the wetlands from their catchments areas. A total of 18 species of fishes species were recorded from these aquatic ecosystems.

### 3.14 Socio-Economic Environment

#### 3.14.1 Introduction

The socio-economic and demographic profile of the study area is discussed in the following sections of this chapter. The study area encompasses settlements located within Ri Bhoi

District. Information regarding the number of villages, their geographical area, household count, population figures, and literacy rates has been sourced from the *District Census Handbook, 2011* for Ri Bhoi District. Infrastructure development in any region inevitably influences the socio-economic conditions of the local population. These effects can be either beneficial or adverse, depending on the nature and scale of the proposed activities. To evaluate the potential socio-economic impacts of the proposed expansion of Barapani (Shillong) Airport, it is essential to first understand the existing socio-economic conditions in the region.

### **3.14.2 Demographic and Occupational Pattern of Ri Bhoi District**

**Table 3.37** shows the demographic details of Ri Bhoi District. Ri Bhoi District covers a geographical area of approximately 2378 square kilometers, accounting for about 10.6% of the total area of Meghalaya, which spans 22429 square kilometers.

As per 2011 Census, Ri Bhoi district had population of 258840 of which male and female were 132388 and 126452 respectively. The male population constitutes 51.2% while female population is 48.9%. Ri Bhoi District population constituted 8.7 % of total Meghalaya population.

#### **Ri Bhoi Literacy Rate**

Average literacy rate of Ri Bhoi in 2011 was 75.67% (persons aged 7 and above). If things are looked out at gender wise, male and female literacy were 76.79% and 74.49% respectively. Total literates in Ri Bhoi District were 155859 of which male and female were 80977 and 74882, respectively.

#### **Sex Ratio in Ri Bhoi District**

With regards to sex ratio in Ri Bhoi, there are 955 females per 1000 males, which is lower than the sex ratio Meghalaya (989).

#### **Population Density of Ri District**

Population density is Ri District is 127 persons per sqkm

#### **Occupational Pattern of Ri Bhoi District**

Ri Bhoi District exhibits a predominantly agrarian occupational structure with gradual diversification into other sectors.

### **1. Primary Sector (Agriculture and Allied Activities)**

**Dominant Occupation:** A majority of the population in Ri Bhoi is engaged in agriculture, particularly in subsistence farming and shifting cultivation (locally known as jhum).

**Major Crops:** Rice (main staple), maize, millets, pulses, and cash crops like ginger, turmeric (notably Lakadong variety), and areca nut.

**Horticulture:** Increasing engagement in pineapple, banana, and orange cultivation.

**Animal husbandry:** Rearing of cattle, pigs, poultry, and goats is common.

**Fisheries:** Practiced at small-scale, especially in low-lying areas and wetlands.

### **2. Secondary Sector (Manufacturing and Industry)**

**Small-scale Industries:** Handloom weaving, traditional crafts, and food processing units are emerging, especially in peri-urban areas.

**Construction work:** Provides seasonal employment to both local and migrant laborers.

**Industrial Growth:** The presence of industrial units in Umiam Industrial Area (near Nongpoh) contributes to employment in manufacturing and service-related industries.

### **3. Tertiary Sector (Services and Trade)**

**Government Employment:** Includes teachers, police, forest guards, and other administrative roles.

**Private Sector Jobs:** Retail trade, hospitality (hotels and restaurants along NH-6), and transport services are gaining significance.

**Tourism-related Services:** Growing near natural attractions like Umiam Lake, providing opportunities in eco-tourism, guide services, and hospitality.

#### **3.14.3 Demographics Details of the Settlements in the Study Area**

The study area is located Ri Bhoi District. Demographic details including data on settlements with number of households, population as well as scheduled cast and scheduled tribe in the settlements located in 10 km radius of expansion of Barapani (Shillong) Airport has been obtained from census records 2011 and presented in **Table 3.38**. From the tabulated data following observations can be made:

## **A. House Holds**

In the settlements located in the study area, there are total 5384 households as per census records 2011.

## **B. Population**

As per census records, the population of settlements in the study area is 30837. The male population constituted nearly 54.1% persons while the female population is 45.9% of the total population.

## **C. Sex Ratio**

As per census records, sex ratio is defined as the number of females per 1000 males. As per census records, sex ratio in settlements located in the study area are 850, which is more than from sex ratio for Ri Bhoi (955) and Meghalaya State (989).

## **D. Schedule Caste**

In the study area, scheduled castes population is 0.23%.

## **E. Schedule Tribe**

In the study area, scheduled tribes' population is 80.8% of the total population.

## **F. Population Below 6 Years**

In the study area, population below 6 years population is 20.2% of the total population.

### **3.14.4 Socio-Economic Status of the Study Area**

About 80% of the population depends on agriculture: staple (paddy, maize, winter vegetables) and cash crops (ginger, pineapple, turmeric. The area is a key hub for horticulture and ginger area, capsicum; however, poor market access and pricing practices limit farmers' income. Allied activities like piggery, poultry, fish farming, handloom are prevalent in the study area.

### **Cropping Pattern**

In the region, rice is the principal food grain, cultivated both through traditional jhum (slash-and-burn) methods and in wet paddy fields. Maize is another widely grown crop, particularly during the winter season. Small millets are typically cultivated during the rabi season. Cowpea, rich in protein, is grown in rice fallow areas during the summer. Soybean is also cultivated

during the kharif season. Among cash crops, ginger stands out as one of the major produce of Ri-Bhoi, while the Lakadong variety of turmeric is especially popular. Additionally, a variety of fruits such as oranges, bananas, papayas, and litchis are extensively grown across the region.

## **Livestock**

Rearing of livestock, though popular, is only a subsidiary occupation of the area. In terms of number, poultry takes the first place followed by cattle, pigs and goats. In terms of economic value, cattles are the most important. In order to provide protection to the livestock and poultry from the ravage of contagious and non-contagious diseases through treatment and preventive vaccination and to improve the level of production of livestock, the Ri Bhoi district has a total number of 15 dispensaries, 2 Aid Centres and 1 mobile veterinary dispensary. Two veterinary dispensaries viz., Umden Veterinary Dispensary and Cattle Farm Kyrdemkulai are equipped with artificial insemination facilities.

### **3.14.5 Living Standards and Infrastructure**

Availability of amenities like education, medical, water supply, communication, road network, electricity, etc. significantly reflects the level of development of an area. The amenity available in the study area are presented **Table 3.38**: Information on available amenities in the study area was gathered during field studies and the same is discussed in the following subsections:

#### **Educational Facilities**

The primary level education facilities are available in mostly all the settlements. Excellent educational facilities including higher education institutes, engineering and technology institutes, medical etc are available in the Shillong and availed by the people of the study area.

#### **Medical Facilities**

In the study area good medical facilities are available in the area. Most of the village can access medical facilities at distance of maximum 5 km.

#### **Drinking Water Supply**

All villages of the study area have drinking water facility.

#### **Communication**

The villages of the study area have phone connections. Mobile network is also available in the all villages of the study area.

### **Approach to villages**

All the villages in the study area can be approached by pacca or gravel roads.

### **Power Supply**

Electricity exists in all the villages for agricultural/all purposes.

### **3.15 Heritage Structures with Study area**

There are no heritage structures within 5 km from the proposed expansion of Barapani Airport.



**Table 3.37: Demographic Details of the Study Area**

| <b>Sr. No.</b> | <b>Village Name</b> | <b>Total House holds</b> | <b>Total Population</b> | <b>Male Population</b> | <b>Female Population</b> | <b>Male (0-6)</b> | <b>Female (0-6)</b> | <b>Scheduled Castes</b> | <b>Total Scheduled Tribes Male</b> | <b>Total Scheduled Tribes Female</b> |
|----------------|---------------------|--------------------------|-------------------------|------------------------|--------------------------|-------------------|---------------------|-------------------------|------------------------------------|--------------------------------------|
| 1.             | Nongspung A         | 34                       | 183                     | 101                    | 82                       | 26                | 14                  | 0                       | 100                                | 81                                   |
| 2.             | Umden la-ang        | 60                       | 304                     | 163                    | 141                      | 46                | 40                  | 0                       | 161                                | 141                                  |
| 3.             | Umden Nongtluh      | 92                       | 548                     | 270                    | 278                      | 42                | 41                  | 0                       | 269                                | 278                                  |
| 4.             | Nartap              | 64                       | 399                     | 202                    | 197                      | 42                | 41                  | 0                       | 202                                | 197                                  |
| 5.             | Nonglum             | 33                       | 186                     | 100                    | 86                       | 87                | 90                  | 0                       | 5                                  | 6                                    |
| 6.             | Mawrong             | 203                      | 1260                    | 611                    | 649                      | 130               | 126                 | 0                       | 606                                | 647                                  |
| 7.             | Mawlyngkhung        | 125                      | 717                     | 350                    | 367                      | 66                | 78                  | 0                       | 346                                | 365                                  |
| 8.             | Sohpdok             | 72                       | 374                     | 192                    | 182                      | 35                | 47                  | 0                       | 190                                | 180                                  |
| 9.             | Lyngsaw             | 35                       | 178                     | 96                     | 82                       | 26                | 15                  | 5                       | 94                                 | 79                                   |
| 10.            | Tdohumsiang         | 80                       | 480                     | 232                    | 248                      | 48                | 60                  | 0                       | 227                                | 244                                  |
| 11.            | Laiphew Diengngan   | 173                      | 942                     | 501                    | 441                      | 141               | 103                 | 0                       | 475                                | 424                                  |
| 12.            | Tdohumshiaiw        | 47                       | 220                     | 109                    | 111                      | 24                | 31                  | 0                       | 108                                | 110                                  |
| 13.            | Khlieh Umtrew       | 82                       | 517                     | 260                    | 257                      | 63                | 68                  | 0                       | 258                                | 254                                  |
| 14.            | Rilong              | 85                       | 468                     | 259                    | 209                      | 77                | 51                  | 0                       | 250                                | 199                                  |
| 15.            | Mawkhap             | 43                       | 216                     | 122                    | 94                       | 29                | 21                  | 0                       | 119                                | 90                                   |
| 16.            | Bir                 | 34                       | 176                     | 104                    | 72                       | 32                | 22                  | 0                       | 102                                | 72                                   |
| 17.            | Thad                | 155                      | 660                     | 348                    | 312                      | 99                | 60                  | 0                       | 346                                | 311                                  |
| 18.            | Syllei-U-Lar        | 58                       | 310                     | 156                    | 154                      | 39                | 41                  | 0                       | 156                                | 154                                  |
| 19.            | Madan Rtiang        | 27                       | 138                     | 76                     | 62                       | 18                | 13                  | 0                       | 75                                 | 62                                   |
| 20.            | Khwenng             | 98                       | 551                     | 267                    | 284                      | 66                | 58                  | 2                       | 264                                | 281                                  |
| 21.            | Kdonghulu           | 44                       | 252                     | 120                    | 132                      | 11                | 22                  | 0                       | 118                                | 132                                  |
| 22.            | Mawbri              | 118                      | 714                     | 356                    | 358                      | 68                | 58                  | 0                       | 355                                | 356                                  |
| 23.            | Umlangling          | 75                       | 430                     | 217                    | 213                      | 57                | 59                  | 0                       | 212                                | 209                                  |
| 24.            | Pynthor             | 140                      | 844                     | 436                    | 408                      | 86                | 91                  | 2                       | 431                                | 408                                  |
| 25.            | Umsawriang          | 57                       | 310                     | 167                    | 143                      | 40                | 21                  | 0                       | 163                                | 139                                  |
| 26.            | Umktieh             | 187                      | 1066                    | 530                    | 536                      | 121               | 127                 | 0                       | 509                                | 532                                  |
| 27.            | Umroi               | 1300                     | 8198                    | 5290                   | 2908                     | 580               | 562                 | 56                      | 1742                               | 1808                                 |

| Sr. No. | Village Name              | Total House holds | Total Population | Male Population | Female Population | Male (0-6)  | Female (0-6) | Scheduled Castes | Total Scheduled Tribes Male | Total Scheduled Tribes Female |
|---------|---------------------------|-------------------|------------------|-----------------|-------------------|-------------|--------------|------------------|-----------------------------|-------------------------------|
| 28.     | Pyllun                    | 156               | 891              | 405             | 486               | 65          | 104          | 0                | 291                         | 377                           |
| 29.     | Umiet                     | 161               | 757              | 378             | 379               | 98          | 90           | 0                | 358                         | 365                           |
| 30.     | Umden Arka                | 117               | 653              | 330             | 323               | 90          | 74           | 0                | 330                         | 323                           |
| 31.     | Umden Mission             | 114               | 600              | 289             | 311               | 47          | 71           | 0                | 266                         | 301                           |
| 32.     | Umtung                    | 139               | 797              | 413             | 384               | 94          | 95           | 0                | 413                         | 384                           |
| 33.     | Mawtneng                  | 150               | 879              | 438             | 441               | 85          | 77           | 0                | 432                         | 439                           |
| 34.     | Ludaitkhla B              | 171               | 994              | 524             | 470               | 120         | 73           | 0                | 515                         | 464                           |
| 35.     | Bhoilymbong (Lumsohpieng) | 199               | 1067             | 535             | 532               | 92          | 96           | 0                | 527                         | 527                           |
| 36.     | Umket                     | 173               | 941              | 449             | 492               | 98          | 94           | 0                | 444                         | 490                           |
| 37.     | Palwi                     | 72                | 434              | 216             | 218               | 54          | 55           | 0                | 216                         | 218                           |
| 38.     | Umiam Hydel Project A     | 42                | 261              | 133             | 128               | 18          | 21           | 6                | 95                          | 94                            |
| 39.     | Umiam Hydel Project B     | 58                | 335              | 163             | 172               | 27          | 23           | 0                | 108                         | 124                           |
| 40.     | Umiam Hydel Project C     | 62                | 308              | 143             | 165               | 15          | 19           | 0                | 63                          | 72                            |
| 41.     | Umiam Hydel Project D     | 161               | 820              | 397             | 423               | 60          | 71           | 0                | 270                         | 296                           |
| 42.     | Lumdiengngan              | 73                | 369              | 185             | 184               | 36          | 48           | 0                | 185                         | 184                           |
| 43.     | Mynsain                   | 15                | 90               | 39              | 51                | 77          | 67           | 0                | 39                          | 51                            |
|         | <b>Total</b>              | <b>5384</b>       | <b>30837</b>     | <b>16672</b>    | <b>14165</b>      | <b>3175</b> | <b>3038</b>  | <b>71</b>        | <b>12435</b>                | <b>12468</b>                  |

Source: Census Record-2011

**Table 3.38: Amenities in the Study Area**

| <b>Sr No</b> | <b>Village Name</b> | <b>Pre - Primary School</b> | <b>Primary School</b> | <b>Middle School</b> | <b>Secondary School</b> | <b>Health Facility</b> | <b>Drinking Water</b> | <b>Hand Pump/ Well/ Borewell/ Spring</b> | <b>Telephone/ Mobile</b> | <b>Approach Road</b> |
|--------------|---------------------|-----------------------------|-----------------------|----------------------|-------------------------|------------------------|-----------------------|------------------------------------------|--------------------------|----------------------|
| 1.           | Nongspung A         | Yes                         | Yes                   | Yes                  | No                      | No                     | Yes                   | Yes                                      | Yes                      | Yes                  |
| 2.           | Umden Ia-ang        | Yes                         | Yes                   | Yes                  | No                      | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 3            | Umden Nongtluh      | Yes                         | Yes                   | Yes                  | Yes                     | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 4.           | Nartap              | Yes                         | Yes                   | No                   | No                      | No                     | Yes                   | Yes                                      | Yes                      | Yes                  |
| 5.           | Nonglum             | Yes                         | Yes                   | No                   | No                      | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 6.           | Mawrong             | Yes                         | Yes                   | Yes                  | Yes                     | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 7.           | Mawlyngkhung        | Yes                         | Yes                   | Yes                  | No                      | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 8.           | Sohpdok             | Yes                         | Yes                   | Yes                  | No                      | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 9.           | Lyngsaw             | Yes                         | Yes                   | No                   | No                      | No                     | Yes                   | Yes                                      | Yes                      | Yes                  |
| 10.          | Tdohumsiang         | Yes                         | Yes                   | No                   | No                      | No                     | Yes                   | Yes                                      | Yes                      | Yes                  |
| 11.          | Laiphew Diengngan   | Yes                         | Yes                   | Yes                  | No                      | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 12.          | Tdohumshiaiw        | Yes                         | Yes                   | No                   | No                      | No                     | Yes                   | Yes                                      | Yes                      | Yes                  |
| 13.          | Khlieh Umtrew       | Yes                         | Yes                   | Yes                  | No                      | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 14.          | Rilong              | Yes                         | Yes                   | Yes                  | No                      | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 15.          | Mawkhap             | Yes                         | Yes                   | No                   | No                      | No                     | Yes                   | Yes                                      | Yes                      | Yes                  |
| 16.          | Bir                 | Yes                         | Yes                   | No                   | No                      | No                     | Yes                   | Yes                                      | Yes                      | Yes                  |
| 17.          | Thad                | Yes                         | Yes                   | Yes                  | No                      | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 18.          | Syllei-U-Lar        | Yes                         | Yes                   | No                   | No                      | No                     | Yes                   | Yes                                      | Yes                      | Yes                  |
| 19.          | Madan Rtiang        | Yes                         | Yes                   | No                   | No                      | No                     | Yes                   | Yes                                      | Yes                      | Yes                  |
| 20.          | Khweng              | Yes                         | Yes                   | Yes                  | No                      | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 21.          | Kdonghulu           | Yes                         | Yes                   | Yes                  | Yes                     | No                     | Yes                   | Yes                                      | Yes                      | Yes                  |
| 22.          | Mawbri              | Yes                         | Yes                   | Yes                  | Yes                     | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 23.          | Umlangling          | Yes                         | Yes                   | No                   | No                      | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 24.          | Pynthor             | Yes                         | Yes                   | Yes                  | Yes                     | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 25.          | Umsawriang          | Yes                         | Yes                   | Yes                  | No                      | No                     | Yes                   | Yes                                      | Yes                      | Yes                  |
| 26.          | Umktieh             | Yes                         | Yes                   | Yes                  | Yes                     | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 27.          | Umroi               | Yes                         | Yes                   | Yes                  | Yes                     | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |

| <b>Sr No</b> | <b>Village Name</b>       | <b>Pre - Primary School</b> | <b>Primary School</b> | <b>Middle School</b> | <b>Secondary School</b> | <b>Health Facility</b> | <b>Drinking Water</b> | <b>Hand Pump/ Well/ Borewell/ Spring</b> | <b>Telephone/ Mobile</b> | <b>Approach Road</b> |
|--------------|---------------------------|-----------------------------|-----------------------|----------------------|-------------------------|------------------------|-----------------------|------------------------------------------|--------------------------|----------------------|
| 28.          | Pyllun                    | Yes                         | Yes                   | No                   | No                      | No                     | Yes                   | Yes                                      | Yes                      | Yes                  |
| 29.          | Umiet                     | Yes                         | Yes                   | Yes                  | No                      | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 30.          | Umden Arka                | Yes                         | Yes                   | Yes                  | No                      | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 31.          | Umden Mission             | Yes                         | Yes                   | Yes                  | No                      | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 32.          | Umtung                    | Yes                         | Yes                   | Yes                  | No                      | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 33.          | Mawtneng                  | Yes                         | Yes                   | Yes                  | Yes                     | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 34.          | Ludaitkhla B              | Yes                         | Yes                   | No                   | No                      | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 35.          | Bhoilymbong (Lumsohpieng) | Yes                         | Yes                   | Yes                  | Yes                     | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 36.          | Umket                     | Yes                         | Yes                   | Yes                  | No                      | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 37.          | Palwi                     | Yes                         | Yes                   | No                   | No                      | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 38.          | Umiam Hydel Project A     | Yes                         | Yes                   | Yes                  | Yes                     | No                     | Yes                   | Yes                                      | Yes                      | Yes                  |
| 39.          | Umiam Hydel Project B     | Yes                         | Yes                   | Yes                  | Yes                     | No                     | Yes                   | Yes                                      | Yes                      | Yes                  |
| 40.          | Umiam Hydel Project C     | Yes                         | Yes                   | Yes                  | No                      | No                     | Yes                   | Yes                                      | Yes                      | Yes                  |
| 41.          | Umiam Hydel Project D     | Yes                         | Yes                   | No                   | No                      | Yes                    | Yes                   | Yes                                      | Yes                      | Yes                  |
| 42.          | Lumdiengngan              | Yes                         | Yes                   | No                   | No                      | No                     | Yes                   | Yes                                      | Yes                      | Yes                  |
| 43.          | Mynsain                   | Yes                         | Yes                   | No                   | No                      | No                     | Yes                   | Yes                                      | Yes                      | Yes                  |

## **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 proposed expansion of Barapani (Shillong) 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 the expansion of Barapani (Shillong) 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: (i.) planning and design stage; (ii) construction stage; and (iii) operation stage.

This chapter discusses the identification and appraisal of various environmental impacts due to the planning, design construction and operation of the expansion of Barapani (Shillong) Airport. The construction and operation phases of the expansion of Barapani (Shillong) Airport will comprise various activities, each of which may have adverse or beneficial impact on environmental parameters. Various anticipated environmental impacts during the construction and operation phases on the environmental parameters have been studied to evaluate and estimate its impact on the environment. The environmental impacts can be categorized as either primary or secondary. Primary impacts are those, which are attributable directly to the project, secondary impacts are those, which are indirectly induced and typically include the associated impacts and changed pattern of social and economic activities by the expansion of Barapani (Shillong) Airport.

The design, construction and operational phase of the expansion of Barapani (Shillong) Airport comprises various activities each of which may have an impact on some or other environmental parameters. Various environmental attributes during the construction and operation phase have been studied/analyzed to estimate the overall impacts on the surrounding environment.

Due to the proposed expansion of Barapani (Shillong) Airport, water environment, air environment, noise, land environment, ecological environment and socio-economic factors are identified as the significant environmental components likely to be affected. The anticipated impacts on the environmental components are identified, quantitatively/qualitatively evaluated, predicted and discussed below with suitable mitigation measures.

#### **4.1.1 Methodology for Qualitatively Assessment of Environmental Impacts**

The anticipated environmental impacts due to the proposed expansion of Barapani (Shillong) 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 for the proposed expansion of Barapani (Shillong) Airport in the area. For the expansion of Barapani (Shillong) Airport, the impacts assessment has been carried out in the following three steps:

- Step 1 : Identification of interface between project activities and 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 the proposed expansion of Barapani (Shillong) Airport, it is determined whether an interface exists between project activity and an environmental receptor.

In Step 2, on the basis of interface identified in Step 1, potential environmental impacts due to the proposed expansion of Barapani (Shillong) Airport 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**.

**Table 4.1: Impact Assessment Rating Matrix**

| <b>Impact</b>      |            | <b>Criteria</b>                                     |
|--------------------|------------|-----------------------------------------------------|
| Nature of Impact   | Beneficial | Positive                                            |
|                    | Adverse    | Negative                                            |
| Duration of Impact | Short term | Impacts shall be confined to a stipulated time      |
|                    | Long term  | Impacts shall continue till the end of project life |
| Impacted Area      | Localized  | Impacts shall be confined within 10 km radius       |
|                    | Regional   | Impacts shall continue beyond 10 km radius          |

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).

The significance of each environmental impact is determined by assessing the impact's severity against the likelihood of the environmental impact occurring, as summarized in the environmental impact significance assessment matrix provided in **Table 4.2**.

**Table 4.2: Impact Assessment Rating Matrix**

| Impact Severity | Impact Likelihood                                                         |                                                                                   |                                                            |                                                                      |
|-----------------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------|----------------------------------------------------------------------|
|                 | Unlikely ( <i>e.g.</i> not expected to occur during the project lifetime) | Low Likelihood ( <i>e.g.</i> may occur once or twice during the project lifetime) | Medium Likelihood ( <i>e.g.</i> may occur every few years) | High Likelihood ( <i>e.g.</i> 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

The one of primary purpose of the proposed expansion of Barapani (Shillong) Airport is to provide facilities for departure and arrival of air passengers by construction of new terminal building, runway extension for landing and take-off A 320 types, taxiway, apron for 5 nos. of Code - C Aircraft in power - in push - back configuration and associated facilities. Accordingly, keeping in view the current and future requirement, proposed terminal building, runway extension, taxiway and apron at expansion of Barapani (Shillong) Airport are proposed.

The likely impacts of the proposed expansion of Barapani (Shillong) Airport would be due to:

- Pre-construction Phase
- Construction phase, which would be mainly regarded as temporary or short term; and
- Operation phase, which would have long-term and permanent impacts.

The construction and operation phases of the proposed expansion of Barapani (Shillong) Airport comprise of various activities, which have been considered to assess the anticipated impact on one or other environmental parameter as described in the following sections:

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 expansion of Barapani (Shillong) Airport and corresponding mitigation measures for construction and operation phases have been described in the following sub-sections:

#### **4.2 Anticipated Impact and Mitigation Measures for Pre-Construction Phase**

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

#### **4.3 Anticipated Impact and Mitigation Measures for Construction Phase**

The construction phase will mainly consist of transportation of machinery and construction materials to be used for construction, clearing and levelling of land, construction of terminal



building, runway extension taxi way apron, etc and associated works as per approved design, etc.

#### **4.3.1 Topography & Physiography**

Topography at the site is almost plain. The construction for the proposed expansion of Barapani (Shillong) Airport will be confined within existing 416.16 Acres land and encumbrance free 22 Acres land by Government of Meghalaya. For expansion and construction of runway, 1273976 cum cutting and 197136 cum filling will be required, which will be utilized at the site. Impact related to excavations and transportation of excavated materials will not appear from the project. Hence, the anticipated impact on the topography during construction phase is rated as:

| <b>Environmental Impact Rating</b> | <b>Topography &amp; Physiography</b> |
|------------------------------------|--------------------------------------|
| Nature of Impact                   | Adverse                              |
| Duration of Impact                 | Long term                            |
| Impacted Area                      | Localized                            |
| Likelihood of Occurrence           | Low                                  |
| Severity of Impact                 | Low                                  |
| Significance of Impact             | Low                                  |

#### **Mitigation Measures**

- 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.
- Borrowing of soil will be procured only from approved borrow area having valid environmental from Environmental Impact Assessment Authority (SEIAA), Meghalaya.

#### **4.3.2 Land Use Pattern**

For construction of proposed extension of runway under the expansion of Barapani (Shillong) Airport, total 22 Acres additional land is required, which is being transferred by State Govt of Meghalaya to AAI. The land use pattern of 22 Acres land will be changed permanently, however this impact will be localized. The impact on the land use pattern of the area during construction phase is rated as:

| <b>Environmental Impact Rating</b> | <b>Land Use pattern</b> |
|------------------------------------|-------------------------|
| Nature of Impact                   | Adverse                 |
| Duration of Impact                 | Long term               |
| Impacted Area                      | Localized               |
| Likelihood of Occurrence           | Low                     |

|                        |            |
|------------------------|------------|
| Severity of Impact     | Slight     |
| Significance of Impact | Negligible |

### **Mitigation Measures**

- Land clearing for construction site will be kept to the absolutely minimum practicable;
- 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.

### **4.3.3 Soil Quality**

At the time of construction, small quantity of debris, cuttings of construction materials, etc, will be generated at the construction site. Inert wastes and debris generated at the construction site will be collected time to time and disposed suitably to avoid contamination of earth.

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

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

| <b>Environmental Impact Rating</b> | <b>Soil Quality</b> |
|------------------------------------|---------------------|
| Nature of Impact                   | Adverse             |
| Duration of Impact                 | Short term          |
| Impacted Area                      | Localized           |
| Likelihood of Occurrence           | Low                 |
| Severity of Impact                 | Slight              |
| Significance of Impact             | Negligible          |

### **Mitigation Measures**

- Top soil from the construction sites and runway extension area will be preserved and reused for green area and landscaping on city side of airport.

- Compaction and stabilization will be ensured during filling to ensure that no loose soil is washed away with runoff during rains,
- Restoration of land surface with the site condition and contours, prior to initiation of construction activities,
- Wastes, fuel, oil drums, used oil, etc. would be collected and disposed properly,
- Dust bins will be placed at requisite locations at construction site and there will be segregation of wastes before disposal,
- Used oil from maintenance of DG sets engines and construction equipment will be collected separately in drums and will be handed over to the authorized used oil recyclers by the Meghalaya Pollution Control Board (MSPCB) as per the CPCB guidelines.
- Approx. 15-20 kg per day municipal wastes, like, plastic, paper, packing waste, bottles, oil contaminated cottons and clothes, food waste from labour camp, etc will also be generated and may contaminate soil of the site, if not disposed properly. These wastes will be segregated and disposed as per Solid Waste Management Rule, 2016.

#### **4.3.4 Drainage Pattern**

For construction of the expansion of Barapani (Shillong) Airport, existing 416.16 Acres and 22 Acres land provided by Government of Meghalaya will be used. Contour mapping of entire project has been done and based on that drainage and storm water management planning has been done for project development activities. The storm water management has been designed by providing storm water drains including both sides of runway and culverts. Drains and culverts will meet the requirement of DGCA-CAR requirement. Storm water management/drainage plan for the airport has been prepared to ensure that no rain water accumulation at and around the Barapani airport.

It will be ensured that no flooding at and around the airport during rains. The anticipated impact on the natural drainage pattern during construction phase is rated as:

| <b>Environmental Impact Rating</b> | <b>Drainage Pattern</b> |
|------------------------------------|-------------------------|
| 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**

- Slope and storm water management shall be provided to maintain drainage and flow of runoff in the drain.

- At the airport site, storm water drains including both sides of runway and 9 culverts have been provided.
- Drainage at the site will be maintained as per drainage counter at the site, therefore, no flooding will be occurred at and around the expansion of Barapani (Shillong) Airport during the construction phase.

#### **4.3.5 Flooding**

The expansion of Barapani (Shillong) Airport is not geographically vulnerable to floods. There is no direct record of runway flooding or airport shutdown due to internal flooding at Shillong. During the construction of the proposed expansion of Barapani (Shillong) Airport, natural drainage will be maintained properly by storm water management.

The impact from the flood due to construction of the expansion of Barapani (Shillong) Airport is rated as:

| <b>Environmental Impact Rating</b> | <b>Natural Disaster- Flood</b> |
|------------------------------------|--------------------------------|
| Nature of Impact                   | Adverse                        |
| Duration of Impact                 | Short term                     |
| Impacted Area                      | Localized                      |
| Likelihood of Occurrence           | Low                            |
| Severity of Impact                 | Low                            |
| Significance of Impact             | Minor                          |

#### **Mitigation Measures**

- Area within the site for construction of expansion of Barapani (Shillong) Airport shall be graded properly;
- Natural drainage will be maintained at the airport site by providing culverts and drains.
- Construction of storm water drainage channels will not allow water logging at the construction site and in surrounding area.

#### **4.3.6 Water Resources**

During the construction phase of the proposed expansion of Barapani (Shillong) Airport, approx 40-50 kl/day water will be required depending upon the type of construction activities. Water requirement will be met through water supply by borewells/ Greater Shillong Water Supply Scheme. The construction will be completed within in approximately approx. 24 months time. The construction water requirement would be temporary in nature depending nature of construction activities. 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:

| <b>Environmental Impact Rating</b> | <b>Water Resources</b> |
|------------------------------------|------------------------|
| 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

- Continuous efforts will be made to optimize/reduce water usage,
- Continuous attempts will be made to avoid wastage and leakage of water,
- Record of water consumption on a daily basis will be maintained, and
- Reuse of treated waste water for greenery and landscaping.

#### **4.3.7 Water Quality**

Water will be required for the construction purposes during the period of construction especially for concreting and compaction of excavated earths. The water requirement will be met by extracting ground water and from through water supply by Greater Shillong Water Supply Scheme.

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. At the construction site 150 to 200 skilled, semiskilled and labour may be required for the construction activities depending construction activities. Wastewater generated from domestic purposes will be minimal as most of the workers will be from the local areas. Waste water generated during the construction phase will be treated in septic tanks followed by soak pits.

During the construction phase, excavated loose soil generated from foundation, taxi way and apron may be washed out from the site with runoff during rains, which may increase the turbidity and suspended solids in runoff from construction site. However, this impact may last when first rain is over as loose soil will be stabilised after first rainfall. Therefore, this impact will be temporary in nature.

The overall impact during construction phase on water quality is summarized as the follows:

| <b>Environmental Impact Rating</b> | <b>Water Quality</b> |
|------------------------------------|----------------------|
| Nature of Impact                   | Adverse              |
| Duration of Impact                 | Short term           |
| Impacted Area                      | Localized            |

| <b>Environmental Impact Rating</b> | <b>Water Quality</b> |
|------------------------------------|----------------------|
| Likelihood of Occurrence           | Low                  |
| Severity of Impact                 | Slight               |
| Significance of Impact             | Negligible           |

### **Mitigation Measures**

- Excavation and site clearing work will be planned during non-rainy season,
- All debris and wastes from the construction sites will be collected and disposed off suitably,
- Silt traps will be provided to prevent the discharge of excessive suspended solids,
- Oil trap will be provided in the drainage line to prevent contamination of runoff by any oil spillage from construction machineries,
- To prevent contamination from spillage of oil, storage areas will be made by cemented floor, bunded and will be cleaned at regular intervals,
- Wastewater generated from the domestic activities (kitchen/toilet) will be treated in septic tank after passing through oil trap followed by soak pit or used for green belt development, and
- Used oil and oil contaminated cotton & clothes will be given to authorised used oil recyclers.

### **4.3.8 Ambient Air Quality**

The potential sources of air emissions during construction phase of the expansion of Barapani (Shillong) Airport will be as follows:

- Dust from earth works (during site preparation & excavation),
- Fugitive emissions from vehicles running to the construction site,
- Emissions from the operation of construction equipment and machines for compaction,
- 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 NO<sub>2</sub>, SO<sub>2</sub>, CO, un-burnt hydrocarbons and particulate matter (PM<sub>10</sub> & PM<sub>2.5</sub>).

The impact of construction activities on ambient air quality may be 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 will be 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 may also result in marginal increase in the levels of SO<sub>2</sub>, NO<sub>2</sub>, unburnt hydrocarbons and particulate matter (PM<sub>10</sub> & PM<sub>2.5</sub>). 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 construction 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.

During the excavation 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.

The emissions from the DG sets may cause localised 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.

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:

| <b>Environmental Impact Rating</b> | <b>Ambient Air Quality</b> |
|------------------------------------|----------------------------|
| Nature of Impact                   | Adverse                    |
| Duration of Impact                 | Short term                 |
| Impacted Area                      | Localized                  |
| Likelihood of Occurrence           | High                       |
| Severity of Impact                 | Low                        |
| Significance of Impact             | Minor                      |

### **Mitigation Measures**

- Dust suppression systems (water spray) will be used as per requirement at the construction site;

- Earth moving equipment, typically a bulldozer with a grader blade and ripper, will be used for excavation work;
- Vehicles used for transportation of construction materials will be have pollution under control certificates.
- Proper barricading
- Construction materials and earth will be fully covered during transportation to/from the construction site by road;
- Standard prescribed by the CPCB/MSPCB for stack height and emissions from DG sets will be complied with;
- Preventive maintenance will be carried out for vehicles and pollution check will be mandatory on periodic basis all the vehicles approaching to the construction site;
- 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/MSPCB.

#### **4.3.9 Noise Levels**

During the construction phase of the project, noise will be generated from various sources. Some major sources of noise generation during construction phase of project 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, and
- 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**

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

### **Resultant Noise Level**

The combined effect of above sources can be determined as per the following equation:

$$L_{p(\text{total})} = 10 \log (10^{(L_{p1}/10)} + 10^{(L_{p2}/10)} + 10^{(L_{p3}/10)} + \dots)$$

Where:  $L_{p1}$ ,  $L_{p2}$  and  $L_{p3}$  are noise pressure level at a point due to different sources in dB (A).

For an approximate estimation of dispersion of noise in the ambient air from the source point, a standard mathematical model for sound wave propagation is used. The sound pressure level generated by noise sources decreases with increases 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 objects in the transmission path. The noise level generated from a source would decrease with increase in distance from the source because of the wave divergence.

For hemispherical sound wave propagation through homogenous loss of free medium, noise levels at various locations can be calculated due to different sources using model based on the first principles as per the following equation:

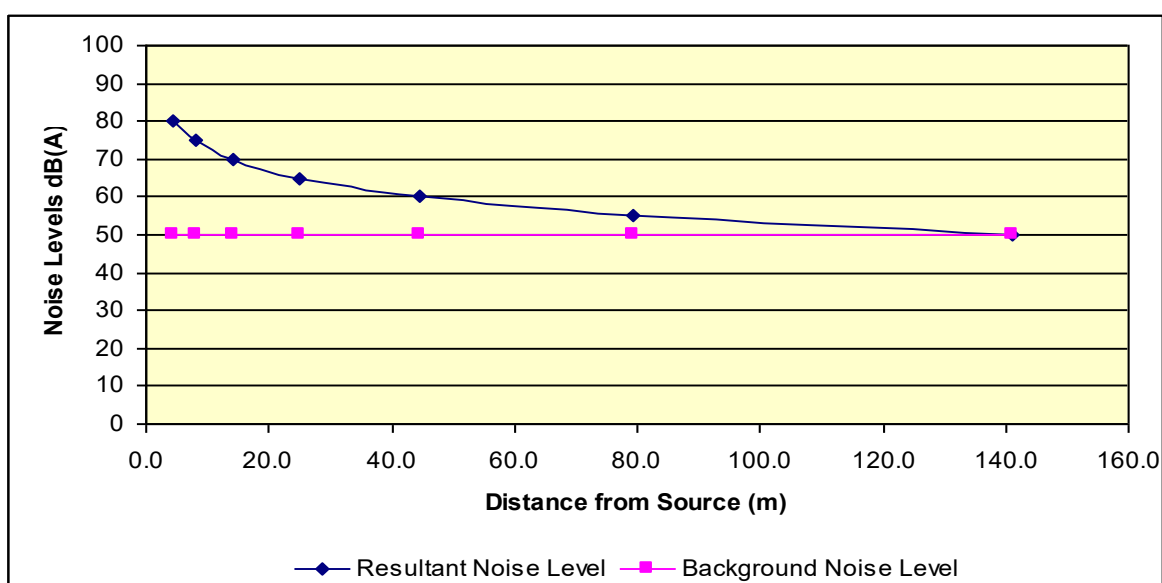
$$L_{p2} = L_{p1} - 20 \log(r_2) - 8$$

Where:  $L_{p2}$  and  $L_{p1}$  - Sound Pressure Level (SPLs) at points located at source and at distances of  $r_2$  from the source respectively in dB (A).

The resultant maximum noise level for the above sources as calculated using combined effect equation is 85 dB(A). Assuming no environmental attenuation factors, noise modelling has been done, which shows noise level will mingle with the baseline noise level within short distance. Noise modelling results for construction phase have been given in **Table 4.4** and shown in **Figure 4.1**:

**Table 4.4: Noise Modelling Results**

| Area         | Permissible Limits (Day Time) | Distance from Source |
|--------------|-------------------------------|----------------------|
| Silence Zone | 50 dB (A)                     | 141.2 m              |
| Residential  | 55 dB (A)                     | 79.6 m               |
| Commercial   | 65 dB (A)                     | 25.3 m               |
| Industrial   | 75 dB (A)                     | 8.8 m                |



**Figure 4.1: Attenuation of Noise from Source during Construction**

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 (maximum upto 141 m) and only during daytime within the construction. 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 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 75-80 dB (A) in an eight (8) hour shift for which all statutory precautions as per law will be implemented. Use of proper Personal Protective Equipment (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. Hence, the impact on the noise level during construction phase is rated as given in the table below:

| <b>Environmental Impact Rating</b> | <b>Noise Level</b> |
|------------------------------------|--------------------|
| Nature of Impact                   | Adverse            |
| Duration of Impact                 | Short term         |
| Impacted Area                      | Localized          |
| Likelihood of Occurrence           | High               |
| Severity of Impact                 | Slight             |
| Significance of Impact             | Negligible         |

### **Mitigation Measures**

- Silencers will be provided to modulate the noise generated by machines;
- Protective devices ear muff/ plugs like will be provided to the workers; and
- Provision of rubber padding/ noise isolators to DG sets and construction machines
- Preventive maintenance of the machine/ equipment will be carried out;
- Green area and landscaping will also attenuate noise level;
- Barricading will be provided around the construction site for control fugitive dust emissions.
- Monitoring of ambient noise level/ source emissions will be carried out as per details given in *Chapter 6* or as stipulated by the CPCB/ MSPCB.

### **4.3.10 Terrestrial Ecology**

During the proposed expansion of Barapani (Shillong) Airport, no trees will be felled as state has provided required land free from all encumbrances. Further, shrubs and ground flora will also be cleared for the construction of the proposed development. Therefore, marginal impact is anticipated on terrestrial ecology during the construction phase. No Forest land involved in the project. Further there is no forest land in the within vicinity of the project.

No tree cutting is required as Government of Meghalaya will handover encumbrances free 22 Acres land to AAI for the expansion of Barapani (Shillong) Airport.

### **Mitigation Measures**

- Landscaping from construction phase to strengthening flora in the area; and
- Indigenous species will be selected which will be suitable for local climacteric conditions.

#### **4.3.11 Occupational Safety and Health**

During construction phase of the expansion of Barapani (Shillong) Airport, 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 construction sites at expansion of Barapani (Shillong) Airport and may have potential adverse impacts on the Occupational Safety and Health. Hence, overall impact is rated as follows:

| <b>Environmental Impact Rating</b> | <b>Occupational Safety &amp; Health</b> |
|------------------------------------|-----------------------------------------|
| Nature of Impact                   | Adverse                                 |
| Duration of Impact                 | Short term                              |
| Impacted Area                      | Localized                               |
| Likelihood of Occurrence           | High                                    |
| Severity of Impact                 | Low                                     |
| Significance of Impact             | Low                                     |

#### **Mitigation Measures**

##### ***General Occupational Health and Safety Measures***

- Provide effective dust suppression measures during earth work.
- 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 Equipment (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;
- Sanitary facilities like toilets and bath rooms will be provided and workers will be instructed use them;
- Housekeeping at the work site will be maintained well.
- Solid waste generated at the site will be collected and disposed as per standard practices.
- Motivational, warning and informatary 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.

#### **4.3.12 Socio-Economic Environment**

The construction phase of the expansion of Barapani (Shillong) Airport will have beneficial impacts on social environment. Private land acquisition will be done by the State Government after paying compensation and other benefits as per The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (RFCTLARR).

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 the project. Hence, impact on economic impacts is rated as follows:

| <b>Environmental Impact Rating</b> | <b>Resettlement Issues</b> |
|------------------------------------|----------------------------|
| Nature of Impact                   | Beneficial                 |
| Duration of Impact                 | Short term                 |
| Impacted Area                      | Regional                   |
| Likelihood of Occurrence           | High                       |
| Severity of Impact                 | High                       |
| Significance of Impact             | Moderate                   |

#### **Employment**

During the construction of the proposed expansion of Barapani (Shillong) Airport, 150 to 200 skilled and semiskilled 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 labourers will get indirect employment also during the 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:

| <b>Environmental Impact Rating</b> | <b>Employment</b> |
|------------------------------------|-------------------|
| Nature of Impact                   | Beneficial        |
| Duration of Impact                 | Short term        |
| Impacted Area                      | Localized         |
| Likelihood of Occurrence           | High              |
| Severity of Impact                 | Medium            |
| Significance of Impact             | Low               |

### **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.

### **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:

| <b>Environmental Impact Rating</b> | <b>Influx of Construction Workers</b> |
|------------------------------------|---------------------------------------|
| Nature of Impact                   | Adverse                               |
| Duration of Impact                 | Short term                            |
| Impacted Area                      | Localized                             |
| Likelihood of Occurrence           | Low                                   |
| Severity of Impact                 | Low                                   |
| Significance of Impact             | Negligible                            |

## **4.4 Operation Phase**

During operation phase, the proposed expansion of Barapani (Shillong) Airport will comprise mainly the following activities:

- Operation of the proposed terminal building;
- Operation of taxiway and apron for parking of 2 (two) aircraft;
- Increase in passengers/visitors/ staff movement at departure and arrival of terminal building;
- Vehicle movement at airport for drop and pick up;
- Operation of DG sets;
- Operation of HVAC in new terminal building, etc.

During the operation of the proposed expansion of Barapani (Shillong) Airport, the following sources of pollution are anticipated:

- Exhaust emissions in the form of particulate matters, NO<sub>x</sub>, SO<sub>2</sub> CO and unburnt hydrocarbons will be emitted from aircraft movement (take-off, landing and taxiing), vehicular movement, and operation of DG sets;
- Wastewater from domestic usages which include, food outlets, washing hands, toilets and urinals, etc;
- Energy consumption for HVAC and lightings in proposed terminal buildings;
- Solid waste from aircraft, 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 the proposed expansion of Barapani (Shillong) Airport and corresponding mitigation measures for operation phase have been described in the following sub-sections.

#### **4.4.1 Topography and Physiography**

During operation phase of the proposed expansion of Barapani (Shillong) Airport, no impact is anticipated on the topography and physiography of the area. Hence, no mitigation measure is required.

#### **4.4.2 Water Resources**

During operation phase, total fresh water requirement is estimated as 371 kld. Fresh water requirement will be for domestic (306 kld), fire testing (5 kld) and HVAC (60 kld) purposes. 257 kld waste water will be generated from the expansion of Barapani (Shillong) Airport, which will be treated in 275 kld capacity sewage treatment plant (STP).

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

| <b>Environment Impact Rating</b> | <b>Water Resources</b> |
|----------------------------------|------------------------|
| Nature of Impact                 | Adverse                |

| Environment Impact Rating | Water Resources |
|---------------------------|-----------------|
| Duration of Impact        | Long term       |
| Impacted Area             | Localized       |
| Likelihood of Occurrence  | High            |
| Severity of Impact        | Medium          |
| Significance of Impact    | Low             |

### **Mitigation Measures**

- Continuous efforts will be made to reduce water consumption using less water required cisterns;
- Water efficient urinal and toilets will be provided in proposed terminal building.
- Efforts will be made to stop wastage and leakage of water;
- Sewage and domestic waste water will be treated in Sewage Treatment Plant
- Treated waste water will be used for greenery & landscaping at the expansion of Barapani (Shillong) Airport.

### **4.4.3 Water Quality**

Total estimated wastewater generation during the operation phase is 257 kld, which will be treated in Sewage Treatment Plant (STP) of capacity 275 kld. After treatment, treated wastewater is reused for flushing and horticulture purposes. No wastewater will be discharged outside the expansion of Barapani (Shillong) Airport premises. The overall impact on water quality during operation phase is rated as follows:

| Environmental Impact Rating | Water Quality |
|-----------------------------|---------------|
| Nature of Impact            | Adverse       |
| Duration of Impact          | Long term     |
| Impacted Area               | Localized     |
| Likelihood of Occurrence    | High          |
| Severity of Impact          | Medium        |
| Significance of Impact      | Low           |

### **Mitigation Measures**

- Collection of waste water and treatment of waste water in Sewage Treatment Plant (STP) of 275 kld;
- Efficient operation of STP will be ensured;
- Avoid spillage of fuel and lube oil and storing them on concrete floor;
- Solid waste collection and disposal as per Solid Waste Management Rule 2016;



- Regular testing and analysis of treated waste water from STP to ensure effectiveness of STP and compliance of discharge standards.

#### **4.4.4 Waste Management**

Approx. 1240 kg per day solid waste will be generated during operation of the expansion of Barapani (Shillong) Airport, which will be collected, segregated and managed by external agency for disposal as per Solid Waste Management Rule, 2016. Hence, the impact on the soil will be insignificant as an organized solid waste collection and disposal practices will be followed at the expansion of Barapani (Shillong) Airport.

From the expansion of Barapani (Shillong) Airport, about 150 liters used oil will be generated during the maintenance of DG sets. Used oil generated from the expansion of Barapani (Shillong) Airport will be disposed to authorised used oil recyclers.

About 150 kg per year e-wastes will be generated from the expansion of Barapani (Shillong) Airport, which will be disposed to authorised e-waste recyclers as per e-wastes management rules 2016.

The overall impact on waste management during operation phase of the expansion of Barapani (Shillong) Airport is rated as follows:

| <b>Environmental Impact Rating</b> | <b>Water Quality</b> |
|------------------------------------|----------------------|
| Nature of Impact                   | Adverse              |
| Duration of Impact                 | Long term            |
| Impacted Area                      | Localized            |
| Likelihood of Occurrence           | High                 |
| Severity of Impact                 | Low                  |
| Significance of Impact             | Negligible           |

#### ***Mitigation Measures***

- Municipal solid waste collection bins will be placed at strategic locations in the new terminal building;
- Third party agency will be hired for disposal of solid wastes as per the provisions of the Solid Waste Management Rule, 2016;
- Solid waste generated from the expansion of Barapani (Shillong) Airport after development during operation phase will be transported in close containers;
- Used lubricating waste oil and oil contaminated clothes etc will be collected separately in containers and will be disposed to authorized recyclers as per CPCB/Meghalaya Pollution Control Board (MSPCB) guidelines.

#### **4.4.5 Ambient Air Quality**

During the operational phase of expansion of Barapani (Shillong) Airport, the intermittent air emissions will be generated from aircraft engines during approach, landing, taxiing, take-off and initial climb, which is termed as reference Landing and Take-off Cycle (LTO cycle). The air pollutants of concern from the aircraft emissions are un-burnt Sulphur Dioxide, Hydrocarbons (HC), Carbon Monoxide (CO) and Nitrogen Dioxide (NO<sub>2</sub>) as per ICAO guidelines.

For power back up at the expansion of Barapani (Shillong) Airport, 2 DG Sets of 380 kVA and 3 DG sets of 1000 kVA capacities each will be available, which will be sufficient during operation of proposed terminal building and other associated facilities at Barapani (Shillong) Airport after expansion. Exhaust emissions comprising NO<sub>2</sub>, SO<sub>2</sub> and particulate matter in small quantity will be generated from the operation of DG sets, which will be operated only to meet the power requirement during grid power failure.

Vehicular emissions will also be generated at the expansion of Barapani (Shillong) Airport from the operation of vehicular traffic as ground support vehicles, passengers pickup and dropping vehicles. These vehicles will be mainly diesel and petrol driven and are source of mainly CO, HC and NO<sub>2</sub> emissions.

For prediction of anticipated impact of emissions from expansion of Barapani (Shillong) Airport after operation, estimation of emissions load from Aircraft LTO, DG sets and vehicles is essential. The emissions load estimation from various emission sources has been carried out in following subsection:

##### **Aircraft Emissions**

Airport Air Quality Manual 2011 of International Civil Aviation Organization (ICAO) has been referred for the aircraft emissions, which states emissions for various types of aircraft based on one LTO cycle for SO<sub>2</sub>, NO<sub>2</sub>, CO and HC pollutants. The referred emission rates for one LTO have been converted to g/sec based on the duration of one LTO cycle in seconds. As per International Civil Aviation Organization (ICAO), time and thrust setting for Reference LTO Cycle is 32.9 minutes (1974 seconds). During peak hour, it is considered that there will be total 2 LTO (2 LTO for each Aircraft) at the expansion of Barapani (Shillong) Airport, which includes all types of aircraft. For aircraft emissions estimation purpose, LTO cycle emissions from A 320 types of aircraft have been considered.

The estimated aircraft emissions from expansion of Barapani (Shillong) Airport during operation are given in **Table 4.5**.

**Table 4.5: Estimated Aircraft Emissions from Barapani (Shillong) Airport during operation**

| Parameter                                                                                                                                                        | Units        | Type of Aircraft and Emissions |        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--------------------------------|--------|
| Type of Aircraft                                                                                                                                                 | -            | A 320                          | ATR 72 |
| <b>Emissions per LTO Cycle</b>                                                                                                                                   |              |                                |        |
| SO <sub>2</sub>                                                                                                                                                  | Kg/LTO cycle | 0.77                           | 0.2    |
| HC                                                                                                                                                               | Kg/LTO cycle | 0.57                           | 0.29   |
| CO                                                                                                                                                               | Kg/LTO cycle | 6.19                           | 2.33   |
| NO <sub>x</sub>                                                                                                                                                  | Kg/LTO cycle | 9.01                           | 1.82   |
| <b>Total Emissions</b>                                                                                                                                           |              |                                |        |
| SO <sub>2</sub>                                                                                                                                                  | g/s          | 0.39                           | 0.10   |
| HC                                                                                                                                                               | g/s          | 0.29                           | 0.15   |
| CO                                                                                                                                                               | g/s          | 3.14                           | 1.18   |
| NO <sub>x</sub>                                                                                                                                                  | g/s          | 4.56                           | 0.92   |
| Assuming that during peak hour, there will be LTO (1 each type of aircraft). The total emissions based on 3 LTOs are calculated for above two types of aircraft. |              |                                |        |
| SO <sub>2</sub>                                                                                                                                                  | g/s          | 1.17                           | 0.3    |
| HC                                                                                                                                                               | g/s          | 0.87                           | 0.45   |
| CO                                                                                                                                                               | g/s          | 9.42                           | 3.54   |
| NO <sub>x</sub>                                                                                                                                                  | g/s          | 13.68                          | 2.76   |
| <b>Total Emissions</b>                                                                                                                                           |              |                                |        |
| SO <sub>2</sub>                                                                                                                                                  | g/s          | 1.47                           |        |
| HC                                                                                                                                                               | g/s          | 1.32                           |        |
| CO                                                                                                                                                               | g/s          | 12.96                          |        |
| NO <sub>2</sub>                                                                                                                                                  | g/s          | 16.44                          |        |

(Source: Airport Air Quality Manual 2011, ICAO)

### Emissions from the Operation of DG Sets

Two DG sets of 380 kVA are operational at the airport. As part of expansion three DG sets of 1000 kVA capacity each will be installed at Barapani (Shillong) Airport during operation to meet the power requirement during grid power failure.

The exhaust emissions comprising mainly NO<sub>2</sub> and SO<sub>2</sub> will be generated from the operation of DG sets to be operated in the event of grid power supply failure. Intermittently particulate matter (PM), carbon monoxide (CO) and un-burnt hydrocarbons will be emitted during operation of DG sets. Exhaust emissions from DG sets will be intermittent source of emissions as DG sets will be operated only during grid power failure. Stack height of each DG set will be as per the CPCB standard.

The estimated exhaust emissions characteristics from the DG sets are presented in **Table 4.6**.

**Table 4.6: Emissions From DG Sets Stacks**

| Sn. | Parameters                      | DG Set Stack<br>(2x380 kVA) | DG Set Stack<br>(2x1000 kVA) |
|-----|---------------------------------|-----------------------------|------------------------------|
| 1.  | Stack Height Above Building (m) | 10                          | 15                           |
| 2.  | Stack Dia (m)                   | 0.15                        | 0.30                         |
| 3.  | Flue Gas:                       |                             |                              |
|     | • Temperature (°C)              | 290                         | 300                          |
|     | • Velocity (m/s)                | 15.7                        | 21.5                         |
| 4.  | Pollution Loads                 |                             |                              |
|     | • PM <sub>2.5</sub> (g/s)       | 0.05                        | 0.15                         |
|     | • PM <sub>10</sub> (g/s)        | 0.03                        | 0.10                         |
|     | • SO <sub>2</sub> (g/s)         | 0.16                        | 0.44                         |
|     | • NO <sub>x</sub> (g/s)         | 0.18                        | 0.50                         |

### **Emissions from Vehicular Movement**

Vehicular emissions will also be generated from the operation of ground support vehicles within the airport and vehicular traffic for pickup and dropping of passengers at the expansion of Barapani (Shillong) Airport during operation. These vehicles are mainly diesel and petrol driven and emit mainly CO, HC and NO<sub>2</sub>. The peak hourly vehicular movement 250 vehicles (including the ground service vehicles, two wheelers, buses and light duty vehicles mainly cars and light carriage vehicles). The emissions from the diesel and petrol driven vehicles have been calculated based on the CPCB emissions standards for Bharat Stage –VI. The estimated vehicular emissions at expansion of Barapani (Shillong) Airport during operation are given in **Table 4.7**.

**Table 4.7 : Estimated Vehicular Emissions from expansion of Barapani (Shillong) Airport during operation**

| Source | Emission Rate of Pollutants from Vehicles Cars (g/s) |                 |       |
|--------|------------------------------------------------------|-----------------|-------|
|        | CO                                                   | NO <sub>x</sub> | PM    |
| Cars   | 1.16                                                 | 0.14            | 0.015 |

Total emissions from aircraft, DG sets and vehicles movement from expansion of Barapani (Shillong) Airport during operation are given in **Table 4.8**.

#### **4.4.5.1 Air Pollution Modelling**

There will be no continuous emissions source from expansion of Barapani (Shillong) Airport during operation. Air flights and vehicular movement remain intermittent at the airport. DG sets will be also operated intermittently in the event of grid power failure. For air pollution dispersion modelling DG sets have been considered continuous source of emissions. For

obtaining short-term incremental ground level concentration (glc) isopleths, AERMOD dispersion model based was used.

AERMOD is based on the Gaussian plume model, which is a common approach for simulating pollutant dispersion in the atmosphere. It's a steady-state model, meaning it assumes that pollutant emissions and meteorological conditions are relatively constant over the time period being modeled. AERMOD requires detailed terrain and meteorological data to accurately simulate pollutant dispersion. The model uses pre-processors like AERMET and AERMAP to prepare this data. This pre-processor processes meteorological data (wind speed, wind direction, temperature, etc.) to provide input for AERMOD. This pre-processor processes terrain data to account for the effects of hills and valleys on pollutant dispersion. This pre-processor is used to calculate building downwash effects, which can influence the dispersion of pollutants from stacks near buildings. AERMOD can handle a variety of source types, including point sources (e.g., stacks), area sources, and volume sources. AERMOD is specifically designed to handle complex terrain, where the landscape significantly affects wind flow and pollutant dispersion. AERMOD incorporates concepts about the structure and behavior of the atmospheric boundary layer, which is the lower portion of the atmosphere where most pollutant dispersion occurs.

Rectangular grid with 500 m grid point distance is used up to a distance of +10,000 m in X and Y directions with stack coordinate as (O, O). For aircraft and vehicular emissions, multiple volume sources are considered while for DG set stack point model source is considered.

#### **4.4.5.2 Source Characteristics**

The estimated emission details for DG sets, aircraft and vehicles are given in **Tables 4.5, 4.6 and 4.7**.

#### **4.4.5.3 Atmospheric Stability**

The persistence of atmospheric stability class has been estimated using hourly monitored wind velocity data along with compiled data for sunrise, sunset, solar insolation for day-time and cloud cover for night-time for the site.

#### **4.4.5.4 Mixing Height**

The knowledge of the site specific mixing height (convective stable boundary layer and inversion height or nocturnal boundary layer) is crucial in a realistic adoption of appropriate plume rise and vertical dispersion parameters. In the absence of site specific mixing heights, "Hourly Mixing Height and Assimilative Capacity of Atmospheric in India" published by Environmental Monitoring and Research Centre, India Meteorological Department, New Delhi, 2008, has been referred for hourly mixing heights.

#### 4.4.5 Presentation of Results

For the short-term simulations for point emission sources, the concentrations were estimated on around 1600 receptors to obtain an optimum description of variations in concentrations over the site in 10 km radius covering 16 directions. The incremental concentrations are estimated for the study period representing winter season. The results ground level concentrations for SO<sub>2</sub>, NO<sub>2</sub> and Particulate Matter (PM) are presented in **Table 4.8**.

**Table 4.8: Predicted 24-Hourly Short Term Incremental Concentrations**

| Sr No. | Parameters                             | Predicted Maximum GLC | Latitude      | Longitude     | Distance (km) | Direction |
|--------|----------------------------------------|-----------------------|---------------|---------------|---------------|-----------|
| 1.     | PM <sub>10</sub> (µg/m <sup>3</sup> )  | 22.6                  | 25°42'21.95"N | 91°58'29.07"E | Airport Site  |           |
| 2.     | PM <sub>2.5</sub> (µg/m <sup>3</sup> ) | 3.5                   | 25°42'21.03"N | 91°58'30.94"E |               |           |
| 3.     | SO <sub>2</sub> (µg/m <sup>3</sup> )   | 6.9                   |               |               |               |           |
| 4.     | NO <sub>x</sub> (µg/m <sup>3</sup> )   | 11.9                  |               |               |               |           |
| 5.     | CO (µg/m <sup>3</sup> )                | 70.1                  | 25°42'22.21"N | 91°59'4.94"E  | 0.16          | E         |

#### Predicted Concentrations

GLCs values presented in **Table 4.8** reveals DG set and other emission sources will be operated intermittently, maximum predicted incremental short term 24 hourly ground level concentrations of, PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, and NO<sub>2</sub> likely to be encountered are 22.6 µg/m<sup>3</sup>, 3.5 µg/m<sup>3</sup>, 6.9 µg/m<sup>3</sup> and 11.9 µg/m<sup>3</sup> will be at will be within the airport site. The ground level concentration for CO is occurring at a distance of 0.16 km in east direction from Barapani (Shillong) Airport during operation. Isopleths for predicted ground level concentrations for PM<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub>, NO<sub>2</sub> and CO are given in **Figure 4.2** to **4.6**, respectively.

The air pollution dispersion modelling predictions indicate that the maximum ground level concentrations for PM<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub>, NO<sub>2</sub> and CO when added to baseline monitored values, resultant concentrations of PM<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub>, NO<sub>2</sub> and CO will be well within the prescribed limits of 60 µg/m<sup>3</sup>, 100 µg/m<sup>3</sup>, 80 µg/m<sup>3</sup> (for SO<sub>2</sub> and NO<sub>2</sub>) and 2000 µg/m<sup>3</sup>, respectively for industrial, residential, rural and other area. However, it is important to mention that flights, vehicles and DG set will not be operated continuously. DG set will be operated only during grid power failure. Therefore, anticipated impacts will be much below to the predicted ground level constructions.

#### Resultant Concentrations

The maximum incremental GLCs from Barapani (Shillong) Airport during operation for SO<sub>2</sub>, NO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub>, when added to baseline air quality monitoring results carried during study period, resultant concentrations for monitored parameters remains below the stipulated National Ambient Air Quality Standard. Based on the predicted concentrations of various pollutants due to operation of Barapani (Shillong) Airport after expansion, it can be inferred that low impact is

anticipated on the ambient air quality of the area, suitable mitigation measures will be taken. The resultant concentrations by adding baseline and predicted ground level concentration are as given below:

**Table 4.9: Resultant Concentrations**

| Sr No.                                                        | Locations                           | Distance | Direction | Baseline conc. $\mu\text{g}/\text{m}^3$ | GLC ( $\mu\text{g}/\text{m}^3$ ) | Resultant Concentration $\mu\text{g}/\text{m}^3$ |
|---------------------------------------------------------------|-------------------------------------|----------|-----------|-----------------------------------------|----------------------------------|--------------------------------------------------|
| <b>PM<sub>10</sub> (<math>\mu\text{g}/\text{m}^3</math>)</b>  |                                     |          |           |                                         |                                  |                                                  |
| 1.                                                            | Project Site                        | --       | --        | 55                                      | 22.7                             | 77.7                                             |
| 2.                                                            | Norgarh Umroi (Presbyterian Church) | 1.85 km  | N         | 49                                      | 6.8                              | 55.8                                             |
| 3.                                                            | Bhoriymbong                         | 4.65 km  | ENE       | 48                                      | 3.4                              | 51.4                                             |
| 4.                                                            | Umkteih                             | 1.95 km  | E         | 41                                      | 0.1                              | 41.1                                             |
| 5.                                                            | Nanglakhit                          | 3.5 km   | S         | 47                                      | 0.7                              | 47.7                                             |
| 6.                                                            | Umed Umroi                          | 2.15 km  | SW        | 49                                      | 0.4                              | 49.4                                             |
| 7.                                                            | Umeit                               | 3.65 km  | W         | 44                                      | 0.6                              | 44.6                                             |
| 8.                                                            | Habitation                          | 4.15 km  | N         | 51                                      | 0.01                             | 51.0                                             |
| <b>PM<sub>2.5</sub> (<math>\mu\text{g}/\text{m}^3</math>)</b> |                                     |          |           |                                         |                                  |                                                  |
| 1.                                                            | Project Site                        | --       | --        | 26                                      | 3.4                              | 29.4                                             |
| 2.                                                            | Norgarh Umroi (Presbyterian Church) | 1.85 km  | N         | 20                                      | 0.121                            | 20.1                                             |
| 3.                                                            | Bhoriymbong                         | 4.65 km  | ENE       | 23                                      | 0.11                             | 23.1                                             |
| 4.                                                            | Umkteih                             | 1.95 km  | E         | 20                                      | 0.06                             | 20.1                                             |
| 5.                                                            | Nanglakhit                          | 3.5 km   | S         | 22                                      | 0.23                             | 22.2                                             |
| 6.                                                            | Umed Umroi                          | 2.15 km  | SW        | 23                                      | 0.34                             | 23.3                                             |
| 7.                                                            | Umeit                               | 3.65 km  | W         | 21                                      | 0.29                             | 21.3                                             |
| 8.                                                            | Habitation                          | 4.15 km  | N         | 24                                      | 0.01                             | 24.0                                             |
| <b>SO<sub>2</sub> (<math>\mu\text{g}/\text{m}^3</math>)</b>   |                                     |          |           |                                         |                                  |                                                  |
| 1.                                                            | Project Site                        | --       | --        | 7.8                                     | 6.90                             | 14.7                                             |
| 2.                                                            | Norgarh Umroi (Presbyterian Church) | 1.85 km  | N         | 7.1                                     | 1.42                             | 8.5                                              |
| 3.                                                            | Bhoriymbong                         | 4.65 km  | ENE       | 6.7                                     | 1.32                             | 8.0                                              |
| 4.                                                            | Umkteih                             | 1.95 km  | E         | 7.7                                     | 0.13                             | 7.8                                              |
| 5.                                                            | Nanglakhit                          | 3.5 km   | S         | 6.6                                     | 0.64                             | 7.2                                              |
| 6.                                                            | Umed Umroi                          | 2.15 km  | SW        | 7.5                                     | 1.69                             | 9.2                                              |
| 7.                                                            | Umeit                               | 3.65 km  | W         | 6.8                                     | 1.11                             | 7.9                                              |
| 8.                                                            | Habitation                          | 4.15 km  | N         | 7.8                                     | 0.03                             | 7.8                                              |
| <b>NO<sub>x</sub> (<math>\mu\text{g}/\text{m}^3</math>)</b>   |                                     |          |           |                                         |                                  |                                                  |
| 1.                                                            | Project Site                        | --       | --        | 16.9                                    | 11.9                             | 28.8                                             |
| 2.                                                            | Norgarh Umroi (Presbyterian Church) | 1.85 km  | N         | 15.9                                    | 0.79                             | 16.7                                             |
| 3.                                                            | Bhoriymbong                         | 4.65 km  | ENE       | 14.4                                    | 0.38                             | 14.8                                             |
| 4.                                                            | Umkteih                             | 1.95 km  | E         | 13.1                                    | 0.21                             | 13.3                                             |
| 5.                                                            | Nanglakhit                          | 3.5 km   | S         | 14.2                                    | 0.89                             | 15.1                                             |

| Sr No.                                          | Locations                           | Distance | Direction | Baseline conc. $\mu\text{g}/\text{m}^3$ | GLC ( $\mu\text{g}/\text{m}^3$ ) | Resultant Concentration $\mu\text{g}/\text{m}^3$ |
|-------------------------------------------------|-------------------------------------|----------|-----------|-----------------------------------------|----------------------------------|--------------------------------------------------|
| 6.                                              | Umed Umroi                          | 2.15 km  | SW        | 13.3                                    | 1.21                             | 14.5                                             |
| 7.                                              | Umeit                               | 3.65 km  | W         | 13.1                                    | 1.18                             | 14.3                                             |
| 8.                                              | Habitation                          | 4.15 km  | N         | 16.3                                    | 0.04                             | 16.3                                             |
| <b>CO (<math>\mu\text{g}/\text{m}^3</math>)</b> |                                     |          |           |                                         |                                  |                                                  |
| 1.                                              | Project Site                        | --       | --        | 180                                     | 42.62                            | 222.6                                            |
| 2.                                              | Norgarh Umroi (Presbyterian Church) | 1.85 km  | N         | 170                                     | 22.97                            | 193.0                                            |
| 3.                                              | Bhoriymbong                         | 4.65 km  | ENE       | 100                                     | 21.32                            | 121.3                                            |
| 4.                                              | Umkteh                              | 1.95 km  | E         | 100                                     | 0.69                             | 100.7                                            |
| 5.                                              | Nanglakhit                          | 3.5 km   | S         | 100                                     | 3.98                             | 104.0                                            |
| 6.                                              | Umed Umroi                          | 2.15 km  | SW        | 100                                     | 25.31                            | 125.3                                            |
| 7.                                              | Umeit                               | 3.65 km  | W         | 100                                     | 8.96                             | 109.0                                            |
| 8.                                              | Habitation                          | 4.15 km  | N         | 210                                     | 0.09                             | 210.1                                            |

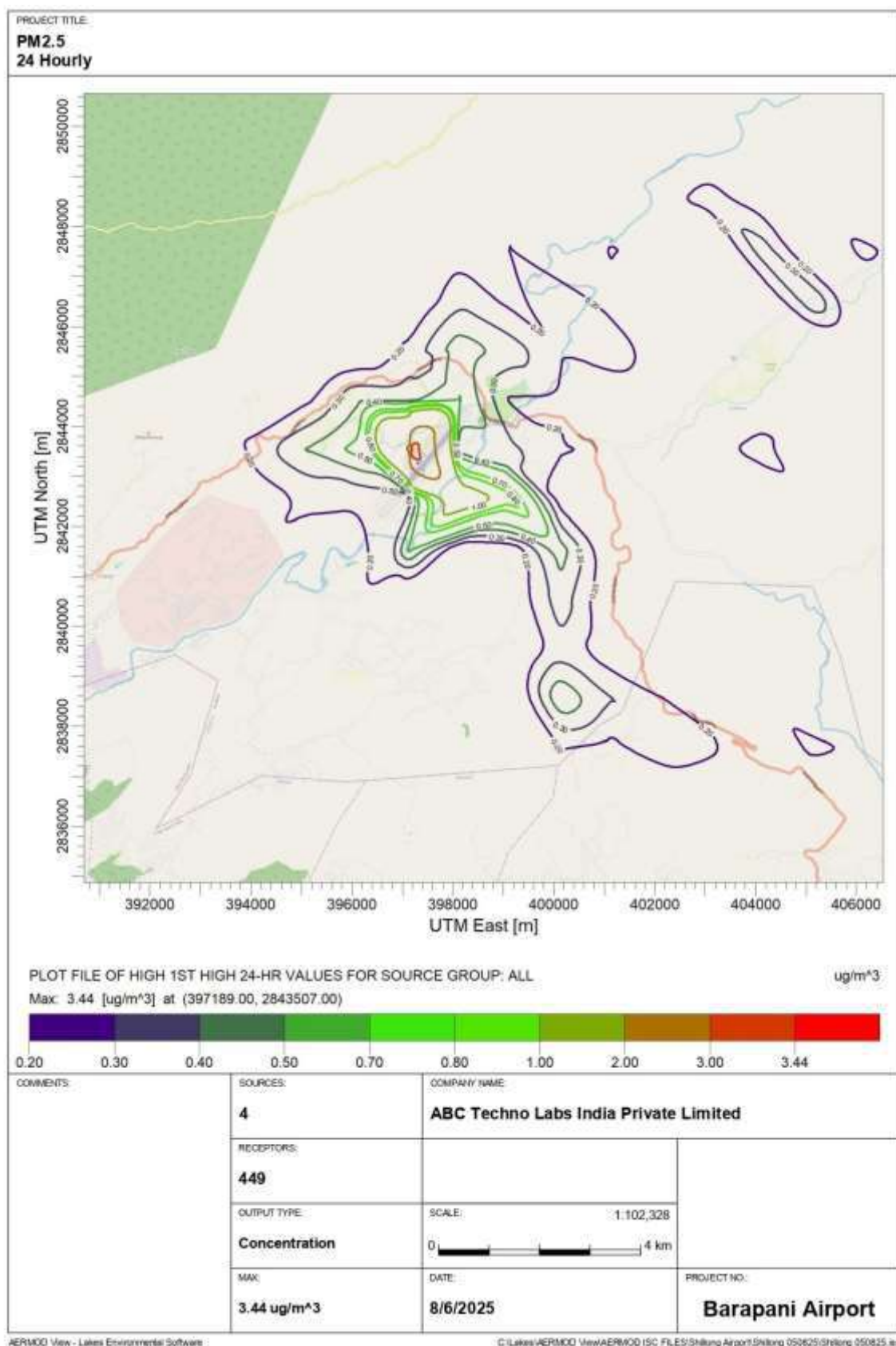
Hence, overall impact on ambient air quality during operation phase is summarized as follows:

| <b>Environmental Impact Rating</b> | <b>Air Quality</b> |
|------------------------------------|--------------------|
| Nature of Impact                   | Adverse            |
| Duration of Impact                 | Long term          |
| Impacted Area                      | Localized          |
| Likelihood of Occurrence           | High               |
| Severity of Impact                 | Low                |
| Significance of Impact             | Low                |

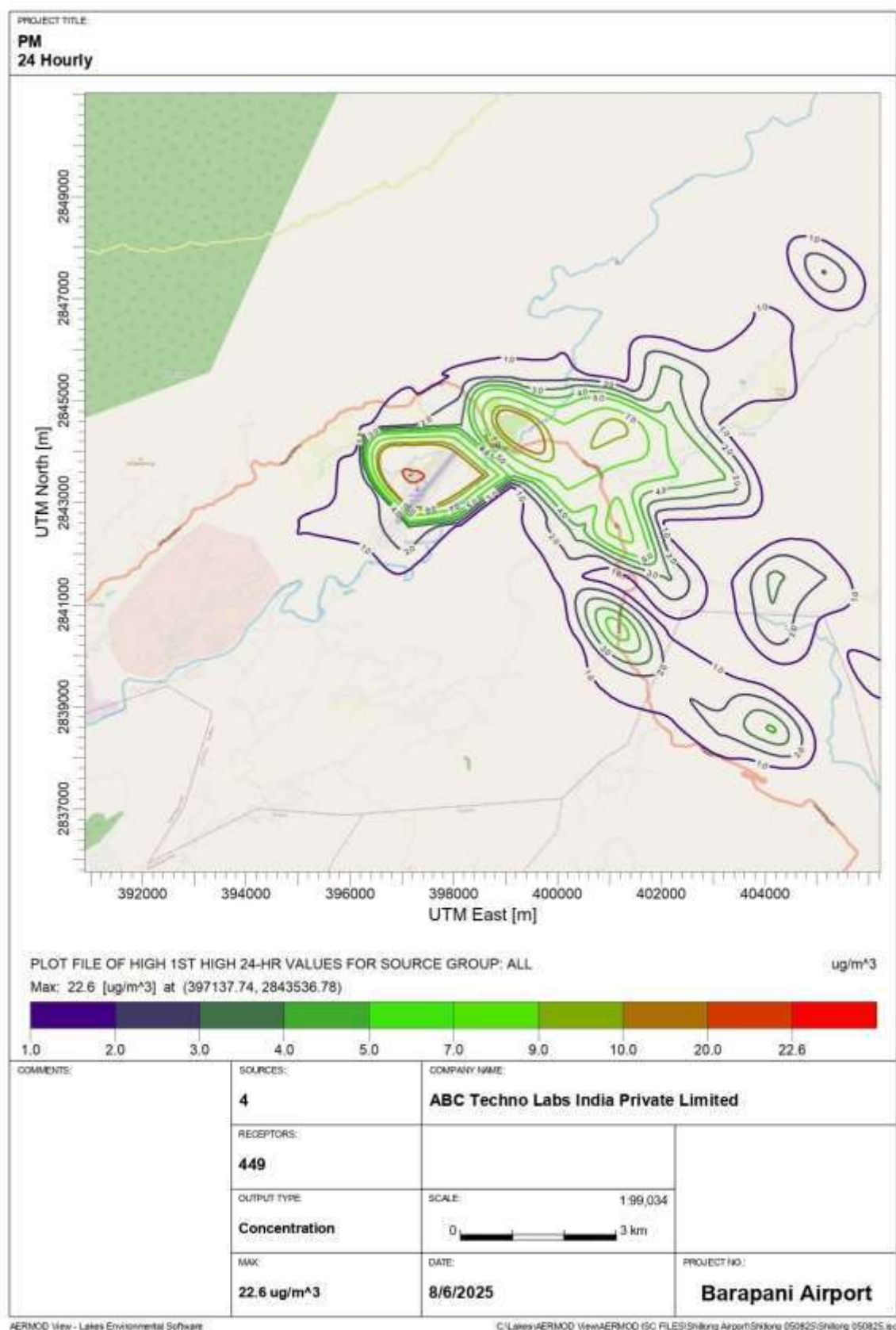
### **Mitigation Measures**

- Compliance of all standards prescribed by the ICAO during operation of aircraft by preventive maintenance and monitoring;
- Stack heights of DG sets will be 12 m from ground level;
- Proper traffic management plan will be prepared to ensure that there is no traffic congestion at in front of proposed terminal building. It will help in reduction of vehicular emissions from the airport.
- Ground vehicles at Barapani (Shillong) Airport after expansion during operation 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.

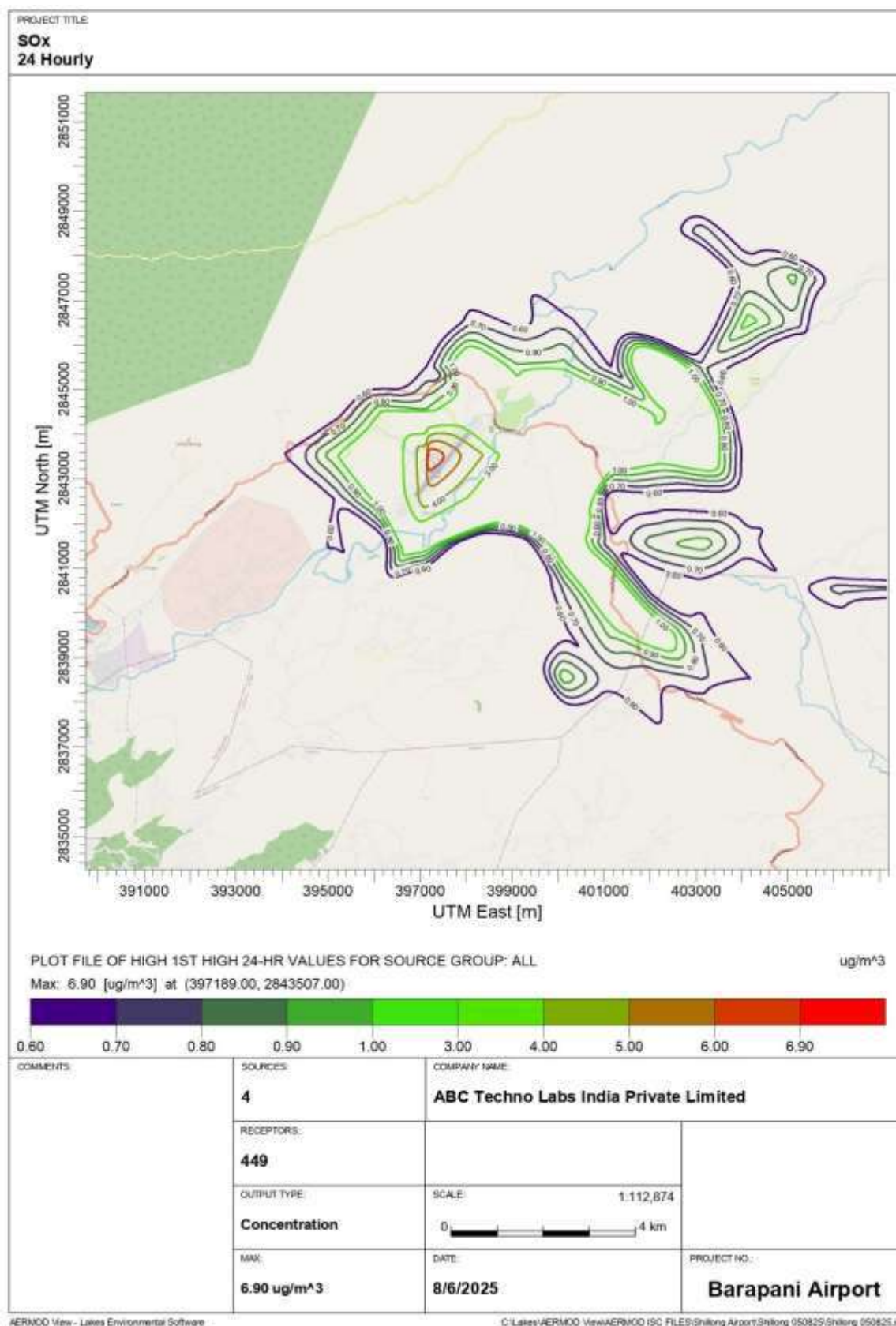




**Figure 4.2: Predicted Level Concentrations for PM<sub>2.5</sub>**

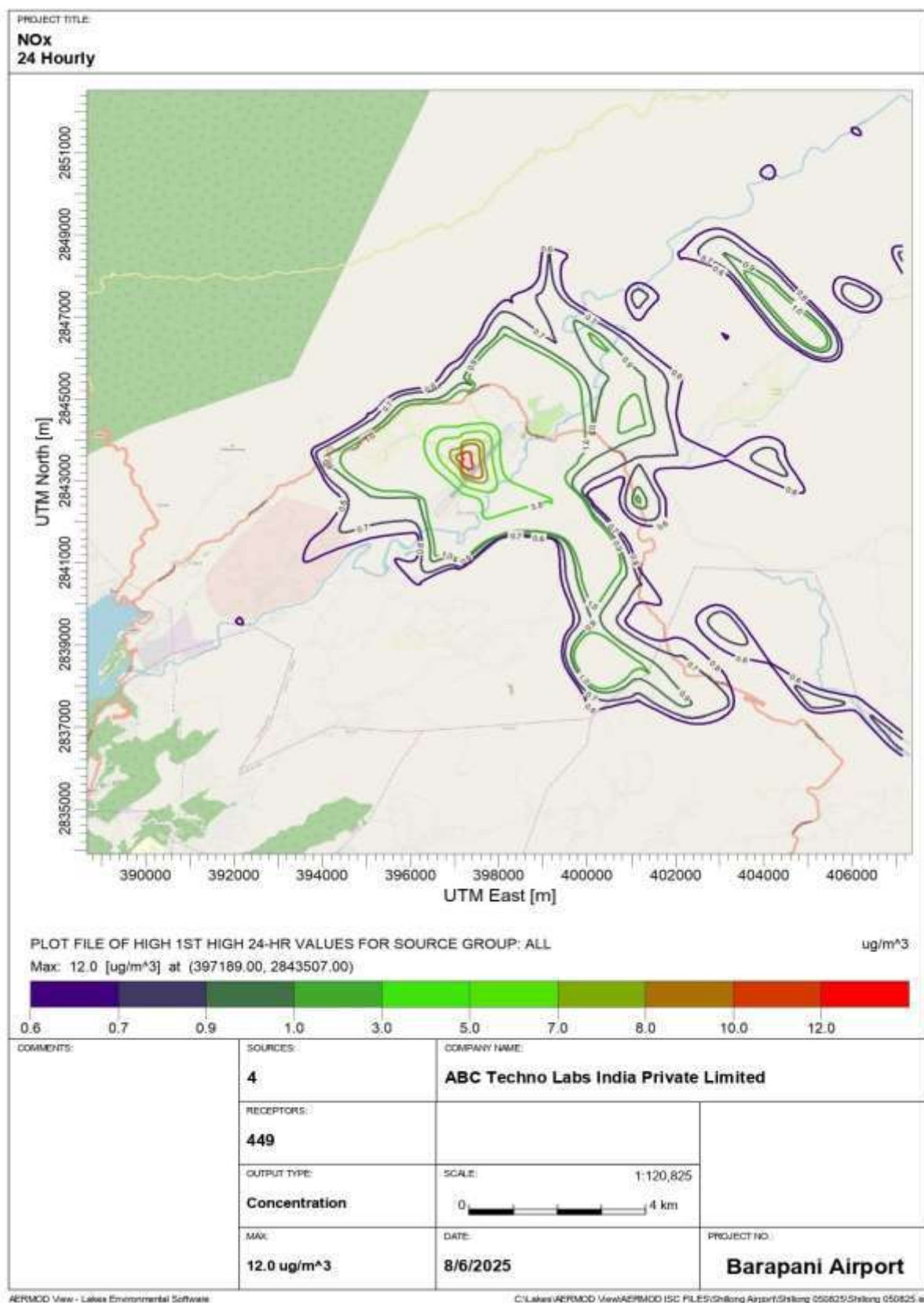


**Figure 4.3: Predicted Level Concentrations for PM<sub>10</sub>**

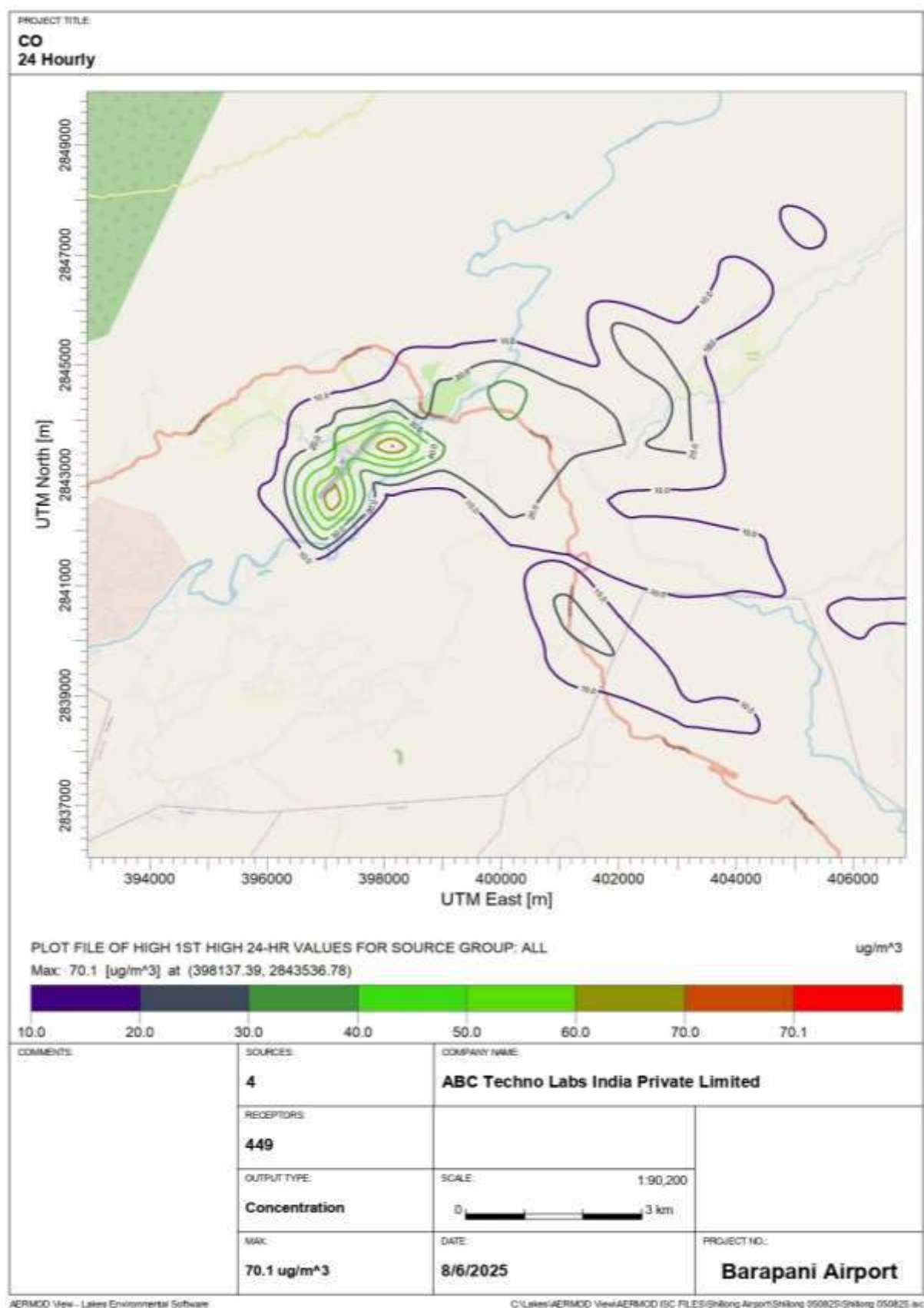


**Figure 4.4: Predicted Level Concentrations for SO<sub>2</sub>**





**Figure 4.5: Predicted Level Concentrations for NO<sub>2</sub>**



**Figure 4.6: Predicted Level Concentrations for CO**

#### **4.4.6 Noise Levels**

During operation phase of the Barapani (Shillong) Airport after expansion, landing, take-off and taxiing of various types of aircraft 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 aircraft;
- 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 aircraft.

#### **Noise Levels for Various Aircraft**

The Effective Perceived Noise Level from various aircraft are given below:

| <b>Sn</b> | <b>Type of Aircraft</b> | <b>Arrival EPNdB</b> | <b>Departure EPNdB</b> |
|-----------|-------------------------|----------------------|------------------------|
| 1.        | AB 320                  | 99                   | 94                     |
| 2.        | ATR 72                  | 103                  | 100                    |

To predict the impact on the existing noise levels in the study area due to the operation of airport after proposed development, taxi way, apron and associated work, Aviation Environmental Design Tool (AEDT) developed by Federal Aviation Administration (FAA), USA has been used. This model has inbuilt information on the various types aircraft.

Aircraft noise modelling through Aviation Environmental Design Tool (AEDT) uses (1) computation of the flight-segment geometric and physical parameters; (2) flight-segment noise-level interpolation process; (3) atmospheric absorption adjustment; (4) acoustic impedance adjustment; (5) flight-segment noise-fraction adjustment for exposure-based metrics; (6) aircraft speed adjustment for exposure-based metrics; (7) updated lateral attenuation adjustment; (8) ground-based directivity adjustment for observers behind start-of-take off-roll, as well as for computing metrics associated with run-up operations; (9) new helicopter noise modelling capabilities and associated adjustments (including advancing tip mach number, lateral directivity, static directivity and static duration adjustments); (10) metric computation process; and (11) development of a recursively-subdivided irregular grid methodology, which is used for computing noise contours.

## **Aircraft Noise Modelling Results**

The predicted noise levels and influenced area due to aircraft movement at Barapani (Shillong) Airport after expansion during operation are given in **Table 4.9**. The predicted noise contours are presented in **Figure 4.7**.

**Table 4.9: Noise Levels And Area of Influence**

| <b>Sr. No.</b> | <b>Noise Levels dB(A)</b> | <b>Area of Influence (km<sup>2</sup>)</b> | <b>Remark</b>                                                                                                                          |
|----------------|---------------------------|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| 1.             | 90- 85                    | 0.06                                      | Predicted noise levels confined within the boundary of Barapani (Shillong) Airport after expansion                                     |
| 2.             | 85 - 80                   | 0.11                                      | Predicted noise levels confined within the boundary of Barapani (Shillong) Airport after expansion                                     |
| 3.             | 80 - 75                   | 0.89                                      | Predicted noise levels confined within the boundary of Barapani (Shillong) Airport after expansion                                     |
| 4.             | 75 - 70                   | 0.92                                      | Predicted noise levels are partly out site boundary of Barapani (Shillong) Airport after expansion                                     |
| 5.             | 70- 65                    | 1.12                                      | About 0.65 km <sup>2</sup> of area is within this noise levels are outside the boundary of Barapani (Shillong) Airport after expansion |
| 6.             | 65 - 60                   | 1.43                                      | About 0.92 km <sup>2</sup> of area is within this noise levels are outside the boundary of Barapani (Shillong) Airport after expansion |
| 7.             | 60 - 55                   | 2.18                                      | About 1.93 km <sup>2</sup> of area is outside Barapani (Shillong) Airport after expansion                                              |
| 8.             | 55 – 50                   | 6.2                                       | Total 5.6 km <sup>2</sup> of area is outside of Barapani (Shillong) Airport after expansion                                            |
| 9.             | 50 - 45                   | 7.2                                       | Total 6.2 km <sup>2</sup> of area is outside of Barapani (Shillong) Airport after expansion                                            |

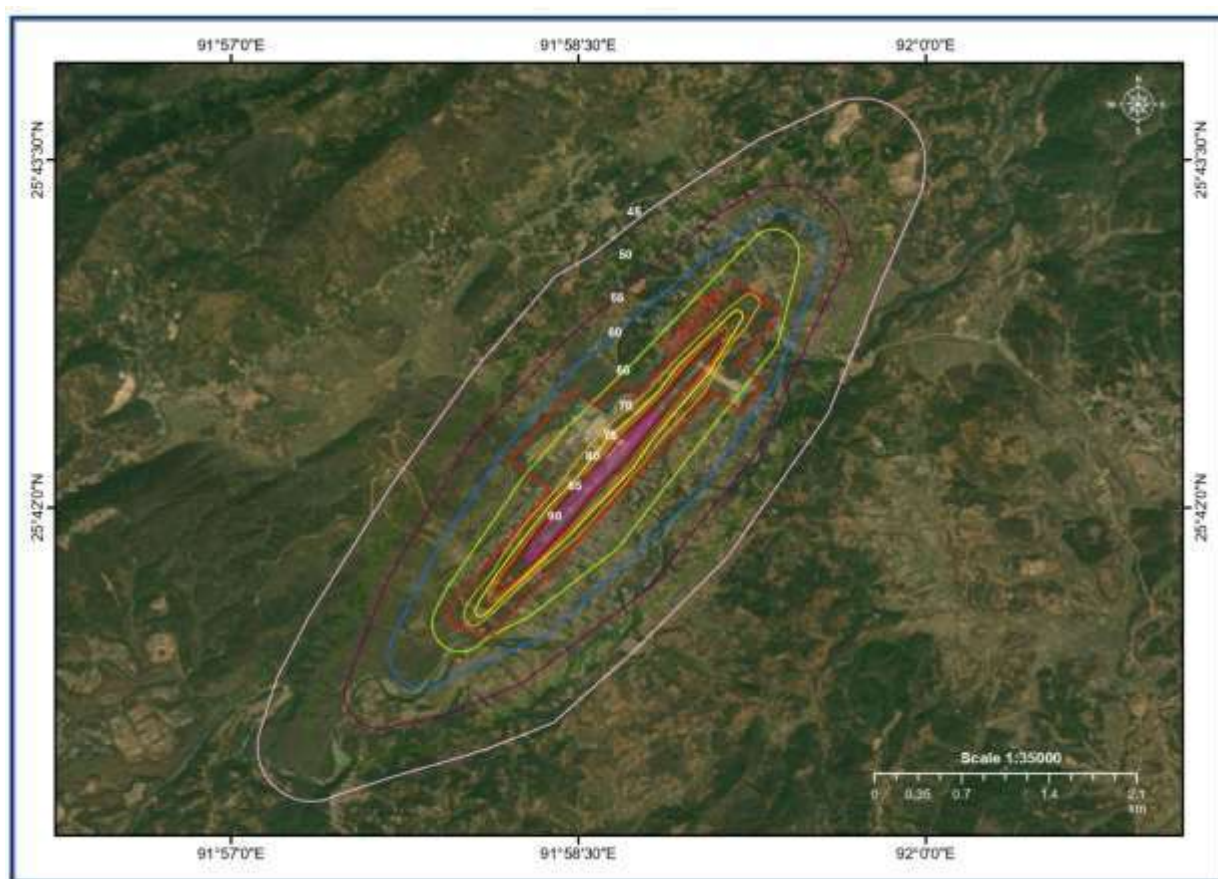
The noise levels from 70-90 dB(A) will be confined within the boundary of the Barapani (Shillong) Airport after expansion. The noise levels of 55 to 70 dB(A) cross the boundary and affect 4.73 km<sup>2</sup> of area outside boundary of Barapani (Shillong) Airport after expansion. The noise levels of 45-55 dB(A) cross the boundary and affect 11.8 km<sup>2</sup> of area outside the boundary of Barapani (Shillong) Airport after expansion. Boundary ball around the Barapani (Shillong) Airport after expansion and green belt development will significant attenuate noise levels from the Barapani (Shillong) Airport after expansion. The impact of noise levels due to the operation of the Barapani (Shillong) Airport after expansion will be within permissible levels. Further, noise mitigation measures to be implemented at and around the Barapani (Shillong) Airport after expansion will further reduce the noise levels in nearby settlements.

## **DG Sets**

For power back up 2 DG sets 380 kVA and 3 DG sets of 1000 kVA capacities each (two operation and one standby) will be available at Barapani (Shillong) Airport after expansion to meet the power requirement in the event of grid power failure. DG Sets will be provided with acoustic enclosures as per CPCB guidelines. Therefore, noise levels will be essentially within 70 dB(A), as per prescribed noise standards.

It is evident from the above discussions that generation of noise level from aircraft landing and take-off operation will be for a short duration (few seconds) with in the premises of Barapani (Shillong) Airport after expansion. Hence, the overall impact on noise levels is rated as follows:

| Impact Rating            | Noise Level |
|--------------------------|-------------|
| Nature of Impact         | Adverse     |
| Duration of Impact       | Long term   |
| Impacted Area            | Localized   |
| Likelihood of Occurrence | High        |
| Severity of Impact       | Low         |
| Significance of Impact   | Low         |



**Figure 4.7: Predicted Noise Levels Contours due to Aircraft Operations**



### **Mitigation Measures**

- The compliance of all standards prescribed by the ICAO during operation of aircraft by preventive maintenance and monitoring,
- Proper traffic management has been prepared to ensure that there is no traffic congestion at the airport. It helps in reduction of vehicular noise emissions from the airport,
- DG sets have been provided with acoustic enclosure as per CPCB guidelines,
- Proposed terminal building will be sound proof,
- Ground staff wears earplug while attending the aircraft,
- Green belt, landscaping and boundary at the airport act as barrier for noise;
- Green belt/plantation in the nearby settlements
- Monitoring of ambient air quality/source emission will be carried out as per monitoring plan.

#### **4.4.7 Traffic Management and Parking Facilities**

At the Barapani (Shillong) Airport after expansion traffic management will be provided in such a way no traffic congestion during passenger drop and pick up departure and arrival. At the Barapani (Shillong) Airport, parking facilities will be provided for 148 cars and 60 bikes. In addition, airport staff parking will also be provided for 49 cars and 40 two wheelers.

At the arrival and departure, there will be proper traffic management. During the operation of the Barapani (Shillong) Airport after expansion, there is no possibility of traffic congestion, as proper traffic management plan has been designed. Hence, overall impact on traffic management during operation phase of Barapani (Shillong) Airport after expansion is rated as follows:

| <b>Environmental Impact Rating</b> | <b>Traffic Management</b> |
|------------------------------------|---------------------------|
| Nature of Impact                   | Adverse                   |
| Duration of Impact                 | Long term                 |
| Impacted Area                      | Localized                 |
| Likelihood of Occurrence           | Moderate                  |
| Severity of Impact                 | Slight                    |
| Significance of Impact             | Negligible                |

### **Mitigation Measures**

- All vehicles will be parked in designated parking area only;
- Traffic management plan will implement.
- Road crossings will be well marked and signalled.

- Informatory and warning signages will be retro reflective type provided, clearly visible in the night.
- Marshals will be deployed to guide the vehicles and stop vehicles to avoid traffic jam at arrival and departure of Barapani (Shillong) Airport after expansion.

#### **4.4.8 Impact of Traffic on Highway and Roads Management**

Shillong Bypass is passing close to Barapani (Shillong) Airport. Shillong bypass is starting at Km 61.800 of NH-6 (Guwahati–Shillong Section) and ends at Mawryngkneng at Km 34.900 of NH-44 (Shillong–Jowai section). Therefore, from Shillong, Barapani Airport is approached by four lane Guwahati–Shillong Section of NH 6 and then by Shillong Bypass.

The traffic study was carried out the following two highways:

- Shillong Bypass near Barapani Airport on 22 May 2025
- Guwahati–Shillong Section of NH 6 near Umiam on 26 May 2025

#### **A. Conversion of Vehicles to PCU as per IRC 64:1990**

The conversion factor used to convert vehicles to Passenger Car Unit (PCU) as per IRC 64:1990 are given below:

| <b>Sn.</b> | <b>Type of Vehicles</b>                   | <b>Conversion Factor to Convert in PCU</b> |
|------------|-------------------------------------------|--------------------------------------------|
| 1.         | Two Wheelers                              | 0.5                                        |
| 2.         | Passenger car, pick-up van, auto-rickshaw | 1                                          |
| 3.         | Mini Bus                                  | 1.5                                        |
| 4.         | Truck or Bus                              | 3.0                                        |
| 5.         | Tempo / Pickup                            | 1                                          |
| 6.         | Mini LCV / LCV                            | 1.5                                        |
| 7.         | 2 Axle Trucks                             | 4                                          |
| 8.         | 3 Axle Trucks                             | 4                                          |
| 9.         | Multi Axle Vehicles                       | 4.5                                        |

#### **B. Traffic Count on Shillong Bypass**

Daily traffic Counts on Shillong Bypass starting at Km 61.800 of NH-6 (Guwahati–Shillong section) and ends at Mawryngkneng at Km 34.900 of NH-44 (Shillong–Jowai section) were carried out on 23 May 2025 and presented below in **Table 4.10**. This traffic count includes traffic from Barapani Airport also.

**Table 4.10: Daily Traffic Count on Shillong Bypass**

| Sn. | Type of Vehicles    | Vehicles | PCU         |
|-----|---------------------|----------|-------------|
| 1.  | Two Wheelers        | 214      | 107         |
| 2.  | Cars/Jeep/Vans      | 1857     | 1857        |
| 3.  | Mini Bus            | 23       | 35          |
| 4.  | Buses               | 41       | 123         |
| 5.  | Tempo / Pickup      | 356      | 356         |
| 6.  | Mini LCV / LCV      | 311      | 467         |
| 7.  | 2 Axle Trucks       | 302      | 906         |
| 8.  | 3 Axle Trucks       | 217      | 868         |
| 9.  | Multi Axle Vehicles | 1063     | 4784        |
| 10. | Autos/Others        | 34       | 34          |
|     | <b>Total</b>        |          | <b>9536</b> |

IRC Carrying Capacity of 2-Lane Shillong Bypass as IRC:64-1990 (Guidelines for Capacity of Roads in Rural Areas) are presented below:

| Level of Service (LOS)      | PCU/Day (4-lane divided road)          |
|-----------------------------|----------------------------------------|
| A (Free flow)               | Up to 5,000                            |
| B–C (Stable flow)           | Up to 10,000                           |
| D (Design Service Volume)   | 15,000 PCU/day (Standard IRC capacity) |
| E (Near Capacity)           | 17,000–18,000                          |
| F (Over Capacity/Congested) | > 18,000 PCU/day                       |

### C. Traffic Count on Guwahati–Shillong section of NH 6

The Guwahati–Shillong Section of NH 6 is four lane highway and used to travel from Barapani Airport to Shillong. Daily traffic counts on Guwahati–Shillong section were carried out near Umiam on 26 May 2025 and presented are given below in **Table 4.11**. This traffic count includes traffic from Barapani Airport to Shillong.

**Table 4.11: Daily Traffic Count on Guwahati–Shillong Section of NH 6**

| Sn. | Type of Vehicles    | Vehicles | PCU  |
|-----|---------------------|----------|------|
| 1.  | Two Wheelers        | 436      | 218  |
| 2.  | Cars/Jeep/Vans      | 6674     | 6674 |
| 3.  | Mini Bus            | 45       | 68   |
| 4.  | Buses               | 83       | 249  |
| 5.  | Tempo/Pickup        | 143      | 143  |
| 6.  | Mini LCV/LCV        | 728      | 1092 |
| 7.  | 2 Axle Trucks       | 918      | 2754 |
| 8.  | 3 Axle Trucks       | 667      | 2668 |
| 9.  | Multi Axle Vehicles | 1663     | 7484 |

|     |              |    |              |
|-----|--------------|----|--------------|
| 10. | Autos/Others | 73 | 73           |
|     | <b>Total</b> |    | <b>21422</b> |

IRC Carrying Capacity of 4-Lane Divided Highway Guwahati to Shillong Section as IRC:64-1990 (Guidelines for Capacity of Roads in Rural Areas) is given below:

| <b>Level of Service (LOS)</b> | <b>PCU/Day (4-lane divided road)</b>       |
|-------------------------------|--------------------------------------------|
| A (Free Flow)                 | up to 20,000 PCU/day                       |
| B–C (Stable Flow)             | up to 35,000 PCU/day                       |
| D (Design Service Volume)     | 40,000 PCU/day (typically used for design) |
| E (Approaching Capacity)      | 45,000–50,000 PCU/day                      |
| F (Forced Flow/Congestion)    | > 50,000 PCU/day                           |

The Level of Services (LOS) for Shillong Bypass and Guwahati – Shillong Section NH 6

| <b>Name of Road/Highway</b>      | <b>Daily Traffic (PCU)</b> | <b>LOS</b>        |
|----------------------------------|----------------------------|-------------------|
| Shillong Bypass                  | 9536                       | B–C (Stable flow) |
| Guwahati – Shillong Section NH 6 | 21422                      | B–C (Stable Flow) |

The Level of Services (LOS) for Shillong Bypass and Guwahati – Shillong Section NH 6 are within B-C (Stable flow), hence capacity of both highways is well enough for passenger car traffic due to operation of Barapani (Shillong) Airport. Anticipated contribution of traffic due to Barapani (Shillong) Airport after expansion on the Shillong Bypass and Guwahati – Shillong Section NH 6 will be merely <2 %. Therefore, there is no possibility of traffic jam due airport passengers' vehicles on the Shillong Bypass and Guwahati – Shillong Section NH 6 due to operation of Barapani Airport after expansion.

#### **4.4.9 Terrestrial Ecology**

At the Barapani Airport, green area and landscaping will be developed on 8250 sqm area city side. 103 trees will be planted at the Barapani (Shillong) Airport after expansion (@80 sqm for 1 tree). Treated waste water from STP will be used for irrigation of green belt. This has positive and long-term beneficial impact on terrestrial ecology of the area. Hence, overall impact on terrestrial ecology during operation phase is rated as follows:

| <b>Environmental Impact Rating</b> | <b>Terrestrial Ecology</b> |
|------------------------------------|----------------------------|
| Nature of Impact                   | Beneficial                 |
| Duration of Impact                 | Long term                  |
| Impacted Area                      | Localized                  |
| Likelihood of Occurrence           | High                       |
| Severity of Impact                 | Low                        |
| Significance of Impact             | Minor                      |

### **Mitigation Measures**

- Landscaping/ plantation/greenery will be increased after expansion.
- Indigenous species of trees will be planted after expansion.

#### **4.4.10 Heritage Structures**

There is no heritage, historical or archaeological structure in the area around the Barapani (Shillong) Airport after expansion. Therefore, no impact is anticipated due to construction of development of Barapani (Shillong) Airport after expansion. Hence, no mitigation measure is required.

#### **4.4.11 Occupational Hazards and Safety**

The most significant occupational hazards from the airport operation at Barapani (Shillong) Airport after expansion 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. The overall impact on occupational hazards and safety during operation phase is rated as follows:

| <b>Environmental Impact Rating</b> | <b>Occupational Hazard &amp; Safety</b> |
|------------------------------------|-----------------------------------------|
| Nature of Impact                   | Adverse                                 |
| Duration of Impact                 | Long term                               |
| Impacted Area                      | Localized                               |
| Likelihood of Occurrence           | Low                                     |
| Severity of Impact                 | Slight                                  |
| Significance of Impact             | Negligible                              |

### **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 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 will be placed on the handling of

luggage 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 will 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
- Firefighting facilities will be provided in new 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 ear muff and ear plug, high visible vest with refractive tape will be provided to ground staffs at the Barapani (Shillong) Airport after expansion.
- 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.

#### **4.4.12 Impacts to Socio-Economic Environment**

Operation phase of the Barapani (Shillong) Airport after expansion will open additional direct and indirect job opportunities in the area and region. Further, it will attract more and more commercial and developmental activities in the area. Therefore, positive impacts are anticipated on socio-economic environment during operation phase of Barapani (Shillong) Airport after expansion.

#### **Employment and Economic Growth**

The Barapani (Shillong) Airport after expansion will result in a boost in trade, commercial and industrial activities 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. Hence, overall impact during operation phase is rated as:

| <b>Environmental Impact Rating</b> | <b>Employment &amp; Economic Growth</b> |
|------------------------------------|-----------------------------------------|
| Nature of Impact                   | Beneficial                              |
| Duration of Impact                 | Long term                               |
| Impacted Area                      | Regional                                |
| Likelihood of Occurrence           | High                                    |
| Severity of Impact                 | Medium                                  |
| Significance of Impact             | Moderate                                |

## **CHAPTER-5**

### **ANALYSIS OF ALTERNATIVES**

#### **5.1 Introduction**

The consideration of alternatives of the proposed Barapani (Shillong) 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 proposed Barapani (Shillong) 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.

The examining feasible alternative means of carrying out a task involves answering the following three questions:

- (i) What are the alternatives?
- (ii) What are the environmental impacts associated with each alternative? and
- (iii) What is the rationale for selecting the preferred alternative?

#### **5.2 Alternative of Project Site**

Barapani Airport is an operational airport. Area of existing passenger terminal building is 5000 sqm with a peak hour handling capacity of 200 passengers and 0.5 MPPA. Air passengers are increasing rapidly at Barapani Airport. Therefore, there is urgent need for expansion terminal building. Further, existing runway 04/22 having dimension 1829m x 45m is suitable for the operation of ATR-72 type of aircraft. For operation of category C aircraft A 320, runway to be extended to 2400m. Therefore, AAI has decided for the expansion of Barapani (Shillong) airport. The 22 Acres encumbrance free land will be handed over by the Meghalaya State Govt to AAI for the expansion of Barapani Airport.

Barapani Airport is operational airport and expansion activities will be located on the available 416.16 Acres land and additional 22 Acres land to be provided by government of Meghalaya. No alternative sites have been considered as the project under present proposal is expansion of Barapani airport.



### **5.3 Alternative for Proposed Terminal Building**

At the Barapani Airport, construction of centrally air-conditional proposed terminal building of modular design with all modern facilities and amenities is proposed as per the layout plan. The terminal building covering an area of 5550 sqm will be designed for increasing the consolidated peak hour capacity to 1620 passengers (810 Arrival + 810 Departure) as per BCAS norms, with a provision of 2 nos. Passenger Boarding Bridge and to match the level of Service as per Civil Aviation Regulation (CAR) and International Airport Transport Association's (IATA) recommendations. The building will be provided with aesthetically appealing & soothing interior decoration matching the modern structure.

### **5.4 Alternative for Energy Conservation Measures**

During design and construction of proposed terminal building at the Barapani Airport necessary measures will be taken for conservation of energy in line with "Energy Conservation Building Code-2017" and "National Building Code 2016". The important energy conservation measures proposed for proposed terminal building are described below:

- Proposed Terminal building will be designed and constructed for GRIHA Rating 5 star,
- Use of Energy Efficient building material & glass,
- Use of LED lamps instead of GLS lamps,
- Use of Solar Backed up Light Emitting Diode Lamps instead of par lamps,
- Energy efficient HVAC system,
- Solar passive techniques for terminal building,
- Use of 5 Star BEE energy efficiency rating electrical equipments,
- Microprocessor-based Building Management System (BMS) will be installed for minimization of energy consumption,
- Automatic lighting on/ off control system will be provided in the civil enclave area for optimum utilization of energy.

It is proposed that 150 KWp solar power generation plant will be established at Barapani (Shillong) Airport to produce clean energy.

By adopting above measures about 30% energy will be saved the Barapani (Shillong) Airport.

### **5.5 Alternative for Green Building**

The domestic passenger terminal building at Barapani (Shillong) Airport will comply "Green Rating

for Integrated habitat Assessment (GRIHA) 5 star Rating. GRIHA is a rating tool that helps to assess the performance of their building against certain nationally acceptable benchmarks. It evaluates the environmental performance of a building holistically over its entire life cycle, thereby providing a definitive standard for what constitutes a 'green building'. The rating system, based on accepted energy and environmental principles, will seek to strike a balance between the established practices and emerging concepts, both national and international.

## **5.6 Sanitary Fixtures And Toilet Accessories**

All water closets will be wall hung with concealed dual flushing cistern and in lodders and staff toilets WC will be provided with dual flushing cistern. Under counter/ circular above counter wash basins with battery operated auto sensor pillar taps will be provided.

- Flat back wash basins with CP brass self closing pillar tap will be provided in lodders and staff toilets.
- Semi stall urinal with battery operating auto sensor flush valves.
- Frosted Glass urinal portion with metal clips.
- CP adjustable shower with Diverter and spout in rest room's and VIP toilet.
- Vitreous china recess toilet paper holder.
- Automatic soap dispenser on wash basins (Stainless steel).
- Automatic air purifier (stainless steel).
- Toilet tissue paper holder (Stainless steel).
- Automatic electrically operated hand drier (Stainless steel).

## **CHAPTER 6**

### **ENVIRONMENTAL MONITORING PLAN**

#### **6.1 Statutory Compliance /Returns**

The Airports Authority of India will submit required statutory returns/compliance reports for the Barapani (Shillong) Airport as per the following schedule:

- Uploading of half yearly compliance report on Parivesh Portal in respect of the stipulated prior environmental clearance's terms and conditions in hard and soft copies to the Regional Office of Ministry of Environment, Forest and Climate Change (MoEF&CC).
- Submission of environmental statement (Form V) for the financial year ending 31<sup>st</sup> March to the concerned regulatory authority on or before 30<sup>th</sup> September every year.

#### **6.2 Environmental Monitoring**

To ensure the effective implementation of the mitigation measures and environmental management plan during construction and operation phases of the proposed Barapani (Shillong) Airport, it is essential that an effective environmental monitoring plan be designed and followed during construction and operation phases. Suitable mitigation measures will be taken in case monitored parameters are exceeding the stipulated limits. As part of post project monitoring, Airports Authority of India will collect and monitor following data regularly:

- Compilation of emission inventory to quantify airport sources and the contribution to baseline emissions;
- Compilation of the emission inventory for aircraft sources will be undertaken;
- Continuous noise level monitoring by online integrated noise meters within Barapani (Shillong) Airport premises. This noise meter will be connected to central monitoring station where all the data is stored and processed.

##### **6.2.1 Ambient Air Quality (AAQ) Monitoring**

Ambient air quality parameters recommended for construction and operation of the Barapani (Shillong) Airport are PM<sub>2.5</sub>, PM<sub>10</sub>, NO<sub>2</sub>, SO<sub>2</sub>, CO. These are to be monitored at designated locations starting from the commencement of construction activities. Ambient air quality monitoring data will be generated twice in a week once in a season during construction phase and operation phase at all identified locations in accordance to the National Ambient Air Quantity Standards.

### **6.2.2 Water Quality Monitoring**

The parameters relevant for analysis of quality of treated waste water from STP are pH, total dissolved solids, total suspended solids, BOD, COD, oil & grease, etc. The sampling and analysis of ground water quality will be carried out in accordance with the Indian Standard Drinking Water Specification - IS 10500:2012.

### **6.2.3 Noise Levels Monitoring**

The measurements of noise levels would be carried out at the boundaries of the Barapani (Shillong) Airport in accordance to the Ambient Noise Standards formulated by Ministry of Environment, Forest and Climate Change (MoEF&CC). Noise level would be monitored on twenty-four hourly basis. Noise will be recorded at "A" weighted frequency using a slow time response mode of the measuring instrument.

### **Monitoring Protocol and Measurement Procedures For Airport Noise Zone**

Monitoring Protocol and Measurement Procedures to comply Ministry of Environment, Forest and Climate Change, Government of India's Notification No G.S.R. 588 (E) Dated 18.06.2018 for Airport Noise Standards are given below:

#### **1. Objective**

The objective of this document is to specify suitable requirements and procedure for carrying out monitoring of ambient noise level around due to aircraft. A proper database is essential for planning and executing suitable noise control programme for airports in the country.

This protocol is applicable to the Barapani (Shillong) Airport which operate for passenger and cargo operation. The central pollution control board has developed guidelines on requirement and procedure for monitoring ambient noise level due to aircraft. As per noise mapping studies, the guidelines on requirement and procedure for monitoring ambient noise level due to aircraft needs to be modified considering international practices and upcoming airport noise standards. The guidelines on requirement and procedure for monitoring aircraft noise (protocol) for existing and upcoming airport noise zone is given in the noise index.

#### **2. Noise Index**

- It is proposed that day and night average sound levels( $leq$ ) will be used to know the sound exposure on residents/zones due to aircrafts and for land use planning and control around airports by development authorities.

- The measurement of aircraft noise will be according to airport noise standard, the unit will be in dB(A) in Leq for day and night periods. The measurements of units are as per the timing given below
- Day time will mean from 6.00 a.m. to 10.00 p.m.
- Night time will mean from 10.00 p.m. to 6.00 a.m.
- dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing.
- "Decibel" is a unit in which noise is measured.
- "A", in dB(A) Leq, denotes the frequency weighting in the measurement of noise and corresponds to frequency response characteristics of human ear.
- Leq: It is energy mean of the noise level, over a specified period.
- All civil airports have to follow the civil aviation requirements specified for the airports for noise mapping, monitoring and action plans and amendments thereof.

### **3. Event Detection**

Different event detection techniques can be used depending on the situations, as given below:

- Event may be considered to start and end 10 dB below the A- weighted maximum sound pressure level of an aircraft operation.
- Event may be considered above a threshold value, which may be kept 5dB above the background sound level.
- Events of less than 10 seconds duration will not be recorded as these may be from sources other than aircraft movements. experience will also be used to differentiate and exclude noise from sources other aircraft operations.

### **4. Site Selection**

- The site will be so selected to minimize disturbances from other sources for proper event detection.
- The minimum A-weighted maximum sound pressure level from aircraft movements will be at least 15 dB above the background noise level.

### **5. Type of Monitoring Stations**

- Monitoring stations will be permanent for all runaway approaches. For mobile monitoring it can be either mobile vans mounted or portable noise monitoring terminal can be used as temporary stations.

### **6. Number and Locations of Monitoring Stations**

- At least two permanent stations will be installed per runaway.

- The permanent monitoring stations will be located on both sides of the runway, at the nearest residential area/silence zone and as far as possible under the flight paths of the aircrafts.
- In addition, temporary stations will be used for specific noise monitoring activity under the flight paths, where noise levels are expected to be higher.

## **7. Instrumentation**

- The instrument system, will meet the requirement for a class 1 instrument specified in IEC 61672-1(2002) Class 1.
- Noise monitoring station will consist of a weatherproof microphone, a data storage and analysis device and information transmission system such as a land line phone / GSM (global system for mobile communications).

## **8. Installation of Sound Level Meter**

- Sound level meter will be installed in flat terrain having no excessive sound absorption characteristics such as thick, matted or tall grasses, shrubs, or wooded areas.
- No obstructions significantly influencing the sound field from the aircraft will exist within a conical space above the point on the ground vertically below the microphone.
- The cone is defined by an axis normal to the ground and by half angle of 80 degrees from this axis. The microphone height will be at least 4 m, preferably 10 m, above the ground level.

## **9. Meteorological Measurement**

- Meteorological parameters such as wind speed, wind direction, relative humidity, air temperature and occurrence of rain will be recorded.

## **10. Noise Monitoring**

- Noise monitoring will be carried out continuously for 24 hours a day, 365 days a yr in permanent stations.
- In temporary stations, noise will be monitored continuously for minimum 7, as per requirements.

## **11. Parameters To Be Monitored**

- One second sound level (Leq i) will be recorded for 16 hrs day time (6.00 AM to 10.00 PM) and for 8 hrs night time (10.00PM to 6.00 AM) will be monitored.

## **12. Data Reporting**

- The noise monitoring data will be regularly compiled, documented and published by the Authorities designated by the Ministry of Civil Aviation.

### **6.2.4 Soil**

During construction and operation phases of the Barapani (Shillong) Airport, soil may be contaminated if suitable mitigation measures are not taken. Therefore, composite sample of soil will be collected and analyzed during construction and operation phases.

Environmental monitoring plan for various environmental parameters is given in **Table 6.1**:

**Table 6.1: Environmental Monitoring Plan for the Development of Barapani Airport**

| <b>Environmental Component</b> | <b>Project stage</b> | <b>Parameter</b>                                                              | <b>Standards</b>                                  | <b>Locations</b>                                                      | <b>Duration/ Frequency</b>                       |
|--------------------------------|----------------------|-------------------------------------------------------------------------------|---------------------------------------------------|-----------------------------------------------------------------------|--------------------------------------------------|
| Air                            | Construction Phase   | PM <sub>2.5</sub> , PM <sub>10</sub> , SO <sub>2</sub> , NO <sub>2</sub> , CO | National Ambient Quality Standards                | At Airport, Norgarh Umroi, Umktieh and Umed Umroi                     | Continuous 24-hourly, once in season             |
|                                | Operation Phase      | PM <sub>2.5</sub> , PM <sub>10</sub> , SO <sub>2</sub> , NO <sub>2</sub> , CO | National Ambient Quality Standards                | At Airport, Norgarh Umroi, Umktieh and Umed Umroi                     | Continuous 24-hourly, once in season             |
| Water Quality                  | Construction Stage   | Parameters as per IS 10500:2012                                               | As per potable water quality standards (IS 10500) | One sample at the Barapani Airport                                    | Once in six months during the construction phase |
|                                | Operation Phase      | Parameters as per IS 10500:2012                                               | As per potable water quality standards (IS 10500) | Barapani Airport                                                      | Once in six months during the operation phase    |
| Treated Waste Water from STP   | Operation Phase      | pH, TDS, TSS, BOD, COD, Oil & Grease                                          | As per prescribed standards                       | One sample of treated waste water at outlet of STP                    | Once in month                                    |
| Noise                          | Construction Phase   | Day and Night Time Noise Level in dB (A)                                      | As per National Noise standards                   | 4 locations on the boundary of Barapani Airport                       | Once in season during the construction phase     |
|                                | Operation Phase      | Day and Night Time Noise Level in dB (A)                                      | As per National Noise standards                   | Terminal building arrival and departure, Boundary of Barapani Airport | Once in season during the operation phase        |
| Soil                           | Construction         | Composite sample from the site for Physio-chemical parameters                 | As per EMP                                        | At Barapani Airport                                                   | Pre and Post Monsoon for 3 years                 |



| <b>Environmental Component</b> | <b>Project stage</b> | <b>Parameter</b>                                              | <b>Standards</b> | <b>Locations</b>    | <b>Duration/ Frequency</b>       |
|--------------------------------|----------------------|---------------------------------------------------------------|------------------|---------------------|----------------------------------|
|                                | Operation            | Composite sample from the site for Physio-chemical parameters | As per EMP       | At Barapani Airport | Pre and Post Monsoon for 5 years |

### **6.3 Environmental Reporting System**

Monitoring and evaluation are critical activities in implementation of environmental management measures. The reporting system will operate linearly with the contractor who is at the lowest rung of the implementation system reporting to the Airports Authority of India. All reporting by the contractor will be on a monthly basis.

The compliance monitoring and the progress reports on environmental components may be clubbed together and submitted to the Airports Authority of India monthly during the implementation period. The operation stage monitoring reports may be half yearly and annually provided the project Environmental Completion Report shows that the implementation was satisfactory.

Responsibilities for overseeing will rest with the Airports Authority of India. 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).

During the implementation period, a compliance report may include description of the items of EMP. It would also report to the management about actions taken to enforce compliance. It may however, be noted that certain items of the EMP might not be possibly complied with for a variety of reasons. The intention of the compliance report is not to suppress these issues but to bring out the circumstances and reasons for which compliance was not possible. This would help in reinforcing the implementation of the EMP.

The photographic records will also be established to provide useful environmental monitoring tools. A full record will be kept as part of normal contract monitoring. Reporting and Monitoring Systems for various stages of construction and related activities have been proposed to ensure timely and effective implementation of the EMP.

The reporting system has been prepared for the following phases of the Barapani Airport, viz:

- Pre construction stage
- Construction Stage, and
- Operation Stage

#### **6.4 Environmental Monitoring Cost**

The budget for environmental monitoring for construction and operation phases of the Barapani Airport has been estimated and presented in **Table 6.2** and **6.3**, respectively. The construction phase monitoring period for the Barapani Airport has been considered for 1 years while for operation phase monitoring period has been taken for 5 years.

**Table 6.2 - Cost of Environmental Monitoring for Construction Phase**

| <b>Components</b> | <b>Item</b>                                                                                                                                  | <b>Unit</b>                                                                       | <b>Unit Cost</b>      | <b>Quantity</b>       | <b>Total Cost (Rs)</b> |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-----------------------|-----------------------|------------------------|
| Air               | Ambient Air Quality monitoring at construction site in tandem with construction activities at 4 sides boundary of the airport site           | Continuous 24-hourly, twice a week once in every season during Construction Phase | Rs 7,000/-per sample  | 16                    | 112000                 |
| Water             | Water at the site for construction period                                                                                                    | Pre and Post Monsoon                                                              | Rs 8,000/- per sample | 4                     | 32000                  |
| Noise             | At equipment yard                                                                                                                            | No. of Samples                                                                    | 3,000/- per sample    | As and when necessary | 90000                  |
|                   | Ambient noise levels monitoring at construction site in tandem with construction activities at 4 sides boundary of the Agartala airport site | One day hourly measurement, once in 6 months for 1 years                          | 3,000/-               | 12                    | 36000                  |
| Soil              | Composite sample from the site for Physio-chemical parameters                                                                                | Pre and Post Monsoon                                                              | Rs 6,000/- per sample | 6                     | 36000                  |
|                   | <b>Total</b>                                                                                                                                 |                                                                                   |                       |                       | <b>306000</b>          |

**Table 6.3 - Cost of Environmental Monitoring for Operation Phase**

| <b>Components</b> | <b>Item</b>                                                                                 | <b>Unit</b>                                                   | <b>Unit Cost</b>      | <b>Quantity</b> | <b>Total Cost (Rs)</b>  |
|-------------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------|-----------------------|-----------------|-------------------------|
| Air               | Six Monthly Monitoring of DG sets emissions                                                 | 2 no of samples every year for 5 years                        | 6,000/- per sample    | 10              | 60000                   |
|                   | Ambient air quality monitoring during operation phase at 4 locations                        | Continuous 24-hourly, twice a week once in season for 5 years | 7,000/- per sample    | 40              | 280000                  |
| Water             | Water from Airport for 5 years of operation phase                                           | Pre and Post Monsoon                                          | Rs 8,000/- per sample | 10              | 80000                   |
|                   | Treated waste water from outlet Sewage Treatment Plant (STP) for 5 years of operation phase | Every 6 Months                                                | Rs 4000/- per sample  | 10              | 40000                   |
| Noise             | Online noise monitoring system for Aircraft Noise                                           | Noise measurement                                             | Lump sum              |                 | 600000                  |
|                   | Terminal building arrival and departure, takeoff and landing side of boundary               | Noise measurement, once in 6 months for 5 years               | 3,000/- per sample    | 40              | 120000                  |
| Soil              | Composite sample from the site for Physio-chemical parameters                               | Pre and Post Monsoon for 5 years                              | Rs 8,000/- per sample | 10              | 80000                   |
|                   | <b>Total (for five years )</b>                                                              |                                                               |                       |                 | <b>1260000</b>          |
|                   |                                                                                             |                                                               |                       |                 | <b>Rs 252000/- year</b> |

## **CHAPTER – 7**

### **(ADDITIONAL STUDIES)**

#### **7.1 RISK ASSESSMENT & DISASTER MANAGEMENT PLAN**

##### **7.1.1 Introduction**

At the Barapani (Shillong) Airport, there will not be tank farm area. The existing system of refueling ATF through oil bowsters will be continued. HSD will be stored in day tanks for DG sets operation during grid power failure.

Hazard analysis involves the identification and quantification of various probable hazards (unsafe conditions) that may occur at the Barapani (Shillong) Airport. On the other hand, risk analysis deals with the identification and quantification of risks, the equipment/facilities and personnel exposed, due to accidents resulting from the hazards present at the Barapani (Shillong) Airport after expansion.

Hazard occurrences at the Barapani (Shillong) Airport after expansion may result in on-site implications, like:

- Storage of HSD for DG sets operation;
- Leakage of flammable materials, like, HSD followed by fire;
- Bomb threat at terminal building, and aircraft; and
- Natural calamities like, earthquake, high winds, etc.

Other incidents, which can also result in a disaster at the Barapani (Shillong) Airport after expansion, are:

- Agitation/forced entry by external group of people; and
- Sabotage;
- Air raids; and
- Crashing of aircrafts i.e. while landing or take-off.

Risk analysis follows an extensive hazard identification and analysis. It involves the identification and assessment of risks to the people exposed to hazards present. This requires a thorough knowledge of failure probability, credible accident scenario, vulnerability of populations, etc. For emergency response planning, risk analysis is carried out for worst case scenarios.

##### **7.1.2 Approach for the Risk Analysis**

Risk involves the occurrence or potential occurrence of various type accidents consisting of an event or sequence of events. The risk analysis assessment study covers the following:

- Identification of potential hazard areas;
- Identification of representative failure cases;
- Visualization of the resulting scenarios in terms of fire and explosion;
- Assess the overall damage potential of the identified hazardous events and the impact zones from the accidental scenarios;
- Assess the overall suitability of the site from hazard minimization and disaster mitigation points of view;
- Furnish specific recommendations on the minimization of the worst accident possibilities; and
- Preparation of disaster management plan (DMP), on-site and off-site emergency response plan.

### **7.1.3 Hazard Identification**

#### **7.1.3.1 Introduction**

There is no proposal for provision of fuel tank farm. However, the existing system of refueling ATF through oil bowzers will be continued. High Speed Diesel (HSD) will be stored in day tank of DG sets and barrels as per requirement. If HSD is stored more than 1000 litres, permission will be obtained from Chief Controller of Explosive (CCE) for storage of HSD at the Barapani (Shillong) Airport.

Preliminary hazards analysis is based on the philosophy "*Prevention is better than cure*". Identification of hazards at the Barapani (Shillong) Airport after expansion is of primary significance in the risk analysis, quantification and cost-effective control of accidents. A classical definition of – hazard states that hazard is in fact the characteristic of system that presents potential for an accident. Hence, all the components of a system need to be thoroughly examined to assess their potential for initiating or propagating an unplanned event/sequence of events, which can be termed as an accident. Hazard identification has been carried out in the purview of following:

- Identification of hazards based on Manufacture, Storage and Import of Hazardous Chemicals (Amendment) Rules 2000); and
- Identification of hazards due to handling and storage of HSD based on qualitative/quantitative techniques.

#### **7.1.3.2 Identification of Hazards**

At the Barapani (Shillong) Airport after expansion, HSD will be stored and handled for DG sets operation and ATF. It is essential to have comprehensive information on High-Speed Diesel (HSD)

will be handled at the Barapani (Shillong) Airport. An understanding of their physico-chemical properties of HSD will help for hazard identification.

### **High Speed Diesel (HSD)**

High speed diesel is a mixture of straight run product (150 °C and 350 °C) with varying amount of selected cracked distillates and is composed of saturated hydrocarbons (primarily paraffins including iso, and cycloparaffins), and aromatic hydrocarbons (including naphthalenes and alkylbenzenes). Its exact composition depends on the source of crude oil from which it is produced and the refining methods used.

Physical properties of high speed diesel are as given below:

|                                |                            |
|--------------------------------|----------------------------|
| Boiling point/Range            | : 215 – 376 °C             |
| Physical state                 | : Liquid                   |
| Appearance                     | : Yellowish Brown          |
| Vapour pressure                | : 2.12 to 26mm Hg at 21 °C |
| Odour                          | : Perceptible odour        |
| Solubility in water @ 30 deg.C | : Insoluble                |
| Specific gravity               | : 0.86 - 0.90 at 20 °C     |
| Pour Point                     | : 6 - 18 °C                |
| Flammability                   | : Yes                      |
| LEL                            | : 0.6%                     |
| UEL                            | : 6%                       |
| Flash point (deg C)            | : 32 (°C)                  |
| TDG Flammability               | : Class 3                  |
| Auto Ignition Temp             | : 225 °C                   |

HSD presents a moderate fire hazard. On heating, it can cause pressure rise with risk of bursting and subsequent explosion. It also forms explosive mixture with air particularly in an empty container.

### **Aviation Turbine Fuel (ATF)**

Aviation Turbine Fuel (ATF) is clear colourless to yellow liquid with slight petroleum odor. It is flammable liquid and highly flammable in presence of open flame and spark. The flammability of ATF is ranked as 2 by National Fire Protection Association (NFPA).

Physical and chemical properties of ATF are as given below:

|                |          |
|----------------|----------|
| Physical state | : Liquid |
| Boiling Point  | : 160°C  |



|                           |                               |
|---------------------------|-------------------------------|
| Specific Gravity          | : 0.81 (Water = 1) at 15.6 oC |
| Vapor Pressure            | : 1 kPa (@ 37.8°C)            |
| Vapor Density             | : 5.7 (Air = 1)               |
| Auto-Ignition Temperature | : 210°C                       |
| Flash Points              | : 38°C                        |
| Flammable Limits          | : Lower: 0.7% Upper: 5 %      |
| Viscosity                 | : 8 cSt @ -20.0 °C            |
| Solubility                | : Low PPM range in water      |

### **7.1.3.3 Identification of Hazards Based on MSIHC Rule, 2000**

Manufacturing, Storage, Import of Hazardous Chemicals (Amendment) Rules, 2000 has been enforced by Govt. of India under Environment (Protection) Act, 1986. For the purpose of identifying hazard installations the rules employ certain criteria based on toxic, flammable and explosive properties of chemicals. MSIHC Rule is applicable for storage of HSD at the Barapani (Shillong) Airport after development.

#### **Hazardous Conditions**

An accidental release of HSD for DG operation from barrels and ATF for filling in aircraft may result in formation of fixed or spreading pool of released quantities. In case of immediate ignition a pool fire will result. Delayed ignition may result in explosion or flash fire, if quantity of explosive mass is sufficient and some confinement is present.

#### **Pool Fire**

A leak or spill of sufficient quantities of petroleum product will result in an accumulation of petroleum product on the ground. If ignited, the resulting fire is known as spreading or fixed pool fire. In case any object comes in contact with the flame above the pool, it will be severely damaged or destroyed and personnel exposed to flame will suffer extensive burn injuries. Objects and personnel outside the actual flame volume may also be affected or injured by radiant heat. The extent of damage or injury depends on the heat flux and duration of fire and exposure. If a large area of the body receives second and third degree burns, it can result in fatalities.

The extent of injury to people depends on the heat flux and duration of exposure. The extent of damage to personnel and property depends on the size of the pool and the duration of fire.

## Thermal Effects

In case of fire, thermal effect is likely to cause injury or damage to people and objects. A substantial body of experimental data exists and forms the basis for thermal effect estimation. The consequence caused by exposure to heat radiation is a function of:

- Radiation energy onto the human body [ $\text{kW/m}^2$ ];
- Exposure duration [sec];
- Protection of the skin tissue (clothed or naked body).

The following damage distances for thermal radiation have been used:

|                      |   |                                                                           |
|----------------------|---|---------------------------------------------------------------------------|
| 37.5 $\text{kW/m}^2$ | : | Damage to process equipment. 100% fatality in 1min. 1% fatality in 10sec. |
| 12.5 $\text{kW/m}^2$ | : | First degree burn for 10 sec exposure                                     |
| 4.0 $\text{kW/m}^2$  | : | First degree burn for 30 sec exposure                                     |

## Vapour Cloud Explosion/Flash fire

Vapour cloud explosion scenarios have been considered for confined (over pressure scenario) as well as non-confined scenario (flash fire).

If a released HSD is not ignited directly, the vapour cloud will spread in the surrounding area towards wind direction. The drifting cloud will mix with air. As long as the vapour concentration is between the lower and upper explosion limits, the vapour cloud may be set on fire by an ignition source. In case of delayed ignition of a vapour cloud, two physical effects may occur: a flash fire (non-confined) over the whole length of the flammable vapour cloud; a vapour cloud explosion (confined) which results in blast wave, with typical peak overpressures circular around the ignition source. For generation of overpressure effects, some degree of confinement of the flammable cloud is required. The extent of injury to people & damage to property or environment depends on the cloud size, explosive mass in the cloud and the degree of confinement at the time of ignition.

## Delayed Ignition & Explosion

In case of delayed ignition of a natural vapour cloud, two physical effects may occur:

- A flash fire (non-confined explosion) over the whole length of the explosive vapour cloud;
- A vapour cloud explosion (confined explosion) that results in blast wave, with typical peak overpressures circular around the ignition source. For generation of overpressure effects, some degree of confinement of the flammable cloud is required.

The following **Table 7.1** gives damage criteria with respect to the peak overpressures resulting from a blast wave:

**Table 7.1 Damage Effects due to Overpressures**

| Peak Overpressure | Damage Type       |
|-------------------|-------------------|
| 0.830 bar         | Total Destruction |
| 0.350 bar         | Heavy Damage      |
| 0.170 bar         | Moderate Damage   |
| 0.100 bar         | Minor Damage      |

The **Table 7.2** below gives an illustrative listing of damage effects caused by peak overpressure.

**Table 7.2: Illustrative Damage Effects due to Overpressures**

| Peak Overpressure (Bar) | Failure                                              |
|-------------------------|------------------------------------------------------|
| 0.005                   | 5 % Window Shattering                                |
| 0.02                    | 50 % Window Shattering                               |
| 0.07                    | Collapse of a roof of a tank                         |
| 0.07-0.14               | Connection failure of panelling                      |
| 0.08-0.1                | Minor Damage to Steel Framework                      |
| 0.15-0.2                | Concrete block wall shattered                        |
| 0.2                     | Collapse of Steel Framework                          |
| 0.2-0.3                 | Collapse of self framing Steel panel building        |
| 0.2-0.3                 | Ripping of empty oil tanks                           |
| 0.2-0.3                 | Deformation of a pipe bridge                         |
| 0.2-0.4                 | Big trees topple over                                |
| 0.3                     | Panelling torn off                                   |
| 0.35-0.4                | Piping failure                                       |
| 0.35-0.8                | Damage to Distillation Column                        |
| 0.4-0.85                | Collapse of pipe bridge                              |
| 0.5                     | Loaded Train Wagon overturned                        |
| 0.5                     | Brick walls shattered                                |
| 0.5-1.0                 | Movement of round tank, failure of connecting piping |

(Source: TNO)

#### **7.1.3.4 Maximum Credible Accident Analysis (MCAA)**

At the Barapani (Shillong) Airport after expansion, HSD may be released from barrels, causing possible fire and explosion resulting damage human and property in the surrounding area. This section deals with the question of how the consequences of the release of such substances and the damage to the surrounding area can be determined by means of models. Maximum Credible Accident analysis encompasses certain techniques to identify the hazards and calculate the

consequent effects in terms of damage distances of heat radiation, vapor cloud explosion, etc. Depending upon the effective hazardous attributes and their impact on the event, the maximum effect on the surrounding environment and the respective damage caused can be assessed.

Barapani (Shillong) Airport may mainly pose flammable and explosion hazards due to unwanted release or leakage of HSD. Consequence analysis is basically a study of quantitative analysis of hazards due to various failure scenarios. It is that part of risk analysis, which considers failure cases and the damage caused by these failure cases. It is done in order to form an opinion on potentially hazardous outcome of accidents and their possible consequences. The reason and purpose of consequence analysis are many folds like:

- Estimation of consequence distances;
- Design Criteria.
- Protection of other installations;
- Emergency Planning; and

The results of consequence analysis are useful for getting information about all known and unknown effects that are of importance when some failure scenario occurs and also to get information as how to deal with the possible catastrophic events.

#### **7.1.3.5 Scenarios Considered for MCA Analysis**

HSD will be stored in day tank of DG sets and barrels, while ATF will come in tanker. The selected scenarios for consequence calculations are given in **Table 7.3**.

**Table 7.3: Selected Scenarios for Consequence Calculations**

| <b>Scenario No.</b> | <b>Description</b>                                                         | <b>Outcomes</b>                               |
|---------------------|----------------------------------------------------------------------------|-----------------------------------------------|
| 1.                  | Leakage of HSD from day tank followed by Immediate/delayed ignition        | Pool Fire/ Vapour Cloud Explosion/ Flash Fire |
| 2                   | ATF Tanker on Fire during refueling followed by Immediate/delayed ignition | Pool Fire/ Vapour Cloud Explosion/ Flash Fire |

#### **Model Used For Consequence Analysis**

The consequence analysis studies involve a large number of calculations for which established computing aids are essential. PHAST software of DNV has been used to perform the consequence calculations. PHAST is a consequence and risk assessment software for calculation of physical effects (fire, explosion, atmospheric dispersion) of the escape of hazardous materials. PHAST software allows detailed modelling and quantitative assessment of release of pure and mixtures of liquid and gaseous chemicals.

### Scenario-1: Leakage of HSD from day tank Followed by Immediate/ delayed ignition

On release of HSD from day tank of DG set, HSD will be spread on the ground and spread pool of HSD will be formed. On early or delayed ignition, spread pool fire will be observed. Consequence calculations for release HSD from day tank followed by fire have been carried out as per the details given below:

- Pool Fire Heat Radiation**

On ignition of spreading pool, thermal radiation distances will be as given:

| Radiation Level        | Thermal Radiation Level Distances (m) |           |           |
|------------------------|---------------------------------------|-----------|-----------|
|                        | 4 m/s – B                             | 3 m/s – D | 2 m/s - E |
| 37.5 kW/m <sup>2</sup> | 3.13                                  | 4.44      | 4.76      |
| 12.5 kW/m <sup>2</sup> | 8.65                                  | 8.87      | 7.77      |
| 4 kW/m <sup>2</sup>    | 16.11                                 | 15.43     | 13.65     |

**Vapour Cloud Explosion:** In the event of delayed ignition after release of HSD, vapours of HSD will be generated from the surface of spreading pool and dispersed into the atmosphere towards prevailing wind directions. However, no vapour cloud explosion will be occurred:

**Flash Fire :** In the event of delayed ignition, vapours of HSD will be generated from the surface of spread pool and dispersed into the atmosphere towards prevailing wind directions. The distances of HSD vapours within the UFL and LFL are given below:

| Concentrations | Distances (m) |           |           |
|----------------|---------------|-----------|-----------|
|                | 3 m/s – B     | 3 m/s – D | 2 m/s - E |
| UFL            | 0.52          | 0.63      | 0.71      |
| LFL            | 7.23          | 8.56      | 9.76      |

Flash Fire Envelope distances will be as given below:

| Concentrations  | Flash Fire Envelope Distances (m) |           |           |
|-----------------|-----------------------------------|-----------|-----------|
|                 | 3 m/s – B                         | 3 m/s – D | 2 m/s – E |
| Furthest Extent | 7.23                              | 8.56      | 9.76      |

### Scenario - 2: ATF Tanker on Fire

In the event of ATF tanker (truck mounted) on fire, thermal radiation will be occurred in the surrounding area. Thermal radiation distances will be as given:

| Radiation Level        | Thermal Radiation Level Distances (m) |           |           |
|------------------------|---------------------------------------|-----------|-----------|
|                        | 4 m/s – B                             | 3 m/s – D | 3 m/s - E |
| 37.5 kW/m <sup>2</sup> | 5.56                                  | 5.09      | 5.16      |
| 12.5 kW/m <sup>2</sup> | 14.74                                 | 13.82     | 13.81     |
| 4 kW/m <sup>2</sup>    | 21.87                                 | 21.12     | 21.34     |

**Explosion Effects:** In the event of fire in ATF tanker, explosion may take place. Maximum distances for overpressure are as given below:

| Concentrations | Distances (m) |           |           |
|----------------|---------------|-----------|-----------|
|                | 4 m/s – B     | 3 m/s – D | 3 m/s - E |
| Over Pressure  | 62.3          | 64.7      | 56.8      |

### 7.1.3.6 Risk Mitigation Measures

The risk mitigation measures for handling of HSD and ATF are as given below:

- Prompt action in the event of an accidental release of HSD or ATF will be taken to control the release.
- Where there is a possibility of a flammable liquid spill, provisions will be made to ensure as follows: (i) the spread of the spill is limited; (ii) non-flammable absorbent material is available for immediate use; (iii) ignition sources can be quickly removed; and (iv) the area is well ventilated.
- Routine testing and inspection will be carried out hoses and ATF fueling tanker and record will be maintained.
- Leakages from tanker will be prevented by a suitable regime of preventive maintenance and inspection.
- Heat and smoke detectors will be provided at strategic locations.
- Fire fighting facilities will be provided near handling of HSD and ATF.
- Firefighting facilities will be tested as per schedule.
- Ground staff near aircraft will be trained to take measure in the event of spillage and during fire emergency.
- Fueling in Aircraft and filling of DG sets 'day tank' will be done under the supervision of trained operators.
- Open vents will be provided of goose neck type, covered with a 4 to 8 mesh screen to discharge the vapours of hydrocarbons from storage tanks,.
- Every ATF tanker, including all metal connections, will be electrically continuous and effectively earthed.
- Static grounding of aircraft will be ensured whenever the aircraft is parked; including during refueling.
- Check list for operators for checking safety system and equipment will be prepared and check records kept in safe custody.
- The critical operating steps will be displayed on the board near the location where applicable.
- Standard Operating Procedure (SOP)" will be followed while fueling the aircraft.
- Mock drills will be conducted in every three months involving all concerned agencies.
- All concerned agencies will be provided Disaster Management Plan and regular interaction will be made.

## **Risk Mitigation Measures for Fueling of Aircraft**

- Earthing and bonding connections will be attached and mechanically firm.
- Equipment performing aircraft servicing function will not be positioned within 3 m radius of aircraft fuel vent openings.
- Equipment other than that performing aircraft servicing functions will not be positioned within 15 m of aircraft during fuel servicing operations.
- The accessibility to the aircraft by fire vehicles will be established during aircraft fuel servicing.
- Handheld intrinsically safe communication devices used within 3 m from the fuel vent will be intrinsically safe.
- Presence of at least 2 x 9kg ABC dry powder fire extinguishers at both sides of the refueling browser / dispenser will be ensured.
- Spark plugs & other exposed terminal connections will be insulated.
- All vehicles, other than those performing fuel servicing, will not be driven or parked near aircraft wings.
- Electric tools, drills or similar tools likely to produce sparks or arcs will not be used.
- A clear area for emergency evacuation of the aircraft will be maintained at the rear (or front) aircraft exit door.

## **7.2 Disaster Management Plan**

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.

### **7.2.1 Objective of Emergency Planning**

The objective of the disaster management plan is to describe the emergency response organization, the resources available and response actions applicable. It deals with various types of emergencies that could occur at the Barapani (Shillong) Airport with the response organization structure being deployed in the shortest time possible during an emergency. Thus, the objectives of emergency response plan can be summarized as:

- Rapid control and containment of the hazardous situation;
- Minimizing the risk and impact of an event/accident; and
- Effective rehabilitation of the affected persons, and prevention of damage to property.

To effectively achieve, the objectives of emergency planning, the critical elements that form the backbone of the plan are:

- Reliable and early detection of an emergency and careful planning;
- The command, co-ordination, and response organization structure along with efficient trained personnel;
- The availability of resources for handling emergencies;
- Appropriate emergency response actions;
- Effective notification and communication facilities;
- Regular review and updating of the plan; and
- Proper training of the personnel.

### **7.2.2 Categorization of Emergencies**

The emergencies at Barapani (Shillong) Airport after expansion can be classified under several headings. These headings are listed below together with a description of the type of emergency.

#### **i. 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 and HSD storage, etc.

#### **ii. Natural Disasters**

The Barapani (Shillong) Airport is located in Seismic Zone V as per seismic classification. Seismicity is moderate natural hazard for the Barapani (Shillong) Airport. However, necessary design measures have been taken for making structure earthquake proof.

### **7.2.3 Key Functions of Airport Director and Other Supporting Organizations/Agencies/Services for mitigation of emergency at the Barapani (Shillong) Airport**

Concerned officers and other external supporting organizations/agencies/services will be called upon as necessary to mitigate crisis depending on the nature of emergency. Table below summarizes the general key functions of Airports Authority of India (AAI) and other supporting organizations/agencies/services during crisis at the Barapani (Shillong) Airport.



| <b>Sn</b> | <b>Organization/ /Agencies/Services</b> | <b>Key Functions</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-----------|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.        | Airport Fire Service                    | <ul style="list-style-type: none"> <li>• Fire-fighting operations</li> <li>• Post-accident fire protection</li> <li>• Evacuate injured passengers to hospitals</li> <li>• Support structural fire-fighting and evacuation</li> <li>• Support mitigation of dangerous goods accidents/incidents</li> <li>• Inform fire brigade.</li> </ul>                                                                                                                                                   |
| 2.        | Terminal Building Management            | <ul style="list-style-type: none"> <li>• Activate Key Officials and other external agencies/services such as hospitals, panel doctors, ambulance services,</li> <li>• Activate the Emergency Response and Interaction Centre (ERIC) Group</li> <li>• Set up the Emergency Coordination Centre (ECC), Friends and Relatives Reception Centre (FRRC)</li> <li>• Passenger facilitation and business recovery at terminal buildings</li> <li>• Support terminal building evacuation</li> </ul> |
| 3.        | Engineering                             | <ul style="list-style-type: none"> <li>• Provide technical support and assistance</li> <li>• Support recovery efforts</li> </ul>                                                                                                                                                                                                                                                                                                                                                            |
| 4.        | Local Police                            | <ul style="list-style-type: none"> <li>• Guarding of site and preservation of evidence at the Barapani (Shillong) Airport including eye-witness accounts and photography.</li> <li>• Maintain law and order at the site.</li> </ul>                                                                                                                                                                                                                                                         |

#### **7.2.4 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 Barapani (Shillong) 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:

### **i. 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:

- a. Formulate strategic plans and policies, as well as engage in high level decision making for the mitigation of crisis.
- b. Control, coordinate and support operations during an Incident.
- c. Oversee the work and progress of protracted fire-fighting and rescue, and salvage operations.
- d. Liaise with the airline concerned, local authorities, ministries, and governmental departments for support.
- e. Arrange and provide welfare to the staff involved in the mitigation of crisis.
- f. Regulate the release of information to the public on the facts of the aircraft disaster.
- g. Issue press releases and organize press conferences.
- h. Ensure that the post-accident Barapani (Shillong) Airport can resume normal operations in the shortest possible time.

### **ii. 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:

- a. Support incident site fire-fighting and rescue operations through liaison and coordination

with the external organizations/agencies/ services.

- b. Facilitate mobilization of external resources to the crash site, such as issuing emergency passes and arranging with Apron Control for "Follow-me" vehicles.
- c. Arrange and facilitate visits by the WVIPs to the site (if any).

### **iii. 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.

### **iv. 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.

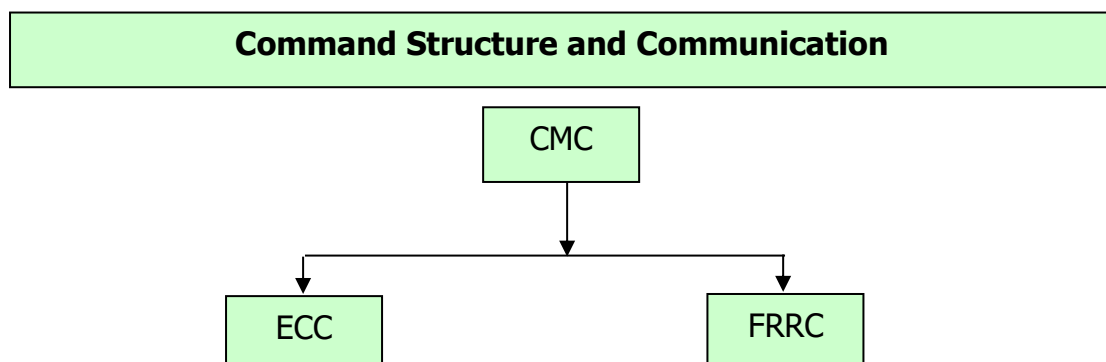
On receiving the "Fire" message, Terminal Director will set up the FRRC.

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:



### **7.2.5 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.

### **7.2.6 Emergency Procedures**

#### **7.2.6.1 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.

#### **7.2.6.2 Fires on the Ground (Fires Involving at Airport *i.e.* Non-Aircraft Related Fires)**

Fire may occur at any of the part of the Barapani (Shillong) Airport. If out of control, such a fire may cripple the key Barapani (Shillong) 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.

### **7.2.7 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.

### **7.2.8 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.

The 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.

### **7.2.9 Updating of Emergency Plan**

The proposed 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.

### **7.3 Social Impact Assessment and R&R Action Plan**

The Barapani (Shillong) Airport covers 416.16 Acres area. 22 Acres land (16 acres for Runway Extension by 571m and another 6 Acres of land for Relocation of Isolation Bay) required for the proposed expansion of runway and isolation pad will be transferred by Govt to Meghalaya to Airports Authority India for proposed expansion. Therefore, Social Impact Assessment and R&R Action plan is not required as land acquisition will be carried by Govt. to Meghalaya. The anticipated impacts on socio- economic environment due the proposed development of Barapani (Shillong) Airport have been identified and assessed in Chapter 4 of the EIA report.



## **CHAPTER- 8**

### **PROJECT BENEFITS**

#### **8.1 General**

The proposed expansion of Barapani (Shillong) Airport, is likely to open domestic /export markets. There is export possibility in the region through Barapani (Shillong) Airport. Shillong exports a variety of goods, including ginger, oranges, handicrafts, betel leaves, raw hides, bay leaves, fresh tomatoes, and various other agricultural produces.

#### **8.2 Direct and Indirect Benefits**

The direct and indirect benefits of the Barapani (Shillong) Airport are as follows:

##### **Direct Benefits**

- Better infrastructure facilities for passenger
- For safe landing and takeoff of aircrafts at Barapani (Shillong) Airport
- Increase in regional economy as it will boost tourism and commercial activities in the region.
- Generation of more revenue to the state, hence more development of the region.

##### **Macro Level Benefits**

- Boost in trade and commerce and more people to travel in the state.
- Employment opportunity to people.
- More business and industrial opportunities

## **CHAPTER 9**

### **ENVIRONMENTAL COST BENEFIT ANALYSIS**

#### **9.1 General**

The Environmental Cost Benefit Analysis was not recommended during scoping stage and in TOR granted by State Expert Appraisal Committee (SEAC) of State Environmental Impact Assessment Authority (SEIAA), Meghalaya. Hence, the Environmental Cost Benefit Analysis was not carried out.

## **CHAPTER 10**

### **ENVIRONMENTAL MANAGEMENT PLAN**

#### **10.1 Introduction**

The Environmental Impact Assessment (EIA) has identified environmental impacts those are likely to arise during construction of the proposed expansion of Barapani (Shillong) 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 expansion of Barapani (Shillong) 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 the proposed expansion of Barapani (Shillong) Airport.

#### **10.2 Environmental Management Measures**

##### **10.2.1 Soil**

###### ***Construction Phase***

During the construction phase of the proposed expansion of Barapani (Shillong) Airport, the following measures shall be adopted to minimize adverse impacts on soil:

- The top soil from all areas to be permanently covered will be stripped to a specified depth of 15 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.
- 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.
- All metal, paper, plastic wastes, debris and cuttings shall be collected from the site as soon as particular construction activity is over,
- 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.
- 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

### ***Operation Phase***

Approx. 1240 kg/d solid waste will be generated from the Barapani Airport in the form of paper, plastics, polyethylene bags and food waste, etc. Solid waste from the Barapani Airport will be collected in waste bins.

Approx. 30 kg sludge generated from STP will be used as manure for greenery and landscaping development.

The following measures shall be adopted to minimize adverse impacts in soil, during operation phase.

- Fuel and waste oil from 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.
- Drains shall be provided in and around the storage yards and drains will be fitted with oil interceptors.
- The solid waste handling and disposal services will be outsourced by Airports Authority of India to authorized agency to ensure proper disposal of solid waste generated at the Barapani Airport. AAI will ensure that solid waste is being managed as per Solid Waste Management Rule 2016.

### **10.2.2 Water Quality**

#### ***Construction Phase***

The following mitigation measures will be adopted to avoid impacts on water quality during construction phase of the expansion of Barapani Airport:

- Efforts will be made to conserve the water;
- Appropriate sanitation facilities (septic tank) to be provided for the construction workers to reduce impact on water quality.
- The construction wastes will be collected and disposed suitably.
- Control of spillage of fuel oil and storage of oil barrels on cemented floor.
- Waste oil generated during maintenance of construction equipment will be collected and disposed to MSPCB approved waste oil recyclers for recycling and reuse.

- Runoff from fuelling area, vehicle parking areas, etc. will be passed through oil interceptor.

### **Operation Phase**

The following measures will be taken to protect water quality at the Barapani Airport during operation phase:

- Sewage generated at the Barapani Airport will be collected and sent to sewage treatment plant for proper treatment and disposal for recycling.
- Municipal wastes generated at the Barapani Airport will be collected and disposed suitably as per standards practices.
- Used oil generated at the Barapani Airport will be collected and disposed to MSPCB approved waste oil recyclers for recycling and reuse.

The following measures will be taken to protect water quality at the Barapani Airport during operation phase:

- Sewage generated will be collected and sent to sewage treatment plant for proper treatment and reuse.
- Use of treated water for non-potable purposes like flushing 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 Barapani Airport for the reduction of usage of water.
- Rainwater recharge pits are proposed to harness and manage storm water runoff.
- As a part of pollution control measure before discharging the storm water to the waterway channel/pond, four oil-water separator (OWS) units are proposed.
- Silt pits 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 drainage design of Barapani 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.

## I. Sewage (Waste Water) Management

Sewage generated from the Barapani (Shillong) Airport will be treated in well-designed Sewage Treatment Plant (STP). Sequencing Batch Reactor (SBR) type sewage treatment plant of 275 KLD capacity will be installed at the Barapani (Shillong) Airport.

The Sequencing Batch Reactor (SBR) is a activated sludge process technology designed to treat sewage and domestic wastewater in batch mode. It combines equalization, aeration, and clarification in a tank, making it space-efficient and cost-effective. The treatment process is carried out in a sequence of steps within the same reactor, offering flexibility and high treatment efficiency.

Design parameters for the STP are given below:

| Sl. | Parameters       | Before Treatment | After Treatment   |
|-----|------------------|------------------|-------------------|
| 1.  | pH               | 7.5 - 8.5        | 6.0 - 8.5         |
| 2.  | BOD              | 250-450 mg/l     | Less than 10 mg/l |
| 3.  | Suspended Solids | 250-400 mg/l     | Less than 10 mg/l |
| 4.  | COD              | 600-800 mg/l     | Less than 30 mg/l |
| 5.  | Oil & Grease     | 50-100 mg/l      | Less than 10 mg/l |

## II. Process Description of SBR based STP

As per water balance diagram, 257 kl/d sewage will be generated Barapani (Shillong) Airport, which will be treated in SBR based STP of 275 kld capacity. The existing SBR based STP has capacity of 50 kld, which will be extended to 275 kld capacity. Sewage will be collected and treated in well-designed SBR based sewage treatment plant. After meeting stipulated standards, treated waste water will be utilized for flushing purpose, irrigation of greenery and landscaping.

The as-built General Arrangement Drawing of the STP installed at Barapani Airport is presented in **Figure 10.1**. The Process Flow Diagram is provided in **Figure 10.2**, the Hydraulic Flow Diagram in **Figure 10.3**, and the as-built P&ID of the STP is shown in **Figure 10.4**.

### Key Process Steps in SBR-based STP:

#### 1. Preliminary Treatment

- **Coarse Screening:** Incoming sewage/waste water will be passed through coarse screen to remove large solids, plastics, rags, and debris (if any).
- **Sewage Collection Tank:** Sewage/waste water after coarse tank will be collected in sewage collection tank.

- **Fine Screening:** Sewage/waste water from sewage collection tank will be passed through fine screen. It ensures the protection of downstream equipment and improves overall treatment efficiency by removing smaller floating and suspended solids that pass through coarse screens.
- **Grit Removal:** Grit chambers will allow the removal of sand, gravel, and other heavy particles to prevent abrasion in downstream equipment.

## **2. SBR Reactors (Tanks)**

In an SBR-based Sewage Treatment Plant, the SBR tanks are the core components where the actual biological treatment of wastewater takes place. These tanks perform multiple treatment functions in a cyclical and sequential manner, all within the same tank—making the process efficient and compact. The core of the process operates in batch mode through the following sequential phases:

- **Fill:** Wastewater is filled into the SBR tanks either under static or mixed conditions.
- **Aeration:** Air is introduced using fine bubble diffusers. This phase supports microbial activity for the degradation of organic matter (BOD, COD), nitrification, and partial phosphorus removal.
- **Settle:** Aeration is stopped, allowing biomass (activated sludge) to settle and form a clear supernatant.
- **Decant:** The treated effluent is discharged from the top without disturbing settled sludge using decanter mechanisms.

### **Clarified Water Tank**

- The clarified water tank is a **post-treatment storage** component in an SBR-based STP. It temporarily stores the **treated effluent (supernatant)** after it is decanted from the SBR tank before it is either reused, disinfected, or discharged.

## **3. Sludge Handling**

- **Waste Activated Sludge (WAS):** A portion of the settled biomass is periodically wasted to a sludge holding tank.
- **Sludge Dewatering:** Sludge will be dewatered using a filter press.
- **Dried sludge will be sent for Disposal:** Dewatered sludge is disposed of in accordance with regulatory norms.

#### **4. Tertiary Treatment**

**Pressure Sand Filter (PSF)** – It removes residual suspended solids (turbidity) from the clarified water after biological treatment and acts as a physical filtration unit using graded sand as media. In PSF, water from the clarified tank is pumped through a sand bed and particles are trapped in the voids between sand grains.

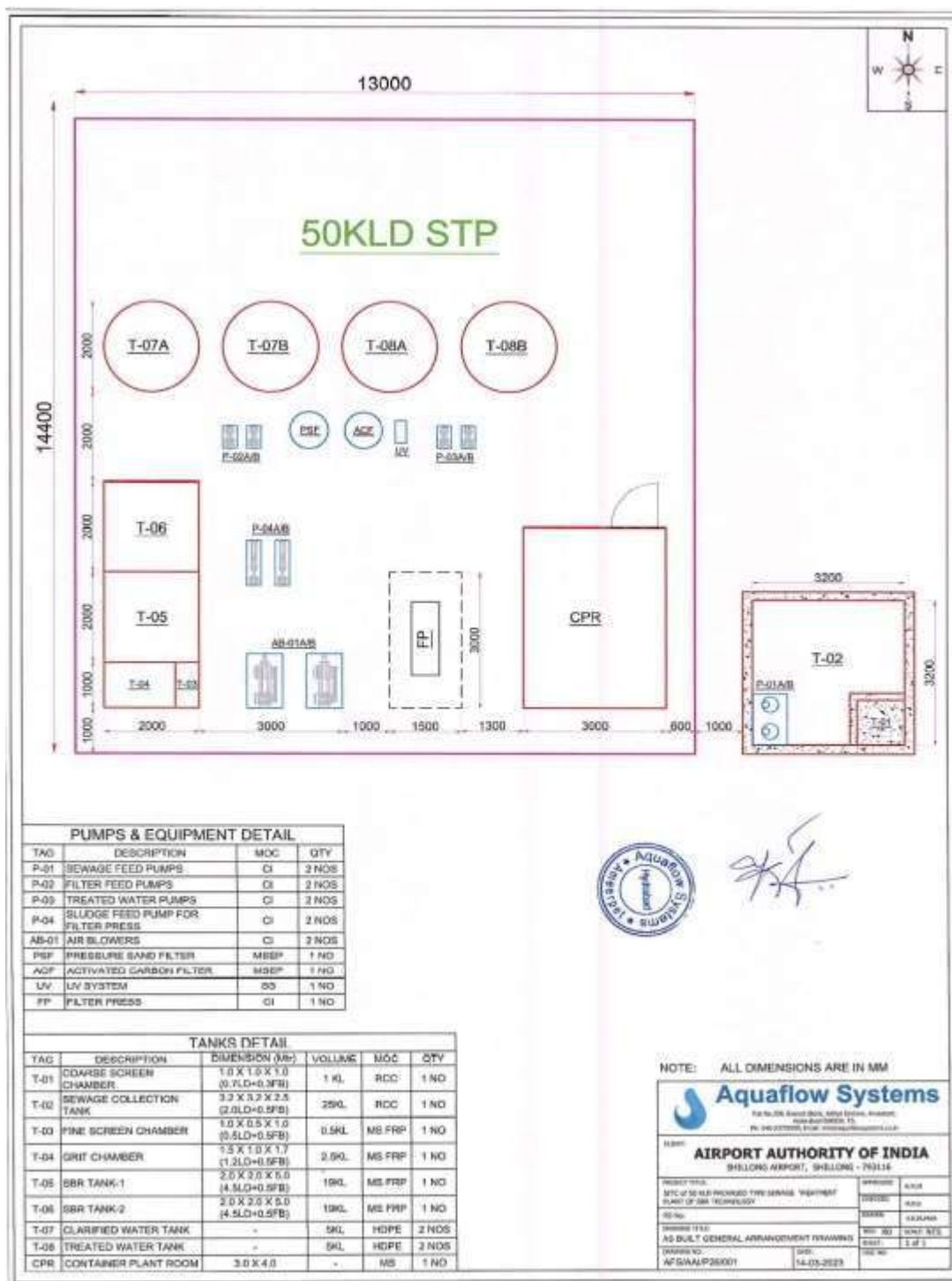
**Activated Carbon Filter (ACF)** – ACF removes color, odor, organic compounds, and residual chlorine and enhances the aesthetic quality of the treated water. Treated water from PSF flows through a bed of activated carbon media and adsorption removes dissolved organic impurities and some micropollutants.

**Ultraviolet (UV) Disinfection** – After ACF treated water will pass through a chamber where it's exposed to UV light (usually at 254 nm). UV rays damage microbial DNA, preventing reproduction. This process will disinfect the filtered water by inactivating pathogens (pathogenic bacteria, Faecal coliforms, viruses, protozoa) and ensures the water is safe for reuse or discharge to sensitive environments.

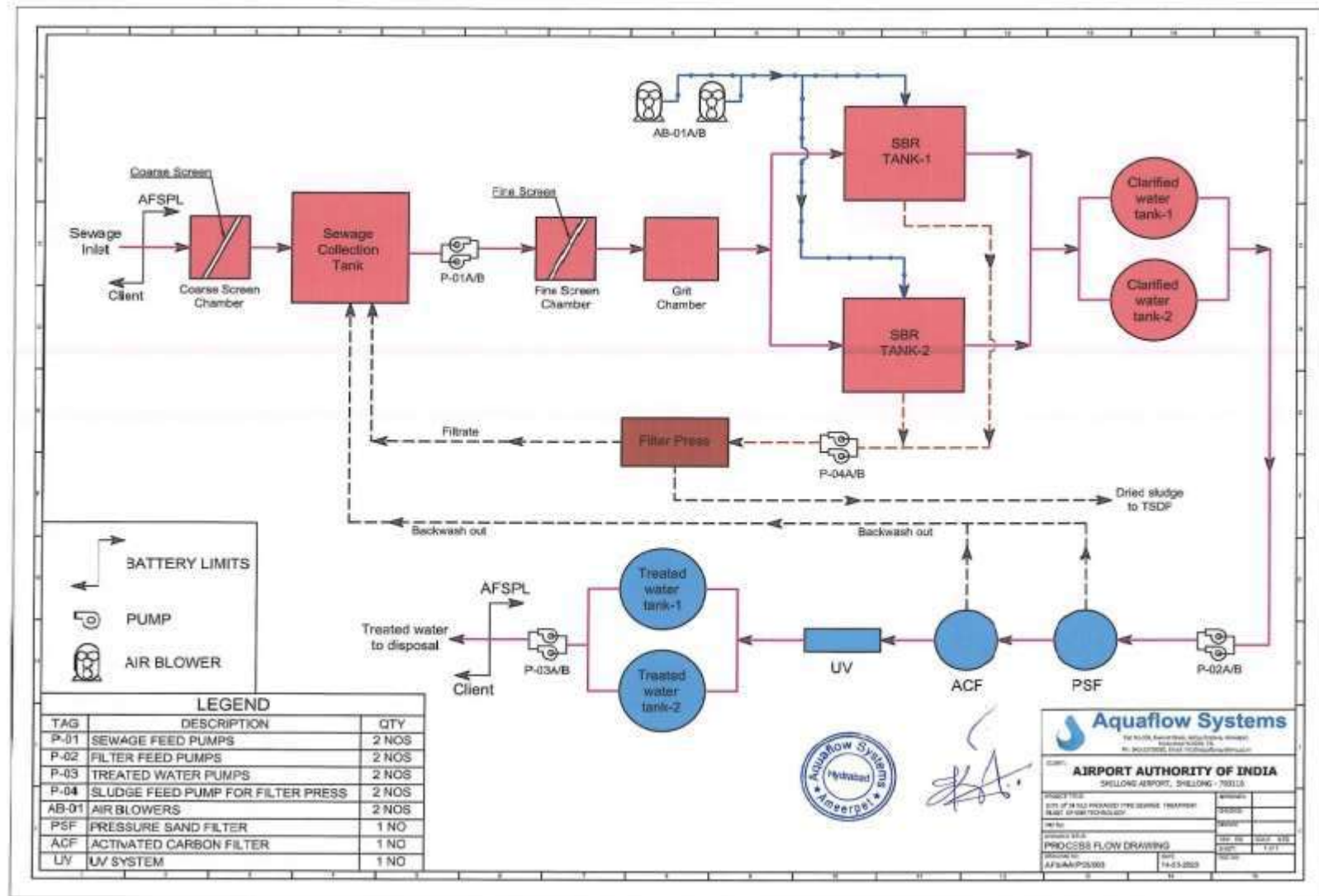
#### **Treated Water Reuse or Disposal**

The treated waste water from SBR STP will be reused for gardening and toilet flushing.





**Figure 10.1:As Built General Arrangement Drawing for STP Installed at the Barapani Airport**



**Figure 10.2 : Process Flow Diagram for STP Installed at the Barapani Airport**

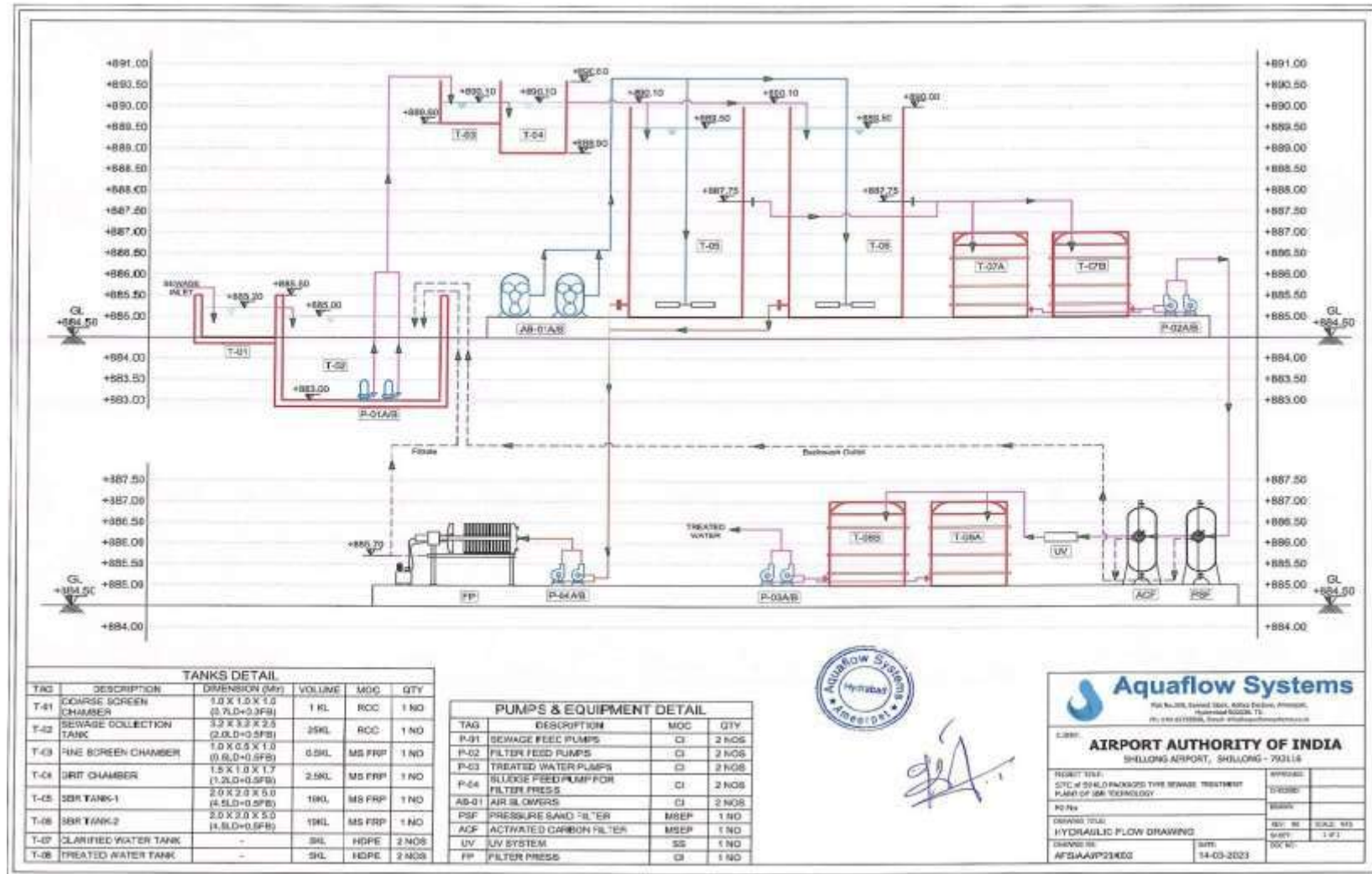


Figure 10.3 : Hydraulic Flow Diagram for STP Installed at the Barapani Airport

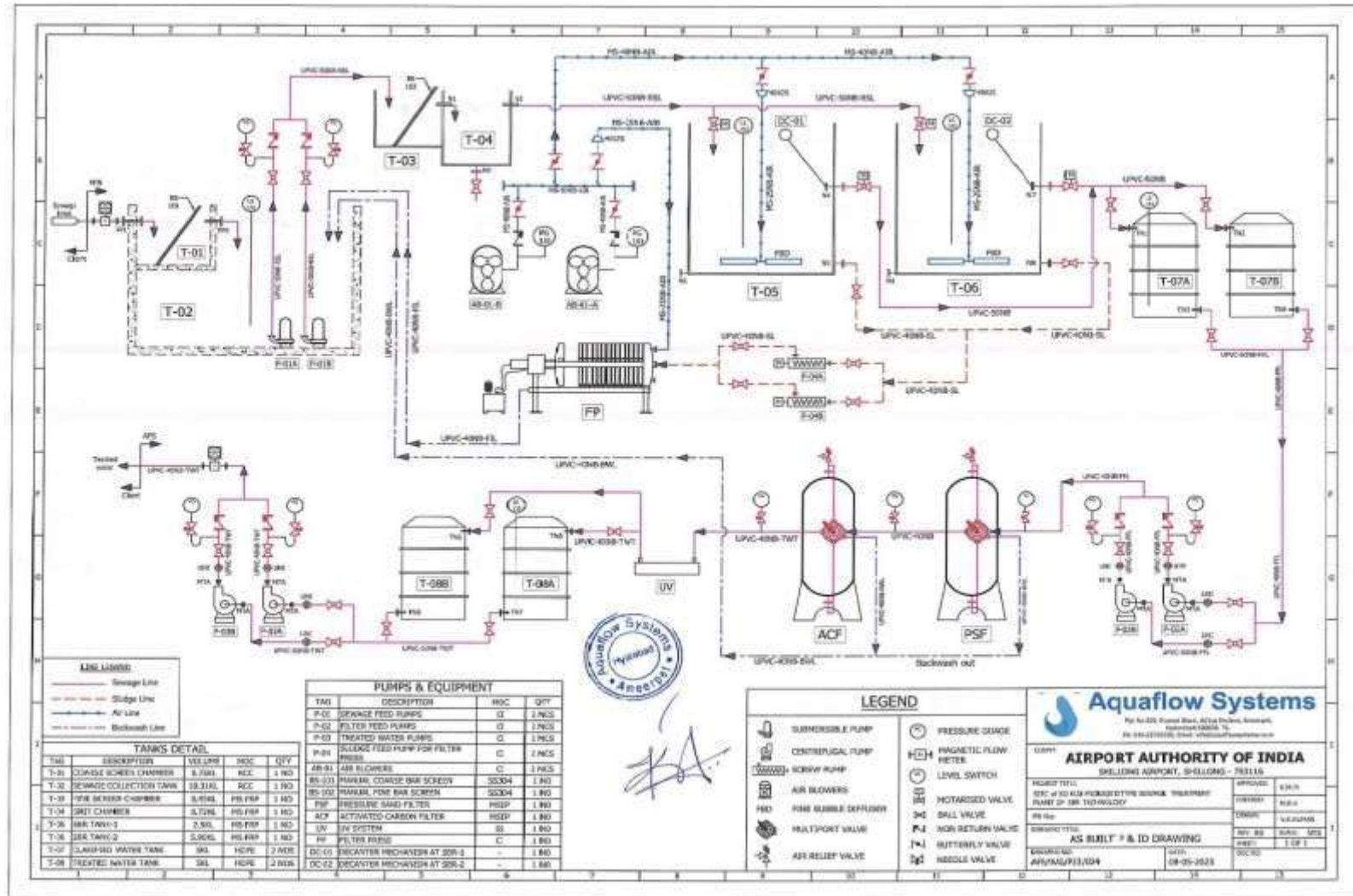


Figure 10.4 : As Built P&ID Drawing for STP Installed at the Barapani Airport

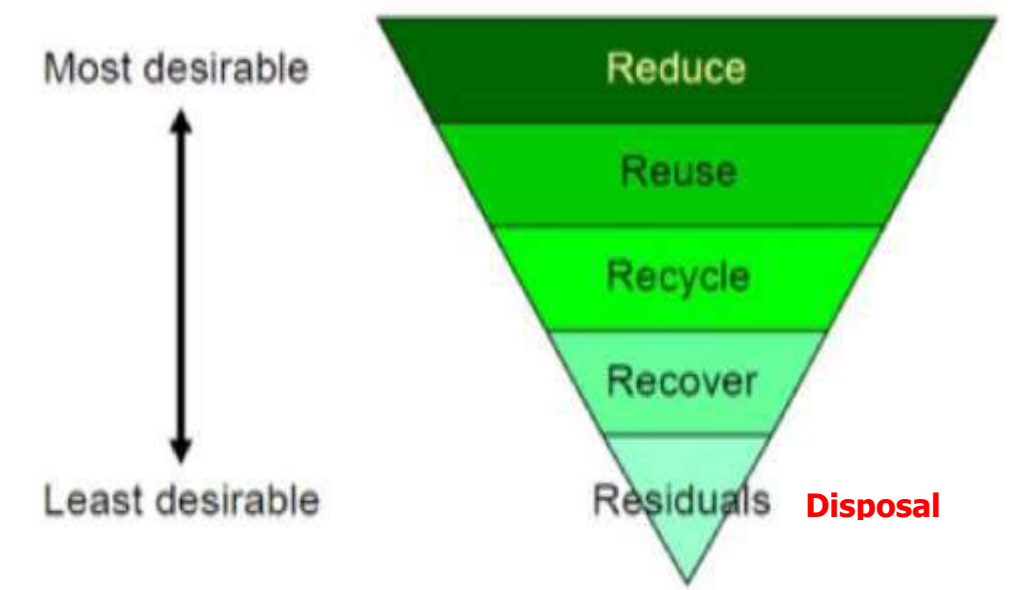


### 10.2.3 Waste Management

#### **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.



#### **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.

Demolition of buildings is not proposed to be generated at the project site and incumbrance free land will be provided by the Govt of Meghalaya.

#### **Operation Phase**

The following mitigation measures will be taken for management of solid waste during operation phase of the Barapani Airport.

- Solid wastes management at the Barapani (Shillong) Airport will be carried out as per Solid Wastes Management Rule, 2016.
- Solid wastes will be collected in designated waste bins based on their types, placed at the strategic locations in the Barapani (Shillong) Airport.

Details of solid wastes to be generated from the Barapani (Shillong) Airport are as given below:

| S. No.     | Solid waste Generation From                                     | Nos./Day | Waste generation Par Person /kg | Kg/day             |
|------------|-----------------------------------------------------------------|----------|---------------------------------|--------------------|
| <b>I.</b>  | <b>From Barapani Airport</b>                                    |          |                                 |                    |
| 1.         | Arriving & Departing Passengers                                 | 4400     | 0.2                             | 880                |
| 2.         | Airport Staff & Visitor                                         | 400      | 0.1                             | 40                 |
| 3.         | Residential                                                     | 100      | 0.2                             | 20                 |
| <b>II.</b> | <b>From Aircraft (de-plane)</b>                                 |          | @20 kg/flight                   | 300                |
|            |                                                                 |          |                                 | <b>1240</b>        |
|            | <b>Total Solid Wastes to be Generated from Barapani Airport</b> |          |                                 | <b>1240 kg/day</b> |

Approx. 1240 kg per day solid wastes comprising paper, plastic, tin cane, biodegradable food wastes, non-biodegradable inert wastes, etc. will be generated from the proposed Barapani Airport, which will be collected, segregated and disposed as per provisions of Solid Waste Management Rule, 2016. Approx. 30 kg sludge will also be generated from STP which will be used as manure at the Barapani Airport.

Details of solid wastes to be generated from the Barapani Airport are as given below:

| Types of Solid Wastes                  | Kg/day      |
|----------------------------------------|-------------|
| Recyclable Plastic Wastes              | 600         |
| Biodegradable Paper Wastes             | 120         |
| Recyclable Metal Waste (Tin cans, etc) | 140         |
| Biodegradable food wastes              | 360         |
| Non-Biodegradable Inert Wastes         | 20          |
| <b>Total Quantity</b>                  | <b>1240</b> |

Solid waste segregation and disposal is not proposed at the site as it will attract birds hazards. The solid wastes handling and disposal services will be outsourced by Airports Authority of India to Third party to ensure proper disposal of solid waste generated at the Barapani (Shillong) Airport. AAI will ensure that solid wastes are being managed and disposed as per Solid Waste Management Rule, 2016.

## **Solid Waste Management for Wastes Generated from Barapani (Shillong) Airport**

Solid Wastes Management for 1240 kg/day solid wastes generated from the Barapani (Shillong) Airport will be as given below:

- Colour Coded Dual Waste Bins for collection of biodegradable food wastes & paper wastes and for non-biodegradable plastic wastes, metal and inert wastes will be placed in terminal building, arrival & departure and in parking area.
- Wastes collected from the Barapani (Shillong) Airport will be segregated as recyclable wastes, biodegradable organic wastes and non-biodegradable inert wastes.
- 600 kg/day recyclable plastic wastes and 140kg/day recyclable metal waste (tin cans, etc) (total 740 kg/day recyclable wastes) will be given for recycling to scrap dealer through third party hired by AAI
- 480 kg/day Biodegradable food and paper wastes will be treated in two Organic Waste Converter (OWC) of 1000 kg capacity each and to be used as manure at the Barapani Airport for development of landscaping and plantation.
- About 20 kg/day non-biodegradable inert wastes will be disposed at the sanitary landfill site.

The solid waste handling and disposal services will be outsourced to authorized agency to ensure disposal of solid waste generated from the Barapani Airport as solid waste segregation and disposal is not proposed at the site as it will attract birds hazards. Solid waste generated in the aircraft will also be disposed off at the designated waste collection points from where the agency will pick up the garbage bags.

The collected garbage will be transported in covered container and will arrange to dispose off after segregation of recyclable wastes as per provisions of Solid Wastes Handling Rule 2016. After collection of garbage, garbage bins will be disinfected every day by sprinkling disinfectant powder. Weekly washing of garbage bins will also be carried out by this agency.

Maintenance and workshop are not proposed at Barapani (Shillong) Airport, therefore, there will be no such type of waste generation.

**Hazardous Waste Management** - From the Barapani Airport, about 200 liters used oil will be generated during the maintenance of DG sets. Used oil generated from the Barapani (Shillong) airport will be disposed to authorised used oil recyclers.

**e-wastes Management** - About 250 kg per year e-wastes will be generated from the Barapani (Shillong), which will be disposed to authorised e-waste recyclers as per e-wastes management rules 2016.

#### **10.2.4 Air Quality Control Action Plan**

##### ***Construction Phase***

During the construction phase, only marginal deterioration of ambient air quality is expected at the construction site due to operation of construction equipment and machineries, dust emissions from loading and unloading of raw materials, cement and soils, dust emissions from the batch plant, fugitive emissions from vehicle movement, etc. However, this deterioration will be temporary in the nature during construction phase. 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.
- Six feet curtain boundary will be provided around the project site.
- Installation of batch mix plant (if required by the contractor) at isolated place and providing cover shed around the plant,
- Pollution Under Control Certificate will be mandatory for all vehicles approaching to the site. Any vehicle not meeting the vehicular pollution standards will not be allowed within the construction site and for the construction activity;
- Air pollution control action plan will be implemented during construction and operation phases; and will be published it at the main entrance of the site.

##### **Operation Phase**

Major pollutants from the Barapani (Shillong) Airport operation will be emitted from aircraft exhaust, vehicular traffic as ground support, pickup and dropping at the Barapani (Shillong) Airport and from DG sets. The major pollutants are mainly Nitrogen di-oxide and Carbon monoxide besides particulates and sulphur di-oxide. The baseline ambient air quality levels in the project area are within the permissible limits as specified as National Ambient Air Quality Standards. The following methods of abatement of pollution will be employed for the air pollution control at the source level during operation phase of the Barapani (Shillong) Airport:

- Shut down combustion engines when not in use,
- Single engine taxiing and reduced taxiing is effective in reducing emissions of HC and CO from aircraft,
- Height of the stack for DG sets will be kept as per CPCB guidelines,
- Proper car parking facilities and traffic flow to avoid traffic congestion, and



- Providing suitable green belt to reduce the impact of air pollution.

### **10.2.5 Noise Levels**

#### **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 silencers on the construction machineries,
- Noise standards will be strictly enforced for vehicles, equipment, and construction machineries, etc,
- All construction equipment used for an 8-hour shift will conform to a standard of less than 75 dB (A),
- Vehicles and construction equipment with internal combustion engines without proper silencer will not be allowed to operate at the construction site,
- If required, machineries producing high noise, such as concrete mixers, generators etc, shall be provided with noise shields and their usage timings can be regulated,
- Shock absorbing techniques will be adopted to reduce vibration and noise,
- Machineries and vehicles will be maintained regularly, with particular attention to silencers and mufflers, to keep construction noise levels to minimum, and
- 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.

#### **Operation Phase**

During the operational phase of the Barapani (Shillong) Airport, 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 project has been calculated. It was observed that the noise levels at the airport boundary will vary up to 65 dB (A). It can be stated that the impact on the present noise levels from the noise modelling, due to Barapani (Shillong) 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:

Approach 1: Reduction of Noise Source

Approach 2: Landuse Planning and Management

Approach 3: Noise Abatement Operational Procedures

Approach 4: Operating Restrictions

**Reduction of Noise at Source:** New and latest aircrafts which are designed with minimum source noise levels will be allowed at the Barapani (Shillong) Airport.

**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.
- Aircrafts with certified engines only will 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 taxiing.
- DG sets will be fitted 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.

### **10.2.6 Vehicle Parking and Traffic Management**

At the Barapani (Shillong) Airport, parking facilities will be provided for 148 cars and 60 bikes. In addition, airport staff parking will also be provided for 49 cars and 40 two wheelers. Vehicle parking and traffic management plan for Barapani Airport are shown in **Figure 10.5**.

Barapani Airport is already operational. The proposed expansion of Barapani Airport is aimed to provide better infrastructure facilities for air passengers. Traffic circulation plan for departure and arrival will be such that there is no traffic congestion at the Barapani (Shillong) Airport.



- ✚ Use of eco-friendly construction materials with low embodied energy and high durability to achieve sustainability and reduce the carbon footprint of the terminal building.
- ✚ The following glazing parameters will be adhered to while selecting the glass for exterior fenestrations.
  - Visible Light Transmitted (VLT) > 30%
  - Infrared radiation (IR) – 10-14%
  - Solar Heat Gain Coefficient (SHGC) < 0.25
  - U Value < 2.0 W/m<sup>2</sup>K
- ✚ Window-to-wall ratio (WWR) should not exceed 60%.
- ✚ Skylights should not exceed 5% of the roof area. Solar Heat Gain Coefficient (SHGC) for skylights should not exceed 0.35.
- ✚ Integrating smart building management systems & automation for energy management, monitoring & control to optimize energy use & operational efficiency. Improving energy efficiency reduces operational costs as well as enhances environmental performance of the terminal building.
- ✚ Optimizing lighting systems in passenger terminal building involves leveraging - LED technology, daylighting strategies, intelligent control systems like motion sensors, and by incorporating energy-efficient lighting solutions and advanced control mechanisms, terminals can achieve significant energy savings and provide a comfortable environment for passengers.
- ✚ Installation of timeclock that can start and stop the system under different schedules for three different day-types per week.
- ✚ Temperature Controls so as to provide both heating and cooling. Controls shall be capable of providing a temperature dead band of 3.0°C within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum. It shall be interlocked to prevent simultaneous heating and cooling.
- ✚ Two speed motors, pony motors, or variable speed drives controlling the fans, or controls capable of reducing the fan speed to at least two third of installed fan power.
- ✚ Automatic lighting controls will function on timer circuits based on independent program schedule.
- ✚ CFL/LED will be used in place of incandescent lamps in common areas and parking.
- ✚ Lighting for exterior applications will be controlled by time switch that is capable of automatically turning off the exterior lighting when daylight is available or the lighting is not required.
- ✚ Façade lighting and façade non-emergency signage will have separate time switches Interior lighting power shall be as per the requirements of ECBC 2017 / or NBC 2016.
- ✚ Energy efficient motors (IE > 2: high efficiency class) and pumps will be used. Power factor shall be maintained around unity. APFC panel with capacitor will be used for Common Load & Fixed Capacitor for Transformer to minimize the losses.
- ✚ Autoclaved Aerated Concrete (AAC) blocks will be used in construction for energy saving.

- ✚ Lighting and switching of common area shall be designed keeping in mind day light integration.
- ✚ Roof insulation shall be planned to conserve energy.
- ✚ The water supply pumping system shall be provided with variable speed drive to conserve energy.
- ✚ The building structure will be also incorporate light wells to channel natural sunlight from the roof to the first floor.
- ✚ The high ceiling space of the terminal will have a conventional air volume HVAC system employing stratification principles to conserve energy.
- ✚ Refrigerants used in HVAC equipment- Low or no Ozone Depletion Potential and Global Warming Potential.
- ✚ Halon free fire suppression system will be used.
- ✚ Adhesives, sealants, paints and carpets will be specified to have very limited or no volatile organic compounds.
- ✚ The arched form of the roof structure will be designed to promote natural cooling by harnessing the laminar airflow over its surfaces. The roof surface will also reflect energy, limit heat gain and channel rainwater for collection and use in building.

#### **(viii.) Comfort Systems and Controls**

##### **Ventilation:**

- ✚ Exterior building features, including facades, illuminated roofs, architectural features, entrances, exits, loading docks, and illuminated canopies, and exterior building grounds lighting that is provided through the building's electrical service.

##### **Controls:**

- ✚ Temperature Controls so as to provide both heating and cooling. Controls shall be capable of providing a temperature dead band of 3.0°C within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum. It shall be interlocked to prevent simultaneous heating and cooling.
- ✚ Two speed motors, pony motors, or variable speed drives controlling the fans, or Controls capable of reducing the fan speed to at least two third of installed fan power.

#### **(ix.) Renewable Energy Integration in Terminal Building**

- ✚ Integrating renewable energy sources such as solar PV Plant in terminal buildings enhances sustainability through carbon footprint reduction & reduces reliance on traditional power sources.
- ✚ Barapani Airport will install 150 kW solar panels to harness solar power.

## **10.2.8 Carbon Neutrality**

### **A. Renewable Energy Adoption:/ Carbon-Free Electricity Generation**

The energy consumption from the fossil fuel is planned to be reduced by utilization of Energy generation from the solar power plant. State policy allows the net metering upto solar power plant of capacity 150 KWp. In order to take advantage of both monetary saving and carbon free electricity generation, a solar plant of capacity of 150 KWp with net metering facility is envisaged for Barapani (Shillong) Airport

### **B. Energy Efficiency**

- (a.) **Thermal Performance:** The Works shall be designed and executed to comply with the following or ECBC-2017 (Energy Conservation Building Code) whichever is more stringent:  
Vertical Façade • U-value for glazing systems - 1.6 W/m<sup>2</sup>/K
- (b.) Internal & external lighting systems shall be provided as per Lux level as per GRIHA-V and ECBC requirements.
- (c.) UPS capacity shall be suitable to cater for all of the above-mentioned loads plus 20% spare capacity. UPS shall conform to ECBC 2017 for minimum efficiency level at 100% load.
- (d.) All Smart Metering (Energy, Water etc.) to be as per ECBC Norms to comply GRIHA
- (e.) Providing PIR/Occupancy Sensor as per mandatory requirement of GRIHA-2019 & ECBC 2017 in small, enclosed spaces such as Office areas, IT Room, Smoke Room, Baby Care room, Prayer Room, Luggage Facility, Toilets, and Corridors etc.
- (f.) LED lighting fixtures shall be provided with inbuilt Harmonic suppression system (THD < 10) in all areas and buildings to achieve the illumination levels conforming to latest IS Code, NBC 2016, ECBC 2017 latest up to date.
- (g.) Transformers shall have no load losses/ Full Load losses as per ECBC 2017/ GRIHA requirement.
- (h.) All high efficiency motors will be used (minimum IE-4) except for Firefighting.
- (i.) Energy Conservation Features in HVAC System Air-conditioning & ventilation system design shall be equipped with energy conservation features to reduce overall energy demand of the building and minimize operating costs. Some of the features are as follows:
  - ✚ High COP (Low IKW/ TR) water cooled chilling machines. Minimum requirement 5 Star rating as per ECBC-2017 up to date amendment.
  - ✚ Secondary variable speed pumping system for chilled water distribution system.
  - ✚ VFD on cooling tower fans.
  - ✚ Chiller Plant Optimizer to optimize the total chiller plant room operation.

- ✚ Energy efficient motors for AHUs and for ventilation fans as per latest ECBC+ /super ECBC guideline.
- ✚ Selection of high efficiency fans for air handling units and ventilation system.
- ✚ Variable frequency drive shall be used for all AHU's.
- ✚ Demand Control Ventilation (DCV) System with indoor air quality sensors (CO2 sensor) to modulate the fresh air quantity.
- ✚ Use of individual and multiple air handling units which can be shut down during unoccupied or partially occupied periods.
- ✚ High efficient latest technology low-pressure drop filters (ESP Filter) having efficiency minimum equivalent to MERV-14 rating.
- ✚ UVGI system for indoor air quality.
- ✚ BTU meters at each chiller

#### **10.2.8.1 GRIHA Rating 5 Star for Proposed Terminal Building**

Airports Authority of India has planned for green building certification for terminal building under Green Rating for Integrated Habitat Assessment (GRIHA) organization. Out of possible 104 points for Criterion as per GRIHA Dashboard, minimum 81 to 90 points will be achieved for 5 Stars GRIHA rating.

Eco-friendly building materials including fly ash bricks, fly ash paving blocks, RMC, lead free paints, use of PPC in concrete etc. will be used as per design by EPC concessionaire.

#### **10.2.8.2 150 kWp Grid Tied Ground Mounted SPVPP**

AAI has planned for to install 250kWp Grid Tied Ground Mounted Solar Photovoltaic Power Plant (SPVPP) at the Barapani Airport. Bills of materials for 150 kWp Grid Tied Ground Mounted SPVPP are given in **Table 10.1:**

**Table 10.1: Bill of Materials for 150 kWp Grid Tied Ground Mounted SPVPP**

| <b>Sn.</b> | <b>Item Description</b> | <b>Specifications</b>                                                                          | <b>Indicative Make</b> |
|------------|-------------------------|------------------------------------------------------------------------------------------------|------------------------|
| 1.         | Solar Module            | Solar Module of Minimum 310 Wp Manufactured on Automated Production Lines with greater than 16 | Trina or equivalent    |

| Sn. | Item Description                                             | Specifications                                                                        | Indicative Make              |
|-----|--------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------------------|
|     |                                                              | % module efficiency (DC Capacity = 100 kWp)                                           |                              |
| 2.  | Module Mounting Structure                                    | G.I. Sheets with Excellent Corrosion Resistance                                       | Standard Make                |
| 3.  | Power Conditioning Unit (Inverters)                          | Power Conditioning Unit with MPPT Charge Controller and above 98% Efficiency Inverter | Fronius or equivalent        |
| 4.  | Cables                                                       | DC Cable – 1C x 4sq mm, Cu<br>AC Cable – as per detailed design                       | Polycab – AC<br>SIECHEM – AC |
| 5.  | Protection Devices                                           | Lighting Arrestors<br>Earthing Protection                                             | Ellipse or Equivalent        |
| 6.  | HDEP Pipe                                                    | Underground HT Cable Laying                                                           | Standard Make                |
| 7.  | Data Logging + DG Synchronization + Reverse Power Controller | SolGrid-Power Management System                                                       | RelyOn Solar                 |

## Details of Solar Module

### Features

- 310-320 Wp Multi Crystalline Solar Module from reputed supplier.
- With more than 15% module efficiency. These are used in MW Solar Farms
- 72 Cells modules with low iron anti refractive coated glass gains additional 2% energy.
- Superior resistance to PID (potential induced degradation)
- Upto 25 years true liners power output warranty.
- 10 years global workmanship warranty.

Details of solar module are given in **Table 10.2**.

**Table 10.2: Details of Solar Module**

|                             |                                                |
|-----------------------------|------------------------------------------------|
| Peak Power (Pmax)           | 315 Wp                                         |
| Max Power Current (Imp)     | 9.10 A                                         |
| Short Circuit Current (Isc) | 8.55 A                                         |
| No. of Cells                | 72                                             |
| Max Power Voltage (Vmp)     | 36.9 V                                         |
| Open Circuit Voltage (VoC)  | 45.4 V                                         |
| Tolerance                   | 0, +5                                          |
| Module Efficiency (%)       | 16.2                                           |
| Weight                      | 25 kg                                          |
| Glass                       | High Transmission Low Iron Tempered glass      |
| Frame                       | Anodized Aluminum alloy with twin wall profile |



|              |                             |
|--------------|-----------------------------|
| Junction Box | IP 65/IP 67, 3 bypass diode |
|--------------|-----------------------------|

### **Invertors:**

In this system outdoor type PCU (invertors) technology:

- Enhance power output than conventional inverter – 6-8 %
- Designated to withstand in extreme weather conditions
- Design life of 12-15 years
- Greater than 98.3 % efficiency at peak power
- Harmonics below 1.8 %
- Degree of protection IP 66
- Cooling : Regulated air cooling
- Data logging system allow continuous monitoring of the energy generation
- Able to run in synchronization with Diesel generator in case of grid failure.

### **Module Mounting Structures**

Fixed mounting type structures will be provided.

- G.I. sheets that have excellent corrosion resistance.
- Capable of withstand high wind speed upto 150 kmph

### **Module Mounting Structures**

#### **1) Reverse Power Control**

- a. Continuous monitoring of load and taking corrective action on power from solar power system
- b. Ensures that power does not flow into the grid – critical where net metering is not in yet rolled out
- c. Response and corrective action in less than one minute.
- d. Maximum power drawn from solar system
- e. Consumption from grid can be brought down to as low as 1% of the load.

#### **2.) Real Time Remote Monitoring of system parameters**

- a. Access through internet
- b. Graphical presentation

#### **3.) Alerts**

- a. For information
- b. For corrective action

#### **4.) Weather Monitoring**

- a. Measurement of radiation, temperature and comparison with generation
- b. Available in charts and line diagram

#### **5.) Performance Calculations**

- a. Ready availability for PR (performance ratio), Radiation yield (kWh/m<sup>2</sup>/day), PLF (plant loading factor)

#### **6.) Local Storage**

Continuously storing data will be available on local memory chips or on pen drive for ready reference.

#### **10.2.9 Rain Water Harvesting**

The Barapani Airport is located in high rainfall area with 2150 mm mean annual rainfall. Static water level is less than 10 m. At the Barapani Airport, rainwater harvesting will be provided as per central Ground Water board guidelines by EPC contractor. Typical rain water harvesting pit design is shown in **Figure 10.3**.

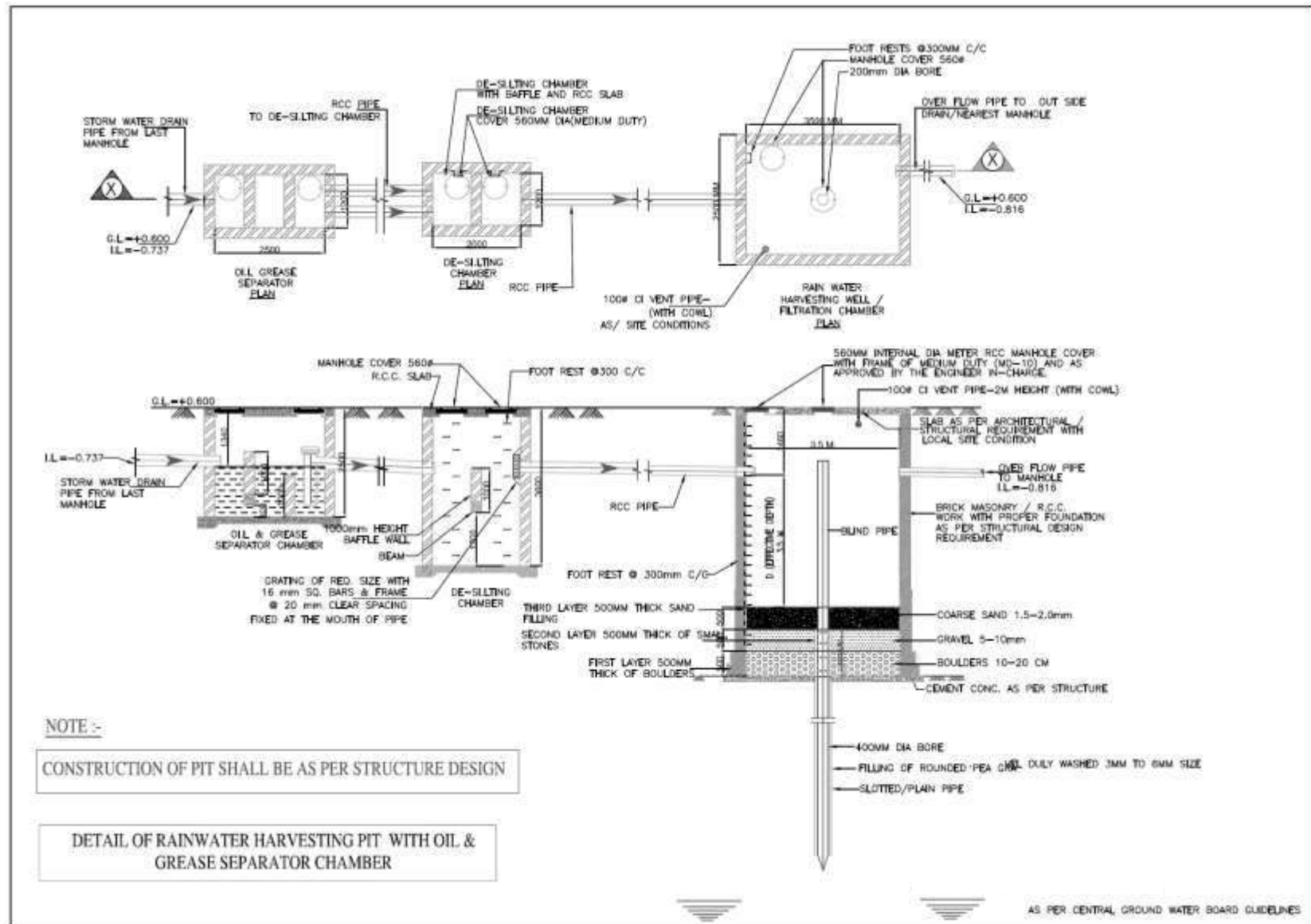


Figure 10.6: Typical Rain Water Harvesting Pit Design

### **10.2.10 Birds Hazard Management**

Bird hazard management is a critical aspect of airside safety at Shillong Airport due to its surrounding natural landscape, vegetation, water bodies and climatic conditions that attract bird activity. Effective and continuous implementation of bird control measures is essential to ensure safe aircraft operations and compliance with DGCA and ICAO safety standards.

#### **10.2.10.1 Airport Bird Strike Control Programme**

AAI has birds hazard management plan, which include several conventional bird control programs for inside and outside Barapani (Shillong) Airport.

##### **A. Inside Airport**

- Birds 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 six shot guns.
- Appropriate management of garbage, waste, and trash at the Barapani Airport,
- Periodic rodent and pest control at operational areas at Barapani Airport.
- Measures to prevent roosting and removing nest from pylon light, windsocks and other structures.

##### **II. Dissemination of Birds**

###### **A. Defence Systems**

- Shotguns by bird scarers alongside of runway.
- Bird scaring pistol (exploding and whistling Sound)
- Vehicle mounted Scarecrow.
- Zone guns placed along the runway.
- Grass cutting regularly.

###### **B. Use of Barriers**

- Covering open drain near to runway, taxiway and apron with suitable 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**

- Only permitted 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.

### **III. Mitigation Measures and Management for Birds Hazards**

The following mitigation measures will be implemented to mitigate bird hazards:

- Occurrence and movements of birds in flying path and at the airport/in the vicinity will be monitored regularly.
- Avian radar data will be used to predict bird activities and minimize the risk of bird strikes during take-off and landing of aircraft.
- Green/grass area of the airport will be managed to control bird-aircraft conflicts. This will include removing attractants like pests, weeds, poorly drained areas, and food sources at airport.
- Bird scarers and zone guns will be used for managing bird hazards at the airport. However, intelligent use of these devices, with regular changing of their positions, can be effective in reducing the movements of birds on the runway and in adjoining areas.
- Solid waste generated from airport and aircraft may attract birds, therefore solid waste from airport terminal building and aircraft will be collected and disposed in close containers as per Solid Waste Management Rule 2016 by engaging third party.
- Regular inspection of the runway and continuous monitoring of birds on the runway and in the landing and takeoff zones before and after flight activity may prevent bird strikes at lower altitudes.
- The buildings of the Barapani airport will be covered with birds proofing barriers to prevent birds from perching on them regularly.
- Durable spike covers will be fitted on the lamps shades, poles, signboards, etc at airport to prevent birds from perching on them.

### **IV. Periodic Review and Adaptive Management**

- The Bird Hazard Management Plan (BHMP) is reviewed quarterly based on bird strike reports and seasonal trends.
- Recommendations from the DGCA's wildlife hazard management guidelines are incorporated in regular updates.

#### **10.2.10.2 Proactive Measures to Prevent Wild or Stray Animals**

- The total boundary wall including the security gates will be constructed in such a way that stray animal cannot enter, as far as practicable gain access into the airside. All drains where dog might get access are covered with steel barricades.
- Boundary wall will be patrolled patrol; drain will be checked each morning and on regular basis for breaches done on wall or in the drains by animals.
- All sections of the wall and drains where animals might be able to gain access to the airside are reported to E&M team for immediate action for rectifying the same.
- Fence and drain will be repaired or modify from where access gained by the animals can be blocked.

#### **II. Control at Airport Access Security Gates**

- Airport security group (CISF) at all the entry gates will be briefed and made aware to be more vigilant so that animals do not enter the operational area through the operating gates.
- Removal and prevention of any food source for wildlife on airside and around area.
- In ramp safety meetings airlines and their appointed in- flight catering and cleaning agencies will be 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.

#### **10.2.11 Green Belt and Landscape Plan for Barapani Airport**

The Barapani (Shillong) Airport has limitation for green belt /plantation because of aviation safety and bird hazards. However, to minimize the impact of noise and vehicular emission during takeoff and landing of aircraft, green area/landscaping is proposed on 8250 sqm area of city side of the Barapani Airport. 103 trees will be planted at the Barapani airport (@80 sqm for 1 tree). Treated waste water from STP will be used for irrigation of green belt.

Green belt/plantation in the nearby area will also be carried with the help of local community involvement. Large canopy trees and fast-growing small trees of indigenous species will be selected for plantation. It is proposed to plant 103 trees sapling at the Barapani Airport.

Open areas will be planned in various locations in different land use zone of Barapani Airport. Landscaping and green area of 8250 sqm will be provided. As part of environmental sustainability measures to the Barapani Airport, statutory requirements of tree plantation and to create natural ambience befitting a landmark international airport, several green areas shall be developed city side of Barapani Airport. A holistic green area/ landscape master plan has been prepared in this

regard, inclusive of elements like plantation, etc. Due care will be taken to avoid attracting birds due to proposed tree plantation & landscape development.

**1. Bird Menace:** Trees and shrubs attract insects and birds, which are potential threat to aircraft operations within and around Barapani 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) will be guided by height restrictions imposed by Airports Authority of India. Hence, any type of dense vegetation's with very high trees cannot be developed in vicinity of Barapani 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 at Barapani Airport is to create a unique, green environment, drawing inspiration from local landscape ensuring sustainability, and offering a memorable experience for passengers, staff and visitors alike.

### **Proposed Flora in Landscaping**

The plants (Only native trees, shrubs, creepers, hedge and ground covers must be provided as per GRIHA) have been selected as per local climatic conditions and their easy maintenance. Tree avenues have been designed to provide directional movement and shaded canopies to cut the glare and enhance the micro-climate. Plants are grouped as per their properties:

- Aroma
- Color
- Texture
- Shade

Plants with different texture, aroma and color will be proposed. Planting palette has been done with color bandings to bring vibrancy in the soft scaping. They give the site a comforting and appealing air and draw people in together. Plants with shading properties will be proposed in the

parking area. To complement the tress, we are proposing shrubs, creepers, hedges and ground covers to cover the ground space.

Tree, shrubs and ground cover for horticulture and Landscaping at the Barapani (Shillong) Airport are given in **Table 10.3**.



**Table 10.3 : Tree, Shrubs and Ground Cover for Horticulture and Landscaping at Barapani Airport**

| Sn | Type        | Binominal Name               | Local Name         | Description                                                                                                                                                                                                                                                                                                                              | Image                                                                                |
|----|-------------|------------------------------|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 1. | Tree-Palm   | <i>Alocasia macrorrhizos</i> | Giant Taro         | <i>Alocasia macrorrhizos</i> is a species of flowering plant in the arum family (araceae). Common names include giant taro, 'ape, giant alocasia, biga, and pia.<br>It is also known as Giant Upright Elephant Ears. <i>Alocasia macrorrhizos</i> is evergreen perennial, which is excellent to bringing a lush look to the landscaping. |   |
| 2. | Tree - Palm | Areca Vestiaria              | Orange Collar Palm | <i>Areca vestiaria</i> is a species of palm. Its morphology is more diverse than other species of palms, and in particular the color of its upper trunk / crownshaft changes depending on altitude (varying between red and orange).                                                                                                     |  |

| Sn | Type        | Binominal Name | Local Name    | Description                                                                                                                                                                                                                                                                                                                   | Image                                                                               |
|----|-------------|----------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 3. | Tree - Palm | Caryota Mitis  | Fishtail Palm | <i>Caryota mitis</i> , known as the clustering fishtail palm or fishtail palm, is a species of palm. <i>Caryota mitis</i> has clustered stems up to 10 m (33 feet) tall and 15 cm (6 inches) in diameter. Leaves can be up to 3 m (10 feet) long. Flowers are purple, and the fruits—harmful to humans—are dark purple or red |  |

| Sn | Type        | Binominal Name          | Local Name | Description                                                                                                                                                                                                                                                                                                                                                                       | Image                                                                               |
|----|-------------|-------------------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 4. | Tree - Palm | <i>Euterpe Oleracea</i> | Acai Palm  | <i>Euterpe Oleracea</i> is a palm tree. It is tall and slender growing up to 25-30 m high. Its leaves are pinnate and up to 3 m long each. It is medicinally used for haemorrhages, fevers, wounds, scorpion stings, diarrhoea, and jaundice. The fruit is small, purple-black in colour, and can be eaten raw. It has a thin, fibrous, fleshy pulp that is rich in antioxidants. |  |

| Sn | Type      | Binominal Name           | Local Name  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Image                                                                               |
|----|-----------|--------------------------|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 5. | Tree-Palm | Syagrus<br>Romanzoffiana | Queen Palms | <p>Queen palms is stately, single-trunked palm is crowned by a beautiful head of glossy, bright green, soft, pinnate leaves forming a graceful, drooping canopy.</p> <p>Queen Palm can be recognized as a solitary palm with smooth gray stem, widely spaced leaf scars, pinnate leaves with leaflets spread in several planes and irregularly spaced along the axis in groups of two to seven. It is a medium-sized palm, quickly reaching maturity at a height of up to 15 m tall, with pinnate leaves having as many as 494 leaflets, although more typically around 300, each leaflet being around 50 cm in length and 3-5 cm in width. Inflorescence is up to 1-2.5 m long, surrounded by a woody spathe. Separate male and female white flowers are borne on a single inflorescence. Fruits are oblong to spherical, yellow to orange, 2-3 cm long.</p> |  |

| Sn | Type        | Binominal Name            | Local Name   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Image                                                                                |
|----|-------------|---------------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 6. | Tree - Palm | <i>Dypsis Lutescens</i>   | Areca Palm   | Golden Cane Palm is clump-growing with ringed, bamboo-like stems and yellow leaf-ribs. The foliage is evergreen, of fine texture and yellow-green in color. Pinnate, 6 to 8 pale green leaves per stem, 80 to 100 leaflets, to 8 feet long (2.4 m). Yellow if grown with enough light, 2 feet long. Yellow male and female flowers on the same inflorescence. Flower stalk coming from below the leaves. Fruit is yellow to purple, 2 cm, oval in shape. This is one of the most useful Palms of the tropics the world around.                                                                                                                               |   |
| 7. | Tree - Plam | <i>Wodyetia Bifurcata</i> | Foxtail Palm | Foxtail palm is a beautiful palm with one of the most spectacular leaves. The pale green arching fronds have leaflets that radiate out at all angles from the leaf stem, thus appearing like a bottlebrush or the tail of a fox. The mature tree has a canopy of 8-10 leaves, each with the characteristic foxtail or bottlebrush appearance, and a crown of leaves 15-20 ft across. Foxtail palm is thornless and has a slender, closely ringed bottle shaped to columnar trunk that grows up to 30 ft tall. It bears white blossoms of both sexes at the base of its crown, and a single palm is capable of producing fertile seeds. Foxtail palm produces |  |



| Sn | Type      | Binominal Name            | Local Name     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Image                                                                               |
|----|-----------|---------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|    |           |                           |                | colorful clusters of red to orange-red fruit, each containing just one seed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                     |
| 8. | Tree-Palm | <i>Phoenix Sylvestris</i> | Wild Date Palm | <p>Phoenix sylvestris (sylvestris - latin, of the forest) also known as silver date palm, indian date, sugar date palm or wild date palm.</p> <p>Wild Date Palm is the wild cousin of the better known Date Palm. It looks the same in almost every way, but shorter height at maturity. It varies from 4 to 8 m in height and 40 cm in diameter. The leaves are 3 m long, gently recurved, on 1 m petioles with spines near the base. The leaf crown grows to 10 m wide and 7.5-10 m tall containing up to 100 leaves. The inflorescence grows to 1 metre with white, unisexual flowers forming to a large, pendent infructescence.</p> |  |

| Sn | Type        | Binominal Name        | Local Name          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Image                                                                               |
|----|-------------|-----------------------|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 9. | Tree - Palm | <i>Rhapis Excelsa</i> | Broadleaf Lady Palm | Rhapis excelsa grows up to 4 m in height and 30 mm in diameter in multi-stemmed clumps with glossy, palmate evergreen leaves divided into broad, ribbed segments. Leaf segments are single or few in young plants and increase to a dozen or more in mature plants; segments are divided to the petiole. Leaf-ends are saw-toothed unlike most other palms, occurring on slender petioles ranging from 20 to 60 cm in length. New foliage emerges from a fibrous sheath which remains attached to the base. As the plants age, the sheaths fall, revealing the bamboo-like trunks. This usually dioecious palm species produces a small inflorescence at the top of the plant with spirally-arranged, fleshy yellow flowers containing three petals fused at the base. Ripe fruit are fleshy and white, though <i>Rhapis Excelsa</i> more readily propagates via underground rhizome offshoots. |  |

| <b>Sn</b> | <b>Type</b> | <b>Binominal Name</b> | <b>Local Name</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Image</b>                                                                        |
|-----------|-------------|-----------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 10.       | Tree        | Roystonea regia       | Royal Palm        | Royal Palm is a truly aristocratic palm which makes a memorable impression wherever it is grown. Massive and symmetrical with a smoothly sculpted trunk this palm looks almost artificial. Eight inch long leaflets are arranged in rows along the 10' length of bright green pinnate leaves. Composed of 15 - 20 leaves, the canopy sits atop the crown shaft - a smooth, glossy extension of the trunk composed of the overlapping bases of the leaves. The crownshaft looks really smooth green. The trunk of the Royal Palm is swollen at the base. It constricts about halfway up and then bulges again just below the crownshaft creating a dramatic profile. The trunk is a smooth light gray that looks as if it had been cast from concrete. Royal palm produce a large 3' to 4' inflorescence on which both male and female flowers are borne, just at the base of the green crownshaft. |  |



| Sn  | Type        | Binominal Name                | Local Name  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Image                                                                               |
|-----|-------------|-------------------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 11. | Tree - Palm | <i>Hyophorbe Lagenicaulis</i> | Bottle Palm | Bottle palm has a large swollen (sometimes bizarrely so) trunk. It is a myth that the trunk is a means by which the palm stores water. Bottle palms have only four to six leaves open at any time. Leaf fronds are compound, mildly recurving, ascending to spreading, upwardly arching, 4 to 6; leaflets stiff, narrow, up to 140, each about 60 cm long. The flowers of the palm arise from under the crownshaft, borne in branched inflorescences, cream, horn-like, about 75 cm long. Fruits are oblong, ripening from green to orange to black, about 3 cm long. The genus name <i>Hyophorbe</i> comes from the Greek hys, 'a pig', phorbe, in reference to the fruit being eaten by pigs. Its species name <i>lagenicaulis</i> means 'with a flask-shaped stem'. |  |

| Sn  | Type        | Binominal Name        | Local Name | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Image                                                                               |
|-----|-------------|-----------------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 12. | Tree - Palm | <i>Cycus Revoluta</i> | Palm Sago  | Sago palms have become very popular landscape plants in modern, classy Indian gardens. But most people do not realize that these are not palms at all, despite the name and appearance. Sago palm is actually a cycad. Cycads are a group of plants that are very primitive in their origins. Fossils have been found on almost every continent on the planet. It is often stated that cycads have evolved little since the days of the dinosaurs. There are species that seemed to show little evolution over millions of years. Therefore as a group, cycads are often referred to as "living fossils". Sago Palms have erect, sturdy trunks that are typically about one to two feet in diameter, sometimes wider and can grow into very old specimens with twenty feet of trunk. The leaves are a dark olive green and about three to four feet long when the plants are of a reproductive age. Sago palms are very slow growing plants. So, mostly one finds only young plants which have not grown a stem and look like a rosette of leaves coming from a stem near the ground. The name revoluta was given because of the revolute ( <i>to curl back</i> ) nature of the leaflets; the edges roll under the leaflet. |  |

| Sn  | Type | Binominal Name               | Local Name   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Image                                                                                 |
|-----|------|------------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 13. | Tree | <i>Ficus Elastica</i>        | Brush Rubber | <p>It is a large tree in the banyan group of figs, growing to 30– 40 m (100–130 ft) – rarely up to 60 m or 195 ft – tall, with a stout trunk up to 2 m (6 ft 7 in) in diameter. The trunk develops aerial and buttressing roots to anchor it in the soil and help support heavy branches.</p> <p>It has broad shiny oval leaves 10–35 cm (4–14 in) long and 5–15 cm (2–6 in) broad; leaf size is largest on young plants (occasionally to 45 cm or 17+1/2 in long), much smaller on old trees (typically 10 cm or 4 in long). The leaves develop inside a sheath at the apical meristem, which grows larger as the new leaf develops. When it is mature, it unfurls and the sheath drops off the plant. Inside the new leaf, another immature leaf is waiting to develop.</p> |    |
| 14. | Tree | <i>Polyalthia Longifolia</i> | Ashoka       | <p>The weeping, branching habit of this 25-foot tall tree gives it a narrow columnar shape. Glossy green, long, narrow leaves have attractive wavy edges. Ashok is commonly seen as a lofty column, very graceful with its downward-sweeping branchlets and shining, green foliage ; but sometimes wide-spreading slender branches issue from the straight trunk and form a compact symmetrical crown. It is a very</p>                                                                                                                                                                                                                                                                                                                                                       |  |

| Sn  | Type | Binominal Name                       | Local Name | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Image                                                                                |
|-----|------|--------------------------------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|     |      |                                      |            | popular tree in India. The bark is smooth and dark greyish-brown. Flowers appear during March and April. For a short period — two or three weeks only — the tree is covered with a profusion of delicate, star-like flowers, which, being palest-green in colour, give the tree a peculiar hazy appearance. They grow in clusters from small protuberances all along the dark branchlets. Each flower, borne on a slim, green stem has a tiny calyx and six long, narrow, wavy petals arranged in two sets of three. |   |
| 15. | Tree | <i>Erythrina Variegata</i><br>Indian | Coral Tree | <p><i>Erythrina variegata</i>, commonly known as tiger's claw or indian coral tree.</p> <p>Variegata is a thorny deciduous tree growing to 27 m tall. The leaves are pinnate with a 20 cm petiole and three leaflets, each leaflet up to 20 cm long and broad. It has dense clusters of scarlet or crimson flowers and black seeds.</p>                                                                                                                                                                              |  |



| Sn  | Type | Binominal Name                | Local Name | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Image                                                                                |
|-----|------|-------------------------------|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 16. | Tree | <i>Filicium Decipiens</i>     | Fern Tree  | Filicium decipiens, is ferntree, medium-sized fern tree or fern leaf tree. It is planted as an ornamental tree. Leaves are pinnate, leaflets 6-8 pair, smooth, shining, opposite or some alternate, stalkless, linear oblong, 4-6 inches long, with a prominent midrib. Leaf spine has a leafy wing on either side between the leaflets. Flowers are small, numerous, unisexual, in erect narrow panicles, 6-8 inches long, in leaf axils. Sepals are narrow, smooth, persistent. Petals in male flowers as long as sepals, in female small. Disk is very hairy. Drupe is ovoid, 0.5 inch in diameter, purple shining. |   |
| 17. | Tree | <i>Lagerstroemia Speciosa</i> | Jarulul    | Lagerstroemia speciosa is a deciduous or semi-deciduous small to medium-sized or rarely large tree up to 40(45) m tall; bole fairly straight to crooked, branchless for up to 18 m, up to 100(-150) cm in diameter, often fluted and sometimes with small buttresses, bark surface smooth or with small papery flakes, grey to light fawn-brown mottled, inner bark fibrous, grey-fawn to yellow, turning dirty mauve or purple upon exposure; crown usually bushy and spreading.                                                                                                                                      |  |

| Sn  | Type | Binominal Name         | Local Name   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Image                                                                                |
|-----|------|------------------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 18. | Tree | <i>Cassia Fistula</i>  | Amaltas      | <p>Deciduous, medium sized tree. Leaf fall occurs in April-May. Bright yellow flowers appear during the months of may- june. One of the best flowering trees The golden shower tree is a medium-sized trees , growing to 10–20 m (33–66 ft) tall with fast growth.</p> <p>The leaves are deciduous, 15–60 cm long, and pinnate with three to eight pairs of leaflets, each leaflet 7– 21 cm long and 4–9 cm broad.</p>                                                                                                     |   |
| 19. | Tree | <i>Albizia Lebbeck</i> | Indian Siris | <p>Albizia lebbeck is a species of plant in the family fabaceae, native to the indian subcontinent and myanmar. It is widely cultivated and naturalised in other tropical and subtropical regions, including australia. Common names in english include siris, indian siris, east indian walnut, broome raintree, lebbeck, lebbek tree, frywood, koko and woman's tongue tree. the latter name is a play on the sound the seeds make as they rattle inside the pods. Siris is also a common name of the genus albizia.</p> |  |

| Sn  | Type | Binominal Name            | Local Name      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Image                                                                               |
|-----|------|---------------------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|     |      |                           |                 | It is a tree growing to a height of 18–30 m tall with a trunk 50 cm to 1 m in diameter. The leaves are bipinnate, 7.5–15 cm long, with one to four pairs of pinnae, each pinna with 6–18 leaflets. The flowers are white, with numerous 2.5–3.8 cm long stamens, and very fragrant. The fruit is a pod 15–30 cm long and 2.5–5.0 cm broad, containing six to twelve seeds.                                                                                                                                                                                                                                                                                              |                                                                                     |
| 20. | Tree | <i>Alstonia Scholaris</i> | Blackboard Tree | <i>Alstonia Scholaris</i> Tree is an elegant evergreen tree. In October small, greenish white yet fragrant flowers appear. After sunset the fragrance of the flowers prevails in the surroundings, leaving most people wondering about the source of the scent as the flowers themselves are not very noticeable. It is a tall elegant tree with greyish rough bark. Branches are whorled, and so are the leaves, that is, several of them coming out of the same point. The tree is really elegant whether it is flowering or not. The slightly rounded, leathery, dark green leaves form whorls of 4–7 and a very regular branching gives the tree a beautiful shape. |  |

| Sn  | Type | Binominal Name            | Local Name | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Image                                                                                |
|-----|------|---------------------------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 21. | Tree | <i>Azadirachta Indica</i> | Neem       | Neem is a fast growing tree that can reach a height of 15-20 m, rarely to 35-40 m. It is evergreen but under severe drought it may shed most or nearly all of its leaves. The fairly dense crown is roundish or oval and may reach the diameter of 15-20 m in old, free-standing specimens. The trunk is relatively short, straight and may reach a diameter of 1.2 m. The bark is hard, fissured or scaly, and whitish-grey to reddish-brown. The sapwood is greyish-white and the heartwood reddish when first exposed to the air becoming reddish-brown after exposure. |   |
| 22. | Tree | <i>Bauhinia Purpurea</i>  | Kachnar    | Phanera purpurea is a small to medium-size deciduous tree growing to 17 feet (5.2 m) tall. The leaves are 10–20 centimetres (3.9–7.9 in) long and broad, rounded, and bilobed at the base and apex. The flower are conspicuous, pink, and fragrant, with five petals                                                                                                                                                                                                                                                                                                       |  |



| Sn  | Type | Binominal Name         | Local Name  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Image                                                                                |
|-----|------|------------------------|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 23. | Tree | <i>Cassia Javanica</i> | Pink Shower | <i>Cassia Javanica</i> is a tree with drooping slender branchlets. Leaves are long, with 10-16 pairs of leaflets. Leaflets are broadly elliptic to ovate-oblong, more or less equal-sided, top round to blunt notched, Yellow-green stipules are membranous to leaf-like and sickle shaped to broadly elliptic, pointed or rounded at both ends. Pinkish flowers are borne in lateral racemes on short side branches. Petals are five, bright pinkish, broadly spoon-shaped, blunt to obovate. The blade of the petals is contracted into a narrow, long claw. Stamens are 10; three longest.recurved, their filaments in the middle suddenly thickened. |   |
| 24. | Tree | <i>Ceiba Speciosa</i>  | Silk Floss  | <i>Ceiba Speciosa</i> tree is often rated among the most beautiful trees in the world. Also called Silk Floss Tree. Floss Silk Tree is also well known for the large spikes protecting the trunk and limbs. It has pale green leaves palmately divided into 5-7 pointed leaflets. The young trees start out growing fast, straight, and narrow, then slowly develop broadly spreading umbrella canopies as they age. The petals vary from pale pink to rose to purple or burgundy at the tips and grade into ivory with brownish spots or                                                                                                                |  |

| Sn  | Type | Binominal Name           | Local Name   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Image                                                                               |
|-----|------|--------------------------|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|     |      |                          |              | blotches at the base. After blooming, pear shaped fruits appear which have a silky floss on the seeds, hence the name.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                     |
| 25. | Tree | <i>Melaleuca Citrina</i> | Bottle Brush | Melaleuca citrina is a shrub that lives for approximately ten years[5] and grows to 5 m tall but more usually in the range 1–3 m high and wide. It has hard, fibrous or papery bark and its young growth is usually covered with soft, silky hairs. Its leaves are arranged alternately and are 26–99 mm long, 4–25 mm wide, hard, flat, narrow egg-shaped with the narrower end near the base and with a pointed but not sharp end. There are between 7 and 26 branching veins clearly visible on both sides of the leaves and a large number of distinct oil glands visible on both surfaces of the leaves. |  |

| Sn  | Type | Binominal Name            | Local Name | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Image                                                                                |
|-----|------|---------------------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 26. | Tree | <i>Delonix regia</i>      | Gulmohar   | <i>Delonix regia</i> is a species of flowering plant in the bean family fabaceae, subfamily caesalpinioideae. . It is noted for its fern-like leaves and flamboyant display of orange-red flowers over summer. In many tropical parts of the world it is grown as an ornamental tree and in english it is given the name royal poinciana, flamboyant, phoenix flower,[citation needed] flame of the forest, or flame tree (one of several species given this name).                                                                                                                                                                                                                 |   |
| 27. | Tree | <i>Terminalia Mantaly</i> | Almond     | <p><i>Terminalia mantaly</i> is a deciduous or evergreen tree with conspicuously layered branches, growing 10 - 20 metres tall.</p> <p>Small to medium tree, 10-20m height. Crown arranged in layered tiers. Bark smooth, mottled pale grey with protruding brownish lenticels (streaks or spots). Leaves slightly glossy green, spatulate, uneven to crenate margins. Flowers small, greenish, no petals, clustered along erect inflorescence spikes (up to 5cm long). Fruits smooth, wingless drupes, green when unripe. Suitable as ornamental tree along streets and in parks, due to formal neat appearance, especially majestic if planted in masses. It is fast-growing.</p> |  |

| Sn  | Type       | Binominal Name                | Local Name       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Image                                                                                |
|-----|------------|-------------------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 28. | Small Tree | <i>Melia Azedaracha</i>       | China Berry Tree | <p>The fully grown tree has a rounded crown, and commonly measures 7–12 metres tall, exceptionally 45 m. The leaves are up to 50 centimetres long, alternate, long-petioled, two or three times compound (odd-pinnate); the leaflets are dark green above and lighter green below, with serrate margins.</p> <p>The flowers are small and fragrant, with five pale purple or lilac petals, growing in clusters.</p> <p>The fruit is a drupe, marble-sized, light yellow at maturity, hanging on the tree all winter, and gradually becoming wrinkled and almost white</p> |   |
| 29. | Small Tree | <i>Plumeria Singaporensis</i> | Frangipani       | <p>The genus plumeria is also used as a common name, especially in horticultural circles.</p> <p>The flower, considered sacred, is also known by the names gulancha and kath golap (literally, wood rose).</p>                                                                                                                                                                                                                                                                                                                                                            |  |

| Sn  | Type | Binominal Name               | Local Name | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Image                                                                               |
|-----|------|------------------------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 30. | Tree | <i>Jacaranda Mimosifolia</i> | Black Poui | The tree grows to a height of up to 20 m. Its bark is thin and grey-brown, smooth when the tree is young but eventually becoming finely scaly. The twigs are slender and slightly zigzag; they are a light reddish-brown. The flowers are up to 5 cm long, and are grouped in 30 cm panicles. They appear in spring and early summer, and last for up to two months. They are followed by woody seed pods, about 5 cm in diameter, which contain numerous flat, winged seeds. The blue jacaranda is cultivated for the sake of its large compound leaves, even in areas where it rarely blooms. These leaves are up to 45 cm (long and bi-pinnately compound, with leaflets little more than 1 cm long. There is a white form available from nurseries. |  |



| Sn  | Type         | Binominal Name                 | Local Name | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Image                                                                                |
|-----|--------------|--------------------------------|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 31. | Ground Cover | <i>Cover Ophiopogon</i>        | Lilyturf   | <p>Ophiopogon (lilyturf) is a genus of evergreen perennial. Despite their grasslike appearance, they are not closely related to the true grasses, the poaceae. It typically forms an arching clump to 8 to 12 tall and as wide of narrow, linear, grass-like, dark green leaves. It is native to woodland areas in Japan and Korea.</p> <p>Foliage is similar to that of Liriope (also in the lily family), but leaves are narrower and more refined. Small, 6-tepaled, bell-shaped, white to lilac-tinted flowers bloom in summer in short racemes (2 to 3 long) atop leafless stalks. Flowers are followed by spherical, pea-sized, blue-black berries (1/4 across). Flowers and fruits are usually partially hidden by the foliage.</p> |   |
| 32. | Ground Cover | <i>Pandanus Pygmaeus Pygmy</i> | Screwpine  | <p>The dwarf pandanus pygmaeus is a small shrub with an ornamental foliage that is suited to and can survive in both hot and cold conditions. This plant is ideal for usda zones 9- 11 and can be grown outdoors background planting and as low-growing groundcover or a small 2-5 ft. Shrub. It thrives in full sun, shade, or semi-shade but requires moderate water throughout the growing season. The plant can be used for bonsai and for decorative purposes</p>                                                                                                                                                                                                                                                                     |  |

| Sn  | Type         | Binominal Name        | Local Name          | Description                                                                                                                                                                                                                                                                                                                                                                             | Image                                                                                |
|-----|--------------|-----------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|     |              |                       |                     | <p>due to its unique foliage and foliage colors.</p> <p>Although moderately drought tolerant, during the wintertime this plant can survive temperatures as low as 30 degrees fahrenheit (f) for a short while when matured.</p> <p>Additionally, this plant is also salt tolerant and can withstand summer heat with relative ease.</p>                                                 |                                                                                      |
| 33. | Ground Cover | <i>Rhoeo Discolor</i> | Moses-In-The-Cradle | <p><i>Rhoeo discolor</i> has fleshy rhizomes and rosettes of waxy lance-shaped leaves. Leaves are dark to metallic green above, with glossy purple underneath. These will reach up to 0.30 m (1 ft) long by 76 mm (3 in) wide. They are foliage plants that reach a height of around 0.30 m (1 ft). They are hardy in usda zones 9-12 and are also grown as ornamental houseplants.</p> |  |

| Sn  | Type         | Binominal Name               | Local Name | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Image                                                                                |
|-----|--------------|------------------------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 34. | Ground Cover | <i>Spathyphyllum Walisii</i> | Peace Lily | <p>Peace Lily is a herbaceous perennial which produces flowers in the typical aroid structure: a densely crowded inflorescence called a spadix is subtended by one large bract called a spathe (occasionally two spathes are produced, with the upper spathe smaller). The spadix is generally cream or ivory when young, and turns green with age; the spathe is generally white or white with green nerves distally from the margin, turning green with age.</p> <p>Leaves are basal, glossy and somewhat deeply veined, ovate and acuminate. The petioles are long and the leaves arch gracefully. The plant produces offsets at the base and in time becomes a dense clump.</p> |   |
| 34. | Ground Cover | <i>Anthurium andraeanum</i>  | Laceleaf   | <p><i>Anthurium andraeanum</i> is a genus of herbs often growing as epiphytes on other plants. Some are terrestrial. The leaves are often clustered and are variable in shape. The inflorescence bears small flowers which are perfect, containing male and female structures. The flowers are contained in close together spirals on the spadix. The spadix is often elongated into a spike shape, but it can be globe- shaped or club-shaped. Beneath the spadix is the spathe, a type of bract. This is variable</p>                                                                                                                                                             |  |



| Sn  | Type         | Binominal Name               | Local Name     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Image                                                                                |
|-----|--------------|------------------------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|     |              |                              |                | in shape, as well, but it is lance-shaped in many species. It may extend out flat or in a curve. Sometimes it covers the spadix like a hood. The fruits develop from the flowers on the spadix. They are juicy berries varying in color, usually containing two seeds.                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                      |
| 36. | Ground Cover | <i>Syngonium Podophyllum</i> | Arrowhead Vine | <i>Syngonium podophyllum</i> , commonly called arrowhead vine. It is an evergreen climbing vine that typically grows to 3-6' long. As a houseplant, it is typically grown for its attractive ornamental foliage which changes shape as the leaves mature. Juvenile leaves (to 5.5" long) are ovate with heart-shaped bases and sometimes with silver variegation. Leaves mature to arrow shape. Later leaves become pedate (to 14" long), each with 5-11 leaflets. Tiny green to greenish-white flowers on a spadix are surrounded by a greenish-white spathe (to 4.5" long). Flowers are born in groups in the leaf axils. Flowers give way to brown-black berries. Plants rarely flower in cultivation. Synonymous with nephthytis triphylla. |  |

| Sn  | Type         | Binominal Name          | Local Name     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Image                                                                               |
|-----|--------------|-------------------------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 37. | Ground Cover | <i>Duranta Goldiana</i> | Golden Dewdrop | Duranta goldiana grow and care – shrub to small tree of the genus duranta also known as golden dewdrop, duranta goldiana perennial evergreen used as ornamental plant also grow as bonsai and attract pollinators. Leaves color green with yellow, the shape is elliptic.                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |
| 38. | Grass        | <i>Cynodon Dactylon</i> | Doob Grass     | <p>The blades are a grey-green colour and are short, usually 2– 15 cm long with rough edges. The erect stems can grow 1–30 cm tall. The stems are slightly flattened, often tinged purple in colour.</p> <p>The seed heads are produced in a cluster of two to six spikes together at the top of the stem, each spike 2–5 cm long.</p> <p>It has a deep root system; in drought situations with penetrable soil, the root system can grow to over 2 metres deep, though most of the root mass is less than 60 centimetres (24 in) under the surface. The grass creeps along the ground with its stolons and roots wherever a node touches the ground, forming a dense mat. <i>Cynodon Dactylon</i> reproduces through seeds,</p> |  |

| Sn  | Type   | Binominal Name         | Local Name    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Image                                                                               |
|-----|--------|------------------------|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|     |        |                        |               | <p>stolons, and rhizomes. Growth begins at temperatures above 15 °C with optimum growth between 24 and 37 °C; in winter, the grass becomes dormant and turns brown.</p> <p>Growth is promoted by full sun and retarded by full shade, <i>e.g.</i>, close to tree trunks. Cultivation</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                     |
| 39. | Shrubs | <i>Chinensis 'Red'</i> | Chinese Ixora | <p>Ixora is native to Asia and its name derives from the word 'Isvara' or Ishwara, a name variously meaning God, Supreme Being, Supreme Soul, lord, in India. It is a branched shrub, up to 1 m tall; branches hairless. Leaves are mostly stalkless, opposite decussate, 4-8 x 1.5-6.5 cm, entire, apiculate, blunt or with a short sharp point, 8-15 pairs at lateral nerves, hairless; stipules triangular, cuspidate or awned. Flowers are borne at branch-ends, in dense corymb-like cymes, flower-cluster-stalk very short or absent; bracts about 8 mm long. Flowers are stalkless, bright scarlet, hypanthium 1-1.5 mm long, becoming hairless, teeth, about 0.5 mm long. Flower-tube is prominently long, 2.5-4.0 cm long, 1.5 mm wide, hairless, petals 8-10 x 4-5 mm, twisted in bud, throat hairless. Stamens are 4, inserted on the throat of flower-tube, filaments</p> |  |

| Sn  | Type   | Binominal Name            | Local Name      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Image                                                                                |
|-----|--------|---------------------------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|     |        |                           |                 | very short. Style protruding; stigma 1.5 mm long. Fruit is spherical, red when ripe, crowned with the sepal-cup teeth. It is a very common garden plant.                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                      |
| 40. | Shrubs | <i>Lantana Sellowiana</i> | Weeping Lantana | <p><i>Lantana sellowiana</i> is a small strongly scented flowering low shrub with oval-shaped green leaves. With support it has a climbing 'vine' form, when on edge a trailing form, and on the flat a groundcover form..</p> <p>The inflorescence is a circular head of several purple to lavender to white funnel-shaped flowers with lobed corollas each nearly a centimeter wide. Reports of yellow flowered lantana montevidensis are based on the misidentification of lantana depressa var. Depressa, a florida endemic taxon more closely related to lantana camara.</p> |   |
| 41. | Shrubs | <i>Hamelia Patens</i>     | Firebush        | <p><i>Hamelia patens</i> is a large perennial shrub or small tree in the family rubiaceae, that is native to the american subtropics and tropics. Its range extends from florida in the southern united states to as far south as argentina. common names include firebush, hummingbird bush, scarlet bush, and redhead. In belize, this plant's mayan name is ix canaan and is also known as "guardian of the forest".</p>                                                                                                                                                       |  |

| Sn  | Type   | Binominal Name                    | Local Name    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Image                                                                                |
|-----|--------|-----------------------------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 42. | Shrubs | <i>Tabernaemontana Divaricata</i> | Crape Jasmine | The plant generally grows to a height of 5–6 feet (1.5– 1.8 m) and is dichotomously branched. The large shiny leaves are deep green and about 6 inches (15 cm) in length and 2 inches (5.1 cm) in width. The waxy blossoms are found in small clusters on the stem tips. The (single) flowers have the characteristic 'pinwheel' shape also seen in other genera in the family apocynaceae such as vinca and nerium. Both single and double-flowered forms are cultivated, the flowers of both forms being white. The plant blooms in spring but flowers appear sporadically all year. The flowers of the single form are unscented but the double-flowered form has a pleasing fragrance. |   |
| 43. | Shrubs | <i>Galphimia Nitida</i>           | Galphimia     | Galphimia is a genus in the malpighiaceae, a family of about 75 genera of flowering plants in the order malpighiales; the name is an anagram of malpighia. Galphimia comprises 26 species of large herbs, shrubs, and treelets. Twenty-two species occur in mexico, one ( <i>Galphimia Angustifolia</i> ) extending into texas and one ( <i>Galphimia Speciosa</i> ) ranging to nicaragua; four species ( <i>Galphimia. Amambayensis</i> , <i>Galphimia Australis</i> , <i>Galphimia Brasiliensis</i> , <i>Galphimia Platyphylla</i> ) occur in south america,                                                                                                                             |  |



| Sn  | Type   | Binominal Name           | Local Name    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Image                                                                               |
|-----|--------|--------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|     |        |                          |               | south of the amazon basin. <i>Galphimia gracilis</i> is widely cultivated in warm regions throughout the world (but often confused with <i>Galphimia Glauca</i> and also <i>Galphimia Brasiliensis</i> ). Eight species (of mexico and central america) are distinctive in that the petals become stiff and papery, and persist past the stage of fruit maturation.                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                     |
| 44. | Shrubs | <i>Plumbago Capensis</i> | Cape Plumbago | <i>Plumbago capensis</i> is an evergreen shrub, often grown as a climber, ascending rapidly to 6 m (20 ft) tall by 3 m (10 ft) wide in nature, though much smaller when cultivated as a houseplant.the leaves are a glossy green and grow to 5 cm long.the stems are long, thin, and climbing. The leaves alternate and are 2–5 cm. The five petals are about 2 cm wide and can be pale blue, blue or violet in color. The flowers are arranged in a corymb-like and raceme inflorescence the flower of this plant is complete and bisexual. The sepals and petals are connate while the pistil is adnate. The ovary of the flower is superior and the flower has regular symmetry. It has basal placentation, with 1 locule and 5 carpels. It flowers mostly in the summer, but in the right conditions it can bloom year-round. |  |

| Sn  | Type   | Binominal Name               | Local Name      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Image                                                                               |
|-----|--------|------------------------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 45. | Shrubs | <i>Calliandra Emarginata</i> | Red Powder Puff | This medium-sized shrub is spectacular when in flower. The blooms are brilliant red and really stand out. The foliage is also attractive with light green kidney shaped leaflets, appearing in pairs. This particular variety grows approximately six to seven feet and is always in bloom. For those interested in bright colours, this is a must. The flowers open 9 to 10 months out of the year (often resting in midwinter) and remain for 6 to 8 weeks, their unusual form and bold color attracting attention despite the plant's small stature. 1 to 2 inches across, these blooms offer a nice foil to the soft green leaves of this 10 to 14-inch-high tree. Outdoors, the flowers are butterfly magnets, their nectar attracting many winged visitors. |  |

| Sn  | Type   | Binominal Name          | Local Name | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Image                                                                                |
|-----|--------|-------------------------|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 46. | Shrubs | <i>Murraya Exotica</i>  | Kamini     | Kamini flowers have an aromatic orange-like fragrance. Kamini is a large, multi-trunked shrub, but can grow to become a small tree. It can be pruned and also grown as garden hedge! The evergreen leaflets are dark green and pinnately compound with three to nine leaflets arranged alternately along the spine. The dark green leaves make a dramatic backdrop for the highly fragrant cream colored flowers. The shrub blooms most of the year. The flowers are followed by small oval red fruits with one or two seeds. The shrub is usually propagated from seed |   |
| 47. | Hedge  | <i>Dodonaea Viscosa</i> | Mendru     | Viscosa is a hedge growing to 1–3 m (3.3–9.8 ft) tall, rarely a small tree to 9 m (30 ft) tall. The leaves are variable in shape: generally obovate but some of them are lanceolate, often sessile, 4–7.5 cm (1.6–3.0 in) long and 1–1.5 cm (0.39–0.59 in) broad, alternate in arrangement, and secrete a resinous substance. Leaf base is extended. Leaf texture is leathery, tough, but also pliable. Midribs are medium becoming less visible close to the apex.                                                                                                     |  |



### **10.2.12 Demographic and Socio-Economic Environment**

During the construction phase of the Barapani Airport, about 150 to 200 skilled, semiskilled and unskilled workers will get direct 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:

- Local people will be given preference for employment,
- 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 Barapani Airport,
- Worker engaged in high noise construction machines shall be provided with ear-muff and ear plugs,
- 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,
- Safety slogan and warning board about the safety will be displayed at the strategic locations of construction areas.

### **Construction Camps**

The mitigation measures for construction camps are as given below:

- Necessary basic amenities and welfare facilities will be provided as per Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 (BOCW Act)
- Water supply and toilet facilities at construction camps will be provided to the workers,
- Domestic waste generated at the construction camp will be disposed properly.
- Well-ventilated accommodation, mess, rest rooms, wash rooms and toilets will be provided to workers.
- LPG cylinders will be provided for cooking food and it will be ensured that wood is not by workers for cooking food.
- Proper medical facilities will be provided to workers.

### **10.2.13 Fire Protection Measures**

At the Barapani (Shillong) Airport, firefighting facility will be provided as per fire regulations and Civil Aviation Regulations (CAR).

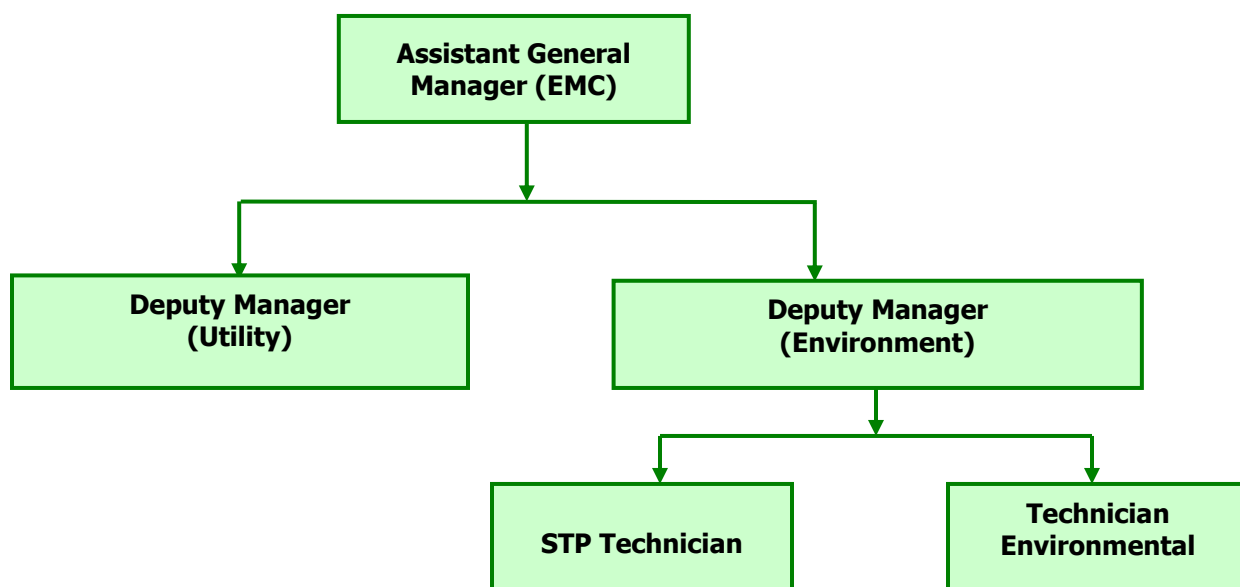
### 10.3 Environmental Management Plan

The Airports Authority of India (AAI) will be responsible for the implementation of mitigation measures suggested in EMP for construction and operation phases of the Barapani Airport. Environmental Management Plan for the Barapani Airport is presented in **Table 10.4**.

#### 10.3.1 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 10.7**.

Environmental Management cell will implement and review the compliance of the stipulated conditions specified in Environmental Clearance and Consent for Establishment. The cell will be responsible to obtain Consent to Establish (CTE) and Consent for Operate (CTO) under Water Act and Air Act from MSPCB.



**Figure 10.7: Organogram for Environmental Management Cell**

## **Roles and Responsibilities of Environmental Monitoring Cell**

### **Assistant General Manager (EMC)**

- Develop and implement environmental management plan.
- Ensure compliance with local, state, and federal environmental regulations.
- Conduct environmental audits and assessments to monitor performance and identify areas for improvement.
- Lead initiatives to waste management and landscaping, energy conservation.
- Stay updated on new laws and regulations affecting the environment.

### **Deputy Manager (Utility)**

- Assist in developing and implementing environmental Management Plan (EMP).
- Develop environmental procedures and policies to mitigate environmental impact and ensure compliance.
- Conduct environmental assessments to identify risks and recommend mitigation plans.
- Develop, implement, and monitor waste management, energy conservation.

### **Deputy Manager (Environment)**

- Ensure efficient operation of STP.
- Assist in preparing, implementing environmental management plan.
- Ensure proper documentation and record-keeping as per contractual requirements.
- Environmental monitoring as per Monitoring plan.
- Monitor CER activities.
- Prepare Compliance report.
- Provide training and assistance to team members.

### **Technician (STP)**

- Efficient operation of STP.
- Maintaining Log book of STP
- Monitoring Water Samples

### **Technician (Environment)**

- Air and Noise Monitoring
- Waste management
- Landscaping and Green Area

### **10.3.2 Training**

The environmental management cell of AAI would be responsible for the implementation of mitigation measures described in the EMP. Personnel working at the site need to be trained for the effective implementation of the environmental issues. To ensure the success of the implementation of mitigation measures, there is a high requirement of training and skill up-gradation of personnel.

As part of the construction and operation, training programs have been worked out for capacity building needs of the personnel. The program consists of number of training modules specific to target groups. The training would cover the basic principles and postulates of environmental assessment.

Looking into the potential requirements of each of the target groups, the following training modules have been suggested for construction and operation phases as part of the EMP.

#### **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 Airport
- Module VII : Planning of environmentally Sustainable Operation of Airport
- Module VIII : Long Term Environmental Issues in Airports Management

**Table 10.4: Environmental Management Plan for Proposed Development of Barapani Airport**

| S. No.     | Environmental Aspect/Issue                             | Management Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Responsibility      |                         |
|------------|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------|
|            |                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Construction Agency | Supervision/ Monitoring |
| <b>I.</b>  | <b>Construction Stage</b>                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |                         |
|            | <b>Activities to be carried out by the Contractor.</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |                         |
| <b>C.1</b> | <b>Site Clearance</b>                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                     |                         |
| C.1.1      | Excavation of earth                                    | <p>For the proposed project 1273976 cum cutting and 197136 cum filling will be required, which will be utilized at site and disposed in environmental sound manner. Surpluse excavated earth will be spread over the airport site.</p> <p>For leveling of land for proposed expansion of Barapani airport, minimum cutting and filling will be ensured and if earth is required, same shall be obtained from approved supplier only.</p>                                                                                     | Contractor          | EMC of AAI              |
| C.1.3      | Construction Wastes Disposal                           | <p>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.</p> <p>Contractor will ensure that any spoils of material unsuitable for fill will not be disposed off near any water course, agricultural land, and natural habitat like grass lands or pastures.</p> <p>All waste materials will be completely disposed and the site will be fully cleaned and certified by Environmental Expert of AAI.</p> | Contractor          | EMC of AAI              |

| S. No. | Environmental Aspect/Issue                       | Management Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Responsibility      |                         |
|--------|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------|
|        |                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Construction Agency | Supervision/ Monitoring |
| C.1.4  | Stripping, stocking and preservation of top soil | <p>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 proposed expansion of Barapani airport will be earmarked for storing topsoil. The locations for stock piling will be pre-identified in consultation and with approval of Environmental Expert of AAI. The following precautionary measures will be taken to preserve them till they are used:</p> <p>(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.</p> <p>(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.</p> <p>(c) It will be ensured by the contractor that the top soil will not be unnecessarily trafficked either before stripping or when in stockpiles.</p> <p>Such stockpiled topsoil will be utilized for covering all disturbed areas including borrow areas top dressing or filling up of plantation and landscaping area.</p> | Contractor          | EMC of AAI              |
| C.1.5  | Accessibility                                    | The contractor will take care that vehicles brining man and materials approaching to the site, are not disturbing local road and public access.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Contractor          | EMC of AAI              |

| S. No. | Environmental Aspect/Issue                                   | Management Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Responsibility      |                         |
|--------|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------|
|        |                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Construction Agency | Supervision/ Monitoring |
| 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          | EMC of AAI              |
| C.2.2  | Quarry Operations                                            | The contractor shall procure aggregate materials from approved quarries by the Department of Geology Mining and District Administration and having valid consent of operated from MSPCB and environmental clearance from DEIAA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Contractor          | EMC of AAI              |
| C.2.3  | Transporting Construction Materials and Haul Road Management | <p>Contractor will maintain roads, which are used for transporting construction materials, equipment and machineries as précised. All vehicles delivering fine materials to the site will be covered to avoid spillage of materials.</p> <p>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.</p> <p>Contractor will arrange for regular water sprinkling as necessary for dust suppression of all such surfaces.</p> <p>The unloading of materials at construction site in/close to settlements will be restricted to daytime only.</p> | Contractor          | EMC of AAI              |
| C.2.4  | Construction Water                                           | The contractor will source the requirement of water preferentially from ground water from bore well to be                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Contractor/AAI      | EMC of AAI              |

| S. No.       | Environmental Aspect/Issue               | Management Measures                                                                                                                                                                                                                                                                                                                              | Responsibility      |                         |
|--------------|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------|
|              |                                          |                                                                                                                                                                                                                                                                                                                                                  | Construction Agency | Supervision/ Monitoring |
|              |                                          | <p>drilled after obtaining permission from competent authority. A copy of the permission will be submitted to AAI prior to initiation of construction.</p> <p>The contractor will take all precaution to minimize the wastage of water in the construction phase of proposed expansion of Barapani airport.</p>                                  |                     |                         |
| <b>C.3</b>   | <b>Construction Work</b>                 |                                                                                                                                                                                                                                                                                                                                                  |                     |                         |
| C.3.1        | Drainage and Flood Control               | Contractor will ensure that no construction materials like earth, stone, or appendage disposed off so as not to block the flow of water in natural drainage.                                                                                                                                                                                     | Contractor          | EMC of AAI              |
| <b>C.4</b>   | <b>Pollution</b>                         |                                                                                                                                                                                                                                                                                                                                                  |                     |                         |
| <b>C.4.1</b> | <b>Water Pollution</b>                   |                                                                                                                                                                                                                                                                                                                                                  |                     |                         |
| C.4.1.1      | Water Pollution from Construction Wastes | <p>The Contractor will take all precautionary measures to prevent the wastewater generated during construction from entering into streams or water bodies.</p> <p>All wastes arising from the proposed expansion of Barapani airport will be disposed off in the manner that is acceptable to the Meghalaya Pollution Control Board (MSPCB).</p> | Contractor          | EMC of AAI              |
| 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, machineries and equipment maintenance and refuelling sites will be located as per approved construction site layout plan.                                                                                                     | Contractor          | EMC of AAI              |



| S. No.       | Environmental Aspect/Issue                                     | Management Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Responsibility      |                         |
|--------------|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------|
|              |                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Construction Agency | Supervision/ Monitoring |
|              |                                                                | <p>Contractor will ensure that all vehicles/machineries 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.</p> <p>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 off in accordance with MoEF&amp;CC and MSPCB guidelines.</p> |                     |                         |
| <b>C.4.2</b> | <b>Air Pollution</b>                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |                         |
| C.4.2.1      | Dust Pollution                                                 | <p>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.</p> <p>Alternatively, only crushers licensed by the MSPCB shall be used to procure materials.</p>                                                                                                                                                                                                                                                                               | Contractor          | EMC of AAI              |
| C.4.2.2      | Emission from Construction Vehicles, Equipment and Machineries | <p>Contractor will ensure that all vehicles, equipment and machineries used for construction are regularly maintained and confirm that pollution emissions levels comply with the relevant requirements.</p> <p>The Contractor will submit PUC certificates for all vehicles/equipment/machineries used for the project.</p>                                                                                                                                                                                                                                                                  | Contractor          | EMC of AAI              |

| S. No.       | Environmental Aspect/Issue                                  | Management Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Responsibility      |                         |
|--------------|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------|
|              |                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Construction Agency | Supervision/ Monitoring |
|              |                                                             | Monitoring results will also be submitted to AAI as per the monitoring plan.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |                         |
| <b>C.4.3</b> | <b>Noise Pollution</b>                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                         |
| C.4.3.1      | Noise Pollution: Noise from Vehicles, Plants and Equipments | <p>The contractor will confirm the following:</p> <ul style="list-style-type: none"> <li>All plants and equipment used in construction shall strictly conform to the MoEF&amp;CC/ CPCB/MSPCB noise standards.</li> <li>All vehicles and equipment used in construction will be fitted with exhaust silencers.</li> <li>Servicing of all construction vehicles and machineries will be done regularly and during routine servicing operations, the effectiveness of exhaust silencers will be checked and if found defective will be replaced.</li> <li>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.</li> <li>Monitoring shall be carried out at the construction sites as per the monitoring schedule and results will be submitted AAI.</li> </ul> | Contractor          | EMC of AAI              |
| <b>C.5</b>   | <b>Safety</b>                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                         |
| C.5.1        | Personal Safety                                             | The contractor will provide:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Contractor          | EMC of AAI              |

| S. No. | Environmental Aspect/Issue        | Management Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Responsibility      |                         |
|--------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------|
|        |                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Construction Agency | Supervision/ Monitoring |
|        | Measures for Labour               | <ul style="list-style-type: none"> <li>• Protective footwear and protective goggles to all workers employed on mixing asphalt materials, cement, concrete etc.</li> <li>• Welder's protective eye-shields to workers who are engaged in welding works</li> <li>• Earplugs to workers exposed to loud noise, and workers working in crushing, compaction, or concrete mixing operation.</li> <li>• Adequate safety measures for workers during handling of materials at site are taken up.</li> <li>• The contractor will comply with all regulations regarding safe scaffolding, ladders, working platforms, stairwells, excavations, trenches and safe means of entry and egress.</li> <li>• The contractor will make sure that during the construction work all relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 are adhered to.</li> <li>• 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.</li> </ul> |                     |                         |
| C.5.3  | Risk from Electrical Equipment(s) | <p>The contractor will take all required precautions to prevent danger from electrical equipment and ensure that:</p> <ul style="list-style-type: none"> <li>• No material will be so stacked or placed as to cause danger or inconvenience to any person or the public.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Contractor          | EMC of AAI              |

| S. No. | Environmental Aspect/Issue | Management Measures                                                                                                                                                                                                                                                                                                                                                                                                                           | Responsibility      |                         |
|--------|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------|
|        |                            |                                                                                                                                                                                                                                                                                                                                                                                                                                               | Construction Agency | Supervision/ Monitoring |
|        |                            | <ul style="list-style-type: none"> <li>All necessary fencing and lights will be provided to protect the public in construction zones.</li> <li>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.</li> </ul>                                 |                     |                         |
| C.5.4  | Risk Force Measure         | <p>The contractor will take all reasonable precautions to prevent danger to the workers and public from fire, etc. resulting due to construction activities.</p> <p>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.</p>       | Contractor          | EMC of AAI              |
| C.5.5  | First Aid                  | <p>The contractor will arrange for:</p> <ul style="list-style-type: none"> <li>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</li> <li>availability of suitable transport at all times to take injured or sick person(s) to the nearest hospital</li> <li>Equipment and trained nursing staff at construction camp.</li> </ul> | Contractor          | EMC of AAI              |

| S. No.     | Environmental Aspect/Issue           | Management Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Responsibility      |                         |
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|            |                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Construction Agency | Supervision/ Monitoring |
| C.5.6      | Informatory Signs and Hoardings      | The contractor will provide, erect and maintain informatory/safety signs, hoardings written in English and Bengali language, wherever required at the construction site.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Contractor          | EMC of AAI              |
| <b>C.6</b> | <b>Archaeological Property</b>       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |                         |
| C.6.1      | Chance Found Archaeological Property | <p>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.</p> <p>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.</p> <p>The AAI will seek direction from the Archaeological Survey of India (ASI) before instructing the Contractor to recommence the work in the site.</p> | Contractor          | EMC of AAI              |
| <b>C.7</b> | <b>Labor Camp Management</b>         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |                         |
|            |                                      | Contractor will follow all relevant provisions of the the Building and the other Construction Workers (Regulation of Employment and Conditions of Service)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Contractor          | EMC of AAI              |

| S. No. | Environmental Aspect/Issue | Management Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Responsibility      |                         |
|--------|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------|
|        |                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Construction Agency | Supervision/ Monitoring |
| C.7.1  | Accommodation              | <p>Act, 1996 for construction and maintenance of labour camp.</p> <p>The contractor will maintain necessary living accommodation and ancillary facilities in functional and hygienic manner at the construction site.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                     |                         |
| C.7.2  | Potable Water              | <p>The contractor will construct and maintain labour accommodation in such a fashion that uncontaminated water is available for drinking, cooking and washing.</p> <p>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.</p> <p>The contractor will also guarantee the following:</p> <ol style="list-style-type: none"> <li>Supply of sufficient quantity of potable water (as per IS) in workplace/labor camp site at suitable and easily accessible places and regular maintenance of such facilities.</li> <li>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.</li> <li>Testing of water will be done every month as per parameters prescribed in IS 10500:2012.</li> </ol> | Contractor          | EMC of AAI              |

| S. No.     | Environmental Aspect/Issue         | Management Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Responsibility      |                         |
|------------|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------|
|            |                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Construction Agency | Supervision/ Monitoring |
|            |                                    | 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       | <p>The contractor will ensure that:</p> <ul style="list-style-type: none"> <li>the sewage system for the camp are designed, built and operated in such a fashion that no health hazards occurs and no pollution to the air, ground water or adjacent water courses take place</li> <li>separate toilets/bathrooms, wherever required, screened from those from men (marked in vernacular) are to be provided for women</li> <li>adequate water supply is to be provided in all toilets and urinals</li> <li>all toilets in workplaces are with dry-earth system (receptacles) which are to be cleaned and kept in a strict sanitary condition</li> <li>night soil is to be disposed off 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.</li> </ul> | Contractor          | EMC of AAI              |
| 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 practices.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Contractor          | EMC of AAI              |
| <b>C.8</b> | <b>Contractor's Demobilization</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                     |                         |

| S. No.    | Environmental Aspect/Issue                          | Management Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Responsibility      |                         |
|-----------|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------|
|           |                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Construction Agency | Supervision/ Monitoring |
| C.8.1     | Clean-up Operations, Restoration and Rehabilitation | <p>Contractor will prepare site restoration plan. The clean-up and restoration operations are to 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.</p> <p>All construction zones will be left clean and tidy, at the contractor's expense, to the entire satisfaction to the Environmental Expert of AAI.</p>                                                                                                                                                                                                                                                      | Contractor          | EMC of AAI              |
| <b>II</b> | <b>Operation Stage</b>                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                     |                         |
| O.1       | Air Pollution                                       | Compliance of all standards prescribed by the ICAO during operation of aircraft by preventive maintenance and monitoring. Stack heights of DG sets will be provided as per the CPCB guidelines. Proper traffic management will be prepared to ensure that there is no traffic congestion at Barapani Airport. It will help in reduction of vehicular emissions from the Barapani airport. Vehicles at the Barapani airport will be maintained and will have a "Pollution Under Control" certificate. Development of greenery and landscaping at Barapani Airport will be helpful in improving ambient air quality. Monitoring of ambient air quality/ source emission will be carried out as per monitoring plan. | Airport Operator    | EMC of AAI              |
| O. 2      | Water Pollution                                     | Continuous efforts will be made to reduce water consumption using less water required cisterns. Pour flush toilets will be used at Barapani Airport, which require (much) less water. Efforts will be made to stop                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Airport Operator    | EMC of AAI              |



| S. No. | Environmental Aspect/Issue | Management Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Responsibility      |                         |
|--------|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------|
|        |                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Construction Agency | Supervision/ Monitoring |
|        |                            | wastage and leakage of water. Reused treated waste water for greenery and landscaping at the Barapani Airport. Provision has been made for rain water harvesting through rain water collection tanks. Collection of waste water and treatment of waste water in 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.                                                                                                                                                                                                                                                                              |                     |                         |
| O. 3   | Soil                       | Approx 1240 kg per day solid waste is generated from Barapani Airport, which is collected, segregated 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 Barapani Airport. It is ensured that agency hired for disposal of solid wastes is disposing solid waste as per the provisions of the Municipal Waste Management Rule, 2016. Solid waste generated from the Barapani 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 MSPCB guidelines. | Airport Operator    | EMC of AAI              |
| O. 4   | Noise Pollution            | All standards prescribed by the ICAO during operation of aircraft by preventive maintenance and monitoring will be complied. Proper traffic management plan is prepared to ensue that there is no traffic congestion at Barapani Airport. It helps in reduction of vehicular emissions from the Barapani Airport. DG sets is                                                                                                                                                                                                                                                                                                                                                                                         | Airport Operator    | EMC of AAI              |

| S. No. | Environmental Aspect/Issue      | Management Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Responsibility      |                         |
|--------|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------|
|        |                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Construction Agency | Supervision/ Monitoring |
|        |                                 | provided with acoustic enclosure as per MSPCB guidelines. Terminal building is sound proof. Ground staff wears earplug while attending the aircraft. Green belt, landscaping and boundary at the Barapani Airport act as barrier for noise. Monitoring of ambient air quality/ source emission will be carried out as per monitoring plan.                                                                                                                                                                                   |                     |                         |
| O. 5   | Energy Conservation             | Use of Energy Efficient building material & glass. LED lamps will be used instead of GLS lamps. Energy efficient HVAC system will be provided. Solar passive techniques will be used for terminal building, star BEE energy efficiency rating electrical Barapani Airport.<br><br>Microprocessor-based Building Management System (BMS) will be installed for minimization of energy consumption. Automatic lighting on/ off control system will be provided in the Barapani Airport area for optimum utilization of energy. | Airport Operator    | EMC of AAI              |
| O. 6   | Terrestrial Ecology             | Landscaping/ greenery will be developed at the Barapani Airport.                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Airport Operator    | EMC of AAI              |
| 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 signages will be retro reflective type provided, clearly visible in the night. Marshals will also be deployed to guide the vehicles and stop vehicles                                                                                                                                                                                                                                 | Airport Operator    | EMC of AAI              |
| O. 8   | Occupational Hazards and Safety | <i>General Safety Measures:</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Airport Operator    | EMC of AAI              |

| S. No. | Environmental Aspect/Issue | Management Measures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Responsibility      |                         |
|--------|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------------|
|        |                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Construction Agency | Supervision/ Monitoring |
|        |                            | <p>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.</p> <p><b>General Health Measures</b></p> <p>Necessary control measure like ear muff and ear plug, high visible vest with refractive tape will be provided to ground staffs at the Barapani Airport. Pre-employment and periodic audiometric medical examinations will be conducted for personnel potentially exposed to high noise areas.</p> |                     |                         |

### **10.3.3Grievance Redressal Mechanism**

In order to ensure that grievances and complaints by local people on any aspect of the environmental and social impacts during construction and operation phases of the proposed project will be addressed in a timely and satisfactory manner and that all possible avenues will be available to resolve their grievances (if any), mechanisms for Grievances Redressal will be setup. Environmental Management Cell will also work as Grievances Redressal Cell (GRC).

Any complaint received from local area regarding environmental and social issues will be forwarded to General Manager (EMC), who will promptly take decision and give instructions to implement necessary measures to resolve the complaints or grievances. To ensure effectiveness of mitigation measures monitoring will be done regularly.

### **10.3.4Reporting and Monitoring System**

Reporting system provides the necessary feedback for project management to ensure quality of the work and that the programs are on schedule. The rationale for a reporting system is based on accountability to ensure that the mitigation measures proposed as part of the Environmental Management and Action Plan gets implemented during construction and operation phase of the development of Barapani Airport.

The reporting system will operate linearly with the contractor who is at the lowest step of the implementation system to the project management and will report to AAI.

The monitoring and evaluation are critical activities in implementation of the project. Environmental monitoring involves periodic checking to ascertain whether activities are going according to the plans. It provides necessary feedback for management to keep the program on schedules.

For the project all reporting by the contractor will be on weekly basis. The AAI environmental cell will be responsible for preparing targets for each of the identified EMAP activities.

The compliance monitoring and the progress reports on environmental components may be clubbed together and submitted to the AAI monthly during each phase of implementation period. At the end of implementation, monthly progress report on environmental issues may be discontinued.

During the construction period, a compliance report may include description of the items of EMAP, which were not complied by any of the responsible agencies. It would also report the

management and field actions taken to enforce compliance. It may however, be noted that certain items of the EMAP might not be possibly complied with in the field due to a variety of reasons. The intention of the compliance report is not to suppress these issues but to bring out the circumstances and reasons for which compliance was not possible. This would help in rationalizing the implementation of the EMAP during the remaining duration of implementation. Solutions for further effective implementation should also come out as a result of the compliance monitoring reports.

Photographic records will also be established to provide useful environmental monitoring tools. A full record will be kept as part of normal contract monitoring. Reporting and Monitoring Systems for various stages of construction and related activities will be proposed to ensure timely and effective implementation of the EMAP.

The reporting by the contractor will be a monthly report like report of progress on construction and will form basis for monitoring.

- Monitoring of facilities at construction camps
- Monitoring of air, noise, soil and water parameters
- Monitoring of survival of plantation
- Monitoring of cleaning of drains

#### **10.4 Corporate Environmental Responsibility (CER ) and CSR Initiatives**

AAI proposed to allocate Rs 3.67 Crores towards Corporate Environmental Responsibility (CER) within the study area for a period of 5 years (2027-2032).

| <b>CER Summary</b>                                                                          | <b>Value (Crore INR)</b> |
|---------------------------------------------------------------------------------------------|--------------------------|
| Total Project cost (Crores INR)                                                             | 489                      |
| Total CER Cost (5 years) (Crores INR) (0.75 % of Total Project Cost from Rs 100-500 Crores) | 3.67                     |
| Average CER cost per Year (Crores INR)                                                      | 0.7335                   |

The Corporate Environmental Responsibility (CER) will comprise, infrastructure creation for sanitation, health, education, skill development, electrification including solar power, solid waste management facilities and plantation in community areas of nearby villages. Corporate environmental responsibility (CER) costs within the study area for a period of 5 years are given in **Table 10.5**.

**Table 10.5: Corporate Environmental Responsibility (CER) within the study area for a period of 5 years**

| Sn. | Year                 | CER Activities                           | Cost                   |
|-----|----------------------|------------------------------------------|------------------------|
| 1.  | 1 <sup>st</sup> Year | Plantation of Indigenous Species         | 1500000                |
|     |                      | Solar Street Lights                      | 1500000                |
|     |                      | Solid Waste Collection and Management at | 1500000                |
|     |                      | Medical Checkup camps                    | 540000                 |
|     |                      | Skill Development Program                | 1800000                |
|     |                      | Environmental Awareness in School        | 500000                 |
| 2.  | 2 <sup>nd</sup> Year | Plantation of Indigenous Species         | 1500000                |
|     |                      | Solar Street Lights                      | 1500000                |
|     |                      | Solid Waste Collection and Management at | 1500000                |
|     |                      | Medical Checkup camps                    | 540000                 |
|     |                      | Skill Development Program                | 1800000                |
|     |                      | Environmental Awareness in School        | 500000                 |
| 3.  | 3 <sup>rd</sup> Year | Plantation of Indigenous Species         | 1500000                |
|     |                      | Solar Street Lights                      | 1500000                |
|     |                      | Solid Waste Collection and Management at | 1500000                |
|     |                      | Medical Checkup camps                    | 540000                 |
|     |                      | Skill Development Program                | 1800000                |
|     |                      | Environmental Awareness in School        | 500000                 |
| 4.  | 4 <sup>th</sup> Year | Plantation of Indigenous Species         | 1500000                |
|     |                      | Solar Street Lights                      | 1500000                |
|     |                      | Solid Waste Collection and Management at | 1500000                |
|     |                      | Medical Checkup camps                    | 540000                 |
|     |                      | Skill Development Program                | 1800000                |
|     |                      | Environmental Awareness in School        | 500000                 |
| 5.  | 5 <sup>th</sup> Year | Plantation of Indigenous Species         | 1500000                |
|     |                      | Solar Street Lights                      | 1500000                |
|     |                      | Solid Waste Collection and Management at | 1500000                |
|     |                      | Medical Checkup camps                    | 540000                 |
|     |                      | Skill Development Program                | 1800000                |
|     |                      | Environmental Awareness in School        | 500000                 |
|     |                      | <b>CER cost per year for 5 Years</b>     | <b>Rs 0.734 Crores</b> |
|     |                      | <b>Total CER cost</b>                    | <b>Rs 3.67 Crores</b>  |

*Note: Every year consultation with District Administration and near by Villages will be carried out to evaluate needs and CER activities will be finalised accordingly.*

**Corporate Social Responsibility (CSR)** - The Corporate Social Responsibility (CSR) Policy of the Airports Authority of India (AAI) is aligned with its overall commitment to maintaining the highest standards of business performance.

### **10.5 Budget for Environmental Management and Monitoring Plan**

For implementation of EMP during construction and operation phase of the proposed development of Barapani Airport, budget for implementation of mitigation measures and environmental management plan to mitigate the potential adverse impacts during construction and operation phases are summarized in **Table 10.6** and **Table 10.7**, respectively. Total budget of Rs 0.68 Crores and Rs 1.24 Crores has been kept for implementation of environmental management plan during construction and operation phases of the proposed development of Barapani Airport. Recurring Cost of Rs 0.35 Crores and Rs 0.69 Crores per annum has been kept for EMP implementation during construction and operation phases. Estimated budget for environmental monitoring plan is given in **Table 6.3** in Chapter 6. Total budget of Rs 0.031 Crores and Rs 0.025 Crores (refer Chapter 6) has been kept for environmental monitoring during construction and operation phases.

**Table 10.6: Budget for Implementation of Environmental Management Plan for Construction Phase**

| <b>Components</b>            | <b>Items</b>                                             | <b>Capital Cost (Rs)</b> | <b>Recurring Cost (Rs)</b> |
|------------------------------|----------------------------------------------------------|--------------------------|----------------------------|
| Air                          | Dust Management with Sprinkling of Water                 | 750000                   | 500000                     |
|                              | Covers for Vehicles Transporting, Construction Materials | 300000                   | 100000                     |
|                              | Shed for de-dusting of cements bags                      | 75000                    | 25000                      |
|                              | Barricading of the Construction Site                     | 1000000                  | 400000                     |
| Water                        | Sanitary Facilities for Construction Workers             | 400000                   | 200000                     |
|                              | Silt Chamber                                             | 250000                   | 50000                      |
|                              | Oil & Grease Traps                                       | 200000                   | 50000                      |
|                              | Storm Water Management                                   | 500000                   | 250000                     |
| Construction Safety          | Facilities to Workers as BoCW Acts 1996                  | 400000                   | 250000                     |
| Soil                         | Preservation of top soils                                | 100000                   | 50000                      |
|                              | Cement Flooring at Fuel Storage Yard                     | 50000                    | 10000                      |
| Waste Management             | Bins for collection of waste from sites                  | 300000                   | 50000                      |
|                              | Solid wastes segregation and disposal                    | 300000                   | 150000                     |
|                              | Disposal of C&D Wastes                                   | 750000                   | 200000                     |
| Noise                        | Ear plugs and muff                                       | 75000                    | 25000                      |
| Occupational Health & Safety | Personal Protective Equipment (PPE)                      | 300000                   | 200000                     |
|                              | First Aide and Medical Check up                          | 250000                   | 200000                     |
|                              | Display of Signages                                      | 300000                   | 200000                     |
| Reporting                    | Reporting of Implementation of EMP                       | 500000                   | 250000                     |
| Environmental Monitoring     | Ambient Air, Water Quality, Noise Monitoring, etc        | Thirty Party             | 306000                     |
|                              | <b>Total</b>                                             | <b>6800000</b>           | <b>3466000</b>             |
|                              | <b>Say</b>                                               | <b>Rs 0.68 Crores</b>    | <b>Rs 0.35 Crores</b>      |



**Table 10.7: Budget for Implementation of Environmental Management Plan During Operation Phase**

| Components                   | Items                                                | Capital Cost (Rs)                | Recurring Cost (Rs)   |
|------------------------------|------------------------------------------------------|----------------------------------|-----------------------|
| Water                        | Oil & Grease Traps                                   | 250000                           | 200000                |
|                              | Storm Water Management                               | Cost added in BOQ for contractor | 400000                |
|                              | STP (SBR Based)                                      | 4000000                          | 1500000               |
| Waste Management             | Waste Collection and Segregation                     | 2500000                          | 1000000               |
| Rainwater                    | Rainwater Harvesting                                 | 1500000                          | 250000                |
| Noise                        | Ear plugs and muff                                   | 75000                            | 50000                 |
|                              | Installation of Noise Monitoring Station             | 1000000                          | 250000                |
| Occupational Health & Safety | Personal Protective Equipment (PPE)                  | 400000                           | 250000                |
|                              | First Aide and Medical Check up                      | 400000                           | 200000                |
| Energy Conservation          | Energy conservation as per ECBC norms                | Covered in BOQ                   | 1000000               |
| Landscaping                  | Landscaping within Airport and Green Belt/plantation | 2500000                          | 1500000               |
| Environmental Monitoring     | Ambient Air, Water Quality, Noise Monitoring, etc    | Third Party                      | 252000                |
|                              | <b>Total</b>                                         | <b>12375000</b>                  | <b>6852000</b>        |
|                              | <b>Say</b>                                           | <b>Rs 1.24 Crores</b>            | <b>Rs 0.69 Crores</b> |

\*\* Cost added in BOQ for contractor

## **Chapter 11**

### **Summary and Conclusions**

#### **11.1 Introduction**

Barapani (Shillong) Airport is the only operational airport in Meghalaya, serving Shillong. It's located in Umroi, about 30 km from the Shillong city center. The airport is situated at an elevation of 887 m above mean sea level, it has a single concrete runway (04/22), measuring 1,829 m in length. Barapani (Shillong) Airport is an operational Airport, belonging to AAI, with an area of 416.16 acres. The Airport has a runway length of 1829 m x 45m and is suitable for ATR - 72 type of aircraft operation. The Barapani airport has existing Passenger Terminal Building covering 5000 sqm and it handles 200 peak hour passengers. Existing apron is suitable for parking of 4 nos. ATR-72/Q - 400 type of aircraft with power - in and power - out configuration. The existing Barapani Airport is operating with valid Environmental clearance obtained from Ministry of Environment, Forest and Climate Change (MOEF&CC) vide file no. 10-28/2018-IA-III dated 7<sup>th</sup> January 2020. The certified copy of compliance report of conditions of Environmental Clearance by Regional Office of Ministry of Environment, Forest and Climate Change, Shillong has been provided.

Airports Authority of India (AAI) has planned for expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion of Terminal Building & Apron And Other Allied Works. AAI has memorandum of understanding (MOU) with the Meghalaya State Government for providing incumbrance free 22 Acres land for the proposed runway extension and relocation of isolation pad. Under the proposed expansion of Barapani airport expansion of terminal building, runway extension, expansion of apron, relocation pad and associated facilities will be constructed.

The expansion of Barapani Airport is covered under category 'B' of item 7 (a) *i.e.* 'Airports' of the schedule to the EIA Notification, 2006 and its subsequent amendments on 20 April 2022, and requires appraisal at State level by State Expert Appraisal Committee (SEAC) and environmental clearance from state Environmental Impact Assessment Authority (SEIAA) Meghalaya.

The proposal for grant of Terms of Reference (ToR) to the project 'Expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion of Terminal Building & Apron And Other Allied Works' by M/s Airports Authority of India, was considered by the State Expert Appraisal Committee in meeting (EC/AGENDA/SEAC/585272/6/2025) held on 20 June, 2025 and TOR was finalized vide TOR Identification no. TO25B2902ML5691923N (File No. ML/SEAC/SEIAA/PP/RB/105/2025) dated 01/08/2025.

## **Location of Proposed Expansion of Barapani Airport**

Barapani (Shillong) Airport is a domestic airport serving Shillong, the capital of Meghalaya, India. It is located at Umroi, situated 30 km from the city centre of Shillong. The Airport is located in Ri Bhoi district of Meghalaya state.

Airport Reference Point (ARP–WGS 84) is 25°42'12" N, 91°58' 41" E

Latitude and Longitude of corner points of Barapani (Shillong) Airport including proposed expansion area are given below:

| <b>Points</b> | <b>Latitude</b> | <b>Longitude</b> |
|---------------|-----------------|------------------|
| PT A          | 25°42'58.56"N   | 91°59'11.38"E    |
| PT B          | 25°42'51.12"N   | 91°59'21.71"E    |
| PT C          | 25°42'32.73"N   | 91°58'40.31"E    |
| PT D          | 25°41'32.60"N   | 91°57'55.01"E    |
| PT E          | 25°41'27.74"N   | 91°58'1.62"E     |
| PT F          | 25°41'26.77"N   | 91°58'7.76"E     |

### **11.2 Description of Project**

Under the proposed expansion, it is proposed to develop the following infrastructure at the existing Barapani (Shillong) airport considering A -320 as a critical aircraft for operations. The pavement strength has been considered with the potential for future upgrades to support A - 321 operations.

(i) Construction of Extended Runway from the existing length of 1829m x 45m to 2400m x 45m with provision of turn pads at both ends and strengthening of existing runway.

(ii) Expansion of Apron for parking of 5 nos. of Code - C Aircraft in power - in push - back configuration & associated GSE area. Strengthening of existing apron, isolation bay and associated taxiways.

(iii) Expansion of Existing Terminal Building by 5,550 sqm increasing the consolidated peak hour capacity to 1620 passengers (810 Arrival + 810 Departure) as per BCAS norms, with a provision of 2 nos. Passenger Boarding Bridge.

(iv) Miscellaneous Works.

Barapani (Shillong) Airport has an area of 416.16 Acres. 22 Acres of additional land (16 acres for Runway Extension by 571m and another 6 Acres of land for Relocation of Isolation Bay)

would be handover by Meghalaya State Government for the proposed expansion. Out of 22 Acres additional land for proposed expansion, 10.3 Acres land will be taken from Defence by Meghalaya State Government by land swap and remaining 11.7 Acres of land will be given by Meghalaya State Govt.

The domestic passenger terminal building at Barapani (Shillong) Airport will comply "Green Rating for Integrated habitat Assessment (GRIHA)" 5 star Rating.

For the proposed project 1273976 cum cutting and 197136 cum filling will be required, which will be utilized at site and disposed in environmental sound manner.

At the Barapani (Shillong) Airport, parking facilities will be provided for 148 cars and 60 bikes. In addition, airport staff parking will also be provided for 49 cars and 40 two wheelers.

The storm water management has been designed by providing storm water drains and culverts. Drains and culverts will meet the requirement of DGCA -CAR requirement.

Total power requirement is estimated as 1750 kW after expansion of Barapani (Shillong) Airport including runway extension. Power will be supplied by Meghalaya Power Distribution Corporation Limited (MPDCL). Presently, 2 DG sets of 380 kVA capacity are available at the Airport. After expansion of Barapani airport 3 DG sets of 1000 kVA will be installed to meet the power requirement during grid power failure

Barapani airport maintains 50 kL underground storage tank (UST) for HSD. Aircraft refueling at Shillong airport is carried by oil companies.

After expansion 300 TR HVAC will be required at the Barapani Airport. During operation phase, total fresh water requirement is estimated as 371 kld. 257 kld waste water will be generated from the Barapani Airport, which will be treated in 275 kld capacity sewage treatment plant (STP).

Total fresh water requirement will be 371 kld including domestic, fire testing and HVAC. Water requirement will be extracted through bore wells after obtaining permission from CGWA.

Approx. 1240 kg per day municipal solid wastes will be generated from terminal building, residential area and from deplaning of aircraft. From the deplaning of aircraft approx. 300 kg per day waste is estimated to be generated. Solid wastes will be segregated and disposed as per Solid Waste Management Rules, 2016 by engaging third party.

During construction phase 220 manpower and during operation phase 165 manpower will get direct employment. From the project indirect employment will be generated for more than 2000 persons per day.

The estimated project cost for expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion of Terminal Building & Apron and Other Allied Works is estimated as Rs 489 Crores.

### **11.3 Description of Environment**

**Topography and Physiography:**—The airport is located at an elevation of about 887 meters above mean sea level. The landscape of the includes low-lying valleys and isolated hillocks, which affect both wind flow patterns and visibility—important considerations for aviation. The airport is located at an elevation of about 887 meters above mean sea level. The site of the expansion of Barapani airport is not affected by flood.

**Soil Characteristics:** The main types of soils occurring in the area are clayey and Clay loam in texture.

**Water Resources:**—Umiam is river flowing at about 15 m the proposed expansion boundary of Barapani Airport. In the study area is drained by Umiam and other natural drainage channels. Umiam lake is about 8 km in WSW direction.

**Water Quality:** Ground water monitoring was carried out in the study area. The results of ground water samples were compared to Indian Standard Specification of drinking water IS: 10500:2012. All analysed parameters meet acceptable limit. The ground water resources in the study area were found fit for drinking purpose. Surface water samples are meeting Class of Water - C as per CBCB Criteria for designated use.

**Micro Meteorology:**—The maximum ambient temperature recorded near the site during the study period was 32.8 °C, while minimum temperature was recorded as 4.2 °C. During the study period, maximum relative humidity recorded near site was 76.4 % while minimum humidity was recorded as 57.1%. During the study period, maximum wind speed recorded near the site was 6.6 kmph while minimum wind speed was recorded as 5.1 kmph. Mean wind speed during the study period recorded as 5.3 kmph. During the study period, predominant wind direction was recorded from NE-E towards SW-E direction.

**Ambient Air Quality:** Ambient air quality monitoring have been carried out at eight locations during winter season for PM<sub>2.5</sub>, PM<sub>10</sub>, SO<sub>2</sub>, NO<sub>2</sub>, NH<sub>3</sub>, O<sub>3</sub>, C<sub>6</sub>H<sub>6</sub>, BaP, Pb, As, Ni and CO.

The 24-hourly PM<sub>2.5</sub> concentrations during the study period vary in the range of 16 to 26 µg/m<sup>3</sup>. The mean PM<sub>2.5</sub> concentration was 20 µg/m<sup>3</sup> and 98% tile value of PM<sub>2.5</sub> concentration was found 25 µg/m<sup>3</sup>.

The 24-hourly PM<sub>10</sub> concentrations during study period vary in the range of 34 µg/m<sup>3</sup> to 55 µg/m<sup>3</sup>. The mean PM<sub>10</sub> concentration was 42 µg/m<sup>3</sup> and 98%tile value of PM<sub>10</sub> concentration was 52 µg/m<sup>3</sup>.

The 24-hourly SO<sub>2</sub> concentrations during study period vary in the range of 4.9 to 7.8 µg/m<sup>3</sup>. The mean SO<sub>2</sub> concentration was 6.1 µg/m<sup>3</sup> and 98%tile value of SO<sub>2</sub> concentration was 7.5 µg/m<sup>3</sup>.

The 24-hourly NO<sub>2</sub> concentrations during study period vary in the range of 9.6 to 16.9 µg/m<sup>3</sup>. The mean NO<sub>2</sub> concentration was 13.0 µg/m<sup>3</sup> and 98%tile value of NO<sub>2</sub> concentration was 16.4 µg/m<sup>3</sup>.

The CO concentrations during study period vary in the range of 0.1 to 0.2 mg/m<sup>3</sup>. The mean CO concentration was 0.10 mg/m<sup>3</sup> and 98%tile value of CO concentration was 0.2 mg/m<sup>3</sup>.

The O<sub>3</sub> concentrations during study period vary in the range of 8.1 to 14.7 mg/m<sup>3</sup>. The mean O<sub>3</sub> concentration was 11.0 mg/m<sup>3</sup> and 98%tile value of O<sub>3</sub> concentration was 13.9 mg/m<sup>3</sup>.

Concentration of Ammonia (NH<sub>3</sub>), Lead (Pb), Benzene (C<sub>6</sub>H<sub>6</sub>), Benzo (a) Pyrene (BaP), Arsenic (As) and Nickel (Ni) in ambient air were found below detectable limit (BDL) during the study period.

**Noise Level:** Noise measurements were carried out at 8 locations. Measured day and time Leq noise levels are within the limit stipulated for ambient noise standards.

**Natural Hazards and Disaster Risk** - The project site is located in seismic zone V and has most earthquake-prone zone, classified as having the highest severity and intensity of seismic activity.

**Biological Environment** - There is no wildlife sanctuary, national park or other protected area within 10 km distance from the Barapani (Shillong) Airport. No forest land is involved in the project. Within 10 km radius area, 8 species of mammals, 1 specie of avifauna and 3 species reptiles are Schedule 1 as per Wildlife Protection Act, 2022.

## **11.4 Anticipated Environmental Impacts & Mitigation Measures**

**Topography & Physiography:-**Topography at the site is almost plain. The construction for the proposed expansion of Barapani (Shillong) Airport will be confined within existing 416.16 Acres land and encumbrance free 22 Acres land by Government of Meghalaya. For expansion and construction of runway, 1273976 cum cutting and 197136 cum filling will be required, which will be utilized at the site. Impact related to excavations and transportation of excavated materials will not appear from the project. Hence, the anticipated impact on the topography during construction phase.

### Mitigation Measures

- Land clearing at the site will be kept to the absolute minimum practicable;
- Construction site would be designed to minimize filling of the earth, and
- Borrowing of earth if required will be ensured only from approved borrow area having valid environmental from District Level Environmental Impact Assessment Authority (DEIAA).

**Drainage Pattern:** The storm water management has been designed by providing storm water drains including both sides of runway and culverts. Drains and culverts will meet the requirement of DGCA -CAR requirement. Storm water management/drainage plan for the airport has been prepared to ensure that no rain water accumulation at the airport.

### **Mitigation Measures**

- Slope and storm water management shall be provided to maintain drainage and flow of runoff in the drain.
- At the airport site, storm water drains including both sides of runway and culverts have been provided.
- Drainage at the site will be maintained as per drainage counter at the site, therefore, no flooding will be occurred at and around the Barapani airport during the construction phase.

### **Water Resources and Water Quality**

During the construction phase of the proposed expansion of Barapani (Shillong) Airport, approx 40-50 kl/day water will be required depending upon the type of construction activities. Water requirement will be met through water supply by borewells/ Greater Shillong Water Supply Scheme.

During operation phase, total fresh water requirement is estimated as 371 kld. Fresh water requirement will be for domestic (306 kld), fire testing (5 kld) and HVAC (60 kld) purposes. 257 kld waste water will be generated from the expansion of Barapani (Shillong) Airport, which will be treated in 275 kld capacity sewage treatment plant (STP).

### ***Mitigation Measures***

- Continuous efforts will be made to reduce water consumption using less water required cisterns;
- Water efficient urinal and toilets will be provided in proposed terminal building.
- Efforts will be made to stop wastage and leakage of water;
- Sewage and domestic waste water will be treated in Sewage Treatment Plant
- Treated waste water will be used for greenery & landscaping at the proposed civil enclave.

### **Soil**

Approx 1240 kg per day solid wastes will be generated during operation of the Barapani Airport, which will be collected, segregated and managed by external agency for disposal as per Solid Waste Management Rule, 2016. Hence, the impact on the soil will be insignificant as an organized solid waste collection and disposal practices will be followed at the Barapani Airport.

### ***Mitigation Measures***

- Municipal solid waste collection bins will be placed at strategic locations in the proposed civil enclave;
- External agency will be hired for disposal of solid wastes as per the provisions of the Solid Waste Management Rule, 2016;
- Solid waste generated from the Barapani Airport will be transported in close containers;
- Used lubricating waste oil and oil contaminated clothes etc will be collected separately in containers and will be sold to authorized recyclers as per CPCB/MSPCB guidelines.

### **Ambient Air Quality**

During the operational phase of the Barapani Airport, sources of emissions will be from Aircraft during taxing and at apron, vehicular emissions from vehicles engaged in ground operations, vehicular emissions from vehicles coming for drop and pick up of passengers and stack emission from DG sets operations during grid power failure.



### ***Mitigation Measures***

- Compliance of all standards prescribed by the ICAO during operation of aircrafts by preventive maintenance and monitoring;
- Stack heights of DG sets will be as per the CPCB guidelines;
- Proper traffic management plan will be prepared to ensure that there is no traffic congestion in front of proposed terminal building. It will help in reduction of vehicular emissions from the proposed civil enclave.
- Ground vehicles at the proposed civil enclave will be maintained and will have a "Pollution Under Control" certificate;
- Development of greenery and landscaping at the Barapani Airport for improving ambient air quality.
- Monitoring of ambient air quality/ source emissions will be carried out as per monitoring plan.

### **Noise Levels**

During operation phase of the Barapani Airport, landing, take-off and taxiing of various types of aircrafts are major sources of air emissions. Aircraft noise modelling has been carried out using AEDT model for Barapani Airport.

The noise levels from 70-90 dB(A) will be confined within the boundary of the Barapani Airport. Boundary wall around the Barapani Airport and green belt development will significantly attenuate noise levels from the Barapani Airport. The impact of noise levels due to the operation of the Barapani Airport will be within permissible levels. Further, noise mitigation measures to be implemented at and around the Barapani Airport will further reduce the noise levels in nearby settlements.

### ***Mitigation Measures***

- The compliance of all standards prescribed by the ICAO during operation of aircrafts by preventive maintenance and monitoring,
- Proper traffic management will be prepared to ensure that there is no traffic congestion at the proposed civil enclave. It will help in reduction of vehicular noise emissions from the proposed civil enclave,
- DG sets will be provided with acoustic enclosure as per CPCB guidelines,
- Terminal building will be sound proof,
- Ground staff will wear earplug while attending the aircraft,

- Green belt, landscaping and boundary at the proposed civil enclave will act as barrier for noise;
- Monitoring of ambient air quality/source emission will be carried out as per monitoring plan.

### **Terrestrial Ecology**

At the Barapani Airport, green area and landscaping will be developed on 8250 sqm area city side. 103 trees will be planted at the Barapani (Shillong) Airport after expansion (@80 sqm for 1 tree). Treated waste water from STP will be used for irrigation of green belt. This has positive and long-term beneficial impact on terrestrial ecology of the area. For irrigation of green belt, treated waste water from STP will be available and used. This will be positive and long term beneficial impact on terrestrial ecology of the area.

### **Mitigation Measures**

- Landscaping/ plantation/ greenery will be developed.
- Indigenous species of trees will be planted for green belt and landscaping.

**Socio-Economic Environment:** The proposed expansion of Barapani Airport will open direct and indirect job opportunities in the area and region. Further, it will attract more and more pilgrims, tourist, trade, commercial and developmental activities in the area. Therefore, positive impacts are anticipated on socio-economic environment during construction and operation phase of the proposed Barapani Airport.

### **11.5 Analysis of Alternatives**

During design and construction of the proposed expansion of Barapani Airport, alternatives for energy conservation, GRIHA Rating 5 star terminal building, energy efficient materials for terminal building, reuse of treated waste water from STP, green belt and landscaping have been analyzed and adopted in design.

### **11.6 Environmental Monitoring Plan**

Environmental monitoring plan have been prepared for ambient air quality, water quality, soil characteristics and noise monitoring to ensure the effective implementation of the mitigation measures and environmental management plan for the Barapani Airport.

Suitable mitigation measures will be taken in case of monitored parameters are exceeding the stipulated limits. Total budget of Rs 0.031 Crores and Rs 0.025 Crores has been kept for environmental monitoring during construction and operation phases.

### **11.7 Risk Assessment & Disaster Management Plan**

Hazard occurrence at the Barapani Airport may result in on-site implications, like, fire at the HSD day tank for DG sets followed by fire, bomb threat at terminal building & aircraft and natural calamities like, earthquake, flood, etc. Other incidents, which can also result in a disaster at the proposed Barapani 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 the Barapani Airport, other supporting organizations/agencies/services for response during emergency at the Barapani Airport.

### **11.8 Project Benefits**

The proposed expansion of Barapani (Shillong) Airport, is likely to open domestic /export markets. There is export possibility in the region through Barapani (Shillong) Airport. Shillong exports a variety of goods, including ginger, oranges, handicrafts, betel leaves, raw hides, bay leaves, fresh tomatoes, and various other agricultural produces.

#### **Direct and Indirect Benefits**

The direct and indirect benefits of the Barapani (Shillong) Airport are as follows:

##### **Direct Benefits**

- Better infrastructure facilities for passenger
- For safe landing and takeoff of aircrafts at Barapani (Shillong) Airport
- Increase in regional economy as it will boost tourism and commercial activities in the region.
- Generation of more revenue to the state, hence more development of the region.

##### **Macro Level Benefits**

- Boost in trade and commerce and more people to travel in the state.
- Employment opportunity to people.
- More business and industrial opportunities

## **11.9 Environmental Management Plan**

The Airports Authority of India will be responsible for the implementation of mitigation measures identified in Environmental Management Plan (EMP) for construction and operation phases of the proposed development of Barapani Airport.

AAI has planned for to install 150kWp grid tied ground mounted solar photovoltaic power plant at Barapani Airport. At the Barapani Airport. Suitable mitigation measures and management will be taken to control bird's hazards at the Barapani Airport. Green belt/plantation in the nearby area will also be carried with the help of local community involvement. Large canopy trees and fast-growing small trees of indigenous species will be selected for plantation. It is proposed to plant 383 trees saplings at Barapani Airport as part of green area and landscaping.

Environmental Management Cell (EMC) is proposed at Barapani Airport to look after day to day basis implementation of mitigation measures for construction and operation phases. 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.

Environmental Management Cell will implement and review the compliance of the stipulated conditions specified in Environmental Clearance and Consent for Establish. The cell will be responsible to obtain Consent for Operate under Water Act and Air Act from MSPCB.

In order to ensure that grievances and complaints by local people on any aspect of the environmental and social impacts during construction and operation phases of the proposed civil enclave will be addressed in a timely and satisfactory manner and that all possible avenues will be available to resolve their grievances (if any), mechanisms for Grievances Redressal will be setup. Environmental Management Cell will also work as Grievances Redressal Cell (GRC).

### **Corporate Environmental Responsibility Initiatives**

AAI has proposed to allocate Rs 3.67 Crores towards Corporate Environmental Responsibility (CER) within the study area for a period of 5 years (2027-2032). The Corporate Environmental Responsibility (CER) will comprise, infrastructure creation for sanitation, health, education, skill development, electrification including solar power, solid waste management facilities and plantation in community areas of nearby villages.

### **11.9.1 Budget for Environmental Management and Monitoring Plan**

Total budget of Rs 0.68 Crores and Rs 1.24 Crores has been kept for implementation of environmental management plan during construction and operation phases of the proposed expansion of Barapani Airport. Recurring Cost of Rs 0.35 Crores and Rs 0.69 Crores per annum has been kept for EMP implementation during construction and operation phases. Total budget of Rs 0.031 Crores and Rs 0.025 Crores has been kept for environmental monitoring during construction and operation phases.

## **CHAPTER 12**

### **Disclosure of Consultants**

#### **12.1 General**

This chapter describes about the environmental consultant engaged in preparation of Environmental Impact Assessment for Expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion of Terminal Building & Apron and Other Allied Works.

#### **12.2 Introduction**

ABC Techno Labs India Private Limited 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 Multi-lab.

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.

#### **12.3 Services of ABC Techno Labs India Private Limited 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
- Turnkey projects
- Water Treatment Plants Sewage Treatment Plant
- Recycling & Water Conservation Systems
- Other services
- Operation & Maintenance of Water & Waste Water Plants
- Water & Waste Water Treatment Chemicals
- Pilot Plant studies
- Feasibility studies & preparation of budgetary estimates
- Zero Discharge System
- **Other services**
- Operation & Maintenance of Water & Waste Water Plants
- Water & Waste Water Treatment Chemicals
- Pilot Plant studies
- Feasibility studies & preparation of budgetary estimates
- **Laboratory services**
- Chemical Testing
- Environmental Testing
- Microbiological Testing
- Food Testing
- Metallurgical Testing

## 12.4 Sectors Accredited by NABET

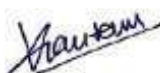
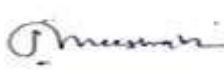
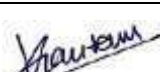
| Sl.No. | Name of sectors                                                                                                                                | NABET Sector No | MoEF&CC Sl. No. |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------------|
| 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.     | Leather/Skin/hide processing industry                                                                                                          | 15              | 4 (f)           |
| 10.    | Chemical Fertilizers                                                                                                                           | 16              | 5 (a)           |
| 11.    | Petro-chemical Complexes                                                                                                                       | 18              | 5 (c)           |
| 12.    | Petrochemical based processing                                                                                                                 | 20              | 5 (e)           |
| 13.    | Synthetic organic chemicals industry                                                                                                           | 21              | 5 (f)           |
| 14.    | Distilleries                                                                                                                                   | 22              | 5 (g)           |
| 15.    | Intergrated Paint Industry                                                                                                                     | 23              | 5 (h)           |
| 16.    | Sugar Industry                                                                                                                                 | 25              | 5 (j)           |
| 17.    | Oil & gas transportation pipe line (crude and refinery/ petrochemical products)                                                                | 27              | 6 (a)           |
| 18.    | Airports                                                                                                                                       | 29              | 7 (a)           |
| 19.    | Industrial estates/ parks/ complexes/ areas, export processing Zones (EPZs), Special Economic Zones (SEZs), Biotech Parks, Leather Complexes   | 31              | 7 (c)           |
| 20.    | Ports, Harbours, Jetties, Marine terminals, break waters and desilting                                                                         | 33              | 7 (e)           |
| 21.    | Highways, Railways, Transport terminals, mass rapid transport system                                                                           | 34              | 7 (f)           |
| 22.    | Common Effluent Treatment Plants (CETPs)                                                                                                       | 36              | 7 (h)           |
| 23.    | Common Municipal Solid Waste Management Facility (CMSWMF)                                                                                      | 37              | 7 (i)           |
| 24.    | Building and large Construction projects including shopping malls, multiplexes, commercial complexes, housing estates, hospitals, institutions | 38              | 8 (a)           |
| 25.    | Townships and Area development projects                                                                                                        | 39              | 8 (b)           |

## 12.5 Expert Team

ABC Techno Labs India Private Limited has carried out this Environmental Impact Assessment (EIA) study for the proposed project. The multi-disciplinary team included expertise in Environmental Impact Assessment, Air & Water pollution & Control measures, Noise Control



measures, Ecology & bio-diversity, Land use, Geology, Environmental Chemistry and Socio-Economic planner. The team members involved in EIA study area.

| S. No                              | Functional Areas     | Name of the Expert/s        | Involvement (Period) | Signature                                                                             |
|------------------------------------|----------------------|-----------------------------|----------------------|---------------------------------------------------------------------------------------|
| 1.                                 | WP                   | Vaishnavi Dhinakaran        | March -Nov 2025      |    |
| 2.                                 | SHW                  | Vinod Kumar Gautam          | March -Nov 2025      |    |
| 3.                                 | AP                   | Abhik Saha                  | March -Nov 2025      |    |
| 4.                                 | EB                   |                             |                      |                                                                                       |
| 5.                                 | AQ                   | Vinod Kumar Gautam          | March -Nov 2025      |    |
| 6.                                 | RH                   | Vinod Kumar Gautam          | March -Nov 2025      |    |
| 7.                                 | HG                   | Dr.Veezhinathan Subramaniam | March -Nov 2025      |  |
| 8.                                 | NV                   | Haneesh KR                  | March -Nov 2025      |  |
| 9.                                 | LU                   | Dr. N Rama Krishnan         | March -Nov 2025      |  |
| 10.                                | SE                   |                             |                      |                                                                                       |
| EIA Coordinator Vinod Kumar Gautam |                      |                             |                      |  |
| Team Member – EIA Coordinator      |                      |                             |                      |                                                                                       |
| 1.                                 | Vaishnavi Dhinakaran |                             |                      |  |


**QUALITY COUNCIL  
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for Education and Training**



**Certificate of Accreditation**

**ABC Techno Labs India Private Limited, Chennai**  
 ABC Tower, 400, 13th Street, SIDCO Industrial Estate, North Phase, Ambattur, Chennai 600098  
*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 –*

| S. No | Sector Description                                                                                                                               | Sector (as per) |           | Cat. |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------|------|
|       |                                                                                                                                                  | NABET           | MoEFCC    |      |
| 1     | Mining of minerals including opencast/ underground mining                                                                                        | 1               | 1 (a) (i) | A    |
| 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 (h)     | 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**  
**Dated: July 11, 2023**

**Certificate No.**  
**NABET/EIA/2225/RA 0290**

**Valid up to**  
**Nov 16, 2025**

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to the QCI-NABET website.



F.No.10-28/2018-IA-III  
Government of India  
Ministry of Environment, Forest and Climate Change  
(IA.III Section)

Indira Paryavaran Bhawan,  
Jor Bagh Road, New Delhi - 3

Date: 7<sup>th</sup> January, 2020

To,

M/s Airport Authority of India,  
Shillong Airport, Barapani, Umroi,  
Shillong - 793116, Meghalaya.  
Email: [enggcivilbarapani.aai@gmail.com](mailto:enggcivilbarapani.aai@gmail.com)

**Subject: Proposed Extension of Runway and Allied Works at Shillong Airport by M/s Airports Authority of India Shillong - Environmental Clearance - reg.**

Sir,

This has reference to your online proposal No. IA/ML/MIS/103943/2018 dated 12<sup>th</sup> October, 2019, submitted to this Ministry for grant of Environmental Clearance (EC) in terms of the provisions of the Environment Impact Assessment (EIA) Notification, 2006 under the Environment (Protection) Act, 1986.

2. The proposal for grant of environmental clearance to the project 'Proposed Extension of Runway and Allied Works at Shillong Airport' by M/s Airports Authority of India Shillong was considered by the Expert Appraisal Committee (Infra-2) in its 46<sup>th</sup> meeting held during 25-26 November, 2019. The details of the project, as per the documents submitted by the project proponent, and also as informed during the above meeting, are as under:-

- (i) Airport Authority of India has proposed expansion of Shilling airport located at Umroi in District of Ri-Bhoi, Meghalaya. The proposal involves expansion activities including runway extension & other allied works. The project activity is classified as category A under item 7 (a) of Schedule of EIA Notification.
- (ii) Presently, Shillong Airport handles the operations of ATR-42 type of Aircraft. The airport currently lacks important facilities such as adequate length of runway to handle bigger Aircrafts, ILS, isolation bay, etc. The task force on Civil Aviation for North-East Region had recommended up-gradation of Shillong airport. The airport will be upgraded to cater for operation of ATR-72, AB-321 type of aircrafts and increased air traffic.
- (iii) The proposed expansion involves development area of about 416.16 acres (Existing: 192 acres & Proposed: 224.16 acres). The land required for expansion of Airport measuring 224.16 acres has already been handover by Collector, Ri-Bhoi District, Nongpoh, Meghalaya Government to Airports Authority of India. The details of proposed developmental works are as follows:
  - Extension of runway from 6000 ft to 7500 ft and strengthening the existing runway for AB-321 type aircraft.
  - Provision of standard basic strip of 300 meters width extending laterally by 150 meters on either side of runway central line and extending longitudinally by 60 m beyond runway ends for the entire runway after extension including provision of runway end safety area (RESA).
  - Providing perimeter lighting along the entire boundary wall.
  - Providing shoulders to the existing runway, apron & taxiway.
  - Provision of isolation bay
  - Expansion of apron to make total dimension 191 x 120 m.
  - Taxi track of dimension 191 x 23 m will be constructed.
  - Provisions of apron flood light.
  - Provisions of approach lighting and up gradation of runway edge light.

*J. Rose*

- Provisions of Instrument Landing System (ILS).
  - Shifting of existing Doppler Very High Frequency Omni Range (DVOR).
- (iv) Details of Airport Facilities are as follows:

| S.No.     | Particulars                      | Existing                                             | Proposed Expansion        | Total                                                       |
|-----------|----------------------------------|------------------------------------------------------|---------------------------|-------------------------------------------------------------|
| <b>1.</b> | <b>Runway Details</b>            |                                                      |                           |                                                             |
| i.        | Runway Length/ dimension         | Length: 6000 ft (1829 m)<br>Dimension: 1829 m x 45 m | Length : 1500 ft          | Length : 7500 ft (2286.58 m)<br>Dimension: 2286.58 m x 45 m |
| ii.       | Runway shoulders                 | Nil                                                  | Width of Shoulder : 7.5 m | Width of Shoulder : 7.5 m                                   |
| iii.      | Runway strip Dimension           | 1949 m x 150 m                                       | 2406.58 m x 300 m         | 2406.58 m x 300 m                                           |
| iv.       | RESA Dimension                   | 90 m x 90 m                                          | 150 m x 90 m              | 150 m x 90 m                                                |
| v.        | Runway lights                    | Single circuit available                             | CAT-1,2 Circuit           | CAT-1,2 Circuit                                             |
| <b>2.</b> | <b>Type of Aircraft handling</b> |                                                      |                           |                                                             |
| i.        | Type of Aircraft                 | ATR-42                                               | AB-321                    | ATR-42, AB-321                                              |
| <b>3.</b> | <b>Apron Details</b>             |                                                      |                           |                                                             |
| i.        | Dimension                        | 91 m x 61 m                                          | 191m x 120 m              | 191m x 120 m                                                |
| <b>4.</b> | <b>Taxiway Details</b>           |                                                      |                           |                                                             |
| i.        | Dimension                        | Width -23 m                                          | 191m x 23 m               | 191m x 23 m                                                 |
| <b>5.</b> | <b>Terminal Building</b>         |                                                      |                           |                                                             |
| i.        | Area                             | 5000 sq.m                                            | Nil                       | 5000 sq.m                                                   |
| ii.       | Capacity                         | 100 Arrival & 100 Departure                          | Nil                       | 100 Arrival & 100 Departure                                 |
| iii.      | Car Parking                      | 140 nos. including 38 nos. for VIP                   | Nil                       | 140 nos. including 38 nos. for VIP                          |
| <b>6.</b> | <b>Navigation Aids</b>           |                                                      |                           |                                                             |
| i.        | DVOR                             | Available                                            | Relocation                | Relocation                                                  |
| ii.       | PAPI                             | Available                                            | Nil                       | Available                                                   |
| <b>7.</b> | <b>Other Facilities</b>          |                                                      |                           |                                                             |
| i.        | Isolation Bay                    | None                                                 | 75 m x 90 m               | 75 m x 90 m                                                 |
| ii.       | ILS (Instrument Landing System)  | None                                                 | Yes                       | Yes                                                         |
| iii.      | Approach lights                  | None                                                 | Yes                       | Yes                                                         |
| <b>8.</b> | <b>AAI staff Accommodation</b>   |                                                      |                           |                                                             |
| i.        | Residential Quarter              | 30 nos.                                              | Nil                       | 30 nos.                                                     |
| ii.       | CISF Barrack                     | 27 nos. of beds                                      | Nil                       | 27 nos. of beds                                             |

- (v) Daily Fresh water requirement will be 27 KLD which will be sourced from Ground water (bore-well). Application for withdrawal of ground water has been submitted to CGWA.
- (vi) 40 KLD of waste water will be generated which will be treated in STP of 50 KLD capacity. 36 KLD of treated water to be used for flushing & landscaping.
- (vii) Municipal solid waste generated about 187 kg/day will be disposed off as per SWM Rules, 2016.
- (viii) No National Park/ Wild Life Sanctuary and Eco-Sensitive Zone exist in 10 km radius area.
- (ix) There is no court case pending for violation of environmental laws against the Extension of Runway & allied works at Shillong Airport, Barapani, Meghalaya.



- (x) Terms of Reference (ToR) was granted by MoEFCC vide letter F.No. 10-28/2018-IA-III dated 17<sup>th</sup> May, 2018.
- (xi) Public Hearing was held on 9<sup>th</sup> January, 2019 at Shillong Airport, District Ri-Bhoi, Meghalaya. The major issues raised during public hearing were related to local employment and developmental activities by AAI.
- (xii) No forest land is involved.
- (xiii) Total estimated cost of the project is Rs. 186 Crores.
- (xiv) Employment Potential: 100.
- (xv) Benefits of the project: The project will boost economic growth benefiting the whole region through the generation of both direct and indirect economic value. The construction and operation of airport will generate direct employment opportunity, indirectly contributed jobs through supply chain, enhance induced impact through tourism. The project will also lead to development in the nearby areas through proposed CER activities.

3. The project/activity is covered under category 'A' of item 7(a) 'Airports' of the Schedule to the EIA Notification, 2006 and its subsequent amendments, and requires appraisal at Central Level by sectoral EAC.

4. During deliberations, it was informed by the project proponent that the Airports Authority of India (AAI) is operating an airport at Umroi, also known as Shillong Airport (a civilian airport located at Barapani, Umroi, 30 kms from Shillong, Meghalaya) with regular flights (1 arrival + 1 departure) with ATRs (ATR-42) to and from Kolkata. The present proposal involves up-gradation of existing airport facilities at Shillong airport. The project includes extension of existing runway length from 6000 ft to 7500 ft and allied works to make it suitable for AB-321 class of aircraft operations. The existing Shillong airport was constructed in the mid-1960s and became operational in the mid-1970s. The project is obtaining Environmental Clearance (EC) for the first time. Hence, compliance of earlier EC is not applicable. Consent to Operate for the existing project has been obtained from MPCB vide letter no. MPCB/TB-CON-12(2010)/2017-2018/29 dated 11.09.2017. Ground water abstraction i.e. 27 KLD will be done by bore well after obtaining permission from CGWA. Application for withdrawal of ground water has been submitted to CGWA & is under process.

The Committee deliberated upon the issues raised during the Public Hearing/Public Consultation meeting conducted by the State Pollution Control Board on 9<sup>th</sup> January, 2019. The issues were raised regarding Road construction & Right of way, Impact on surrounding environment, Issue regarding permission/NOC for construction near airport, Employment, CER activities & development of the area and Land related issues. The Committee noted that issues have satisfactorily been responded by the project proponent and incorporated in the final EIA-EMP report.

5. The EAC, based on the information submitted and clarifications provided by the Project Proponent and detailed discussions held on all the issues, recommended the project for grant of environmental clearance with stipulate conditions. Based on the recommendation of the EAC, the Ministry of Environment, Forest and Climate Change hereby accords Environmental Clearance to the project 'Proposed Extension of Runway and Allied Works at Shillong Airport' by M/s Airports Authority of India Shillong with following specific conditions along with other Standard EC Conditions as specified by the Ministry vide OM dated 4<sup>th</sup> January, 2019 for the said project/activity while considering for accord of environmental clearance:-

#### **A. SPECIFIC CONDITIONS:**

- (i) The land acquisition / purchase shall be in conformity to the LARR Act, 2013 and any other laws and regulations governing land acquisition.

*J. Rose*



- iv. The runoff from paved structures like Runways, Taxiways, can be routed through drains to oil separation tanks and sedimentation basins before being discharged into rainwater harvesting structures.
- v. Storm water drains are to be built for discharging storm water from the air-field to avoid flooding/water logging in project area. Domestic and industrial waste water shall not be allowed to be discharged into storm water drains.
- vi. Rain water harvesting for roof run-off and surface run-off, as plan submitted should be implemented. Rain water harvesting structures shall conform to CGWA designs. Before recharging the surface run off, pre-treatment must be done to remove suspended matter, oil and grease.
- vii. Total fresh water use shall not exceed the proposed requirement as provided in the project details. Prior permission from competent authority shall be obtained for use of fresh water.
- viii. A certificate from the competent authority for discharging treated effluent/ untreated effluents into the Public sewer/ disposal/drainage systems along with the final disposal point should be obtained.
- ix. A detailed drainage plan for rain water shall be drawn up and implemented.
- x. No ground water shall be extracted without prior permission from CGWA.
- xi. A water security plan to the satisfaction of the CGWA shall be drawn up to include augmenting water supply and sanitation facilities and recharge of ground water in at least two villages and schools, as part of the C.S.R. activities.

#### **IV. Noise monitoring and prevention:**

- i. Noise level survey shall be carried as per the prescribed guidelines and report in this regard shall be submitted to Regional Officer of the Ministry as a part of six-monthly compliance report.
- ii. Noise from vehicles and power machinery and equipment on-site should not exceed the prescribed limit. Equipment should be regularly serviced. Attention should also be given to muffler maintenance and enclosure of noisy equipments.
- iii. Acoustic enclosures for DG sets, noise barriers for ground-run bays, ear plugs for operating personnel shall be implemented as mitigation measures for noise impact due to ground sources.
- iv. During airport operation period, noise should be controlled to ensure that it does not exceed the prescribed standards. During night time the noise levels measured at the boundary of the building shall be restricted to the permissible levels to comply with the prevalent regulations. A monitoring station for ambient air and noise levels shall be provided in the village nearest to the airport.
- v. Where construction activity is likely to cause noise nuisance to nearby residents, restrict operation hours between 7 am to 6 pm.

#### **V. Energy Conservation measures:**

- i. Energy conservation measures like installation of LED for the lighting the areas outside the building should be integral part of the project design and should be in place before project commissioning.

#### **VI. Waste management:**

- ii. Soil stockpile shall be managed in such a manner that dust emission and sediment runoff are minimized. Ensure that soil stockpiles are designed with no slope greater than 2:1 (horizontal/vertical).

*J. Rose*



- iii. The project activity shall conform to the Fly Ash notification issued under the E.P. Act of 1986.
- iv. Solid inert waste found on construction sites consists of building rubble, demolition material, concrete, bricks, timber, plastic, glass, metals, bitumen etc shall be reused/recycled or disposed off as per Solid Waste Management Rules, 2016 and Construction and Demolition Waste Rules, 2016.
- v. Any wastes from construction and demolition activities related thereto shall be managed so as to strictly conform to the Construction and Demolition Rules, 2016.
- vi. The project proponents shall implement a management plan duly approved by the State Pollution Control Board and obtain its permissions for the safe handling and disposal of:
  - a. Trash collected in flight and disposed at the airport including segregation, collection and disposed.
  - b. Toilet wastes and sewage collected from aircrafts and disposed at the Airport.
  - c. Wastes arising out of maintenance and workshops
  - d. Wastes arising out of eateries and shops situated inside the airport complex.
  - e. Hazardous and other wastes
- vii. The solid wastes shall be segregated as per the norms of the Solid Waste Management Rules, 2016. Recycling of wastes such as paper, glass (produced from terminals and aircraft caterers), metal (at aircraft maintenance site), plastics (from aircrafts, terminals and offices), wood, waste oil and solvents (from maintenance and engineering operations), kitchen wastes and vegetable oils (from caterers) shall be carried out. Solid wastes shall be disposed in accordance to the Solid Waste Management Rules, 2016 as amended.
- viii. A certificate from the competent authority handling municipal solid wastes should be obtained, indicating the existing civic capacities of handling and their adequacy to cater to the M.S.W. generated from project.
- ix. Used CFLs and TFLs should be properly collected and disposed off/sent for recycling as per the prevailing guidelines/ rules of the regulatory authority to avoid mercury contamination.

## **VII. Green Belt:**

- I. Green belt shall be developed in area as provided in project details, with native tree species in accordance with Forest Department. The greenbelt shall inter alia cover the entire periphery of the Air Port.
- II. Top soil shall be separately stored and used in the development of green belt.

## **VIII. Public hearing and Human health issues:**

- i. Construction site should be adequately barricaded before the construction begins.
- ii. Traffic congestion near the entry and exit points from the roads adjoining the airport shall be avoided. Parking should be fully internalized and no public space should be utilized.
- iii. Provision of Electro-mechanical doors for toilets meant for disabled passengers. Children nursing/feeding room to be located conveniently near arrival and departure gates.
- iv. Emergency preparedness plan based on the Hazard identification and Risk Assessment (HIRA) and Disaster Management Plan shall be implemented.
- v. Provision shall be made for the housing of construction labour within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.
- vi. An onsite disaster management plan shall be drawn up to account for risks and

*S. Bose*



accidents. This onsite plan shall be dovetailed with the onsite management plan for the district.

- vii. Occupational health surveillance of the workers shall be done on a regular basis.

**IX. Corporate Environment Responsibility:**

- i. The company shall have a well laid down environmental policy duly approved by the Board of Directors. The environmental policy should prescribe for standard operating procedures to have proper checks and balances and to bring into focus any infringements/deviation/violation of the environmental / forest /wildlife norms/ conditions. The company shall have defined system of reporting infringements / deviation / violation of the environmental / forest / wildlife norms / conditions and / or shareholders / stake holders. The copy of the board resolution in this regard shall be submitted to the MoEF&CC as a part of six-monthly report.
- ii. A separate Environmental Cell both at the project and company head quarter level, with qualified personnel shall be set up under the control of senior Executive, who will directly report to the head of the organization.
- iii. Action plan for implementing EMP and environmental conditions along with responsibility matrix of the company shall be prepared and shall be duly approved by competent authority. The year wise funds earmarked for environmental protection measures shall be kept in separate account and not to be diverted for any other purpose. Year wise progress of implementation of action plan shall be reported to the Ministry/Regional Office along with the Six Monthly Compliance Report.
- iv. Self environmental audit shall be conducted annually. Every three years third party environmental audit shall be carried out.

**X. Miscellaneous:**

- i. The project proponent shall make public the environmental clearance granted for their project along with the environmental conditions and safeguards at their cost by prominently advertising it at least in two local newspapers of the District or State, of which one shall be in the vernacular language within seven days and in addition this shall also be displayed in the project proponent's website permanently.
- ii. The copies of the environmental clearance shall be submitted by the project proponents to the Heads of local bodies, Panchayats and Municipal Bodies in addition to the relevant offices of the Government who in turn has to display the same for 30 days from the date of receipt.
- iii. The project proponent shall upload the status of compliance of the stipulated environment clearance conditions, including results of monitored data on their website and update the same on half-yearly basis.
- iv. The project proponent shall submit six-monthly reports on the status of the compliance of the stipulated environmental conditions on the website of the ministry of Environment, Forest and Climate Change at environment clearance portal.
- v. The project proponent shall submit the environmental statement for each financial year in Form-V to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently and put on the website of the company.
- vi. The criteria pollutant levels namely;  $PM_{10}$ ,  $PM_{2.5}$ ,  $SO_2$ ,  $NO_x$  (ambient levels) shall be monitored and displayed at a convenient location near the main gate of the company in the public domain.
- vii. The project proponent shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities, commencing the land development work and start of production operation by the project.

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- viii. The project authorities must strictly adhere to the stipulations made by the State Pollution Control Board and the State Government.
- ix. The project proponent shall abide by all the commitments and recommendations made in the EIA/EMP report, commitment made during Public Hearing and also that made during their presentation to the Expert Appraisal Committee.
- x. No further expansion or modifications in the plant shall be carried out without prior approval of the Ministry of Environment, Forests and Climate Change (MoEF&CC).
- xi. Concealing factual data or submission of false/fabricated data may result in revocation of this environmental clearance and attract action under the provisions of Environment (Protection) Act, 1986.
- xii. The Ministry may revoke or suspend the clearance, if implementation of any of the above conditions is not satisfactory.
- xiii. The Ministry reserves the right to stipulate additional conditions if found necessary. The Company in a time bound manner shall implement these conditions.
- xiv. The Regional Office of this Ministry shall monitor compliance of the stipulated conditions. The project authorities should extend full cooperation to the officer (s) of the Regional Office by furnishing the requisite data / information/monitoring reports.
- xv. The above conditions shall be enforced, inter-alia under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, the Air (Prevention & Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986, Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and the Public Liability Insurance Act, 1991 along with their amendments and Rules and any other orders passed by the Hon'ble Supreme Court of India / High Courts/NGT and any other Court of Law relating to the subject matter.
- xvi. Any appeal against this EC shall lie with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.

6. This issues with the approval of the Competent Authority.

*S. Bose*  
(Dr. Subrata Bose)  
Scientist F

**Copy to:**

- 1) The Addl. Principal Chief conservator of Forests (C), Regional office, N.E.Z, Ministry of Environment, Forest and Climate Change (MoEF&CC), Law-u-sib, Lumbatngen, Sawlad, Near M.T.C. workshop, Shillong - 793021.
- 2) The Joint Secretary to the Govt. of Meghalaya, Forests & Environment Department Shillong.
- 3) The Chairman, Central Pollution Control Board Parivesh Bhavan, CBD-cum-Office Complex, East Arjun Nagar, New Delhi - 110 032.
- 4) The Member Secretary, Meghalaya State Pollution Control Board 'Arden', Lumpyngngad, Shillong - 793014.
- 5) Monitoring Cell, MoEF&CC, Indira Paryavaran Bhavan, New Delhi.
- 6) Guard File/ Record File/ Notice Board.
- 7) MoEF&CC website.

*S. Bose*  
(Dr. Subrata Bose)  
Scientist F



भारत सरकार/GOVERNMENT OF INDIA  
क्षेत्रीय कार्यालय/REGIONAL OFFICE  
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय  
MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE  
लुम्बातंग/ LUMBATNGEN,  
शिल्लोंग/SHILLONG-793021  
TEL 0364-2537278; FAX 0364-2536041  
E-mail: [moef@shillong@gov.in](mailto:moef@shillong@gov.in)



No. RO-SHL/E/IA/ML/CON/40/

1164-07

Date: 23.07.2025

सेवा में/To,

The Member Secretary,  
State Environment Impact Assessment Authority (SEIAA),  
Silviculture Building (Adjacent Sylvan House),  
Lower Lachumiere, Shillong  
Meghalaya- 793001

Sub: Forwarding of Certified Compliance Report for Expansion of Barapani (Shillong) Airport including Runway Extension, Expansion of Terminal Building & Apron and other Allied works at Shillong Airport, Barapani, Meghalaya by Airports Authority of India-reg.

Ref: i. File No. 10-28/2018-IA -III dated 7th January 2020.  
ii. Airport Authority of India letter dated 16.06.2025.

Sir/Madam,

With reference to the subject cited above, I am directed to enclose herewith the Certified Compliance Report (CCR) of the project entitled, 'Expansion of Barapani (Shillong) Airport including Runway Extension, Expansion of Terminal Building & Apron and other Allied works at Shillong Airport, Barapani, Meghalaya by Airports Authority of India' prepared by RO, Shillong. Monitoring have been carried out as requested by Airport Director, Barapani (Shillong) Airport for issuance of CCR vide their letter No. AAI/SHL/EIA/2025-26/5718 dated 16.06.2025 (copy enclosed).

This is issued with the approval of Deputy Director General of Forests (C).

भवदीय /Yours faithfully,

Encl: As stated

(Dr. H. Tynsong)  
वैज्ञानिक ई/Scientist E

Copy for kind information to:

i. The Airport Director, M/s Airport Authority of India, Shillong Airport, Barapani, Umroi,  
Meghalaya-793116.

वैज्ञानिक ई/Scientist E



**Monitoring the Implementation of Environmental Safeguards**  
**Ministry of Environment, Forest & Climate Change**  
**Regional Office (Shillong),**

**Monitoring Report**

**Part – I**  
**DATA SHEET**

|    |                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----|--------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. | Project Type: River-valley/Mining/Industry/Thermal/Nuclear/Other (Specify)                             | Infra 2 (Infrastructure) Airport.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 2. | Schedule and category of the Project as per EIA, 2006                                                  | Schedule 7(a), Category A Project (Present Category B1 as per EIA Notification 2006 and amended 20 April 2022)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 3. | Category of the project as per CPCB Guidelines (Red, Orange, Green)                                    | Red Category                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 4. | Name of the project and project proponent                                                              | Extension of runway & allied works at Shillong Airport, Barapani, Meghalaya by Airports Authority of India                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 5. | Clearance Letter (s) / OM No. and date (Chronological Order)                                           | File No. 10-28/2018-IA -III dated 7th January 2020)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 6. | Location                                                                                               | Ri- Bhoi                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|    | a. District (s):                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|    | b. State (s):                                                                                          | Meghalaya                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|    | c. Latitude:                                                                                           | 25°42'49.58"N                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|    | d. Longitude:                                                                                          | 91°59'8.24"E                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 7. | Address for correspondence                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|    | a. Address of concerned Project Chief Engineer (with Pin Code & Telephone/ Telex/ Fax Numbers and id): | Airport Authority of India, Shillong Airport, Barapani, Umroi, Shillong, Meghalaya<br>793116<br>9581440474                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|    | &<br>Address of Executive Project Engineer/ Manager (with pin code/ fax numbers and Email id)          | Airport Director, Shillong Airport, Umroi, Shillong, Meghalaya, 793116<br>9581440474                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 8. | Salient features                                                                                       | <b>(i) Terminal Building</b><br>Area of Existing Passenger Terminal Building is 5000 sqm with a peak hour handling capacity of 200 passengers and 0.5 MPPA.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|    | a. Project                                                                                             | <b>(ii) Runway</b><br>Existing runway 04/22 having dimension 1829m x 45m is suitable for the operation of ATR-72 type of aircraft.<br><br><b>(iii) Apron</b><br>Existing apron is suitable for parking of 4 nos. ATR-72/Q - 400 type of aircraft with power - in and power - out configuration.<br><br><b>Environmental Clearance</b> - Barapani (Shillong) Airport is operating with Environmental Clearance (File No. 10-28/2018-IA -III dated 7th January 2020) obtained from Ministry of Environment Forest and Climate Change (MOEF&CC).<br><br><b>CTE and CTO</b> - CTE and CTO obtained.<br><br><b>Fire NoC</b> - Fire NoC for the Barapani (Shillong) Airport is |

|     |                                                                                                        |                                                                                                                                                          |                            |                             |                   |
|-----|--------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-----------------------------|-------------------|
|     |                                                                                                        | available                                                                                                                                                |                            |                             |                   |
|     | b. Environmental Management Plan                                                                       | Available                                                                                                                                                |                            |                             |                   |
| 9.  | Breakup of the Project area                                                                            | 416.16 Acres                                                                                                                                             |                            |                             |                   |
|     | a. Submergence Area: Forest & Non Forest                                                               | Nil                                                                                                                                                      |                            |                             |                   |
|     | b. Others                                                                                              | Nil                                                                                                                                                      |                            |                             |                   |
| 10. | a. Total Plot Area                                                                                     | 416.16 acres                                                                                                                                             |                            |                             |                   |
|     | b. Built-Up Area                                                                                       |                                                                                                                                                          |                            |                             |                   |
|     | c. Open Space available                                                                                |                                                                                                                                                          |                            |                             |                   |
|     | d. Green belt area                                                                                     |                                                                                                                                                          |                            |                             |                   |
| 11. | Financial Details                                                                                      |                                                                                                                                                          |                            |                             |                   |
|     | a. Project costs as originally planned & subsequent revised estimates and the year of price reference. | Rs 186 Crores total (work reduced to Rs.34.00 crore)                                                                                                     |                            |                             |                   |
|     | b. Allocations made for Environmental Management Plan with item wise & year wise breakup.              | 0.6 Crores                                                                                                                                               |                            |                             |                   |
|     | c. Actual expenditure incurred on the Project so far                                                   | Actual expenditure = Rs. 34,14,99,704.29/-                                                                                                               |                            |                             |                   |
|     | d. Actual expenditure incurred on the Environmental Management Plan so far                             | 0.6 Crores                                                                                                                                               |                            |                             |                   |
| 12. | Forest land requirement                                                                                | Not Applicable                                                                                                                                           |                            |                             |                   |
|     | a. The status of approval for diversion of Forestland for non-forestry use                             |                                                                                                                                                          |                            |                             |                   |
| 13. | Whether project located in Critically Polluted Area/ Severely Polluted                                 | No                                                                                                                                                       |                            |                             |                   |
| 14. | Status of construction                                                                                 | Construction completed and Shillong Airport is in operation.                                                                                             |                            |                             |                   |
|     | a. Date of commencement (Actual and/or planned)                                                        | 24.03.2018                                                                                                                                               |                            |                             |                   |
|     | b. Date of completion (Actual and/or planned)                                                          | Stipulated D.O.C = 23.11.2018<br>Actual D.O.C = 31.08.2022                                                                                               |                            |                             |                   |
| 15. | Production details as per EC & CTO                                                                     | Year                                                                                                                                                     | Total production as per EC | Total production as per CTO | Actual Production |
|     |                                                                                                        | N/A                                                                                                                                                      | N/A                        | N/A                         | N/A               |
| 16. | Reasons for the delay if the project is yet to start                                                   | Construction completed and Shillong Airport is in operation.                                                                                             |                            |                             |                   |
| 17. | KML file of the project                                                                                | PP could not provided the KML file of the project                                                                                                        |                            |                             |                   |
| 18. | Status of Public Hearing Commitments                                                                   | The public hearing for the Project was conducted on 09.01.19 at Shillong Airport, Ri-Bhoi (Meghalaya) by Meghalaya State Pollution Control Board (MPCB). |                            |                             |                   |
| 19. | Status of R&R                                                                                          | N/A (as encumbrance free land was provided by Govt. of Meghalaya)                                                                                        |                            |                             |                   |
| 20. | Dates of site visits                                                                                   | 9/11/2020; 25/02/2022                                                                                                                                    |                            |                             |                   |
|     | a. The dates on which the Project was monitored by Regional Office on previous occasions, if any       |                                                                                                                                                          |                            |                             |                   |
|     | b. Date of site visit for this monitoring Report                                                       | 02/07/2025                                                                                                                                               |                            |                             |                   |
| 21. | Purpose of present Site visit:                                                                         | CCR for Expansion                                                                                                                                        |                            |                             |                   |

|     |                                                                             |                                       |
|-----|-----------------------------------------------------------------------------|---------------------------------------|
| 22. | Pending litigation if any or directions issued by any regulatory authority, | PIL No.4/2021 with MC (PIL) No.3/2021 |
| 23. | Recommendations                                                             | Major Non-Compliance                  |

(डॉ. एच. त्यनसोंग Dr. H. Tynsong)  
वैज्ञानिक 'ई' / Scientist 'E'



# PART – II

## CONDITION WISE COMPLIANCE STATUS OF ALL THE ECS ASSOCIATED WITH THE EXTANT PROJECT.

| S No      | Condition                                                                                                                                                                                                                                                | Status as per six monthly compliance report submitted by the PP                                                                                               | Observations of RO                                                                                                                                                                 |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>A.</b> | <b>Specific Conditions</b>                                                                                                                                                                                                                               |                                                                                                                                                               |                                                                                                                                                                                    |
| 1.        | The land acquisition/purchase shall be in conformity to the LARR Act, 2013 and any other laws and regulations governing land acquisition.                                                                                                                | Contents of para i are duly noted. Land acquisition is a matter under the purview of Govt. of Meghalaya & the land owners. The AAI has no say in this matter. | <i>Complied.</i> Land acquisition activities were executed by the Government of Meghalaya.                                                                                         |
| 2.        | Clearance from Directorate General of Civil Aviation (DGCA) and Airports Authority of India (AAI) for safety and project facilities shall be obtained.                                                                                                   | No reply has been furnished by the PP in the compliance report for this condition.                                                                            | <i>Complied.</i> A necessary clearance for design and execution of work has been obtained from Directorate General of Civil Aviation (DGCA) and Airports Authority of India (AAI). |
| 3.        | Consent to Establish/Operate for the project shall be obtained from the State Pollution Control Board as required under the Air (Prevention and Control of Pollution) Act, 1981 and the Water (Prevention and Control of Pollution) Act, 1974.           | No reply has been furnished by the PP in the compliance report for this condition.                                                                            | <i>Complied.</i> Consent to Establish (CTE) and Consent to operate (CTO) have already been obtained.                                                                               |
| 4.        | Notification GSR 94(E) dated 25 <sup>th</sup> January, 2018 of MoEF&CC regarding Mandatory Implementation of Dust Mitigation Measures for Construction and Demolition Activities shall be complied with.                                                 | No reply has been furnished by the PP in the compliance report for this condition.                                                                            | <i>Complied.</i> This condition is being followed during the Construction and Demolition stage.                                                                                    |
| 5.        | Total water requirement is estimated as 45 KLD, while fresh water requirement will be 27 KLD. Water requirement will be met through ground water with prior permission from CGWA. No ground water shall be extracted without prior permission from CGWA. | No reply has been furnished by the PP in the compliance report for this condition.                                                                            | <i>Complied.</i> AAI Shillong airport has received NOC for abstraction of ground water from CGWA on 27.08.2019.                                                                    |
| 6.        | Aircraft maintenance, sensitivity of the location where activities are undertaken, and control of runoff of potential contaminants, chemicals etc                                                                                                        | No reply has been furnished by the PP in the compliance report for this condition.                                                                            | <i>Complied.</i> The Project Proponent submitted that currently, there is no aircraft maintenance facility at Shillong Airport; therefore, no                                      |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                    |                                                                                                                                                                                                                                                                                             |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     | shall be properly implemented and reported.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                    | pollutants are generated from aircraft maintenance activities at the airport.                                                                                                                                                                                                               |
| 7.  | Waste water generated from the Airport will be treated in MBBR based Sewage Treatment Plant of 50 KLD capacity. Treated waste water will be used for landscaping, flushing, general washing to reduce demand on freshwater resources, There will be zero discharge of treated waste water from airport.                                                                                                                                                                                                                     | No reply has been furnished by the PP in the compliance report for this condition. | <i>Complied.</i> A Sewage Treatment Plant with a capacity of 50 KLD has been installed and is currently operational.                                                                                                                                                                        |
| 8.  | During construction and operational phase AAQ monitoring should include PM <sub>10</sub> , PM <sub>2.5</sub> , SO <sub>2</sub> , NO <sub>x</sub> , NH <sub>3</sub> , CO, CH <sub>4</sub> and Benzene.                                                                                                                                                                                                                                                                                                                       | No reply has been furnished by the PP in the compliance report for this condition. | <i>Not complied.</i> During the construction and operational phases, Ambient Air Quality (AAQ) monitoring for parameters such as PM <sub>10</sub> , PM <sub>2.5</sub> , SO <sub>2</sub> , NO <sub>x</sub> , NH <sub>3</sub> , CO, CH <sub>4</sub> , and Benzene has not been conducted.     |
| 9.  | During airport operation period, noise should be controlled to ensure that it does not exceed the prescribed standards. During night time the noise levels measured at the boundary of the building shall be restricted to the permissible levels to comply with the prevalent regulations. A monitoring station for ambient air and noise levels shall be provided in the village nearest to the airport.                                                                                                                  | No reply has been furnished by the PP in the compliance report for this condition. | <i>Not complied.</i> AAI has not yet established a monitoring station for Ambient Air Quality and Noise Levels in the village closest to the airport, in consultation with the Meghalaya State Pollution Control Board. Additionally, noise level monitoring has not been conducted so far. |
| 10. | Traffic Management Plan as submitted shall be implemented in letter and spirit. Apart, a detailed traffic management and traffic decongestion plan shall be drawn up to ensure that the current level of service of the roads within a 05 Kms radius of the project is maintained and improved upon after the implementation of the project. This plan should be based on cumulative impact of all development and increased habitation being carried out or proposed to be carried out by the project or other agencies in | No reply has been furnished by the PP in the compliance report for this condition. | <i>Partly complied.</i> PP submitted that the State Government is in the process of developing a new approach road to the airport. A traffic management plan is currently being implemented at Shillong Airport, and no traffic congestion has been reported.                               |



|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                           |                                                                                                                                                                                      |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     | <p>this 05 Kms radius of the site in different scenarios of space and time. Traffic management plan shall be duly validated and certified by the State Urban Development department and the P.W.D/competent authority for road augmentation and shall also have their consent to the implementation of components of the plan which involve the participation of these departments.</p>                                                                                                                                                                                        |                                                                                           |                                                                                                                                                                                      |
| 11. | <p>An onsite disaster management plan shall be drawn up to account for risks and accidents. This onsite plan shall be dovetailed with the onsite management plan for the district.</p>                                                                                                                                                                                                                                                                                                                                                                                         | <p>No reply has been furnished by the PP in the compliance report for this condition.</p> | <p><i>Complied.</i> It is informed that this condition is being followed strictly.</p>                                                                                               |
| 12. | <p>No tree cutting/transplantation of existing trees has been proposed in the instant project. The landscape planning should include plantation of native species. The plantation species should be carefully chosen to avoid bird nesting and to improve pollution control and noise control measures. Water intensive and/or invasive species should not be used for landscaping. Adequate area shall be provided for green belt development and landscaping. The green belt development shall be done in consultation with Gujarat Institute of Desert Ecology (GUIDE).</p> | <p>No reply has been furnished by the PP in the compliance report for this condition.</p> | <p><i>Partly complied.</i> PP informed that the green area development &amp; plantation programme will be implemented in consultation with State Forest department of Meghalaya.</p> |
| 13. | <p>A water security plan to the satisfaction of the CGWA shall be drawn up to include augmenting water supply and sanitation facilities and recharge of ground water in at least two villages and schools, as part of the C.S.R. activities.</p>                                                                                                                                                                                                                                                                                                                               | <p>No reply has been furnished by the PP in the compliance report for this condition.</p> | <p><i>Complied.</i> PP has already provided funds under CSR for water supply augmentation &amp; sanitation facilities in nearby villages. Details is given in Annexure-I.</p>        |
| 14. | <p>The company shall draw up and implement a corporate social Responsibility plan as per the Company's Act of 2013.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <p>No reply has been furnished by the PP in the compliance report for this condition.</p> | <p><i>Complied.</i> PP has already provided funds under CSR in nearby villages.</p>                                                                                                  |
| 15. | <p>As per the Ministry's Office Memorandum F.No. 22-65/2017-IA.III dated 1<sup>st</sup> May, 2018, and proposed by the project proponent, an amount</p>                                                                                                                                                                                                                                                                                                                                                                                                                        | <p>No reply has been furnished by the PP in the compliance report for this condition.</p> | <p><i>Complied.</i> CER activities for Sustainable Livelihood and Health and Family Welfare programmes</p>                                                                           |



|           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                    |                                                                                                                                                                                                                                                                                                                       |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|           | of Rs. 2.69 Crore shall be / earmarked under Corporate Environment Responsibility (CER) for the activities such as Community Infrastructure, Education, Sustainable Livelihood and Health & Family Welfare Programmes. The activities proposed under CER shall be restricted to the affected area around the project. The entire activities proposed under the CER shall be treated as project and shall be monitored. The monitoring report shall be submitted to the regional office as a part of half yearly compliance report, and to the District Collector. It should be posted on the website of the project proponent. |                                                                                    | have been carried out AAI, Shillong Airport. CER activities uploaded in AAI website.                                                                                                                                                                                                                                  |
| <b>B.</b> | <b>Standard Conditions</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                    |                                                                                                                                                                                                                                                                                                                       |
| 1.        | The project proponent shall obtain the necessary permission from the Central Ground Water Authority, in case of drawl of ground water / from the competent authority concerned in case of drawl of surface water required for the project.                                                                                                                                                                                                                                                                                                                                                                                     | No reply has been furnished by the PP in the compliance report for this condition. | <i>Complied.</i> This condition has already been complied.                                                                                                                                                                                                                                                            |
| 2.        | A certificate of adequacy of available power from the agency supplying power to the project along with the load allowed for the project should be obtained.                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | No reply has been furnished by the PP in the compliance report for this condition. | <i>Not complied.</i> A certificate of adequacy of available power from the agency supplying power the project along with the load allowed for the project is yet to be obtained.                                                                                                                                      |
| 3.        | All other statutory clearances such as the approvals for storage of diesel from Chief 7 Controller of Explosives, Fire Department, Civil Aviation Department shall be obtained, ) as applicable by project proponents from the respective competent authorities.                                                                                                                                                                                                                                                                                                                                                               | No reply has been furnished by the PP in the compliance report for this condition. | <i>Complied.</i> It is informed that the Airport Fire Station (AFS) has been established in accordance with the guidelines issued by the Bureau of Civil Aviation Security, Ministry of Civil Aviation, Government of India, as revised from time to time. Fire NOC for the terminal building has also been obtained. |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                    |                                                                                                                                                                                                                                                                                           |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4.  | During construction and operational phase AAQ monitoring should include PM <sub>10</sub> , PM <sub>2.5</sub> , SO <sub>2</sub> , NO <sub>x</sub> , NH <sub>3</sub> , CO, CH <sub>4</sub> and Benzene.                                                                                                                                                                                                                                                                                                                          | No reply has been furnished by the PP in the compliance report for this condition. | <i>Not complied.</i> Ambient Air Quality (AAQ) monitoring has not been carried out.                                                                                                                                                                                                       |
| 5.  | The project proponent shall install system to carryout Ambient Air Quality monitoring for common/criterion parameters relevant to the main pollutants released (e.g. PM <sub>10</sub> and PM <sub>2.5</sub> in reference to PM emission, and SO <sub>2</sub> and NO <sub>x</sub> in reference to SO <sub>2</sub> and NO <sub>x</sub> emissions) within and outside the airport area at least at four locations (one within and three outside the plant area at an angle of 120° each) covering upwind and downwind directions. | No reply has been furnished by the PP in the compliance report for this condition. | <i>Not complied.</i> Ambient Air Quality (AAQ) monitoring stations have not been set up at a minimum of four locations—one within the airport premises and three outside—positioned at 120-degree intervals to adequately cover both upwind and downwind directions, as stipulated in EC. |
| 6.  | Soil and other construction materials should be sprayed with water prior to any loading, unloading or transfer operation so as to maintain the dusty material wet.                                                                                                                                                                                                                                                                                                                                                             | No reply has been furnished by the PP in the compliance report for this condition. | <i>Complied.</i> It is informed that this condition is being followed strictly.                                                                                                                                                                                                           |
| 7.  | The excavation working area should be sprayed with water after operation so as to maintain the entire surface wet.                                                                                                                                                                                                                                                                                                                                                                                                             | No reply has been furnished by the PP in the compliance report for this condition. | <i>Complied.</i> It is informed that this condition is being followed strictly.                                                                                                                                                                                                           |
| 8.  | Excavated materials shall be handled and transported in a manner that they do not cause any problems of air pollution.                                                                                                                                                                                                                                                                                                                                                                                                         | No reply has been furnished by the PP in the compliance report for this condition. | <i>Complied.</i> It is informed that this condition is being followed strictly.                                                                                                                                                                                                           |
| 9.  | The soil/construction materials carried by the vehicle should be covered by impervious sheeting to ensure that the dusty materials do not leak from the vehicle.                                                                                                                                                                                                                                                                                                                                                               | No reply has been furnished by the PP in the compliance report for this condition. | <i>Complied.</i> It is informed that this condition is being followed strictly.                                                                                                                                                                                                           |
| 10. | Aircraft maintenance, sensitivity of the location where activities are undertaken, and control of runoff of potential contaminants, chemicals etc shall be properly implemented and reported.                                                                                                                                                                                                                                                                                                                                  | No reply has been furnished by the PP in the compliance report for this condition. | <i>Complied.</i> It is reported that no aircraft maintenance operations are conducted at Shillong Airport. However, storm water drains have been constructed in accordance with the natural contours of the area to prevent water and/or soil pollution.                                  |
| 11. | Run off from chemicals and other contaminants from aircraft maintenance and other areas within the airport shall be                                                                                                                                                                                                                                                                                                                                                                                                            | No reply has been furnished by the PP in the compliance report for this condition. | <i>Complied.</i> It is reported that no aircraft maintenance operations are conducted at                                                                                                                                                                                                  |



|     |                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                    |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     | suitably contained and treated before disposal. A spillage and contaminant containment plan shall be drawn up and implemented to the satisfaction of the State Pollution Control Board.                                                                                           |                                                                                                                                                                                                                                               | Shillong Airport. However, storm water drains have been constructed in accordance with the natural contours of the area to prevent water and/or soil pollution.                                                                                                                                                    |
| 12. | Proper drainage systems, emergency containment in the event of a major spill during monsoon season etc. shall be provided.                                                                                                                                                        | No reply has been furnished by the PP in the compliance report for this condition.                                                                                                                                                            | <i>Complied.</i>                                                                                                                                                                                                                                                                                                   |
| 13. | The runoff from paved structures like Runways, Taxiways, can be routed through drains to oil/separation tanks and sedimentation basins before being discharged into rainwater harvesting structures.                                                                              | The runoff is routed through drains to oil separation tanks and sedimentation basins. Photographs of drains are enclosed as Annexure III.                                                                                                     | <i>Partly complied.</i> As stipulated in the Environmental Clearance (EC), oil separation tanks and sedimentation basins are required to be provided.                                                                                                                                                              |
| 14. | Storm water drains are to be built for discharging storm water from the air-field to avoid flooding/water logging in project area. Domestic and industrial waste water shall not be allowed to be discharged into storm water drains.                                             | Photographs of Storm water drains are enclosed as Annexure III. Contents of para V are duly noted and will be complied with.                                                                                                                  | <i>Complied.</i> The project pertains to an airport, with no industrial activities conducted within the premises. Additionally, no aircraft maintenance operations are carried out at Shillong Airport. Consequently, only domestic wastewater is generated, which is treated at the Sewage Treatment Plant (STP). |
| 15. | Rain water harvesting for roof run-off and surface run-off, as plan submitted should be implemented. Rain water harvesting structures shall conform to CGWA designs. Before recharging the surface run off, pre-treatment must be done to remove suspended matter oil and grease. | The Environment Clearance for the project was received in January' 2020. Therefore construction of RWH structures as per proposed plan in conformance to CGWA, is in Planning stage so the same is noted and will be complied with.           | <i>Complied.</i> The construction of RWH structures has been undertaken and completed on 23.08.2024.                                                                                                                                                                                                               |
| 16. | Total fresh water use shall not exceed the proposed requirement as provided in the project details. Prior permission from competent authority shall be obtained for use of fresh water.                                                                                           | Contents of para vii are duly noted. The Daily fresh water requirement will be 27 KLD. Application for withdrawal of Groundwater has been submitted to CGWA and is under process. Application receipt of the same is enclosed as Annexure IV. | <i>Complied.</i> This condition has been complied.                                                                                                                                                                                                                                                                 |
| 17. | A certificate from the competent authority for discharging treated effluent/untreated effluents into the                                                                                                                                                                          | Contents of para viii are duly noted and will be complied with.                                                                                                                                                                               | <i>Complied.</i> Domestic sewage generated at the airport is treated in the Sewage Treatment                                                                                                                                                                                                                       |

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|     | Public sewer/ disposal/drainage systems along with the final disposal point should be obtained.                                                                                                                                           |                                                                                                                                                                                                                                                                         | Plant (STP), and the treated water is recycled for plantation within the airport premises. No effluent is discharged or disposed of into the public sewer system. The Airports Authority of India (AAI) for Shillong Airport has already obtained Consent to Establish (CTE) and Consent to Operate (CTO) for the Sewage Treatment Plant. |
| 18. | A detailed drainage plan for rain water shall be drawn up and implemented.                                                                                                                                                                | Contents of para ix are duly noted and are being complied with. Detailed Drainage Plan is enclosed as Annexure V.                                                                                                                                                       | <i>Complied.</i> This condition has been complied.                                                                                                                                                                                                                                                                                        |
| 19. | No ground water shall be extracted without prior permission from CGWA.                                                                                                                                                                    | Contents of para x are duly noted and will be complied with. Application for withdrawal of Groundwater has been submitted to CGWA. And is under process. Application receipt of the same is enclosed as Annexure IV.                                                    | <i>Complied.</i> This condition has been complied.                                                                                                                                                                                                                                                                                        |
| 20. | A water security plan to the satisfaction of the CGWA shall be drawn up to include augmenting water supply and sanitation facilities and recharge of ground water in at least two villages and schools, as part of the C.S.R. activities. | Details including expenditure incurred and photographs showing activities undertaken for CSR & CER in villages surrounding Shillong airport are enclosed as Annexure VI.                                                                                                | <i>Complied.</i> This condition has been complied.                                                                                                                                                                                                                                                                                        |
| 21. | Noise level survey shall be carried as per the prescribed guidelines and report in this regard shall be submitted to Regional Officer of the Ministry as a part of six-monthly compliance report.                                         | Contents of para i are duly noted and will be complied with. Monitoring report enclosed as Annexure VII.                                                                                                                                                                | <i>Complied.</i>                                                                                                                                                                                                                                                                                                                          |
| 22. | Noise from vehicles and power machinery and equipment on-site should not exceed the prescribed limit. Equipment should be regularly serviced. Attention should also be given to muffler maintenance and enclosure of noisy equipments.    | Contents of para ii are duly noted and are being/will be complied with. DG Sets have been housed in acoustic enclosures (photographs enclosed as Annexure VIII) and regular maintenance of vehicles and machinery is being done to keep noise within prescribed limits. | <i>Complied.</i> This condition is being followed strictly.                                                                                                                                                                                                                                                                               |
| 23. | Acoustic enclosures for DG sets, noise barriers for ground-run bays, ear plugs for operating personnel shall be                                                                                                                           | Use of PPRs is being ensured at site. Acoustic enclosures for DG sets have been provided. Photographs showing the same                                                                                                                                                  | <i>Complied.</i> This condition is being followed strictly.                                                                                                                                                                                                                                                                               |



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|     | implemented as mitigation measures for noise impact due to ground sources.                                                                                                                                                                                                                                                                                                                                 | are enclosed as Annexure VIII.                                                                                                                                                                                                                                                                                                                                         |                                                                                 |
| 24. | During airport operation period, noise should be controlled to ensure that it does not exceed the prescribed standards. During night time the noise levels measured at the boundary of the building shall be restricted to the permissible levels to comply with the prevalent regulations. A monitoring station for ambient air and noise levels shall be provided in the village nearest to the airport. | Contents of para iv are duly noted and will be complied with. Presently, flight operations are during the day time only, at Shillong airport.                                                                                                                                                                                                                          | <i>Not complied.</i> No monitoring for ambient air and noise has been conducted |
| 25. | Where construction activity is likely to cause noise nuisance to nearby residents, restrict operation hours between 7 am to 6 pm.                                                                                                                                                                                                                                                                          | Contents of para v are duly noted and will be complied with. There is no major construction work envisaged at Shillong airport. Construction activities are restricted during day hours only.                                                                                                                                                                          | <i>Complied.</i> This condition is being followed strictly.                     |
| 26. | Energy conservation measures like installation of LED for the lighting the areas outside the building should be integral part of the project design and should be in place before project commissioning.                                                                                                                                                                                                   | Contents of para i are duly noted and will be complied with.                                                                                                                                                                                                                                                                                                           | <i>Complied.</i> This condition is being followed strictly.                     |
| 27. | Soil stockpile shall be managed in such a manner that dust emission and sediment runoff are minimized. Ensure that soil stockpiles are designed with no slope greater than 2:1 (horizontal/vertical).                                                                                                                                                                                                      | The contents of Para ii are duly noted. However, no major construction works are envisaged at Shillong airport. Soil generated if any, shall be used within airport premises for levelling works.                                                                                                                                                                      | <i>Complied.</i> This condition is being followed strictly.                     |
| 28. | The project activity shall conform to the Fly Ash notification issued under the E.P. Act of 1986.                                                                                                                                                                                                                                                                                                          | The contents of Para iii are not applicable.                                                                                                                                                                                                                                                                                                                           | <i>Complied.</i> This condition is being followed strictly.                     |
| 29. | Solid inert waste found on construction sites consists of building rubble, demolition material, concrete, bricks, timber, plastic, glass, metals, bitumen etc shall be reused/recycled or disposed off as per Solid Waste Management Rules, 2016 and / Construction and Demolition Waste Rules, 2016.                                                                                                      | The contents of Para iv are duly noted and are being/will be complied with. Construction & Demolition waste arising due to existing wall boundary demolition & Construction will be done as per the provisions of C&D Waste Management Rules, 2016. Bricks & Steel: To be Sold to vendors through auction. Other inert waste: used for filling within project boundary | <i>Complied.</i> This condition is being followed strictly.                     |
| 30. | Any wastes from construction and demolition activities                                                                                                                                                                                                                                                                                                                                                     | The contents of Para v are duly noted and are                                                                                                                                                                                                                                                                                                                          | <i>Complied.</i> This condition is being                                        |

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|     | related thereto shall be managed so as to strictly conform to the Construction and Demolition Rules, 2016.                                                                                                                                                                                                                                                                                                                                                                                                                                                | being/will be complied with. Construction & Demolition waste arising due to existing wall boundary demolition & Construction will be done as per the provisions of C&D Waste Management Rules, 2016. Bricks & Steel: To be Sold to vendors through auction. Other inert waste: used for filling within project boundary                                                                                                                                                                                  | followed strictly.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 31. | The project proponents shall implement a management plan duly approved by the State Pollution Control Board and obtain its permissions for the safe handling and disposal of:<br>a. Trash collected in flight and disposed at the airport including segregation, collection and disposal.<br>b. Toilet wastes and sewage collected from aircrafts and disposed at the Airport.<br>c. Wastes arising out of maintenance and workshops<br>d. Wastes arising out of eateries and shops situated inside the airport complex.<br>e. Hazardous and other wastes | The contents of Para vi are noted and are being/will be complied with. Waste handling & management details are enclosed as Annexure IX.                                                                                                                                                                                                                                                                                                                                                                  | <i>Not complied.</i> PP need to prepare a management plan duly approved by the State Pollution Control Board and obtain its permissions for the safe handling and disposal of: (i) Trash collected in flight and disposed at the airport including segregation, collection and disposal, (ii) toilet wastes and sewage collected from aircrafts and disposed at the Airport, (iii) Wastes arising out of maintenance and workshops, (iv) Wastes arising out of eateries and shops situated inside the airport complex and (v) hazardous and other wastes. |
| 32. | The solid wastes shall be segregated as per the norms of the Solid Waste Management Rules, 2016. Recycling of wastes such as paper, glass (produced from terminals and aircraft caterers), metal (at aircraft maintenance site), plastics (from aircrafts, terminals and offices), wood, waste oil and solvents (from maintenance and engineering operations), kitchen wastes and vegetable oils (from caterers) shall be carried out. Solid wastes shall be disposed in accordance to the Solid Waste Management Rules, 2016 as amended.                 | The contents of Para vii are noted and are<br>Being/will be complied with.<br>• All waste fractions are being/will be appropriately recycled / disposed of through authorized recyclers / re-re fitters / sanitary contractors.<br>• Records shall be kept regarding amount and characteristics of all types of wastes<br>• All applicable rules & guidelines will be complied with for handling, storage, management & disposal of waste types generated at the airport.<br>• Sludge generated from STP | <i>Not complied.</i> PP informed - that solid waste management will be implemented in accordance with the Solid Waste Management Rules, 2016, with proper segregation as per the prescribed norms.                                                                                                                                                                                                                                                                                                                                                        |



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|     |                                                                                                                                                                                                                       | will be used as manure for landscaping purpose inside airport premises after proper treatment.                                                                                                                                          |                                                                                                                                                                                                                                                   |
| 33. | A certificate from the competent authority handling municipal solid wastes should be obtained, indicating the existing civic capacities of handling and their adequacy to cater to the M.S.W. generated from project. | Content of para viii are duly noted and will be complied with. Letter regarding proposed Garbage Management Plant sent by Dy. Commissioner, Ri-Bhoi District to State PWD regarding Garbage Management Plant is enclosed as Annexure X. | <i>Not complied.</i> A certificate from the competent authority for handling municipal solid wastes, indicating the existing civic capacities of handling and their adequacy to cater to the M.S.W. generated from project has not been obtained. |
| 34. | Used CFLs and TFLs should be properly collected and disposed off/sent for recycling as per the prevailing guidelines/ rules of the regulatory authority to avoid mercury contamination.                               | Contents of para ix are duly noted and will be Complied with. Waste handling & management details are enclosed as Annexure X.                                                                                                           | <i>Complied.</i> This condition is being followed strictly.                                                                                                                                                                                       |
| 35. | Green belt shall be developed in area as provided in project details, with native tree species in accordance with Forest Department. The greenbelt shall inter alia cover the entire periphery of the Air Port.       | Contents of para i are duly noted and are being/will be complied with. Local plant species such as Bokul are being planted as per EMP. Photographs showing Plantation drive at site are enclosed as Annexure XI.                        | <i>Not complied.</i> The green belt developed in accordance with forest department with native tree species has not been implemented.                                                                                                             |
| 36. | Top soil shall be separately stored and used in the development of green belt.                                                                                                                                        | The contents of Para ii are duly noted. However, no major construction works are envisaged at Shillong airport. Soil generated if any, shall be used within airport premises for leveling works.                                        | <i>Complied.</i> This condition is being followed strictly.                                                                                                                                                                                       |
| 37. | Construction site should be adequately barricaded before the construction begins.                                                                                                                                     | The contents of Para i are duly noted and will be complied with.                                                                                                                                                                        | <i>Complied.</i> This condition is already complied.                                                                                                                                                                                              |
| 38. | Traffic congestion near the entry and exit points from the roads adjoining the airport shall be avoided. Parking should be fully internalized and no public space should be utilized.                                 | The contents of Para ii are duly noted and are being/will be complied with. Traffic Management and Circulation Plan is enclosed as Annexure XII.                                                                                        | <i>Complied.</i> This condition is being followed strictly.                                                                                                                                                                                       |
| 39. | Provision of Electro-mechanical doors for toilets meant for disabled passengers. Children nursing/feeding room to be located conveniently near arrival and departure gates.                                           | The contents of Para in are duly noted and are being/will be complied with. Photographs showing Children nursing/feeding room at Shillong Airport is enclosed as Annexure XIII.                                                         | <i>Complied.</i> This condition is already complied.                                                                                                                                                                                              |
| 40. | Emergency preparedness plan based on the Hazard identification and Risk                                                                                                                                               | The contents of Para iv are duly noted and are being/will be complied with. Details along                                                                                                                                               | <i>Complied.</i> This condition is being followed strictly.                                                                                                                                                                                       |

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|     | Assessment (HIRA) and Disaster Management Plan shall be implemented.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | with Photographs of safety drills being earned out Shillong Airport are enclosed as Annexure XIV.                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                       |
| 41. | Provision shall be made for the housing of construction labour within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, creche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.                                                                                                                                                                                                                                                                                                        | No major construction works are envisaged at Shillong airport. All the expenditure on facilities like insurance etc for labours are incorporated in the tender documents and is the responsibility of the executing agency assigned with the work. Shillong airport management will ensure the compliance of contents of para v in coordination with executing agency. | <i>Complied.</i> This condition is already complied.                                                                                                                                                                                                                                                                                  |
| 42. | An onsite disaster management plan shall be drawn up to account for risks and accidents. This onsite plan shall be dovetailed with the onsite management plan for the district.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | The contents of Para vi are duly noted and have been complied with. Onsite disaster management plan has been submitted along with proposal for obtaining Environmental Clearance. Same shall be implemented at site.                                                                                                                                                   | <i>Complied.</i> It is informed that this condition is being followed strictly.                                                                                                                                                                                                                                                       |
| 43. | Occupational health surveillance of the workers shall be done on a regular basis.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | The contents of Para vii are duly noted and are being/will be complied with.                                                                                                                                                                                                                                                                                           | <i>Complied.</i> It is informed that this condition is being followed strictly.                                                                                                                                                                                                                                                       |
| 44. | The company shall have a well laid down environmental policy duly approved by the Board of Directors. The environmental policy should prescribe for standard operating procedures to have proper checks and balances and to bring into focus any infringements/deviation/violation of the environmental / forest /wildlife norms/ conditions. The company shall have defined system of reporting infringements / deviation / violation of the environmental / forest / wildlife norms / conditions and I or shareholders / stake holders. The copy of the board resolution in this regard shall be submitted to the MoEF&CC as a part of six-monthly report. | The contents of Para i are noted and will be complied with. A corporate environmental responsibility policy prescribing for standard operating procedures to address environmental related issues and to ensure compliance and monitoring as per rules and guidelines will be drafted for Shillong airport.                                                            | <i>Complied.</i> PP submitted an environmental policy. The same is also available on the website of Airport Authority of India. <a href="https://www.aai.aero/en/system/files/resources/Approved%20Environment%20Policy_23.10.18.pdf">https://www.aai.aero/en/system/files/resources/Approved%20Environment%20Policy_23.10.18.pdf</a> |
| 45. | A separate Environmental Cell both at the project and company head quarter level, with qualified personnel shall be set up under the control of                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | The contents of para ii are duly noted and have been complied with. Details of EMC head are as below:                                                                                                                                                                                                                                                                  | <i>Complied.</i> This condition is already complied.                                                                                                                                                                                                                                                                                  |



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|     | senior Executive, who will directly report to the head of the organization.                                                                                                                                                                                                                                                                                                                                                                                                                | Name-Shri. Ganesh Sharma.<br>Designation- Asstt. General Manager (E-C)<br>AAI<br>Educational Qualifications<br>B.E.Tech (Civil), MBA (Operations Management)                                                                            |                                                                                                                                                                                                                                                                                                                                                        |
| 46. | Action plan for implementing EMP and environmental conditions along with responsibility matrix of the company shall be prepared and shall be duly approved by competent authority. The year wise funds earmarked for environmental protection measures shall be kept in separate account and not to be diverted for any other purpose. Year wise progress of implementation of action plan shall be reported to the Ministry/Regional Office along with the Six Monthly Compliance Report. | The contents of para iii are duly noted and will be complied with. Action plan for implementing EMP and environmental conditions along with responsibility matrix is under process and will be implemented as per stipulated condition. | <i>Partly complied.</i> PP submitted that the Environmental Management Plan for both the construction and operation phases has been implemented, and compliance reports have been duly submitted. All regulatory requirements related to environmental management are being met. However, submission of six monthly compliance reports is not regular. |
| 47. | Self-environmental audit shall be conducted annually. Every three years third party environmental audit shall be carried out.                                                                                                                                                                                                                                                                                                                                                              | The contents of para iv are duly noted and will be complied with                                                                                                                                                                        | <i>Not complied.</i> Self-environmental audit annually and every three years third party environmental audit has not been conducted.                                                                                                                                                                                                                   |
| 48. | The project proponent shall make public the environmental clearance granted for their project along with the environmental conditions and safeguards at their cost by prominently advertising it at least in two local newspapers of the District or State, of which one shall be in the vernacular language within seven days and in addition this shall also be displayed in the project proponent's website permanently.                                                                | The contents of para i are duly noted and have been complied with.<br><br>Copy of newspaper advertisement is enclosed as Annexure XV.                                                                                                   | <i>Complied.</i> This condition has been complied.                                                                                                                                                                                                                                                                                                     |
| 49. | The copies of the environmental clearance shall be submitted by the project proponents to the Heads of local bodies, Panchayats and Municipal Bodies in addition to the relevant offices of the Government who in turn has to display the same for 30 days from the date of receipt.                                                                                                                                                                                                       | The contents of para ii are duly noted and will be complied with                                                                                                                                                                        | <i>Complied.</i> This condition has been complied.                                                                                                                                                                                                                                                                                                     |

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| 50. | The project proponent shall upload the status of compliance of the stipulated environment clearance conditions, including results of monitored data on their website and update the same on half-yearly basis.                                                               | The contents of para iii are duly noted and will be complied with.                                                                                                                                                                                                     | The compliance report including monitoring report is available on the AAI web portal. <a href="https://www.aai.aero/sites/default/files/Environment%20Clearance.pdf">https://www.aai.aero/sites/default/files/Environment%20Clearance.pdf</a> .        |
| 51. | The project proponent shall submit six-monthly reports on the status of the compliance of the stipulated environmental conditions on the website of the ministry of Environment Forest and Climate Change at environment clearance portal.                                   | The contents of para iv are duly noted and will be complied with.                                                                                                                                                                                                      | <i>Partly complied. Submission of six monthly compliance reports is not regular.</i>                                                                                                                                                                   |
| 52. | The project proponent shall submit the environmental statement for each financial year in Form-V to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently and put on the website of the company. | The contents of para v are duly noted and will be complied with.                                                                                                                                                                                                       | <i>Not complied.</i> The environmental statement for each financial year in form – V to the concerned State Pollution Control Board has not been submitted nor uploaded on the website of the company.                                                 |
| 53. | The criteria pollutant levels namely; PM <sub>10</sub> , PM <sub>2.5</sub> , SO <sub>2</sub> , NO <sub>x</sub> (ambient levels) shall be monitored and displayed at a convenient location near the main gate of the company in the public domain.                            | The contents of para vi are duly noted and will be complied with. Periodical monitoring of criteria pollutants will be carried out through NABL certified and MoEF&CC recognized monitoring laboratory and results submitted along with six-monthly compliance report. | <i>Not complied.</i> The ambient levels of criteria pollutants—PM <sub>10</sub> , PM <sub>2.5</sub> , SO <sub>2</sub> , and NO <sub>x</sub> —have neither been monitored nor displayed at a publicly accessible location near the company's main gate. |
| 54. | The project proponent shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities commencing the land development work and start of production operation by the project.          | The contents of para vii are duly noted and will be complied with.                                                                                                                                                                                                     | <i>Complied.</i> This condition has been complied.                                                                                                                                                                                                     |
| 55. | The project authorities must strictly adhere to the stipulations made by the State Pollution Control Board and the State Government.                                                                                                                                         | The contents of para viii are duly noted and will be complied with.                                                                                                                                                                                                    | <i>Agreed for compliance.</i>                                                                                                                                                                                                                          |
| 56. | The project proponent shall abide by all the commitments and recommendations made in                                                                                                                                                                                         | The contents of para ix are duly noted and will be complied with.                                                                                                                                                                                                      | <i>Agreed for compliance.</i>                                                                                                                                                                                                                          |



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|     | the EIA/EMP report, commitment made during Public Hearing and also that made during their presentation to the Expert Appraisal Committee.                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                         |                               |
| 57. | No further expansion or modifications in the plant shall be carried out without prior approval of the Ministry of Environment, Forests and Climate Change (MoEF&CC).                                                                                                                                                                                                                                                                                    | The contents of para x are duly noted and will be complied with. No further expansion or modifications in the Shillong airport will be carried out without prior approval of the concerned authorities. | <i>Agreed for compliance.</i> |
| 58. | Concealing factual data or submission of false/fabricated data may result in revocation of this environmental clearance and attract action under the provisions of Environment (Protection) Act, 1986.                                                                                                                                                                                                                                                  | The contents of para xi are duly noted and will be complied with                                                                                                                                        | <i>Agreed for compliance.</i> |
| 59. | The Ministry may revoke or suspend the clearance, if implementation of any of the above conditions is not satisfactory.                                                                                                                                                                                                                                                                                                                                 | The content of para xii are duly noted                                                                                                                                                                  | <i>Agreed for compliance.</i> |
| 60. | The Ministry reserves the right to stipulate additional conditions if found necessary. The Company in a time bound manner shall implement these conditions.                                                                                                                                                                                                                                                                                             | The content of para xiii are duly noted                                                                                                                                                                 | <i>Agreed for compliance.</i> |
| 61. | The Regional Office of this Ministry shall monitor compliance of the stipulated conditions. The project authorities should extend full cooperation to the officer (s) of the Regional Office by furnishing the requisite data / information/monitoring reports.                                                                                                                                                                                         | The contents of para xiv are duly noted.<br>Full cooperation to the officer (s) of the Regional Office will be extended by Shillong airport authorities.                                                | <i>Agreed for compliance.</i> |
| 62. | The above conditions shall be enforced, inter-alia under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, the Air (Prevention & Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986, Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and the Public Liability Insurance Act, 1991 along with their amendments and Rules and any other orders passed by the Hon'ble Supreme | The content of para xv are duly noted.                                                                                                                                                                  | <i>Agreed for compliance.</i> |

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|     | Court of India / High Courts/NGT and any other Court of Law relating to the subject matter.                                                                                              |                                        |                               |
| 63. | Any appeal against this EC shall lie with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010. | The content of para xvi are duly noted | <i>Agreed for compliance.</i> |

**General Remarks:** Numbers of non-compliances has been observed, primarily concerning environmental monitoring, documentation, and waste management. Below are the detailed observations:

- i. During the construction and operational phases, Ambient Air Quality (AAQ) monitoring for parameters such as PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, NO<sub>2</sub>, NH<sub>3</sub>, CO, CH<sub>4</sub>, and Benzene has not been conducted.
- ii. AAI has not yet established a monitoring station for Ambient Air Quality and Noise Levels in the village closest to the airport, in consultation with the Meghalaya State Pollution Control Board. Additionally, noise level monitoring has not been conducted so far.
- iii. PP informed that the green area development & plantation programme will be implemented in consultation with State Forest department of Meghalaya.
- iv. A certificate of adequacy of available power from the agency supplying power the project along with the load allowed for the project is yet to be obtained.
- v. Ambient Air Quality (AAQ) monitoring stations have not been set up at a minimum of four locations—one within the airport premises and three outside—positioned at 120-degree intervals to adequately cover both upwind and downwind directions, as stipulated in EC.
- vi. As stipulated in the Environmental Clearance (EC), oil separation tanks and sedimentation basins are required to be provided.
- vii. PP need to prepare a management plan duly approved by the State Pollution Control Board and obtain its permissions for the safe handling and disposal of: (i) Trash collected in flight and disposed at the airport including segregation, collection and disposed, (ii) toilet wastes and sewage collected from aircrafts and disposed at the Airport, (iii) Wastes arising out of maintenance and workshops, (iv) Wastes arising out of eateries and shops situated inside the airport complex and (v) hazardous and other wastes.
- viii. PP informed that solid waste management will implemented in accordance with the Solid Waste Management Rules, 2016, with proper segregation as per the prescribed norms.
- ix. A certificate from the competent authority for handling municipal solid wastes, indicating the existing civic capacities of handling and their adequacy to cater to the M.S.W. generated from project has not been obtained.
- x. The green belt developed in accordance with forest department with native tree species has not been implemented.
- xi. Submission of six monthly compliance reports is not regular.
- xii. Self-environmental audit annually and every three years third party environmental audit have not been conducted.
- xiii. The environmental statement for each financial year in form – V to the concerned State Pollution Control Board has not been submitted nor uploaded on the website of the company.
- xiv. The ambient levels of criteria pollutants—PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, and NO<sub>x</sub>—have neither been monitored nor displayed at a publicly accessible location near the company's main gate.

## Site Photographs



View of Shillong Airport



View of existing runway of Shillong Airport

  
(डॉ. एच. तिनसोंग Dr. H. Tynsong)  
वैज्ञानिक 'ई' / Scientist 'E'





File No: ML/SEAC/SEIAA/PP/RB/105/2025

Government of India

Ministry of Environment, Forest and Climate Change

(Issued by the State Environment Impact Assessment Authority(SEIAA),  
MEGHALAYA)

\*\*\*



Dated 01/08/2025



To,

PS DEVAKUMAR  
AIRPORTS AUTHORITY OF INDIA SHILLONG  
SHILLONG AIRPORT, UMROI, RI-BHOI, MEGHALAYA-793103  
enggcivilbarapani.aai@gmail.com

**Subject:** Grant of Terms of Reference under the provision of the EIA Notification 2006-regarding.

**Sir/Madam,**

This is in reference to your application for Grant of Terms of Reference under the provision of the EIA Notification 2006-regarding in respect of project Expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion Of Terminal Building & Apron And Other Allied Works submitted to Ministry vide proposal number SIA/ML/INFRA2/540446/2025 dated 06/06/2025.

2. The particulars of the proposal are as below :

|                                            |                                                                                                                                    |
|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| (i) TOR Identification No.                 | TO25B2902ML5691923N                                                                                                                |
| (ii) File No.                              | ML/SEAC/SEIAA/PP/RB/105/2025                                                                                                       |
| (iii) Clearance Type                       | TOR                                                                                                                                |
| (iv) Category                              | B1                                                                                                                                 |
| (v) Project/Activity Included Schedule No. | 7(a) Airports                                                                                                                      |
| (vii) Name of Project                      | Expansion of Barapani (Shillong) Airport Including Runway Extension, Expansion Of Terminal Building & Apron And Other Allied Works |
| (viii) Name of Company/Organization        | AIRPORTS AUTHORITY OF INDIA SHILLONG                                                                                               |
| (ix) Location of Project (District, State) | RI BHOI, MEGHALAYA                                                                                                                 |
| (x) Issuing Authority                      | SEIAA                                                                                                                              |
| (xi) Applicability of General Conditions   | no                                                                                                                                 |
| (xii) Applicability of Specific Conditions | no                                                                                                                                 |

3. In view of the particulars given in the Para 1 above, the project proposal interalia including Form-1(Part A and B) were submitted to the State Environment Impact Assessment Authority(SEIAA) for an appraisal by the State Expert

Appraisal Committee (SEAC) under the provision of EIA notification 2006 and its subsequent amendments.

4. The above-mentioned proposal has been considered by State Environment Impact Assessment Authority (SEIAA) in the meeting held on 28/07/2025. The minutes of the meeting and all the Application and documents submitted [(viz. Form-1 Part A, Part B, Part C EIA, EMP)] are available on PARIVESH portal which can be accessed by scanning the QR Code above.
5. The brief about the salient features of the project along with environment settings, as submitted by the Project proponent in Form-1 (Part A, B and C)/EIA & EMP Reports are available on PARIVESH portal.
6. The SEIAA, based on information & clarifications provided by the project proponent and after detailed deliberations recommended the proposal for grant of Terms of Reference under the provision of EIA Notification, 2006 and as amended thereof subject to stipulation of specific and general conditions as detailed in Annexure (1).
7. The SEIAA has examined the proposal in accordance with the Environment Impact Assessment (EIA) Notification, 2006 & further amendments thereto and after accepting the recommendations of the SEAC hereby decided to grant Terms of Reference for instant proposal of AIRPORTS AUTHORITY OF INDIA SHILLONG under the provisions of EIA Notification, 2006 and as amended thereof.
8. The SEIAA reserves the right to stipulate additional conditions, if found necessary.
9. The Terms of Reference to the aforementioned project is under provisions of EIA Notification, 2006. It does not tantamount to approvals/consent/permissions etc. required to be obtained under any other Act/Rule/regulation. The Project Proponent is under obligation to obtain approvals /clearances under any other Acts/ Regulations or Statutes, as applicable, to the project.
10. This issues with the approval of the Competent Authority.

#### **Copy To**

1. The Dy. Director General of Forests (C), Regional Office, N.E.Z, Ministry of Environment, Forests & Climate Change (Mo EF & CC), Law-u-sib, Lumbatngen, Sawlad, Near M.T.C. workshop, Shillong- 793 021, for information.
2. The Deputy Commissioner, Ri Bhoi District, Nongpoh, Meghalaya for kind information.
3. The Jt. Secretary, Transport Department, Govt. of Meghalaya, Shillong for kind information and necessary action.

#### **Annexure 1**

#### **Standard Terms of Reference for (Airports)**

##### **1. Project Details**

| S. No | Terms of Reference                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.1   | Importance and benefits of the project.                                                                                                                                                                                                                                                                                                                                                                                                               |
| 1.2   | 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. |

| S. No | Terms of Reference                                                                                                                                                                                                                                                                                                    |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.3   | 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. |
| 1.4   | Details of man-power requirement (regular and contract).                                                                                                                                                                                                                                                              |
| 1.5   | The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.                                                                                                                                                                              |
| 1.6   | Submit Layout plans of proposed project indicating runway, terminal building, parking, greenbelt area, utilities etc.                                                                                                                                                                                                 |

## 2. Road And Traffic

| S. No | Terms of Reference                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2.1   | 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.                                                                                                                                                                                                                                                                                                                                                                                                   |
| 2.2   | An assessment of the cumulative impact of all development and increased inhabitation being carried out or proposed to be carried out by the project or other agencies in the core area, shall be made for traffic densities and parking capabilities in a 05 kms radius from the site. A detailed traffic management and a traffic decongestion plan drawn up through an organization of repute and specializing in Transport Planning shall be submitted with the EIA. The Plan to be implemented to the satisfaction of the State Urban Development and Transport Departments shall also include the consent of all the concerned implementing agencies. |

## 3. Land Environment

| S. No | Terms of Reference                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3.1   | 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. |
| 3.2   | 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.                                                                                                                                                                                                                                                                                                                                                                                  |
| 3.3   | The details of excavations, its impacts and the impact of transport of excavated material. A detailed management plan shall be included in compliance with C&D Waste Management Rule, 2016.                                                                                                                                                                                                                                                                                                                                                                                                                                         |

## 4. Drainage



| S. No | Terms of Reference                                                                                                                            |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 4.1   | 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. |

## 5. Water Environment

| S. No | Terms of Reference                                                                                                                                                                                                                                            |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5.1   | 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. Submit CRZ map in case the proposed site falls in CRZ region. |

## 6. Land Acquisition And R&R

| S. No | Terms of Reference                                                                                                                                          |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6.1   | Submit the present land use and permission required for any conversion such as forest, agriculture etc.                                                     |
| 6.2   | Submit details regarding R&R involved in the project.                                                                                                       |
| 6.3   | Submit details of environmentally sensitive places, land acquisition status, rehabilitation of communities/ villages and present status of such activities. |
| 6.4   | Examine baseline environmental quality along with projected incremental load due to the proposed project/activities.                                        |

## 7. Water Management

| S. No | Terms of Reference                                                                                                                                                                                            |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7.1   | 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. |
| 7.2   | Rain water harvesting proposals should be made with due safeguards for ground water quality. Maximize recycling of water and utilization of rain water.                                                       |

## 8. Waste Management

| S. No | Terms of Reference                                                                                                                                                   |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8.1   | Examine details of Solid waste generation (including de-plane waste and hazardous waste) treatment and its disposal.                                                 |
| 8.2   | The impacts of demolition and the activities related thereto shall be examined and a management plan shall be prepared to conform to the C&D Waste Management Rules. |

## 9. Energy Management

| S. No | Terms of Reference                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9.1   | Requirement of power, with source of supply, status of approval.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 9.2   | Details shall be provided regarding the solar generation proposed and the extent of substitution, along with compliance to the ECBC rules.                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 9.3   | A note on appropriate process and materials to be used to encourage reduction in carbon foot print. Optimize use of energy systems in buildings that should maintain a specified indoor environment conducive to the functional requirements of the building by following mandatory compliance measures (for all applicable buildings) as recommended in the Energy Conservation Building Code (ECBC) 2017 of the Bureau of Energy Efficiency, Government of India. The energy system includes air conditioning systems, indoor lighting systems, water heaters, air heaters and air circulation devices. |

## 10. Environmental Monitoring And Management

| S. No | Terms of Reference                                                                                                                                                          |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10.1  | Examine separately the details for construction and operation phases both for Environmental Management Plan and Environmental Monitoring Plan with cost and parameters.     |
| 10.2  | Examine baseline environmental quality along with projected incremental load due to the proposed project/activities.                                                        |
| 10.3  | The air quality monitoring should be carried out as per the notification issued on 16th November, 2009.                                                                     |
| 10.4  | A detailed draft EIA/EMP report should be prepared in accordance with the above additional TOR and should be submitted to the Ministry in accordance with the Notification. |
| 10.5  | Air quality modelling and noise modelling shall be carried out for the emissions from the various types of aircrafts.                                                       |
| 10.6  | Possible carbon footprint contribution from each activities and mitigation measures proposed shall be included as part of Environment Management Plan.                      |

## 11. Disaster Management Plan

| S. No | Terms of Reference                                                                                                              |
|-------|---------------------------------------------------------------------------------------------------------------------------------|
| 11.1  | Submit details of a comprehensive Disaster Management Plan including emergency evacuation during natural and man-made disaster. |

## 12. Socioeconomic Environment

| S. No | Terms of Reference                                                 |
|-------|--------------------------------------------------------------------|
| 12.1  | Examine the impact of proposed project on the nearest settlements. |
| 12.2  | Submit details of corporate social responsibilities (CSR).         |

### 13. Forest

| S. No | Terms of Reference                                                                                                                                                                                                                                                                                                                              |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 13.1  | 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.        |
| 13.2  | Submit status of permission to be obtained from concerned local authorities for the proposed tree cutting/pruning/transplantation.                                                                                                                                                                                                              |
| 13.3  | 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. |

### 14. Court Cases

| S. No | Terms of Reference                                                                                                                              |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 14.1  | Details of litigation pending against the project, if any, with direction/order passed by any Court of Law against the Project should be given. |

### 15. Miscellaneous

| S. No | Terms of Reference                                                                                                                                                                                                                                                                                  |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15.1  | 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 <a href="http://moef.nic.in/Manual/Airport">http://moef.nic.in/Manual/Airport</a> . |

## Annexure 2

### Details of Products & By-products

| Name of the product /By-product          | Product / By-product                     | Existing | Proposed | Total | Unit  | Mode of Transport / Disposal |
|------------------------------------------|------------------------------------------|----------|----------|-------|-------|------------------------------|
| Runway Extension                         | Runway Extension                         | 1829     | 571      | 2400  | m     | By Road                      |
| New Domestic Passenger Terminal Building | New Domestic Passenger Terminal Building | 5000     | 5550     | 10550 | Sq.ft | By Road                      |

Date: 01/08/2025



ISSUED TO: **M/s Barapani (Shillong) Airport,** **TEST REPORT**  
**Airports Authority of India, Barapani,**  
**Umroi, Shillong (Meghalaya)**

|                      |                                                                                                                                               |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Report number        | : ABCTL/AAI/03/AAQ1                                                                                                                           |
| Sample drawn by      | : ABC Techno Labs India Private Limited                                                                                                       |
| Sample description   | : Ambient Air Quality Monitoring -24 Hourly Basis Twice a week for one Month                                                                  |
| Location of sampling | : AAQ1- Project site                                                                                                                          |
| Project name         | : Proposed expansion of Barapani (Shillong) Airport including runway extension, expansion of terminal building & apron and other allied works |
| Date of sampling     | : 03-03-2025 TO 29-05-2025                                                                                                                    |
| Report date          | : 05-06-2025                                                                                                                                  |

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| Parameter Test Method | PM 2.5 $\mu\text{g}/\text{m}^3$ | PM 10 $\mu\text{g}/\text{m}^3$ | SO <sub>2</sub> $\mu\text{g}/\text{m}^3$ | NO <sub>x</sub> $\mu\text{g}/\text{m}^3$ | CO $\text{mg}/\text{m}^3$ | O <sub>3</sub> $\mu\text{g}/\text{m}^3$ | NH <sub>3</sub> $\mu\text{g}/\text{m}^3$ | Lead $\mu\text{g}/\text{m}^3$ | Benzene $\mu\text{g}/\text{m}^3$ | B[a]P $\text{ng}/\text{m}^3$ | NI $\text{ng}/\text{m}^3$ | As $\text{ng}/\text{m}^3$ |
|-----------------------|---------------------------------|--------------------------------|------------------------------------------|------------------------------------------|---------------------------|-----------------------------------------|------------------------------------------|-------------------------------|----------------------------------|------------------------------|---------------------------|---------------------------|
| Date of Monitoring    | EPA 40 CFR P50                  | IS: 5182 P23                   | IS: 5182 P2                              | IS: 5182 P6                              | IS: 5182 P10              | ABCTLS OPA107                           | ABCTLS SOP1005                           | IS: 5182 P22                  | IS: 5182 Part 11                 | ABCTLSOP10                   | ABCTLS OPA102             | ABCTLS SOP1010            |
| 03.03.2025            | 22                              | 45                             | 6.3                                      | 14.8                                     | 0.17                      | 12.1                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 06.03.2025            | 24                              | 48                             | 5.8                                      | 16.3                                     | 0.13                      | 13.3                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 10.03.2025            | 26                              | 53                             | 7.1                                      | 15.5                                     | 0.18                      | 13.1                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 13.03.2025            | 24                              | 51                             | 6.9                                      | 13.9                                     | 0.16                      | 11.6                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 17.03.2025            | 23                              | 47                             | 7.1                                      | 15.9                                     | 0.13                      | 12.8                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 21.03.2025            | 20                              | 42                             | 5.4                                      | 16.4                                     | 0.17                      | 13.5                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 24.03.2025            | 23                              | 48                             | 5.3                                      | 16.7                                     | 0.12                      | 13.1                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 27.03.2025            | 24                              | 50                             | 6.5                                      | 15.1                                     | 0.13                      | 12.9                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 01.04.2025            | 26                              | 55                             | 7.2                                      | 14.6                                     | 0.16                      | 12.2                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 04.04.2025            | 23                              | 48                             | 6.3                                      | 16.9                                     | 0.17                      | 13.6                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 07.04.2025            | 24                              | 51                             | 7.7                                      | 13.5                                     | 0.12                      | 11.7                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 10.04.2025            | 22                              | 47                             | 7.1                                      | 15.7                                     | 0.11                      | 12.1                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 14.04.2025            | 20                              | 43                             | 5.9                                      | 16.8                                     | 0.16                      | 14.1                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 17.04.2025            | 22                              | 46                             | 6.8                                      | 13.6                                     | 0.17                      | 10.6                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 22.04.2025            | 25                              | 52                             | 6.2                                      | 14.8                                     | 0.13                      | 12.5                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 25.04.2025            | 28                              | 49                             | 6.5                                      | 13.1                                     | 0.11                      | 11.1                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 05.05.2025            | 23                              | 51                             | 7.8                                      | 15.8                                     | 0.18                      | 12.7                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 08.05.2025            | 20                              | 42                             | 6.7                                      | 16.3                                     | 0.13                      | 14.2                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 12.05.2025            | 22                              | 47                             | 7.3                                      | 13.4                                     | 0.17                      | 11.3                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 15.05.2025            | 25                              | 53                             | 5.8                                      | 14.6                                     | 0.12                      | 12.4                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 19.05.2025            | 21                              | 45                             | 6.4                                      | 13.1                                     | 0.11                      | 10.6                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 22.05.2025            | 19                              | 41                             | 6.9                                      | 14.9                                     | 0.15                      | 12.5                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 26.05.2025            | 23                              | 49                             | 5.5                                      | 16.6                                     | 0.17                      | 13.9                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 29.05.2025            | 23                              | 52                             | 7.3                                      | 13.3                                     | 0.13                      | 11.2                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| Minimum               | 19                              | 41                             | 5.3                                      | 13.1                                     | 0.11                      | 10.6                                    | -                                        | -                             | -                                | -                            | -                         | -                         |
| Maximum               | 26                              | 55                             | 7.8                                      | 16.9                                     | 0.18                      | 14.2                                    | -                                        | -                             | -                                | -                            | -                         | -                         |
| Average               | 23.0                            | 48                             | 6.6                                      | 15.1                                     | 0.15                      | 12.5                                    | -                                        | -                             | -                                | -                            | -                         | -                         |
| 98 %tile              | 26.0                            | 54                             | 7.8                                      | 16.9                                     | 0.18                      | 14.2                                    | -                                        | -                             | -                                | -                            | -                         | -                         |
| CPCB Standard         | 60                              | 100                            | 80                                       | 80                                       | 2                         | 100                                     | 400                                      | 1                             | 5                                | 1                            | 20                        | 6                         |

BDL.-Below Detection Limit

...End of report...

S. Dharani  
Quality Manager



A. Robson Chinnadurai  
Technical Manager-Lab

Verified by

Authorised Signatory

Terms and Conditions:

\* The test results relate only to the sample(s) tested. \* The test report shall not be reproduced in full or part without the written approval of ABC Techno Labs. \* The test results shall not be valid for more than 15 days from the date of issue of test report for Non-Perishable sample and in the case of Perishable sample test results will be valid for 7 days after date of issue of report or as per customer's requirement. \* The laboratory's responsibility is restricted to report related to sample collection and handling as per the test report as issued for the purpose of client using the data for the intended use and not for any other purpose. \* ABC Techno Labs India Pvt. Ltd. is not responsible for any delay in the test results.

ABCTL/FRM/QA/125B Issued On: 01.05.04.2023



ISSUED TO: **M/s Barapani (Shillong) Airport,** **TEST REPORT**  
**Airports Authority of India, Barapani,**  
**Umroi, Shillong (Meghalaya)**

|                      |                                                                                                                                               |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Report number        | : ABCTL/AAI/03/AAQ2                                                                                                                           |
| Sample drawn by      | : ABC Techno Labs India Private Limited                                                                                                       |
| Sample description   | : Ambient Air Quality Monitoring -24 Hourly Basis Twice a week for one Month                                                                  |
| Location of sampling | : AAQ2- Norgarh Umroi (Presbyterian Church)                                                                                                   |
| Project name         | : Proposed expansion of Barapani (Shillong) Airport including runway extension, expansion of terminal building & apron and other allied works |
| Date of sampling     | : 03-03-2025 TO 29-05-2025                                                                                                                    |
| Report date          | : 05-06-2025                                                                                                                                  |

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| Parameter Test Method | PM 2.5 $\mu\text{g}/\text{m}^3$ | PM 10 $\mu\text{g}/\text{m}^3$ | SO <sub>2</sub> $\mu\text{g}/\text{m}^3$ | NO <sub>x</sub> $\mu\text{g}/\text{m}^3$ | CO $\text{mg}/\text{m}^3$ | O <sub>3</sub> $\mu\text{g}/\text{m}^3$ | NH <sub>3</sub> $\mu\text{g}/\text{m}^3$ | Lead $\mu\text{g}/\text{m}^3$ | Benzene $\mu\text{g}/\text{m}^3$ | B[a]P $\text{ng}/\text{m}^3$ | Ni $\text{ng}/\text{m}^3$ | As $\text{ng}/\text{m}^3$ |
|-----------------------|---------------------------------|--------------------------------|------------------------------------------|------------------------------------------|---------------------------|-----------------------------------------|------------------------------------------|-------------------------------|----------------------------------|------------------------------|---------------------------|---------------------------|
| Date of Monitoring    | EPA 40 CFR P50                  | IS: 5182 P23                   | IS: 5182 P2                              | IS: 5182 P6                              | IS: 5182 P10              | ABCTL/OP/AQ7                            | ABCTL/ SOP/AQ9                           | IS: 5182 P22                  | IS: 5182 Part 11                 | ABCTL/SOP/ 10                | ABCTL/6 OP/AQ17           | ABCTL/ SOP/AQ10           |
| 03.03.2025            | 23                              | 48                             | 5.9                                      | 12.5                                     | 0.13                      | 10.7                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 06.03.2025            | 19                              | 40                             | 5.1                                      | 14.8                                     | 0.11                      | 12.1                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 10.03.2025            | 22                              | 45                             | 5.6                                      | 13.0                                     | 0.12                      | 11.6                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 13.03.2025            | 19                              | 41                             | 6.3                                      | 14.7                                     | 0.16                      | 12.8                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 17.03.2025            | 22                              | 46                             | 6.1                                      | 15.5                                     | 0.14                      | 13.1                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 21.03.2025            | 23                              | 49                             | 5.7                                      | 13.7                                     | 0.11                      | 11.6                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 24.03.2025            | 19                              | 41                             | 5.2                                      | 14.7                                     | 0.16                      | 12.5                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 27.03.2025            | 18                              | 38                             | 5.6                                      | 15.9                                     | 0.17                      | 13.1                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 31.03.2025            | 21                              | 45                             | 5.4                                      | 13.6                                     | 0.16                      | 13.5                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 04.04.2025            | 23                              | 47                             | 6.8                                      | 15.8                                     | 0.11                      | 12.6                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 07.04.2025            | 20                              | 41                             | 5.7                                      | 12.7                                     | 0.17                      | 10.4                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 10.04.2025            | 21                              | 43                             | 6.1                                      | 13.6                                     | 0.16                      | 11.8                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 14.04.2025            | 23                              | 49                             | 5.9                                      | 12.9                                     | 0.13                      | 10.7                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 17.04.2025            | 19                              | 40                             | 6.4                                      | 15.5                                     | 0.17                      | 13.1                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 22.04.2025            | 21                              | 45                             | 5.2                                      | 14.6                                     | 0.12                      | 12.6                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 25.04.2025            | 18                              | 38                             | 5.8                                      | 12.6                                     | 0.14                      | 10.5                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 05.05.2025            | 22                              | 46                             | 6.6                                      | 13.9                                     | 0.11                      | 10.9                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 08.05.2025            | 19                              | 40                             | 7.1                                      | 12.8                                     | 0.13                      | 11.2                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 12.05.2025            | 22                              | 47                             | 6.7                                      | 14.4                                     | 0.15                      | 12.3                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 15.05.2025            | 16                              | 37                             | 5.9                                      | 13.1                                     | 0.12                      | 12.6                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 19.05.2025            | 20                              | 42                             | 6.3                                      | 14.1                                     | 0.17                      | 11.1                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 22.05.2025            | 22                              | 48                             | 5.8                                      | 12.7                                     | 0.11                      | 10.5                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 26.05.2025            | 19                              | 41                             | 6.4                                      | 13.3                                     | 0.16                      | 11.6                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| 29.05.2025            | 23                              | 47                             | 5.9                                      | 14.1                                     | 0.14                      | 12.4                                    | BDL(<5)                                  | BDL(<0.1)                     | BDL(<0.1)                        | BDL(<0.1)                    | BDL(<1)                   | BDL(<1)                   |
| Minimum               | 18                              | 37                             | 5.1                                      | 12.6                                     | 0.11                      | 10.40                                   | -                                        | -                             | -                                | -                            | -                         | -                         |
| Maximum               | 23                              | 49                             | 7.1                                      | 15.9                                     | 0.17                      | 13.10                                   | -                                        | -                             | -                                | -                            | -                         | -                         |
| Average               | 20.7                            | 43.5                           | 6.0                                      | 14.0                                     | 0.14                      | 11.80                                   | -                                        | -                             | -                                | -                            | -                         | -                         |
| 98 %tile              | 23.0                            | 49.0                           | 7.0                                      | 15.9                                     | 0.17                      | 13.10                                   | -                                        | -                             | -                                | -                            | -                         | -                         |
| CPCB Standard         | 60                              | 100                            | 80                                       | 80                                       | 2                         | 100                                     | 400                                      | 1                             | 5                                | 1                            | 20                        | 6                         |

BDL-Below Detection Limit

...End of report...

  
**S. Dharani**  
Quality Manager



  
**A. Robson Chinnadural**  
Technical Manager-Lab

Verified by

Authorised Signatory

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ABCTL/FRM/QA/125 B Issue No.1 Dt.25.04.2023







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ISSUED TO: **M/s Barapani (Shillong) Airport,** **TEST REPORT**  
Airports Authority of India, Barapani,  
Unuroi, Shillong (Meghalaya)

|                      |                                                                                                                                               |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Report number        | : ABCTL/AAI/03/AAQ4                                                                                                                           |
| Sample drawn by      | : ABC Techno Labs India Private Limited                                                                                                       |
| Sample description   | : Ambient Air Quality Monitoring - 24 Hourly Basis Twice a week for one Month                                                                 |
| Location of sampling | : AAQ4-Umrnich                                                                                                                                |
| Project name         | : Proposed expansion of Barapani (Shillong) Airport including runway extension, expansion of terminal building & apron and other allied works |
| Date of sampling     | : 03-03-2025 TO 29-05-2025                                                                                                                    |
| Report date          | : 05-06-2025                                                                                                                                  |

Page 1 of 1

| Parameter          | PM 2.5<br>µg/m³ | PM 10<br>µg/m³ | SO <sub>2</sub><br>µg/m³ | NO <sub>2</sub><br>µg/m³ | CO<br>mg/m³  | O <sub>3</sub><br>µg/m³ | NH <sub>3</sub><br>µg/m³ | Lead<br>µg/m³ | Benzene<br>µg/m³ | B[a]P<br>ng/m³ | NI<br>ng/m³     | As<br>ng/m³    |
|--------------------|-----------------|----------------|--------------------------|--------------------------|--------------|-------------------------|--------------------------|---------------|------------------|----------------|-----------------|----------------|
| Test Method        | EPA 40 CFR P50  | IS: 5182 P23   | IS: 5182 P2              | IS: 5182 P8              | IS: 5182 P10 | ABCTUS OP/IA07          | ABCTU SOP/IA05           | IS: 5182 P22  | IS: 5182 Part 11 | ABCTUSOP/10    | ABCTU\$ OP/IA12 | ABCTU SOP/IA10 |
| Date of Monitoring |                 |                |                          |                          |              |                         |                          |               |                  |                |                 |                |
| 03.03.2025         | 16              | 34             | 6.5                      | 11.4                     | BDU(<0.1)    | 9.5                     | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 06.03.2025         | 18              | 39             | 7.4                      | 10.8                     | BDU(<0.1)    | 8.8                     | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 10.03.2025         | 16              | 35             | 6.1                      | 12.3                     | BDU(<0.1)    | 10.6                    | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 13.03.2025         | 19              | 37             | 7.3                      | 13.4                     | BDU(<0.1)    | 9.1                     | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 17.03.2025         | 19              | 40             | 6.6                      | 13.1                     | BDU(<0.1)    | 11.3                    | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 21.03.2025         | 16              | 34             | 7.7                      | 10.7                     | BDU(<0.1)    | 8.9                     | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 24.03.2025         | 18              | 39             | 6.6                      | 12.5                     | BDU(<0.1)    | 11.2                    | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 27.03.2025         | 20              | 41             | 7.4                      | 11.4                     | BDU(<0.1)    | 9.4                     | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 01.04.2025         | 17              | 35             | 6.2                      | 12.9                     | BDU(<0.1)    | 10.3                    | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 04.04.2025         | 19              | 40             | 6.4                      | 11.5                     | BDU(<0.1)    | 9.4                     | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 07.04.2025         | 18              | 38             | 7.1                      | 11.8                     | BDU(<0.1)    | 8.8                     | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 10.04.2025         | 16              | 34             | 5.5                      | 10.6                     | BDU(<0.1)    | 5.3                     | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 14.04.2025         | 19              | 39             | 5.7                      | 13.0                     | BDU(<0.1)    | 11.6                    | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 17.04.2025         | 20              | 41             | 7.3                      | 12.4                     | BDU(<0.1)    | 10.6                    | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 22.04.2025         | 17              | 38             | 6.4                      | 11.9                     | BDU(<0.1)    | 9.5                     | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 25.04.2025         | 16              | 36             | 5.7                      | 12.5                     | BDU(<0.1)    | 10.2                    | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 05.05.2025         | 19              | 40             | 7.1                      | 10.7                     | BDU(<0.1)    | 8.8                     | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 08.05.2025         | 17              | 38             | 6.6                      | 13.6                     | BDU(<0.1)    | 9.6                     | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 12.05.2025         | 20              | 40             | 5.8                      | 12.4                     | BDU(<0.1)    | 10.5                    | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 15.05.2025         | 16              | 35             | 5.1                      | 10.9                     | BDU(<0.1)    | 9.7                     | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 19.05.2025         | 19              | 39             | 6.6                      | 12.8                     | BDU(<0.1)    | 8.6                     | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 22.05.2025         | 16              | 34             | 6.1                      | 11.1                     | BDU(<0.1)    | 9.7                     | BDU(<5)                  | BDU(<0.1)     | BDU(<0.2)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 26.05.2025         | 20              | 41             | 7.5                      | 12.3                     | BDU(<0.1)    | 10.5                    | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| 29.05.2025         | 16              | 35             | 5.1                      | 10.9                     | BDU(<0.1)    | 8.8                     | BDU(<5)                  | BDU(<0.1)     | BDU(<0.1)        | BDU(<0.1)      | BDU(<1)         | BDU(<1)        |
| Minimum            | 16              | 34             | 5.1                      | 10.6                     | -            | 8.60                    | -                        | -             | -                | -              | -               | -              |
| Maximum            | 20              | 41             | 7.7                      | 13.1                     | -            | 11.60                   | -                        | -             | -                | -              | -               | -              |
| Average            | 17.8            | 37.6           | 6.5                      | 11.8                     | -            | 9.74                    | -                        | -             | -                | -              | -               | -              |
| 98 %tile           | 20.0            | 41.0           | 7.6                      | 13.1                     | -            | 11.46                   | -                        | -             | -                | -              | -               | -              |
| CPCB Standard      | 60              | 100            | 80                       | 80                       | 2            | 100                     | 400                      | 1             | 5                | 1              | 20              | 6              |

...End of report...

S.Dharani  
Quality Manager

A. Robson Chinnadurai  
Technical Manager-Lab

Verified by

### Antihoused Signatory

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4. The test results shall vary to the same level as: The final report shall not be made public in full or part without the written approval of ADELTA. The test results will not be retained for more than 15 days from the date of issue of test report for Non-Purchase contracts and in the case of Purchase contracts the final result will be retained for 7 days after date of issue of report or as per customer requirement. The laboratory's responsibility under this report is limited to between written parameters and it is not to be construed as the following: A. There is no warranty for the purchase of ADELTA by the manufacturer and the manufacturer is not a public or a consumer product. ADELTA/PA/004/12/01 Issue No.1 01.25.04.2003

606124RM090125M 1000000001 01.25.09-2007











ISSUED TO: **M/s Barapani (Shillong) Airport,** **TEST REPORT**  
**Airports Authority of India, Barapani,**  
**Umroi, Shillong (Meghalaya)**

|                      |                                                                                                                                               |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Report number        | : ABCTL/AAI/03/AAQ7                                                                                                                           |
| Sample drawn by      | : ABC Techno Labs India Private Limited                                                                                                       |
| Sample description   | : Ambient Air Quality Monitoring -24 Hourly Basis Twice a week for one Month                                                                  |
| Location of sampling | : AAQ7- Umroi                                                                                                                                 |
| Project name         | : Proposed expansion of Barapani (Shillong) Airport including runway extension, expansion of terminal building & apron and other allied works |
| Date of sampling     | : 03-03-2025 TO 29-05-2025                                                                                                                    |
| Report date          | : 05-06-2025                                                                                                                                  |

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| Parameter Test | PM 2.5<br>µg/m³       | PM 10<br>µg/m³   | SO₂<br>µg/m³      | NOₓ<br>µg/m³      | CO<br>mg/m³      | O₃<br>µg/m³        | NH₃<br>µg/m³        | Lead<br>µg/m³     | Benzene<br>µg/m³    | B[a]P<br>ng/m³ | Ni<br>ng/m³         | As<br>ng/m³          |
|----------------|-----------------------|------------------|-------------------|-------------------|------------------|--------------------|---------------------|-------------------|---------------------|----------------|---------------------|----------------------|
| Method         | EPA 40<br>CFR<br>PM10 | IS: 5182<br>PM10 | IS: 5182<br>PM2.5 | IS: 5182<br>PM2.5 | IS: 5182<br>PM10 | ABCTL/8<br>OP/AAQ7 | ABCTL/9<br>SOP/AAQ9 | IS: 5182<br>PM2.5 | IS: 5182<br>Part 11 | ABCTL/SOP/10   | ABCTL/6<br>OP/AAQ12 | ABCTL/5<br>SOP/AAQ10 |
| 03.03.2025     | 16                    | 35               | 5.3               | 9.9               | BDL(<0.1)        | 8.5                | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 06.03.2025     | 19                    | 39               | 6.1               | 10.4              | BDL(<0.1)        | 9.1                | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 10.03.2025     | 18                    | 37               | 5.8               | 11.5              | BDL(<0.1)        | 10.3               | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 13.03.2025     | 20                    | 41               | 6.7               | 11.1              | BDL(<0.1)        | 9.4                | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 17.03.2025     | 21                    | 43               | 5.1               | 12.6              | BDL(<0.1)        | 10.6               | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 21.03.2025     | 18                    | 40               | 6.5               | 13.1              | BDL(<0.1)        | 11.3               | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 24.03.2025     | 17                    | 38               | 5.3               | 10.5              | BDL(<0.1)        | 9.8                | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 27.03.2025     | 23                    | 42               | 5.9               | 10.9              | BDL(<0.1)        | 8.9                | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 01.04.2025     | 17                    | 35               | 6.7               | 11.4              | BDL(<0.1)        | 9.7                | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 04.04.2025     | 19                    | 39               | 5.6               | 9.5               | BDL(<0.1)        | 8.1                | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 07.04.2025     | 21                    | 44               | 5.2               | 10.5              | BDL(<0.1)        | 9.4                | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 10.04.2025     | 18                    | 40               | 5.3               | 10.1              | BDL(<0.1)        | 9.9                | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 14.04.2025     | 16                    | 37               | 5.1               | 11.7              | BDL(<0.1)        | 10.2               | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 17.04.2025     | 18                    | 36               | 6.5               | 12.2              | BDL(<0.1)        | 11.3               | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 22.04.2025     | 19                    | 39               | 6.2               | 12.8              | BDL(<0.1)        | 11.7               | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 25.04.2025     | 21                    | 42               | 5.1               | 11.1              | BDL(<0.1)        | 9.6                | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 05.05.2025     | 19                    | 40               | 4.9               | 12.1              | BDL(<0.1)        | 10.5               | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 08.05.2025     | 16                    | 37               | 5.2               | 10.9              | BDL(<0.1)        | 9.1                | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 12.05.2025     | 21                    | 44               | 5.7               | 10.2              | BDL(<0.1)        | 8.6                | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 15.05.2025     | 17                    | 35               | 5.1               | 9.6               | BDL(<0.1)        | 8.2                | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 19.05.2025     | 20                    | 41               | 6.8               | 11.2              | BDL(<0.1)        | 10.6               | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 22.05.2025     | 18                    | 36               | 5.7               | 10.4              | BDL(<0.1)        | 9.4                | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 26.05.2025     | 21                    | 44               | 6.7               | 12.6              | BDL(<0.1)        | 10.2               | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| 29.05.2025     | 18                    | 38               | 5.1               | 11.7              | BDL(<0.1)        | 9.6                | BDL(<5)             | BDL(<0.1)         | BDL(<0.1)           | BDL(<0.1)      | BDL(<1)             | BDL(<1)              |
| Minimum        | 16                    | 35               | 4.9               | 9.6               | -                | 8.10               | -                   | -                 | -                   | -              | -                   | -                    |
| Maximum        | 21                    | 44               | 6.8               | 13.1              | -                | 11.70              | -                   | -                 | -                   | -              | -                   | -                    |
| Average        | 18.7                  | 39.3             | 5.7               | 11.2              | -                | 9.75               | -                   | -                 | -                   | -              | -                   | -                    |
| 98 %tile       | 21.0                  | 44.0             | 6.8               | 13.0              | -                | 11.52              | -                   | -                 | -                   | -              | -                   | -                    |
| CPCB Standard  | 60                    | 100              | 80                | 80                | 2                | 100                | 400                 | 1                 | 5                   | 1              | 20                  | 6                    |

...End of report...

S. Dharani  
Quality Manager



A. Robson Chinnadurai  
Technical Manager-Lab

Verified by

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ABCTL/PRM/QA/125 B Issue No 1 of 25, 04/2025



ISSUED TO: **M/s Barapani (Shillong) Airport,** **TEST REPORT**  
**Airports Authority of India, Barapani,**  
**Umroi, Shillong (Meghalaya)**

|                      |                                                                                                                                               |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Report number        | : ABCTL/AAI/03/AAQ8                                                                                                                           |
| Sample drawn by      | : ABC Techno Labs India Private Limited                                                                                                       |
| Sample description   | : Ambient Air Quality Monitoring -24 Hourly Basis Twice a week for one Month                                                                  |
| Location of sampling | : AAQ8- Habitation (AAQM 8)                                                                                                                   |
| Project name         | : Proposed expansion of Barapani (Shillong) Airport including runway extension, expansion of terminal building & apron and other allied works |
| Date of sampling     | : 03-03-2025 TO 29-05-2025                                                                                                                    |
| Report date          | : 05-06-2025                                                                                                                                  |

Page 1 of 1

| Parameter Test     | PM 2.5<br>µg/m³      | PM 10<br>µg/m³  | SO <sub>2</sub><br>µg/m³ | NO <sub>x</sub><br>µg/m³ | CO<br>mg/m³     | O <sub>3</sub><br>µg/m³ | NH <sub>3</sub><br>µg/m³ | Lead<br>µg/m³   | Benzene<br>µg/m³    | B(a)P<br>ng/m³      | Ni<br>ng/m³         | As<br>ng/m³         |
|--------------------|----------------------|-----------------|--------------------------|--------------------------|-----------------|-------------------------|--------------------------|-----------------|---------------------|---------------------|---------------------|---------------------|
| Method             | EPA 40<br>CFR<br>P95 | IS: 5182<br>P23 | IS: 5182<br>P2           | IS: 5182<br>P6           | IS: 5182<br>P10 | ABCTL/5<br>OP/IA/07     | ABCTL/5<br>SO/IA/05      | IS: 5182<br>P22 | IS: 5182<br>Part 11 | ABCTL/5<br>OP/IA/10 | ABCTL/5<br>OP/IA/12 | ABCTL/5<br>SO/IA/10 |
| Date of Monitoring |                      |                 |                          |                          |                 |                         |                          |                 |                     |                     |                     |                     |
| 03.03.2025         | 27                   | 48              | 5.9                      | 15.6                     | 0.16            | 13.1                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 06.03.2025         | 21                   | 43              | 6.1                      | 17.9                     | 0.13            | 12.2                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 10.03.2025         | 24                   | 51              | 5.5                      | 14.4                     | 0.12            | 12.6                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 13.03.2025         | 21                   | 44              | 5.2                      | 12.9                     | 0.17            | 11.2                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 17.03.2025         | 20                   | 43              | 6.8                      | 13.9                     | 0.21            | 13.8                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 21.03.2025         | 19                   | 39              | 7.1                      | 15.8                     | 0.14            | 12.9                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 24.03.2025         | 22                   | 46              | 6.9                      | 16.1                     | 0.16            | 13.6                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 27.03.2025         | 20                   | 40              | 7.4                      | 14.4                     | 0.11            | 12.7                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 01.04.2025         | 21                   | 41              | 6.2                      | 13.5                     | 0.16            | 11.8                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 04.04.2025         | 19                   | 38              | 5.9                      | 14.7                     | 0.15            | 12.5                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 07.04.2025         | 23                   | 49              | 6.3                      | 15.2                     | 0.14            | 13.1                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 10.04.2025         | 22                   | 48              | 6.8                      | 14.6                     | 0.13            | 12.6                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 14.04.2025         | 21                   | 46              | 7.1                      | 16.2                     | 0.17            | 14.7                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 17.04.2025         | 19                   | 39              | 6.1                      | 14.7                     | 0.13            | 12.6                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 22.04.2025         | 20                   | 42              | 7.5                      | 15.5                     | 0.15            | 13.5                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 25.04.2025         | 23                   | 47              | 7.1                      | 13.9                     | 0.18            | 11.5                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 05.05.2025         | 19                   | 40              | 6.6                      | 14.8                     | 0.16            | 12.8                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 08.05.2025         | 22                   | 46              | 6.1                      | 16.3                     | 0.14            | 14.2                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 12.05.2025         | 21                   | 42              | 7.8                      | 13.7                     | 0.15            | 11.6                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 15.05.2025         | 19                   | 39              | 6.3                      | 14.3                     | 0.19            | 12.2                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 19.05.2025         | 22                   | 45              | 5.9                      | 15.7                     | 0.11            | 13.4                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 22.05.2025         | 24                   | 48              | 7.4                      | 13.7                     | 0.18            | 11.8                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 26.05.2025         | 21                   | 45              | 6.8                      | 15.2                     | 0.13            | 12.7                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| 29.05.2025         | 20                   | 42              | 7.4                      | 14.4                     | 0.15            | 12.1                    | BDL(<5)                  | BDL(<0.1)       | BDL(<0.1)           | BDL(<0.1)           | BDL(<1)             | BDL(<1)             |
| Minimum            | 19                   | 38              | 5.2                      | 12.9                     | 0.11            | 11.2                    | -                        | -               | -                   | -                   | -                   | -                   |
| Maximum            | 24                   | 51              | 7.8                      | 16.3                     | 0.21            | 14.7                    | -                        | -               | -                   | -                   | -                   | -                   |
| Average            | 21.1                 | 43.9            | 6.6                      | 14.7                     | 0.15            | 12.6                    | -                        | -               | -                   | -                   | -                   | -                   |
| 98 %tile           | 24.0                 | 50.1            | 7.7                      | 16.3                     | 0.20            | 14.5                    | -                        | -               | -                   | -                   | -                   | -                   |
| CPCB Standard      | 60                   | 100             | 80                       | 80                       | 2               | 100                     | 400                      | 1               | 5                   | 1                   | 20                  | 6                   |

...End of report...

S. Dharani  
Quality Manager



A. Robson Chinnadurai  
Technical Manager-Lab

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ABCTL/AAI/03/AAQ8 B Issue No: 1 of 25.04.2025

ISSUED TO: **M/s Barapani (Shillong) Airport,** **TEST REPORT**  
Airports Authority of India, Barapani,  
Umroi, Shillong (Meghalaya)

|                    |                                                                                                                                               |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Report number      | : ABCTL/AAI/03/N1-N8                                                                                                                          |
| Sampled by         | : ABC Techno Labs India Private Limited                                                                                                       |
| Sample description | : Noise Level Monitoring                                                                                                                      |
| Project Name       | : Proposed expansion of Barapani (Shillong) Airport including runway extension, expansion of terminal building & apron and other allied works |
| Date of sampling   | : 10-03-2025 to 14-03-2025                                                                                                                    |
| Date of Receipt    | : 17-03-2025                                                                                                                                  |
| Date of Analysis   | : 18-03-2025                                                                                                                                  |
| Report date        | : 30-03-2025                                                                                                                                  |

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| Location Code | Sample Location | Lday [dB(A)] | Lnight [dB(A)] | Leq [dB(A)] |
|---------------|-----------------|--------------|----------------|-------------|
| N1            | Project Site    | 61.1         | 53.8           | 59.7        |
| N2            | Norgarh Umroi   | 52.9         | 41.1           | 51.3        |
| N3            | Bhoriymbong     | 49.7         | 43.5           | 48.4        |
| N4            | Umkleh          | 45.1         | 39.1           | 43.9        |
| N5            | Habitation      | 48.2         | 40.8           | 46.8        |
| N6            | Umed Umroi      | 51.9         | 39.6           | 50.3        |
| N7            | Umelt           | 48.6         | 42.8           | 47.4        |
| N8            | Habitation      | 50.8         | 40.3           | 49.2        |

Method: IS: 9989-1981(Reaff: 2023)-Ambient

Ambient Noise Standards

| Zone Classification | Lday dB(A) | Lnight dB(A) |
|---------------------|------------|--------------|
| Industrial Area     | 75         | 70           |
| Commercial Area     | 65         | 55           |
| Residential Area    | 55         | 45           |
| Silence Zone        | 50         | 40           |

...End of report...



S. Dharani  
Quality Manager



Verified by

A. Robson Chinnadurai  
Technical Manager-Lab

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ISSUED TO: **M/s Barapani (Shillong) Airport,** **TEST REPORT**  
**Airports Authority of India, Barapani,**  
**Umroi, Shillong (Meghalaya)**

|                     |                                                                                                                                               |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Report number       | : ABCTL/AAI/03/S1-S4                                                                                                                          |
| Sample collected by | : ABC Techno Labs India Private Limited                                                                                                       |
| Sample description  | : Soil Analysis                                                                                                                               |
| Project Name        | : Proposed expansion of Barapani (Shillong) Airport including runway extension, expansion of terminal building & apron and other allied works |
| Date of sampling    | : 10-03-2025 to 14-03-2025                                                                                                                    |
| Date of Receipt     | : 17-03-2025                                                                                                                                  |
| Date of Analysis    | : 18-03-2025                                                                                                                                  |
| Report date         | : 30-03-2025                                                                                                                                  |

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| S.No | Parameters                              | Test Methods                              | S1            | S2            | S3            | S4            |
|------|-----------------------------------------|-------------------------------------------|---------------|---------------|---------------|---------------|
| 1    | pH                                      | IS-2720(Part 26):1987(RA 2021)            | 6.50          | 6.68          | 7.03          | 6.59          |
| 2    | Bulk Density, g/cc                      | FAO Chapter 3, ABCTL/SOIL/SOP 1           | 1.23          | 1.28          | 1.24          | 1.30          |
| 3    | Electrical Conductivity, mS/cm          | IS -14767:2000 (RA 2021)                  | 0.039         | 0.095         | 0.118         | 0.086         |
| 4    | Total Nitrogen as N, kg/ha              | IS -14684:1999, Reaff:2014                | 174           | 134           | 162           | 208           |
| 5    | Available Phosphorous as P, kg/ha       | FAO Chapter 3, ABCTL/SOIL/SOP 2           | 35.1          | 42.8          | 31.7          | 46.4          |
| 6    | Available Potassium as K, kg/ha         | FAO Chapter 3, ABCTL/SOIL/SOP 7           | 318           | 278           | 354           | 389           |
| 7    | Exchangeable Calcium as Ca, m.eq/100g   | FAO Chapter 3, ABCTL/SOIL/SOP 4           | 16.2          | 14.5          | 17.3          | 15.6          |
| 8    | Exchangeable Magnesium as Mg, m.eq/100g | FAO Chapter 3, ABCTL/SOIL/SOP 5           | 6.78          | 5.36          | 6.55          | 7.11          |
| 9    | Exchangeable Sodium as Na, m.eq/100g    | FAO Chapter 3, ABCTL/SOIL/SOP 6           | 1.03          | 0.97          | 1.14          | 1.31          |
| 10   | Organic matter (%)                      | IS 2720 (Part 22):1972, Reaff:2020        | 0.92          | 1.14          | 1.31          | 1.26          |
| 11   | Sodium Absorption Ratio                 | ABCTL/SOP/S20                             | 0.96          | 0.97          | 1.08          | 1.23          |
| 12   | Boron as B, mg/kg                       | ABCTL/SOP/S13                             | 3.14          | 2.52          | 4.05          | 2.56          |
| 13   | Iron as Fe, mg/kg                       | EPA 3500 B & 7000B                        | 914           | 1026          | 848           | 698           |
| 14   | Copper as Cu, mg/kg                     | EPA 3500 B & 7000B                        | 12.2          | 10.7          | 15.9          | 13.6          |
| 15   | Manganese as Mn, mg/kg                  | EPA 3500 B & 7000B                        | 51.4          | 38.6          | 55.4          | 44.8          |
| 16   | Zinc as Zn, mg/kg                       | EPA 3500 B & 7000B                        | 16.4          | 13.5          | 24.3          | 21.4          |
| 17   | Molybdenum as Mo, mg/kg                 | EPA 3500 B & 7000B                        | BDL(<2)       | BDL(<2)       | BDL(<2)       | BDL(<2)       |
| 18   | Lead as Pb, mg/kg                       | EPA 3500 B & 7000B                        | BDL(<2)       | BDL(<2)       | BDL(<2)       | BDL(<2)       |
| 19   | Nickel as Ni, mg/kg                     | EPA 3500 B & 7000B                        | BDL(<2)       | BDL(<2)       | BDL(<2)       | BDL(<2)       |
| 20   | Chromium as Cr, mg/kg                   | EPA 3500 B & 7000B                        | BDL(<2)       | BDL(<2)       | BDL(<2)       | BDL(<2)       |
| 21   | Cadmium as Cd, mg/kg                    | EPA 3500 B & 7000B                        | BDL(<2)       | BDL(<2)       | BDL(<2)       | BDL(<2)       |
| 22   | Arsenic as As, mg/kg                    | EPA 3500 B & 7000B                        | BDL(<2)       | BDL(<2)       | BDL(<2)       | BDL(<2)       |
| 23   | Mercury as Hg, mg/kg                    | EPA 7471 B                                | BDL<br>(<0.5) | BDL<br>(<0.5) | BDL<br>(<0.5) | BDL<br>(<0.5) |
| 24   | Texture Classification                  |                                           | Clay          | Clay Loam     | Clay          | Clay Loam     |
| 25   | Sand (%)                                | ABCTL/SOP/S21 Issue No-1 Date: 20.05.2023 | 25.6          | 36.2          | 23.8          | 37.2          |
| 26   | Clay (%)                                |                                           | 64.2          | 35.5          | 62.5          | 33.7          |
| 27   | Silt (%)                                |                                           | 10.2          | 28.3          | 13.7          | 29.1          |
| 28   | Water Holding Capacity,%                | ABCTL/SOP/S/22                            | 52.6          | 48.7          | 53.6          | 47.2          |

S1- Project Site, S2- Nongrah Umroi, S3- Rhoymbung, S4- Umktieh

BDL-Below Detection Limit

...End of report...

S. Dharani  
Quality Manager

A. Robson Chinnadurai  
Technical Manager-Lab

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ABCTL/FORM/QA/125B Issue No.1 Dt.25.04.2023



ISSUED TO: **M/s Barapani (Shillong) Airport,**  
**Airports Authority of India, Barapani,**  
**Umroi, Shillong (Meghalaya)**

## TEST REPORT

|                     |                                                                                                                                               |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Report number       | : ABCTL/AAI/03/S5-S7                                                                                                                          |
| Sample collected by | : ABC Techno Labs India Private Limited                                                                                                       |
| Sample description  | : Soil Analysis                                                                                                                               |
| Project Name        | : Proposed expansion of Barapani (Shillong) Airport including runway extension, expansion of terminal building & apron and other allied works |
| Date of sampling    | : 10-03-2025 to 14-03-2025                                                                                                                    |
| Date of Receipt     | : 17-03-2025                                                                                                                                  |
| Date of Analysis    | : 18-03-2025                                                                                                                                  |
| Report date         | : 30-03-2025                                                                                                                                  |

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| S.No | Parameters                             | Test Methods                             | S5        | S6        | S7        |
|------|----------------------------------------|------------------------------------------|-----------|-----------|-----------|
| 1    | pH                                     | IS-2720(Part 26)1987(RA 2021)            | 6.78      | 6.61      | 7.12      |
| 2    | Bulk Density, g/cc                     | FAO Chapter 3, ABCTL/SOIL/SOP 1          | 1.21      | 1.25      | 1.31      |
| 3    | Electrical Conductivity, mS/cm         | IS-34767:2000 (RA 2021)                  | 0.120     | 0.077     | 0.168     |
| 4    | Total Nitrogen as N, kg/ha             | IS-14684:1999, Reaff:2019                | 184       | 152       | 136       |
| 5    | Available Phosphorous as P, kg/ha      | FAO Chapter 3, ABCTL/SOIL/SOP 2          | 52.5      | 44.1      | 39.7      |
| 6    | Available Potassium as K, kg/ha        | FAO Chapter 3, ABCTL/SOIL/SOP 7          | 334       | 302       | 390       |
| 7    | Exchangeable Calcium as Ca, meq/100g   | FAO Chapter 3, ABCTL/SOIL/SOP 4          | 17.5      | 16.8      | 14.7      |
| 8    | Exchangeable Magnesium as Mg, meq/100g | FAO Chapter 3, ABCTL/SOIL/SOP 5          | 6.88      | 5.71      | 5.06      |
| 9    | Exchangeable Sodium as Na, meq/100g    | FAO Chapter 3, ABCTL/SOIL/SOP 6          | 1.22      | 1.45      | 1.36      |
| 10   | Organic matter (%)                     | IS 2720 (Part 22):1972, Reaff:2020       | 1.13      | 1.27      | 0.95      |
| 11   | Sodium Absorption Ratio                | ABCTL/SOP/S20                            | 1.10      | 1.37      | 1.34      |
| 12   | Boron as B, mg/kg                      | ABCTL/SOP/S13                            | 3.05      | 2.62      | 3.79      |
| 13   | Iron as Fe, mg/kg                      | EPA 3500 B & 7000 B                      | 1163      | 904       | 1023      |
| 14   | Copper as Cu, mg/kg                    | EPA 3500 B & 7000 B                      | 14.3      | 11.6      | 16.8      |
| 15   | Manganese as Mn, mg/kg                 | EPA 3500 B & 7000 B                      | 67.5      | 43.8      | 55        |
| 16   | Zinc as Zn, mg/kg                      | EPA 3500 B & 7000 B                      | 17.1      | 26.7      | 19.3      |
| 17   | Molybdenum as Mo, mg/kg                | EPA 3500 B & 7000 B                      | BDL(<2)   | BDL(<2)   | BDL(<2)   |
| 18   | Lead as Pb, mg/kg                      | EPA 3500 B & 7000 B                      | BDL(<2)   | BDL(<2)   | BDL(<2)   |
| 19   | Nickel as Ni, mg/kg                    | EPA 3500 B & 7000 B                      | BDL(<2)   | BDL(<2)   | BDL(<2)   |
| 20   | Chromium as Cr, mg/kg                  | EPA 3500 B & 7000 B                      | BDL(<2)   | BDL(<2)   | BDL(<2)   |
| 21   | Cadmium as Cd, mg/kg                   | EPA 3500 B & 7000 B                      | BDL(<2)   | BDL(<2)   | BDL(<2)   |
| 22   | Arsenic as As, mg/kg                   | EPA 3500 B & 7000 B                      | BDL(<2)   | BDL(<2)   | BDL(<2)   |
| 23   | Mercury as Hg, mg/kg                   | EPA 7471 B                               | BDL(<0.5) | BDL(<0.5) | BDL(<0.5) |
| 24   | Texture Classification                 |                                          | Clay      | Clay      | Clay Loam |
| 25   | Sand (%)                               | ABCTL/SOP/S21 Issue No.1 Date 20.05 2023 | 25.1      | 22.8      | 34.6      |
| 26   | Clay (%)                               |                                          | 60.9      | 66.1      | 36.4      |
| 27   | Silt (%)                               |                                          | 14        | 11.1      | 29        |
| 28   | Water Holding Capacity, %              | ABCTL/SOP/S/22                           | 55.7      | 58.3      | 47.9      |

S5- Umroi, S6- Umiam, S7- ICAR Research Complex for NEH region, Umiam BDL-Below Detection Limit

...End of report...

S. Dharani  
Quality Manager



A. Robson Chinnadurai  
Technical Manager-Lab

Verified by

Authorised Signatory

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ISSUED TO: **M/s Barapani (Shillong) Airport,** **TEST REPORT**  
Airports Authority of India, Barapani,  
Umroi, Shillong (Meghalaya)

|                    |   |                                                                                                                                             |
|--------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------|
| Report number      | : | ABCTL/AAI/03/GW1-GW2                                                                                                                        |
| Sample drawn by    | : | ABC Techno Labs India Private Limited                                                                                                       |
| Sampling method    | : | IS 17614 :Part 21:2021& IS 17614 :Part 25:2021                                                                                              |
| Sample description | : | Ground Water                                                                                                                                |
| Project Name       | : | Proposed expansion of Barapani (Shillong) Airport including runway extension, expansion of terminal building & apron and other allied works |
| Date of Collection | : | 14-03-2025                                                                                                                                  |
| Date of Receipt    | : | 17-03-2025                                                                                                                                  |
| Date of Analysis   | : | 17-03-2025                                                                                                                                  |
| Date Completion    | : | 28-03-2025                                                                                                                                  |
| Report date        | : | 30-03-2025                                                                                                                                  |

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| S. No. | Parameter                             | Unit  | Results           |                   | Test procedure                                                  | Acceptable limit as per IS 10500 : 2012 |
|--------|---------------------------------------|-------|-------------------|-------------------|-----------------------------------------------------------------|-----------------------------------------|
|        |                                       |       | GW1               | GW2               |                                                                 |                                         |
| 1      | Colour                                | Hazen | <1                | <1                | IS 3025 (part 4) 2021                                           | 5                                       |
| 2      | Odour                                 | -     | No Odour Observed | No Odour Observed | IS 3025(part 5)-2018                                            | Agreeable                               |
| 3      | Turbidity                             | NTU   | BDL(<0.5)         | BDL(<0.5)         | IS 3025(part 10)2023                                            | 1                                       |
| 4      | pH at 25 °C                           | -     | 6.89              | 6.75              | IS 3025(part 11)2022                                            | 6.5-8.5                                 |
| 5      | Conductivity at 25 °C                 | µS/cm | 370               | 312               | IS 3025 (part 14) 2013(RA 2019)                                 | Not Specified                           |
| 6      | Total dissolved solids                | mg/l  | 219               | 178               | IS:3025 Part 16-2023                                            | 500                                     |
| 7      | Total Suspended solids                | mg/l  | <2                | <2                | IS:3025 Part 17-2022                                            | Not Specified                           |
| 8      | Total Alkalinity as CaCO <sub>3</sub> | mg /l | 66                | 60                | IS : 3025 Part 23-2023                                          | 200                                     |
| 9      | Total Hardness as CaCO <sub>3</sub>   | mg/l  | 94                | 78                | IS : 3025 Part 21-2009                                          | 200                                     |
| 10     | Calcium as Ca                         | mg/l  | 29                | 24                | IS:3025 Part 40-1991(Reaff: 2019)                               | 75                                      |
| 11     | Magnesium as Mg                       | mg/l  | 5.2               | 4.4               | APHA 24 <sup>th</sup> EDN -3500 Mg B                            | 30                                      |
| 12     | Chloride as Cl <sup>-</sup>           | mg/l  | 78                | 58                | IS -3025 Part 32-1908(Reaff: 2019)                              | 250                                     |
| 13     | Sulphate as SO <sub>4</sub>           | mg/l  | 22                | 14                | APHA 24 <sup>th</sup> EDN -4500-SO <sub>4</sub> <sup>2-</sup> E | 200                                     |
| 14     | Nitrate as NO <sub>3</sub>            | mg/l  | 1                 | 2                 | APHA 24 <sup>th</sup> EDN -4500- NO <sub>3</sub> <sup>-</sup> B | 45                                      |
| 15     | Iron as Fe                            | mg/l  | 0.12              | 0.10              | IS 3025(part 53)1987(Reaff: 2019)                               | 1                                       |
| 16     | Manganese as Mn                       | mg/l  | BDL(<0.01)        | BDL(<0.01)        | APHA 24 <sup>th</sup> EDN -3111 B                               | 0.10                                    |
| 17     | Fluoride as F <sup>-</sup>            | mg/l  | 0.27              | 0.29              | APHA 24 <sup>th</sup> EDN -4500-F B&D                           | 1.00                                    |

GW1- Beneghat, GW2- Nongarh Umroi(Presbyterian Church)

Cond ...

S. Dharani  
Quality Manager



A. Robson Chinnadurai  
Technical Manager-Lab

Verified by

Authorised Signatory

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ABCTL/FRM/001/25/R Issue No.1 On 25.04.2025



ISSUED TO: **M/s Barapani (Shillong) Airport,** **TEST REPORT**  
**Airports Authority of India, Barapani,**  
**Umroi, Shillong (Meghalaya)**

|                    |                        |
|--------------------|------------------------|
| Report no          | : ABCTL/AAI/03/GW1-GW2 |
| Sample description | : Ground Water         |
| Date of report     | : 30.03-2025           |

Page 2 of 2

| S. No. | Parameter                    | Unit      | Results     |             | Test procedure                       | Acceptable Limit as per IS 10500 : 2012 |
|--------|------------------------------|-----------|-------------|-------------|--------------------------------------|-----------------------------------------|
|        |                              |           | GW1         | GW2         |                                      |                                         |
| 18     | Sodium as Na                 | mg/l      | 47          | 38          | IS : 3025 Part 45-1993 (Reaff:2019)  | Not Specified                           |
| 19     | Potassium as K               | mg/l      | 2.7         | 2.3         | IS : 3025 Part 45 -1993 (Reaff:2019) | Not Specified                           |
| 20     | Barium as Ba                 | mg/l      | BDL(<0.1)   | BDL(<0.1)   | APHA 24 <sup>th</sup> EDN -3111 D    | 0.7                                     |
| 21     | Residual Free Chlorine       | mg/l      | BDL(<0.1)   | BDL(<0.1)   | APHA 23 <sup>rd</sup> EDN -4500-Cl B | 0.20                                    |
| 22     | Aluminium as Al              | mg/l      | BDL(<0.03)  | BDL(<0.03)  | APHA 24 <sup>th</sup> EDN 3500 Al B  | 0.03                                    |
| 23     | Cadmium as Cd                | mg/l      | BDL(<0.003) | BDL(<0.003) | APHA 24 <sup>th</sup> EDN -3111 B    | 0.003                                   |
| 24     | Lead as Pb                   | mg/l      | BDL(<0.01)  | BDL(<0.01)  | APHA 24 <sup>th</sup> EDN -3113 B    | 0.01                                    |
| 25     | Copper as Cu                 | mg/l      | BDL(<0.03)  | BDL(<0.03)  | APHA 24 <sup>th</sup> EDN -3111 B    | 0.05                                    |
| 26     | Zinc as Zn                   | mg/l      | 0.03        | 0.02        | APHA 24 <sup>th</sup> EDN -3111 B    | 5.00                                    |
| 27     | Total Chromium as Cr         | mg/l      | BDL(<0.03)  | BDL(<0.03)  | APHA 24 <sup>th</sup> EDN -3111 B    | 0.05                                    |
| 28     | Arsenic as As                | mg/l      | BDL(<0.01)  | BDL(<0.01)  | APHA 24 <sup>th</sup> EDN -3113 B    | 0.01                                    |
| 29     | Cyanide as CN                | mg/l      | BDL(<0.05)  | BDL(<0.05)  | APHA 24 <sup>th</sup> EDN -4500-CN E | 0.05                                    |
| 30     | Selenium as Se               | mg/l      | BDL(<0.01)  | BDL(<0.01)  | APHA 24 <sup>th</sup> EDN -3113 B    | 0.01                                    |
| 31     | Mercury as Hg                | mg/l      | BDL(<0.001) | BDL(<0.001) | APHA 24 <sup>th</sup> EDN -3112 B    | 0.001                                   |
| 32     | Anionic Surfactants as MBAS  | mg/l      | BDL(<0.025) | BDL(<0.025) | APHA 24 <sup>th</sup> EDN 5540 C     | 0.20                                    |
| 33     | Phenolic Compounds as Phenol | mg/l      | BDL(<0.001) | BDL(<0.001) | APHA 24 <sup>th</sup> EDN 5530 B,C   | 0.001                                   |
| 34     | Pesticides                   | mg/l      | Absent      | Absent      | APHA 24 <sup>th</sup> EDN -6630 B, C | Absent                                  |
| 35     | Total Coliforms              | MPN/100ml | <2          | <2          | IS-1622-1981 (Reaff 2019)            | Absent /100ml                           |
| 36     | Fecoli                       | MPN/100ml | <2          | <2          | IS-1622-1981 (Reaff-2019)            | Absent /100ml                           |

GW1- Bengbat, GW2- Norgarh Umroi(Presbyterian Church)

BDL- Below Detection Limit

...End of report....

S- 30/03/25  
S.Dharani  
Quality Manager




J. R. Chinnadurai  
A. Robson Chinnadurai  
Technical Manager-Lab

Verified by

Authorized Signatory

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ISSUED TO: **M/s Barapani (Shillong) Airport,** **TEST REPORT**  
**Airports Authority of India, Barapani,**  
**Umroi, Shillong (Meghalaya)**

|                    |   |                                                                                                                                             |
|--------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------|
| Report number      | : | ABCTL/AAI/03/GW3-GW4                                                                                                                        |
| Sample drawn by    | : | ABC Techno Labs India Private Limited                                                                                                       |
| Sampling method    | : | IS 17614 :Part 21-2021& IS 17614 :Part 25:2021                                                                                              |
| Sample description | : | Ground Water                                                                                                                                |
| Project Name       | : | Proposed expansion of Barapani (Shillong) Airport including runway extension, expansion of terminal building & apron and other allied works |
| Date of sampling   | : | 14-03-2025                                                                                                                                  |
| Date of Receipt    | : | 17-03-2025                                                                                                                                  |
| Date of Analysis   | : | 17-03-2025                                                                                                                                  |
| Date Completion    | : | 28-03-2025                                                                                                                                  |
| Report date        | : | 30-03-2025                                                                                                                                  |

Page 1 of 2

| S. No. | Parameter                             | Unit  | Results           |                   | Test procedure                                                  | Acceptable limit as per IS 10500 : 2012 |
|--------|---------------------------------------|-------|-------------------|-------------------|-----------------------------------------------------------------|-----------------------------------------|
|        |                                       |       | GW3               | GW4               |                                                                 |                                         |
| 1      | Colour                                | Hazen | <1                | <1                | IS 3025 (part 4) 2021                                           | 5                                       |
| 2      | Odour                                 | -     | No Odour Observed | No Odour Observed | IS 3025(part 5)-2018                                            | Agreeable                               |
| 3      | Turbidity                             | NTU   | BDL(<0.5)         | BDL(<0.5)         | IS 3025(part 10)2023                                            | 1                                       |
| 4      | pH at 25 °C                           | -     | 7.05              | 6.98              | IS 3025(part 11)2022                                            | 6.5-8.5                                 |
| 5      | Conductivity at 25 °C                 | µS/cm | 452               | 466               | IS 3025 (part 14) 2013(RA 2019)                                 | Not Specified                           |
| 6      | Total dissolved solids                | mg/l  | 243               | 275               | IS:3025 Part 16-2023                                            | 500                                     |
| 7      | Total Suspended solids                | mg/l  | <2                | <2                | IS :3025 Part 17-2022                                           | Not Specified                           |
| 8      | Total Alkalinity as CaCO <sub>3</sub> | mg /l | 80                | 93                | IS : 3025 Part 23-2023                                          | 200                                     |
| 9      | Total Hardness as CaCO <sub>3</sub>   | mg/l  | 108               | 118               | IS : 3025 Part 21-2009                                          | 200                                     |
| 10     | Calcium as Ca                         | mg/l  | 32                | 37                | IS:3025 Part 40-1991 (Reaff: 2019)                              | 75                                      |
| 11     | Magnesium as Mg                       | mg/l  | 6.8               | 6.1               | APHA 24 <sup>th</sup> EDN -3500 Mg B                            | 30                                      |
| 12     | Chloride as Cl                        | mg/l  | 87                | 96                | IS :3025 Part 32-1988(Reaff: 2019)                              | 250                                     |
| 13     | Sulphate as SO <sub>4</sub>           | mg/l  | 28                | 23                | APHA 24 <sup>th</sup> EDN -4500-SO <sub>4</sub> <sup>2-</sup> F | 200                                     |
| 14     | Nitrate as NO <sub>3</sub>            | mg/l  | 1                 | 2                 | APHA 24 <sup>th</sup> EDN -4500- NO <sub>3</sub> <sup>-</sup> H | 45                                      |
| 15     | Iron as Fe                            | mg/l  | 0.05              | 0.08              | IS 3025(part 53)1987(Reaff: 2019)                               | 1                                       |
| 16     | Manganese as Mn                       | mg/l  | BDL(<0.01)        | BDL(<0.01)        | APHA 24 <sup>th</sup> EDN -3111 B                               | 0.10                                    |
| 17     | Fluoride as F                         | mg/l  | 0.23              | 0.26              | APHA 24 <sup>th</sup> EDN -4500-F B&D                           | 1.00                                    |

GW3- Bangla, GW4- Bhoirymbong

Contd...

S. Dharani  
Quality Manager



A. Robson Chinnadurai  
Technical Manager-Lab

Verified by

Authorised Signatory

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ISSUED TO- **M/s Barapani (Shillong) Airport,** **TEST REPORT**  
Airports Authority of India, Barapani,  
Umroi, Shillong (Meghalaya)

|                    |                        |
|--------------------|------------------------|
| Report no          | : ABCTL/AAI/03/GW3-GW4 |
| Sample description | : Ground Water         |
| Date of report     | : 30-03-2025           |

Page 2 of 2

| S. No. | Parameter                    | Unit      | Results     |             | Test procedure                       | Acceptable limit as per IS 10500 : 2012 |
|--------|------------------------------|-----------|-------------|-------------|--------------------------------------|-----------------------------------------|
|        |                              |           | GW3         | GW4         |                                      |                                         |
| 18     | Sodium as Na                 | mg/l      | 52          | 59          | IS : 3025 Part 45-1993 (Reaff:2019)  | Not Specified                           |
| 19     | Potassium as K               | mg/l      | 3.2         | 3.1         | IS : 3025 Part 45-1993 (Reaff:2019)  | Not Specified                           |
| 20     | Barium as Ba                 | mg/l      | BDL(<0.1)   | BDL(<0.1)   | APIA 24 <sup>th</sup> EDN -3111 D    | 0.7                                     |
| 21     | Residual Free Chlorine       | mg/l      | BDL(<0.1)   | BDL(<0.1)   | APHA 23 <sup>th</sup> EDN -4500-Cl B | 0.20                                    |
| 22     | Aluminium as Al              | mg/l      | BDL(<0.03)  | BDL(<0.03)  | APHA 24 <sup>th</sup> EDN 3500 Al B  | 0.03                                    |
| 23     | Cadmium as Cd                | mg/l      | BDL(<0.003) | BDL(<0.003) | APHA 24 <sup>th</sup> EDN -3111 B    | 0.003                                   |
| 24     | Lead as Pb                   | mg/l      | BDL(<0.01)  | BDL(<0.01)  | APHA 24 <sup>th</sup> EDN -3113 B    | 0.01                                    |
| 25     | Copper as Cu                 | mg/l      | BDL(<0.03)  | BDL(<0.03)  | APHA 24 <sup>th</sup> EDN -3111 B    | 0.05                                    |
| 26     | Zinc as Zn                   | mg/l      | 0.03        | 0.05        | APHA 24 <sup>th</sup> EDN -3111 B    | 5.00                                    |
| 27     | Total Chromium as Cr         | mg/l      | BDL(<0.03)  | BDL(<0.03)  | APHA 24 <sup>th</sup> EDN -3111 B    | 0.05                                    |
| 28     | Arsenic as As                | mg/l      | BDL(<0.01)  | BDL(<0.01)  | APHA 24 <sup>th</sup> EDN -3113 B    | 0.01                                    |
| 29     | Cyanide as CN                | mg/l      | BDL(<0.05)  | BDL(<0.05)  | APHA 24 <sup>th</sup> EDN -4500-CN E | 0.05                                    |
| 30     | Selenium as Se               | mg/l      | BDL(<0.01)  | BDL(<0.01)  | APHA 24 <sup>th</sup> EDN -3113 B    | 0.01                                    |
| 31     | Mercury as Hg                | mg/l      | BDL(<0.001) | BDL(<0.001) | APIA 24 <sup>th</sup> EDN -3112 B    | 0.001                                   |
| 32     | Anionic Surfactants as MBAS  | mg/l      | BDL(<0.025) | BDL(<0.025) | APHA 24 <sup>th</sup> EDN 5540 C     | 0.20                                    |
| 33     | Phenolic Compounds as Phenol | mg/l      | BDL(<0.001) | BDL(<0.001) | APHA 24 <sup>th</sup> EDN 5530 B,C   | 0.001                                   |
| 34     | Pesticides                   | mg/l      | Absent      | Absent      | APIA 24 <sup>th</sup> EDN -6630 B, C | Absent                                  |
| 35     | Total Coliforms              | MPN/100ml | <2          | <2          | IS-1622-1981 (Reaff-2019)            | Absent /100ml                           |
| 36     | E.coli                       | MPN/100ml | <2          | <2          | IS-1622-1981 (Reaff-2019)            | Absent /100ml                           |

GW3- Bangla, GW4- Bhorlymbong

BDL- Below Detection Limit

...End of report...

S. Dharani  
Quality Manager



A. Robson Chinnadurai  
Technical Manager-Lab

Verified by

Authorised Signatory

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ABC/TF/RA/001/25/08 Issue No. 1 04.25.04.2023

ISSUED TO **M/s Barapani (Shillong) Airport,** **TEST REPORT**  
**Airports Authority of India, Barapani,**  
**Umroi, Shillong (Meghalaya)**

|                    |   |                                                                                                                                             |
|--------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------|
| Report number      | : | ABCTL/AAI/03/GW5-GW6                                                                                                                        |
| Sample drawn by    | : | ABC Techno Labs India Private Limited                                                                                                       |
| Sampling method    | : | IS 17614 :Part 21:2021& IS 17614 :Part 25:2021                                                                                              |
| Sample description | : | Ground Water                                                                                                                                |
| Project Name       | : | Proposed expansion of Barapani (Shillong) Airport including runway extension, expansion of terminal building & apron and other allied works |
| Date of sampling   | : | 14-03-2025                                                                                                                                  |
| Date of Receipt    | : | 17-03-2025                                                                                                                                  |
| Date of Analysis   | : | 17-03-2025                                                                                                                                  |
| Date Completion    | : | 28-03-2025                                                                                                                                  |
| Report date        | : | 30-03-2025                                                                                                                                  |

Page 1 of 2

| S. No. | Parameter                             | Unit  | Results           |                   | Test procedure                                                  | Acceptable limit as per IS 10500 : 2012 |
|--------|---------------------------------------|-------|-------------------|-------------------|-----------------------------------------------------------------|-----------------------------------------|
|        |                                       |       | GW5               | GW6               |                                                                 |                                         |
| 1      | Colour                                | Hazen | <1                | <1                | IS 3025 (part 4) 2021                                           | 5                                       |
| 2      | Odour                                 | -     | No Odour Observed | No Odour Observed | IS 3025(part 5)-2018                                            | Agreeable                               |
| 3      | Turbidity                             | NTU   | BDL(<0.5)         | BDL(<0.5)         | IS 3025(part 10)2023                                            | 1                                       |
| 4      | pH at 25 °C                           | -     | 6.78              | 6.90              | IS 3025(part 11)2022                                            | 6.5-8.5                                 |
| 5      | Conductivity at 25 °C                 | µS/cm | 373               | 345               | IS 3025 (part 14) 2013(RA 2019)                                 | Not Specified                           |
| 6      | Total dissolved solids                | mg/l  | 213               | 197               | IS :3025 Part 16-2023                                           | 500                                     |
| 7      | Total Suspended solids                | mg/l  | <2                | <2                | IS :3025 Part 17-2022                                           | Not Specified                           |
| 8      | Total Alkalinity as CaCO <sub>3</sub> | mg /l | 78                | 66                | IS : 3025 Part 23-2023                                          | 200                                     |
| 9      | Total Hardness as CaCO <sub>3</sub>   | mg/l  | 86                | 74                | IS : 3025 Part 21-2009                                          | 200                                     |
| 10     | Calcium as Ca                         | mg/l  | 22                | 25                | IS:3025 Part 40-1991(Reaff: 2019)                               | 75                                      |
| 11     | Magnesium as Mg                       | mg/l  | 7.5               | 3.3               | APHA 24 <sup>th</sup> EDN -3500 Mg B                            | 30                                      |
| 12     | Chloride as Cl <sup>-</sup>           | mg/l  | 65                | 71                | IS :3025 Part 32-1988(Reaff: 2019)                              | 250                                     |
| 13     | Sulphate as SO <sub>4</sub>           | mg/l  | 19                | 13                | APHA 24 <sup>th</sup> EDN -4500-SO <sub>4</sub> <sup>2-</sup> E | 200                                     |
| 14     | Nitrate as NO <sub>3</sub>            | mg/l  | 2                 | 1                 | APHA 24 <sup>th</sup> EDN -4500- NO <sub>3</sub> B              | 45                                      |
| 15     | Iron as Fe                            | mg/l  | BDL(<0.05)        | BDL(<0.05)        | IS 3025(part 53)1987(Reaff: 2019)                               | 1                                       |
| 16     | Manganese as Mn                       | mg/l  | BDL(<0.01)        | BDL(<0.01)        | APHA 24 <sup>th</sup> EDN -3111 B                               | 0.10                                    |
| 17     | Fluoride as F                         | mg/l  | 0.25              | 0.17              | APHA 24 <sup>th</sup> EDN -4500-F B&D                           | 1.00                                    |

GW5- Habitation, S6 - Umed Umroi

Contd....

*S. Dharani*  
S.Dharani  
Quality Manager



*A. Robson Chinnadurai*  
A. Robson Chinnadurai  
Technical Manager-Lab

Verified by

Authorised Signatory

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ABCTL/FRM/QA/125B Issue No. 1 Of 25.04.2023



ISSUED TO: **M/s Barapani (Shillong) Airport,**  
**Airports Authority of India, Barapani,**  
**Umroi, Shillong (Meghalaya)**

## TEST REPORT

|                    |   |                      |
|--------------------|---|----------------------|
| Report no          | : | ABCTL/AAI/03/GW5-GW6 |
| Sample description | : | Ground Water         |
| Date of report     | : | 30-03-2025           |

Page 2 of 2

| S. No. | Parameter                    | Unit      | Results     |             | Test procedure                       | Acceptable limit as per IS 10500 : 2012 |
|--------|------------------------------|-----------|-------------|-------------|--------------------------------------|-----------------------------------------|
|        |                              |           | GW5         | GW6         |                                      |                                         |
| 18     | Sodium as Na                 | mg/l      | 43          | 52          | IS : 3025 Part 45-1993 (Reaff:2019)  | Not Specified                           |
| 19     | Potassium as K               | mg/l      | 3.3         | 1.6         | IS : 3025 Part 45 -1993 (Reaff:2019) | Not Specified                           |
| 20     | Barium as Ba                 | mg/l      | BDL(<0.1)   | BDL(<0.1)   | APHA 24 <sup>th</sup> EDN -3111 D    | 0.7                                     |
| 21     | Residual Free Chlorine       | mg/l      | BDL(<0.1)   | BDL(<0.1)   | APHA 23 <sup>th</sup> EDN -4500-CI B | 0.20                                    |
| 22     | Aluminium as Al              | mg/l      | BDL(<0.03)  | BDL(<0.03)  | APHA 24 <sup>th</sup> EDN 3500 AL B  | 0.03                                    |
| 23     | Cadmium as Cd                | mg/l      | BDL(<0.003) | BDL(<0.003) | APHA 24 <sup>th</sup> EDN -3111 B    | 0.003                                   |
| 24     | Lead as Pb                   | mg/l      | BDL(<0.01)  | BDL(<0.01)  | APHA 24 <sup>th</sup> EDN -3113 B    | 0.01                                    |
| 25     | Copper as Cu                 | mg/l      | BDL(<0.03)  | BDL(<0.03)  | APHA 24 <sup>th</sup> EDN -3111 B    | 0.05                                    |
| 26     | Zinc as Zn                   | mg/l      | 0.03        | 0.03        | APHA 24 <sup>th</sup> EDN -3111 B    | 5.00                                    |
| 27     | Total Chromium as Cr         | mg/l      | BDL(<0.03)  | BDL(<0.03)  | APHA 24 <sup>th</sup> EDN -3111 B    | 0.05                                    |
| 28     | Arsenic as As                | mg/l      | BDL(<0.01)  | BDL(<0.01)  | APHA 24 <sup>th</sup> EDN -3113 B    | 0.01                                    |
| 29     | Cyanide as CN                | mg/l      | BDL(<0.05)  | BDL(<0.05)  | APHA 24 <sup>th</sup> EDN -4500-CN E | 0.05                                    |
| 30     | Selenium as Se               | mg/l      | BDL(<0.01)  | BDL(<0.01)  | APHA 24 <sup>th</sup> EDN -3113 B    | 0.01                                    |
| 31     | Mercury as Hg                | mg/l      | BDL(<0.001) | BDL(<0.001) | APHA 24 <sup>th</sup> EDN -3112 U    | 0.001                                   |
| 32     | Anionic Surfactants as MBAS  | mg/l      | BDL(<0.025) | BDL(<0.025) | APHA 24 <sup>th</sup> EDN 5540 C     | 0.20                                    |
| 33     | Phenolic Compounds as Phenol | mg/l      | BDL(<0.001) | BDL(<0.001) | APHA 24 <sup>th</sup> EDN 5530 B,C   | 0.001                                   |
| 34     | Pesticides                   | mg/l      | Absent      | Absent      | APHA 24 <sup>th</sup> EDN -6630 B, C | Absent                                  |
| 35     | Total Coliforms              | MPN/100ml | <2          | <2          | IS-1622-1981 (Reaff-2019)            | Absent /100ml                           |
| 36     | E.coli                       | MPN/100ml | <2          | <2          | IS-1622-1981 (Reaff-2019)            | Absent /100ml                           |

GW5- Habitation, S6 - Umroi Umroi

BDL- Below Detection Limit

...End of report...

  
**S. Dharani**  
Quality Manager



  
**A. Robson Chinnadurai**  
Technical Manager-Lab

Verified by

Authorised Signatory

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ABCTL/FRM/QA/125 B Issue No.1 Dt:29.04.2023

ISSUED TO: **M/s Barapani (Shillong) Airport,** **TEST REPORT**  
**Airports Authority of India, Barapani,**  
**Umroi, Shillong (Meghalaya)**

|                    |   |                                                                                                                                             |
|--------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------|
| Report number      | : | ABCTL/AAI/03/GW7-GW8                                                                                                                        |
| Sample drawn by    | : | ABC Techno Labs India Private Limited                                                                                                       |
| Sampling method    | : | IS 17614 :Part 21:2021& IS 17614 :Part 25:2021                                                                                              |
| Sample description | : | Ground Water                                                                                                                                |
| Project Name       | : | Proposed expansion of Barapani (Shillong) Airport including runway extension, expansion of terminal building & apron and other allied works |
| Date of sampling   | : | 14-03-2025                                                                                                                                  |
| Date of Receipt    | : | 17-03-2025                                                                                                                                  |
| Date of Analysis   | : | 17-03-2025                                                                                                                                  |
| Date Completion    | : | 28-03-2025                                                                                                                                  |
| Report date        | : | 30-03-2025                                                                                                                                  |

Page 1 of 2

| S. No. | Parameter                             | Unit  | Results           |                   | Test procedure                                                  | Acceptable limit as per IS 10500 : 2012 |
|--------|---------------------------------------|-------|-------------------|-------------------|-----------------------------------------------------------------|-----------------------------------------|
|        |                                       |       | GW7               | GW8               |                                                                 |                                         |
| 1      | Colour                                | Hazen | <11               | <1                | IS 3025 (part 1) 2021                                           | 5                                       |
| 2      | Odour                                 | -     | No Odour Observed | No Odour Observed | IS 3025(part 5)-2018                                            | Agreeable                               |
| 3      | Turbidity                             | NTU   | 0.5               | BDL(<0.5)         | IS 3025(part 10)2023                                            | 1                                       |
| 4      | pH at 25 °C                           | -     | 7.01              | 6.69              | IS 3025(part 11)2022                                            | 6.5-8.5                                 |
| 5      | Conductivity at 25 °C                 | µS/cm | 259               | 284               | IS 3025 (part 14) 2013(RA 2019)                                 | Not Specified                           |
| 6      | Total dissolved solids                | mg/l  | 148               | 162               | IS :3025 Part 16-2023                                           | 500                                     |
| 7      | Total Suspended solids                | mg/l  | <2                | <2                | IS :3025 Part 17-2022                                           | Not Specified                           |
| 8      | Total Alkalinity as CaCO <sub>3</sub> | mg /l | 54                | 63                | IS : 3025 Part 23-2023                                          | 200                                     |
| 9      | Total Hardness as CaCO <sub>3</sub>   | mg/l  | 67                | 75                | IS : 3025 Part 21-2009                                          | 200                                     |
| 10     | Calcium as Ca                         | mg/l  | 21                | 23                | IS:3025 Part 40-1991(Reaff: 2019)                               | 75                                      |
| 11     | Magnesium as Mg                       | mg/l  | 3.5               | 4.3               | APHA 24 <sup>th</sup> EDN -3500 Mg B                            | 30                                      |
| 12     | Chloride as Cl <sup>-</sup>           | mg/l  | 47                | 51                | IS :3025 Part 32-1988(Reaff: 2019)                              | 250                                     |
| 13     | Sulphate as SO <sub>4</sub>           | mg/l  | 12                | 10                | APHA 24 <sup>th</sup> EDN -4500-SO <sub>4</sub> <sup>2-</sup> E | 200                                     |
| 14     | Nitrate as NO <sub>3</sub>            | mg/l  | 1                 | 2                 | APHA 24 <sup>th</sup> EDN -4500- NO <sub>3</sub> B              | 45                                      |
| 15     | Iron as Fe                            | mg/l  | 0.05              | BDL(<0.05)        | IS 3025(part 53)1987(Reaff: 2019)                               | 1                                       |
| 16     | Manganese as Mn                       | mg/l  | BDL(<0.01)        | BDL(<0.01)        | APHA 24 <sup>th</sup> EDN -3111 B                               | 0.10                                    |
| 17     | Fluoride as F                         | mg/l  | 0.14              | 0.18              | APHA 24 <sup>th</sup> EDN -4500-F B&D                           | 1.00                                    |

GW7- Umhang Addab, GW8- Umek

Contd....

  
**S. Dharani**  
Quality Manager



  
**A. Robson Chinnadurai**  
Technical Manager-Lab

Verified by

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ABC TL/PR/MQA/175 B Issue No 1 Dt. 25.04.2023









ISSUED TO: **M/s Barapani (Shillong) Airport,** **TEST REPORT**  
Airports Authority of India, Barapani,  
Umroi, Shillong (Meghalaya)

|                    |                                                                            |
|--------------------|----------------------------------------------------------------------------|
| Report number      | ABCTL/AAI/03/SW1-SW2                                                       |
| Sample description | Surface Water - SW1 - Umiam River Upstream<br>SW2 - Umiam River Downstream |
| Report date        | 30-03-2025                                                                 |

Page 2 of 2

| S. No | Parameter                                              | Unit      | Results     |             | Test Procedure                       |
|-------|--------------------------------------------------------|-----------|-------------|-------------|--------------------------------------|
|       |                                                        |           | SW1         | SW2         |                                      |
| 20    | Iron as Fe                                             | mg/l      | 0.25        | 0.29        | IS:3025 Part 53:2003(Reaff: 2019)    |
| 21    | Manganese as Mn                                        | mg/l      | 0.02        | 0.15        | APIIA 24 <sup>th</sup> EDN -3111 B   |
| 22    | Anionic Surfactants as MBAS                            | mg/l      | BDL(<0.025) | BDL(<0.025) | APIIA 24 <sup>th</sup> EDN -5540 C   |
| 23    | Total Suspended Solids                                 | mg/l      | 2           | 6           | IS:3025 Part 17:2022                 |
| 24    | Dissolved Oxygen as O <sub>2</sub>                     | mg/l      | 6.3         | 5.8         | IS:3025:Part-38:1989(Reaff: 2019)    |
| 25    | Chemical Oxygen Demand                                 | mg/l      | 15          | 22          | IS:3025:Part-58:2023                 |
| 26    | Bio-Chemical Oxygen Demand @ 27°C for 3 days           | mg/l      | BDL(<2)     | 2.2         | IS:3025:Part-44:2023                 |
| 27    | Phenolic compounds as C <sub>6</sub> H <sub>5</sub> OH | mg/l      | BDL(<0.001) | BDL(<0.001) | APHA 24 <sup>th</sup> EDN 5530 B,C,D |
| 28    | Copper as Cu                                           | mg/l      | BDL(<0.03)  | BDL(<0.03)  | APIIA 24 <sup>th</sup> EDN -3111 B   |
| 29    | Mercury as Hg                                          | mg/l      | BDL(<0.001) | BDL(<0.001) | APHA 24 <sup>th</sup> EDN -3112 B    |
| 30    | Cadmium as Cd                                          | mg/l      | BDL(<0.003) | BDL(<0.003) | APHA 24 <sup>th</sup> EDN -3111 B    |
| 31    | Selenium as Se                                         | mg/l      | BDL(<0.01)  | BDL(<0.01)  | APHA 24 <sup>th</sup> EDN -3113 B    |
| 32    | Total Arsenic as As                                    | mg/l      | BDL(<0.01)  | BDL(<0.01)  | APHA 24 <sup>th</sup> EDN -3111 B    |
| 33    | Cyanide as CN                                          | mg/l      | BDL(<0.02)  | BDL(<0.02)  | APHA 24 <sup>th</sup> EDN -4500-CN E |
| 34    | Lead as Pb                                             | mg/l      | BDL(<0.01)  | BDL(<0.01)  | APHA 24 <sup>th</sup> EDN -3111 B    |
| 35    | Zinc as Zn                                             | mg/l      | 0.03        | 0.13        | APHA 24 <sup>th</sup> EDN -3111 B    |
| 36    | Total Chromium as Cr                                   | mg/l      | BDL(<0.03)  | BDL(<0.03)  | APHA 24 <sup>th</sup> EDN -3111 B    |
| 37    | Nickel as Ni                                           | mg/l      | BDL(<0.02)  | BDL(<0.02)  | APHA 24 <sup>th</sup> EDN -3111 B    |
| 38    | Oil & Grease                                           | mg/l      | BDL(<1)     | BDL(<1)     | IS:3025:Part-39:1991(Reaff: 2019)    |
| 39    | Total Coliform                                         | MPN/100ml | 1100        | >1600       | IS-622-1981 (Reaff - 2019)           |
| 40    | Faecal Coliform                                        | MPN/100ml | 14          | 40          | IS-1622-1981(Reaff - 2019)           |

BDL - Below Detection Limit

...End of Report...

S - 30/3/25  
S.Dharani  
Quality Manager



A. Robson Chinnadurai  
Technical Manager-Lab

Verified by

Authorised Signatory

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ABCTL/FRM/04/125B Issue No.1 Dt 25 04 2023