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# GOVERNMENT OF MANIPUR SECRATARIAT: MUNICIPAL ADMINISTRATION HOUSING & URBAN DEVELOPMENT DEPARTMENT

## **NOTIFICATION**

Imphal, the 16th January, 2025

No. SCS-801/1/2025-MAHUD-MAHUD(4): Whereas, Draft notification of the Risk Informed GIS Based Master Plan for Moirang was published in the Extraordinary Manipur Gazette 270 dated 27.02.2024 under Sub-Section 1 of Section 23 read with Section 28 of Manipur Town & Country Planning Act, 1975 for wide publicity inviting opinions and objections, if any, to be submitted within a period of not more than 2 (two) months.

Whereas, no objection and suggestion were received and whereas, the advice of the Manipur Town & Country Planning Board have been obtained as required under Sub-Section 2 of Section 23 of the said Act.

Now, therefore, the Governor of Manipur is pleased to accord approval to the publication of the Risk Informed GIS Based Master Plan for Moirang under Sub-section 3 of Section 23 of the Manipur Town and Country Planning Act, 1975 which is hereby publish for general information as Annexure.

The ANNEXURE will be available at the Town Planning Department website https://tpmanipur.mn.gov.in.

M. JOY SINGH, Commissioner (MAHUD), Government of Manipur.

## Risk Informed GIS Based Master Plan-2043



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#### E. List of Abbreviations

**AMRUT** Atal mission for Rejuvenation and Urban Transformation

**BMW** Bio-Medical Waste

C&D Construction & Demolition
CHC Community Health Centre

**CPHEEO** Central Public Health and Environmental Engineering Organization **DAY-NULM** Deendayal Antyodaya Yojana-National Urban Livelihoods Mission

**DC** Ductile Iron

**FSSM** Faecal Sludge & Septage management

**GTS** Ground Truthing Survey

Ha HectaresHHs Households

IPT Intermediate Public Transport

Km Kilometrem Meter

MLD Million Liter per Day

mm Millimetre

**MoEFCC** Ministry of Environment, Forest and Climate Change

MSL Mean Sea Level

MST Manipur State Transport
pph Person Per Hectares
PSP Public Semi-Public
SHG Self Help Group
Sq. Km Square Kilometre

STP Sewage Treatment Plant
SWM Solid Waste Management

TPD Ton Per Day
ULB Urban Local Body

**URDPFI** Urban and regional Development Plans Formulation and Implementation

WSS Water Supply Scheme
WTP Water Treatment Plant
hph Houses per hectare

## F. Executive Summary

Moirang, located in the Bishnupur district of Manipur, envisioned becoming a model for sustainable urban development, focused on building resilience against natural hazards and ensuring long-term socio-economic growth. The town is aimed to effectively manage its land, infrastructure, and environment while preparing for potential risks like floods, earthquakes, and other natural calamities.

The Risk Informed Master Planning (RIMP) process for Moirang outlined a comprehensive approach to make the town more risk-resilient and disaster-ready. The primary goals of the process are to identify and assess the various hazards and risks that Moirang faced, reduce vulnerability, and improve the town's infrastructure to withstand these risks. The plan's objectives included enhancing land use management by minimizing exposure to natural hazards, using urban planning as a tool for risk assessment, identifying flood-prone and earthquake-prone zones, promoting disaster-resilient designs, and formulating actionable mitigation plans to address potential risks.

The first stage of the RIMP for Moirang involved risk identification, with a focus on understanding the historical hazards that had affected the region, particularly floods and earthquakes. Moirang's location along the Loktak Lake and its proximity to water bodies made it highly susceptible to flooding, especially during the monsoon season. Additionally, Moirang's position in a seismically active area presented an ongoing risk of earthquakes. The risk assessment process included analyzing topography, hydrological data, elevation, and existing urban development to understand how these factors contributed to the town's risk profile.

The methodology for identifying risks included preparing a base map with contour data to analyze elevation variations, examining the proximity of the town to rivers and water bodies, and assessing impervious land surfaces that contributed to flooding in low-lying areas. For earthquake risks, the assessment included analyzing historical earthquake data, fault line proximity, and assessing the built environment for seismic vulnerability. This process allowed for the categorization of Moirang into high, moderate, and low-risk zones based on flood and earthquake risks.

High-risk areas in Moirang included low-lying regions near water bodies, creeks and areas along riverbanks that were prone to flooding. Moderate-risk areas consisted of regions with moderate elevation and a mix of residential, commercial, and agricultural land uses. Low-risk zones were characterized by elevated regions with effective natural drainage and fewer built-up areas, with lower historical seismic activity.

Based on the findings from the risk identification and assessment process, the plan proposed several recommendations. For flood risk mitigation, the focus is on enhancing the town's drainage infrastructure, improving floodwater management systems, and enforcing land-use regulations to restrict development in flood-prone zones. Promoting recreational activities in submerged areas or near wetlands, alongside encouraging low-rise developments, can reduce flood impact and enhance urban resilience. For earthquake risk mitigation, enforcing strict building codes, promoting the use of earthquake-resistant materials, retrofitting existing

buildings, and providing public awareness on seismic safety were deemed crucial. Installation of advanced seismic monitoring systems can provide early warnings and restricting development in high-risk seismic zones can promote resilient urban planning practices.

In conclusion, the Risk Informed Master Plan for Moirang aimed to integrate disaster resilience into the town's development framework. By identifying and addressing key risks and implementing mitigation strategies, Moirang would have evolved into a sustainable, disaster-resilient town capable of thriving amidst challenges. This proactive approach will not only safeguard the town from natural hazards, preserved its cultural heritage, and fostered economic growth but also enhance its overall socio-economic stability and growth potential.

## **Chapter 1 Introduction**

#### 1.1 Background

Moirang, a town in Bishnupur district, is in the central region of Manipur, one of the four valley districts of the state. The town has classified as a tier III city under the Census Town classification, Moirang had a population exceeding 20,000 as per the Census of India, 2011. It is one of the most popular tourist locations in the state. Loktak Lake, Ebudhou Thangjing Temple and INA Museum are the most popular tourist attraction in the town. Some other tourist places in and around Moirang are Sendra Park, Keibul Lamjao National Park, Sangai Ethnic Park, etc.

Two defining characteristics set Moirang apart. The first is its rich historical association with World War II, which lends the town significant historical and cultural importance. The second is its proximity to remarkable natural features, including the iconic Loktak Lake and the Keibul Lamjao National Park. Loktak Lake, a vital water body, is renowned for its unique floating islands or phumdis as shown in Figure 1.1-1. Adding to this uniqueness, the Keibul Lamjao National Park, world's only floating national park, serves as a habitat for the endangered Sangai deer, the state animal of Manipur.



Figure 1.1-1: Beauty of Moirang: Loktak Lake

Source: India Today NE, Accessed on 04.05.2023

https://www.indiatodayne.in/visualstories/webstories/ten-facts-about-loktak-lake-manipur

Moirang is expanding beyond its municipal boundaries. The unregulated growth of settlements can lead to significant challenges, particularly near environmentally sensitive areas like Loktak Lake. These issues include the disruption of natural drainage systems, increased vulnerability to environmental degradation, and the risk of unsustainable urbanization. A risk-informed master plan is essential to address these concerns effectively.

Moirang Town in Manipur State anticipates transformative growth with a GIS-based master plan tailored for 2043. Collaboration with the Moirang Municipal Council is pivotal in steering this development, aligning strategies to address the town's expansion. Recognizing the continuous expansion of Moirang beyond its municipal boundaries, the master plan will incorporate outgrowth areas. By considering the evolving village boundaries and accommodating the needs of these expanding areas, the plan aims to foster inclusive development and maintain a balance between urban and rural spaces. Tourism, driven by landmarks like the INA and Loktak Lake, is central to town's recent growth. The master plan accommodates outgrowth areas beyond municipal boundaries, ensuring a delicate balance between preserving cultural heritage and meeting the needs of a growing population.

The Risk-Informed Master Plan (RIMP) for Moirang will focus on ensuring balanced urban development by addressing the challenges posed by unregulated growth. It will prioritize the preservation of natural ecosystems, such as Loktak Lake and Keibul Lamjao National Park, through zoning and pollution control measures. The plan will also manage unplanned settlements by promoting organized urban growth, improving infrastructure resilience, and integrating stormwater management systems to mitigate flooding risks. Furthermore, it will support balanced tourism practices, protect local resources, and foster community involvement, ensuring that Moirang's development aligns with both ecological preservation and the needs of its growing population.

Developing infrastructure is pivotal, focusing on improving transportation, water supply and waste management to meet the needs of the growing population. The master plan also highlights the importance of managing tourism, protection of tourist attraction places while boosting the local economy. The urban development focuses on creating residential areas centred around the essential amenities, with green spaces and facilities for everyone to enjoy. This Risk Informed Master Plan aims to make Moirang a strong and balanced town by 2043, reflecting its identity and values while setting an example for inclusive development.

## 1.2 Location

The Northeast region of India, which is generally known as the 'Seven Sisters of India', includes seven states, namely Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. Geographically, this region shares an international border with foreign nations, namely, Bangladesh, Bhutan, China, Myanmar and Nepal. Northeast is linked to the rest of the country by a narrow corridor in West Bengal by National Highway 31 known as 'Chicken's Neck' or 'Siliguri Corridor'.

Manipur is one of the landlocked Border States in the north-eastern part of the country and has an international boundary of about 352 km with Myanmar in the southeast. It is bounded by Nagaland in the north, Assam in the west, and Mizoram in the south. It has a total area of 22327 Sq.Km. It lies between 230 49' 45.530" N to 250 42' 1.456" N latitude and 920 58' 23.422" E to 940 43' 35.553" E longitude. Manipur is geographically divided into two parts: the centrally situated valley and the surrounding hills. Imphal, state capital, comprises parts of Imphal East and Imphal West districts. It is the only Class I city which accommodates 9.8% of the total population while accounting for only 3.7% area of the state.

Bishnupur District with it headquarter at Bishnupur is 27 Km from the state capital Imphal and formed on 25-05-1983. The total geographical area of the district is 530 sq km. It is bounded on the North by Imphal West District, on the South by Churachandpur District, on the East by Imphal and Thoubal Districts as represented in Figure 1.2-1. Moirang town is in Moirang subdivision of Bishnupur district which is 45.4 km from the state capital Imphal and 17 km from Bishnupur DHQ. It is 310 km from Guwahati, Assam. This town is surrounded by the Loktak lake, Keibul Lamjao National Park and settled along the NH 150.

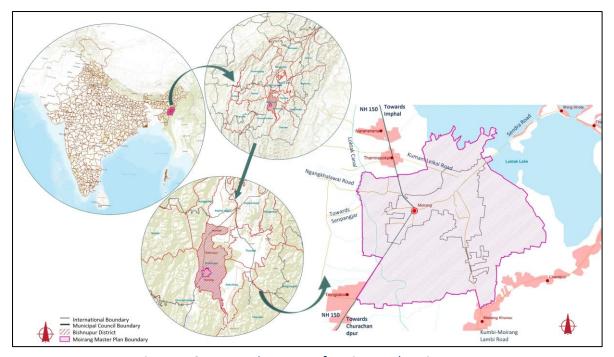


Figure 1.2-1: Location map of Moirang Planning Area

Source: Survey of India

## 1.3 History

Moirang was a prosperous ancient kingdom which flourished during the prehistoric era in South-East Asia. As of today, Moirang is a tourist city located in the northeast of India, 45 km from Imphal, Manipur. It is the valley of enchantment for the tourists across the globe. Moirang was a culturally rich kingdom and was considered 'a land of legends. Among the famous nine incarnation folk stories of Moirang, the romantic story of Khamba-Thoibi is still prominently remembered till today by people in Manipur and surrounding places. The city is also famous for the majestic ancient temple of the Meitie deity, 'Ebuthou Thangjing' (Saxena, 2022).

Moirang was a part of the British empire until the Azad Hind Fauj recaptured a town and a part of Nagaland from their clutches on April 14, 1944. The courageous Indian National Army outnumbered them that Subhas Chandra Bose led. Subhas Chandra Bose and Colonel Shaukat Malik hoisted the tricolour for the first time on Indian soil. The historic occasion was attended by several members of the INA, including a man named Mairembam Koireng Singh, who went on to become Manipur's first Chief Minister (Mairembam, 2009).

## 1.4 Geography

Moirang is one the major towns situated in the valley region of Manipur state. Loktak lake, which is a major source of freshwater in Manipur state is in North-East side of Moirang town. The total planning boundary area is 688.15 Ha, whereas Moirang Municipal Boundary area is 353.13 Ha. Topography of the town is mainly flat and varies from 770-790 m in height. It has several water catchment areas, wetlands, creeks and ponds. Loktak lake is surrounded by small hills such as Sendra hills, Phubala, Thanga, Thanga Khoiram Leikai etc., but these hills are not included in the planning boundary.

## 1.5 Town characteristics

Moirang town served as a tourism centre for Bishnupur district in the state of Manipur, India. It has several tourist attractions that have their own significance. Its history is directly related to WWII and was the military base of India National Army "Azad Hind Fauj". Loktak Lake, the largest freshwater lake in northeast India is also one of the major tourist attractions because of its scenic beauty. It is famous for its aquamarine floating house on biomass locally called "phumdi". World's only floating national park" Keibul Lamjao" is also located in Moirang and is famous for the Brow Antlered deer "Sangai or Dancing deer". Sangai is also the state animal of Manipur and Loktak biodiversity is its only habitat.

## 1.6 People groups

Moirang is a culturally rich city and the entire folk tales of Moirang is uniquely named as 'Moirang Kangleirol' (i.e. literally meaning 'Generation stories of Moirang'). People of Moirang are majority of Meitie community. People speak 'Meiteilon/Manipuri' as language and use 'Meitei-Mayek' as the script. They neither have the concept of a religion nor follow one; but they are worshippers of their forefathers for good luck and prosperity.

Some of the traditional musical instruments used so far are Penna (i.e. modern 'Violin'), Pung (i.e. modern 'drum'), etc. People in Moirang also make various handicrafts and embroidered items. Some of the cultural dances of Moirang are Khamba-Thoibi Jagoi (i.e. the dance presented by 'princess Thoibi' and 'Khamba' in front of deity 'Ebuthou Thangjing'), Maibi Jagoi (i.e. the dance of women priests), Phamnaiba Jagoi (i.e. the dance of the dignitaries in the court of the then Moirang king), etc.

## **Chapter 2 Regional Context**

The chapter offers a comprehensive overview of the town's physiography, covering various aspects that define its natural and physical environment, regional connectivity, transport infrastructure, etc. It delves into the topography, describing the landforms, elevation, and geographical features that shape the area. Detailed information on rainfall patterns is included, highlighting seasonal variations, average annual precipitation, and its impact on local ecosystems and agriculture.

The discussion extends to soil conditions, examining the types of soil found in the region, their fertility, and their suitability for agriculture and construction. Additionally, the chapter explores the climate, including temperature ranges, humidity levels, and seasonal changes that influence the lifestyle, vegetation, and economy of the area. Together, these elements paint a clear picture of the town's physical landscape and environmental characteristics.

#### 2.1 Overview

Moirang town is in Moirang sub-division of Bishnupur District. Moirang subdivision is the southernmost subdivision of Bishnupur that shares its boundary with Bishnupur subdivision in the north, with Churachandpur district from west and south and with Imphal West and Kakching in the east. Moirang Municipal Council Area is 476.06 Ha whereas planning area boundary area is approximately 1703.88 Ha.

## 2.2 Regional Water Resources (Blue Infrastructure)

Regional water resources, commonly referred to as blue infrastructure, encompass the network of water bodies which has been managed and utilized within a region. These include rivers, lakes, reservoirs, wetlands and constructed elements like dams and canals. Blue infrastructure plays a crucial role in ensuring water security, supporting biodiversity and mitigating the impacts of climate change. It not only serves as a source for drinking water and irrigation but also aids in flood control and groundwater recharge.

Locally originated small tributaries control the drainage of the district. There is no large-scale river in the district. Some of the small rivers, which are flowing in the district, are Thongjaorock, Sunusiphai, Nambol, Yangoimacha, Yangoiachouba, Khuga, and Iram etc. Except Khuga River all other rivers start from the hill located at the west of the Tiddim Road

and flows towards east falling into Loktak Lake (CGWB, September 2013). These rivers form a crucial part of the district's blue infrastructure, supporting both the ecological and socioeconomic aspect of the region. They provide essential water for drinking and irrigation which is vital for the district's agricultural needs. Additionally, these rivers play a significant role in maintaining the region's biodiversity and forests that act as habitats for various species. For Bishnupur district, with its terrain prone to flash floods. These water systems contribute to disaster resilience by regulating runoff and reducing erosion.

These surrounding rivers and Loktak lake in Moirang are central to managing water-related risks and hazards. They supply drinking water and irrigation, both of which are crucial for sustaining agriculture in the district. In times of natural disasters like flash floods, these rivers help control runoff and reduce soil erosion, contributing to disaster resilience. The blue infrastructure in Moirang, while serving as a source of water and supporting biodiversity, also plays an active role in reducing the district's exposure to environmental risks.

## 2.3 Regional Green Resources (Green Infrastructure)

Physiographically the district may be divided into three main parts such as Valley or alluvial plain area, area under water or wetland / lakes and area covered under Hillocks and Forest. Alluvial plains cover majority of the district area with a flat gentle regional slope towards Loktak Lake. In Bishnupur district, hillocks and forests, having an area of about 34.12 acres (CGWB, September 2013). Forests act as natural barriers, reducing the velocity of surface runoff. This forest cover is vital for maintaining ecological balance, providing habitat for diverse flora and fauna, including endangered species like the Shirui Lily and Sangai deer. The district's green infrastructure is divided into categories such as evergreen/semi-evergreen forests, deciduous forests, plantations and scrub. It also supports local livelihoods through timber, fuelwood and non-timber forest products. However, challenges such as deforestation and forest fires threaten these ecosystems.

## 2.4 Physiography

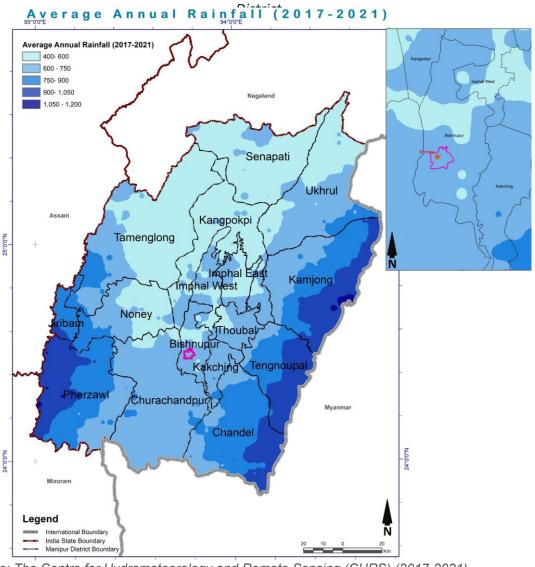
Manipur can be divided into two distinct physical regions: an outer area of rugged hills with narrow valleys and an inner area consisting of flat plains, each with its own unique landforms. Moirang is situated in the valley region of the state, characterized by relatively even terrain.

The contours of the planning area in Moirang range from 700 to 900 meters above sea level, reflecting the gentle variations in elevation typical of the valley region.

Loktak Lake, located in the northwestern part of the planning area, is a significant geographical feature. As the largest freshwater lake in the state, it serves as a critical source of fresh water for Manipur, supporting both ecological balance and human needs.

#### 2.5 Rainfall Data

The average annual rainfall map indicates that five districts in Manipur receive significantly higher rainfall compared to the rest of the state. Bishnupur district, where Moirang is located, experiences moderate rainfall ranging from 400 to 750 mm annually. In Moirang town specifically, the rainfall levels during the period 2017–2021 were recorded between 500 and 750 mm, as reported by the Climate Hazards Resource System (CHRS). This moderate rainfall supports local agriculture and sustains the natural environment while shaping the region's climate patterns as represented in Map 2.5-1Map 2.5-1.



Map 2.5-1: Average Annual rainfall in the Manipur State and Bishnupur

Source: The Centre for Hydrometeorology and Remote Sensing (CHRS) (2017-2021)

#### 2.6 Lakes

Loktak Lake: Loktak, the largest freshwater lake in Northeast India is also known as the 'floating lake' for the numerous phumdis or masses of vegetation it supports. The phumdis float around on the lake's surface due to decay from the bottom. Other than this, the town also has several water catchment areas or ponds. At present these small ponds are used by communities for their day to day works as shown in Figure 2.6-1.

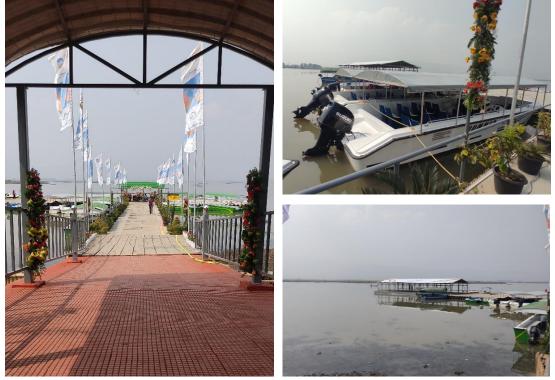


Figure 2.6-1: Loktak Lake Development Authority

Source: Ground Truthing Survey

## 2.7 Natural Vegetation and Biodiversity

a. Loktak lake and its surrounding biodiversity: The Loktak Lake is ecologically rich in flora and fauna. The hills and forests around Moirang possess diverse medicinal herbs and plants as well. The govt of Manipur has set up various institutes of research and development on fisheries, botanical, zoological and other bio-tourism potential aspects in and around Moirang. There are still lots of scientifically unknown plants and animals available in the lake and nearby forests. The tourism facilities at Loktak Lake are taken care of and improved by the Loktak Development Authority. There are floating huts in the lake as shown in Figure 2.7-1.



Figure 2.7-1: Vegetation and Habitation-Loktak Lake Source: Google Images

b. Keibul Lamjao National Park: The park is in the southwestern part of the Loktak lake. This is the last natural habitat of the brow-antlered deer (Sangai), the dancing deer of Manipur as shown in Figure 2.7-2. Keibul Lamjao National Park is the only floating park in the world. A glimpse of the deer in this unique wetland ecosystem is a must for any wildlife enthusiast. Other wildlife to be seen include Hog Deer, Otter, a host of waterfowl and migratory birds, the latter usually sighted during November to March. The Forest Department of Manipur maintains watch towers and two rest houses within the park.



Figure 2.7-2: Keibul Lamjao National Park Safari

Source: The Land of Wanderlust, 2019

https://thelandofwanderlust.com/tag/sangai/

## 2.8 Topography

Slope of an area describe the steepness of the ground surface. It is used to identify the elevations at different locations which helps to model landform, surface runoff, characterization of habitation and identify potential developmental sites. The slope of Moirang Planning area is shown, it is inferred from the map that the main market and majority of residential buildings are present are at lower slope which means these buildings are in plain areas. Moirang is a valley town therefore the slope is not steep except in the northern part of the planning area. Alluvial plains cover majority of the district area with a flat gentle regional slope towards Loktak Lake.

## 2.9 Flora and fauna

The Loktak Lake is ecologically rich in flora and fauna. The hills and forests around Moirang possess diverse medicinal herbs and plants as well. Among the medicinal plants used normally by people, Nongmangkha, Leipungkhanga, Tulashi, etc may be mentioned; and some of the beautiful flowers available in and around Loktak Lake and Moirang are Thambal (i.e. Lotus), Tharo (i.e. water lily), Khongum-malei, Kundo, Leihow, etc.

#### **2.10** Soil

The soil of Moirang planning area can be categorized into two parts. Western part of the planning area has majorly alluvial soil type that is good for farming, whereas eastern part of the town is mainly coming under wetland and have marshy land, which has high water holding or waterlogging capacity that that support plant life.

## 2.11 Regional Connectivity

#### 2.11.1 Inter State

Manipur State Transport (MST) and private buses running daily on NH150 from to Bishnupur to Imphal and then on Asian Highway (AH1) to reach Guwahati via Dimapur and Kohima. Imphal city, being the capital of the state, boasts robust inter-state connectivity. Given its proximity, Bishnupur largely relies on Imphal's transportation infrastructure to travel to other states.

Bir Tikendrajit International Airport formerly known as Tulihal Airport, located in Imphal is approximately 20 km from Bishnupur Town that connects the State to other major cities of India including New Delhi, Kolkata, Guwahati and Silchar. Other than this people also commute via roads. MST provides bus services to Bishnupur to Dimapur and Guwahati via Imphal and Kohima operates on NH 2 on daily basis. Apart from this, a railway line project connecting Imphal to Jiribam and further Assam is under construction. This will also serve to Bishnupur mainly through two proposed railway stations, one is approximately 23 km away Imphal Railway Station and other is Tupul Railway Station, which will be approximately 55 km from the Bishnupur Town.

## 2.11.2 Intra State

Moirang is directly connected by roads to Imphal city, which in turn is connected to Guwahati and Silchar in Assam. National Highway NH-150 passes through Moirang connecting it to nearby cities. Bus services are frequently available from Imphal to Moirang. Bishnupur DHQ town is situated at an approximate distance of 47.2 km from the bus station of Imphal city (as depicted in Figure 2.11-1. Manipur State Transport (MST) operates buses daily on NH 150, providing convenient transportation to reach Imphal, but the locals commute through auto, wingers and private taxis or privately owned vehicles. But the major mode of transport is

private taxis and buses or by privately owned vehicles. Other than this proposed railway project will improve the intra station connectivity of Bishnupur.

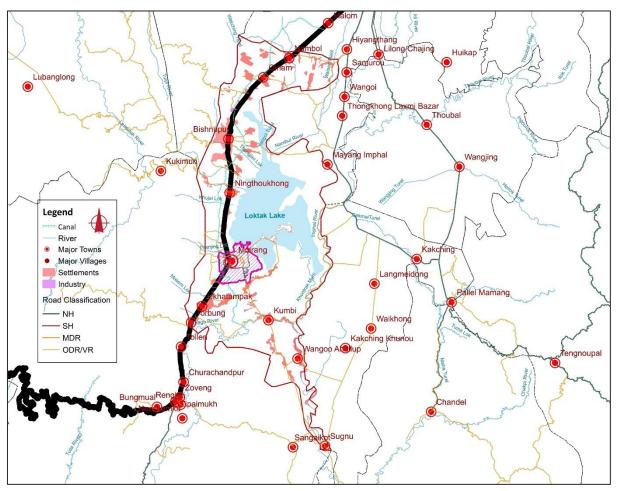


Figure 2.11-1: Settlements influenced by NH 150

Source: Google Earth Imagery

#### 2.11.2.1 Road

MST (Manipur State Transport) buses operate daily on crucial routes connecting Moirang, Bishnupur, and Imphal, facilitating convenient transportation for commuters. The service includes direct routes such as Moirang to Bishnupur and Bishnupur to Churachandpur via Moirang. Inter-district buses cover various key routes, including Imphal-Kwakeithel-Malom-Utlou-Nambol-Keinou-Oinam-Bishnupur-Ningthoukhong-Moirang, Imphal-Patsoi-New Keithelmanbi-Tupul-Noney, and Imphal-Nambol-Moirang-Churachandpur-Pherzawl. Additionally, the introduction of an Inter-district Bus Service has expanded connectivity with routes like Imphal-Noney, Imphal-Moreh, Imphal-Pherzawl, Imphal-Yairipok, Imphal-Kakching, and Imphal-Moirang, enhancing accessibility for travellers across the region. In the first phase,

MST will operate city bus service in two routes, both originating from ISBT, Deulahland. The transport agency would also initially have Imphal-Noney, Imphal-Moreh, Imphal-Kakching, Imphal-Yairipok, Imphal-Moirang and Imphal-Pherzawl inter-district bus services. Public transport for the remaining districts will also be launched at the earliest.

#### 2.11.2.2 Railway

Moirang has no rail connectivity. However, the nearest major railway station is in Dimapur at about 250 km away. From the railway station taxis, buses are available to reach Moirang. Upcoming Imphal railway station is at 38.5 km away from Moirang.

#### 2.11.2.3 Air

Bishnupur, Manipur Heli service by AONE Helicopter. Offers chopper service for weddings, anniversary celebrations, joyrides, advertising in the sky, even family adventures (business, occurrence, pilgrimage, marketing or simply for pleasure).

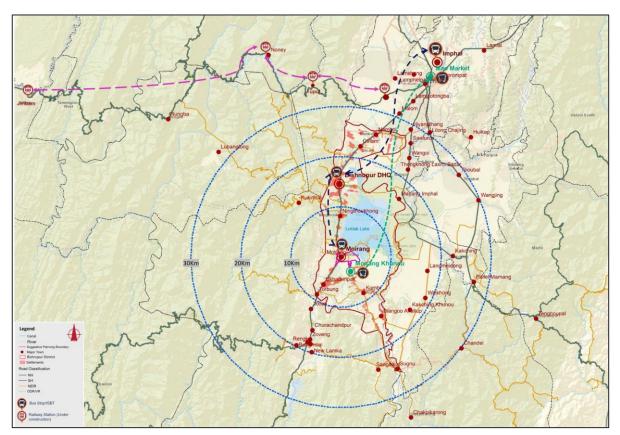


Figure 2.11-2: Intra State connectivity of Moirang Planning Area

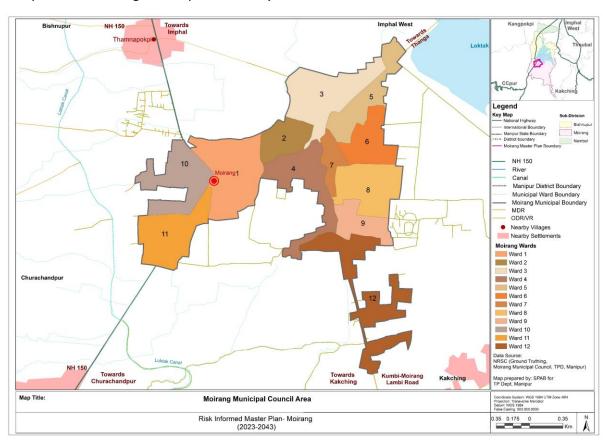
Source: Google Earth Imagery

Figure 2.11-2 shows the radius of 10, 20 and 30 km distance buffer from the main town. This figure depicts the major settlements in theses buffer areas which helps to understand the influence of town on other settlements based on distance and connectivity. Major tourist spot known as Loktak Lake, INA and Keibul Lamjao National Park are inside the 10km radius. The number of major settlements reduced in 20km radius due to topographical challenges in western side. The settlements are in 30km radius from the Moirang town including Imphal, Kangpokpi and Senapati in North direction connected by NH150.

## **Chapter 3 Delineation**

## 3.1 Moirang Municipal Council Area

Moirang Municipal boundary area is 353.13 Ha which is governed by Moirang municipal council. As per census 2011, the town has total population of 20,287 with a population density of 43 Person per Hectares (pph) (Census of India, 2011). The town has 12 wards as shown in Map 3.1-1 and Table 3.1-1. Total road length of the town including local, collector and arterial is approximately 90 km. Moirang is well-connected through NH 150, linking it to Imphal city, Bishnupur, and Churachandpur. Additionally, the significant Kumbi-Moirang-Lambi road connects the town to Kakching. Moirang's central location, along with its tourist attractions, draws a daily influx of 2000 to 3500 visitors during peak season, comprising both tourists and through-passers.



Map 3.1-1: Moirang Municipal Boundary

Source: Moirang Municipal Council

Table 3.1-1: Moirang Municipal Area specifications

S. No.	Specifications	
1	Area	353.13 Ha
2	Population	20287 (Census 2011)
3	Density	43 pph
4	Total Road Network Length	Approximately 90 Km
5	Wards	12
6	Tourist Number	2000-3500

Source: Census of India 2011 and GTS 2023

## 3.2 Moirang Planning Area

Moirang town is spatially growing towards Bishnupur and Imphal that is mainly along the NH 150. Town is also growing towards the Loktak lake, which need to regulate so it will mitigate the haphazard growth in this direction as represented in Map 3.2-1. The total area of Moirang planning area is 1703.88 Ha. It includes the abutting land of Loktak lake towards North-East.

Thannagolo

Thannagolo

Legend

Builtup-2011

Builtup-2016

Builtup-2023

1,0,8 km Distance

Builtup-2023

1,0,8 km Distance

Builtup-203

1,0,8 km Distance

Builtup-204

Builtup-203

1,0,8 km Distance

Builtup-204

Builtup-205

Builtup-203

1,0,8 km Distance

Builtup-204

Builtup-205

Bu

Map 3.2-1: Spatial growth in and around Moirang Town in years

Source: Google Earth Imagery

It also shares its boundary with Naranseina village that comes under the jurisdiction of Bishnupur sub-division, it also delineates the planning boundary from the North direction.

The planning area for Moirang is determined by four primary criteria. Firstly, it considers the spatial growth patterns of the town. Secondly, it aims to regulate the eco-sensitive areas adjacent to Loktak lake. Thirdly, the delineation seeks to establish contiguity between the new settlement and the existing town along the highways. Lastly, it endeavours to meet the anticipated future land demand to facilitate the provision of necessary infrastructure and services. These criteria collectively guide the strategic delineation of Moirang's planning area, ensuring a comprehensive understanding of the town's spatial expansion, environmentally sensitive zones around Loktak lake, connectivity between new and existing settlements, and the accommodation of future land requirements for essential infrastructure and services. suffice the future land demand to provide infrastructure and services.

The proposed planning area as represented in Map 3.2-2, for Moirang town incorporates the contiguous land adjacent to Loktak lake, extending from the north to the northeast and east directions. Narasiena village, situated in the northwest is included in planning area. The southwest boundary aligns with Tronglaobi village, while in the southeast, it shares a boundary with Moirang Khounou village. These boundaries are overlaid with khasra boundaries, aligning the delineated planning boundary accordingly. This strategic delineation adheres to urban planning principles, considering geographic features, neighbouring communities, and ecological aspects for a holistic and sustainable approach to town development.

Bishmopur

Thamasologo

Lostal Lalie

Legend

Kakhing

Kakhing

Lostal Lalie

Legend

Kakhing

Kakhing

Lostal Lalie

Legend

Kakhing

Map 3.2-2: Additional area in Moirang Master Plan Boundary

Source: TPD, Manipur

# Chapter 4 Goals, Methodology & Approach

### 4.1 Vision

The vision is to "Foster a Sustainable Tourism and Risk Resilient Environment for Moirang".

### 4.2 Goals

- 1. To make the town environmentally sustainable that provides a healthy environment for its citizens and is capable of adapting to hazard risks.
- 2. To develop the town in a manner that offers good quality, affordable and safe living environment with efficient mobility systems by promoting more equitable distribution of town services.
- 3. To develop the town into a vibrant destination that stimulates economic, creative, and cultural growth through tourism.

# 4.3 Objectives

- 4. To prioritize environmental concerns and focus on rejuvenation of natural assets, greening of built environments, supporting green economies like urban farming, and creating a diverse portfolio of natural and planned open spaces.
- 5. Safeguarding and enriching the cultural legacy, establishing robust economic connections, and fostering opportunities for cultural immersion, tourism, and vibrant public experiences.
- 6. To develop and upgrade public utilities and infrastructure to withstand and adapt to potential risk, ensuring long term functionality and safety during hazards.
- 7. To reduce pressures on core areas by promoting an uniform distribution developed areas and services, while developing infrastructure that is resilient to risks and thus ensuring minimal disruption during hazards.
- 8. Development of diverse supporting infrastructures for tourism such as hospitality and transportation related infrastructure, and its management.
- 9. To utilize data and technology to monitor risks, evaluate resilience strategies, and make informed decisions that improve long-term urban resilience.

10.

# 4.4 Methodology Adopted for Plan Preparation

The preparation of a master plan involves a meticulous and multi-faceted approach. Commencing with the delineation of the town area based on continuous growth and Abadi considerations, the process evolves through a comprehensive ground truthing survey. This survey captures intricate details related to buildings, roads, natural features, and potential growth areas, serving as a foundation for subsequent planning phases. Simultaneously, secondary data is collected through questionnaires circulated among town authorities and departments. This dataset comprises sector-specific information encompassing agriculture, industry, education, and healthcare, along with details related to essential services like water supply, electricity, and solid waste management. The preparation of the existing land use map involves the integration of data acquired from satellite imagery, aerial photography, and GIS databases. This amalgamation contributes to the formulation of a detailed base map and a comprehensive land use map. To refine the master plan, a comprehensive demographic analysis is undertaken, drawing on census data spanning the past three decades to unveil trends, population growth patterns, and migration dynamics. The current state of infrastructure, encompassing land use, transportation, utilities, and natural resources, undergoes meticulous scrutiny. Demographic, economic, and social dynamics are meticulously analysed to identify major gaps and challenges in services and infrastructure. These valuable insights form the basis for crafting sector-wise proposals, strategically designed to address the identified challenges, thereby contributing to the development of a comprehensive and cohesive master plan. Detailed methodology of master plan preparation of Moirang town is shown in Figure 4.4-1.

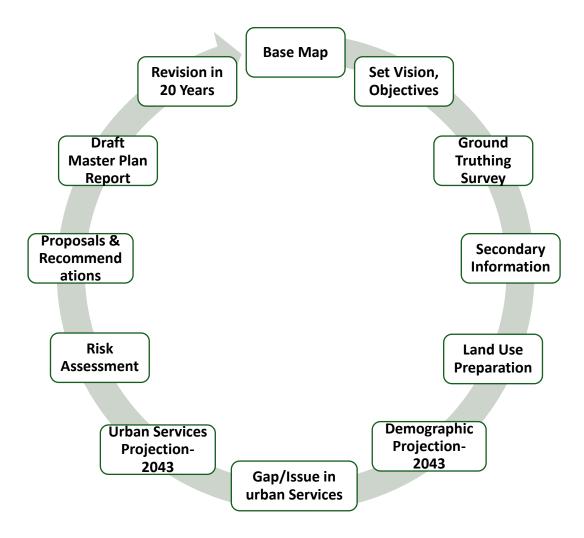


Figure 4.4-1: Methodology for Master Plan

# **Chapter 5 Demography**

The chapter explains the current demographic characteristics of the area.

# 5.1 Demographic profile

As per census 2011, Total population of Moirang Municipal Council (MMC) area is 19,893 with population density of 43 persons per hectare. The total area of MMC is 353.13, whereas planning area includes a village and its outgrowth area and comprising a total area of 1703.88 Ha. The total area of Moirang planning area is 23308 as per census 2011, Table 5.1-1 and Figure 5.1-1.

Table 5.1-1: Demography of Moirang Planning Area

Number of Ward/Census Town/Out-Growth/Villages	12 wards	12 wards with 1 Villages
Total Area (Ha)	353.13	1703.88
Total Population	19,893	23,308
Male Population	9,841	11,603
Female Population	10,052	11,804
Total Households	3,723	4408
Population Density (pph)	43	14
Literacy Rate (%)	83.93	79.51
Sex Ratio	1,021	1,017

**Moirang MCL** 

**Moirang Planning Area** 

Source: Census of India 2011 and Author

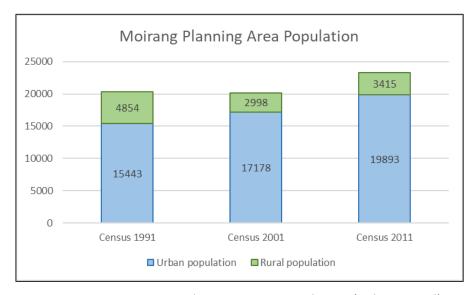


Figure 5.1-1: Moirang Planning Area Population (Urban-Rural)

Source: Census of India (1991, 2001, 2011)

Urban population growth rate is increased from 11.23% to 15.81% during the period 2001-2011. Whereas rural population growth is declined by 38.24% in census 2001 and further increased at the growth rate of 13.91%, as per Census of India, 2011.

# **5.1.1** Population Density

The Figure 5.1-2, illustrates the urban population density, measured in people per hectare (pph), for three Census years: 1991, 2001, and 2011. Over the two decades, the data shows a consistent increase in population density, reflecting urban growth and concentration.

In 1991, the urban population density stood at 32 pph, indicating a relatively low level of urbanization. By 2001, this figure had risen to 36 pph, signalling a moderate increase in population density, likely due to a growing urban population or a reduction in available urban land. The trend continued in 2011, with the population density reaching 42 pph, demonstrating further urban expansion and intensification.

This steady rise in population density over the years underscores the increasing pressure on urban areas to accommodate more people. It highlights the importance of effective urban planning and resource management to ensure sustainable development and improve the quality of life for urban residents. The data is sourced from the Census of India for the years 1991, 2001, and 2011.

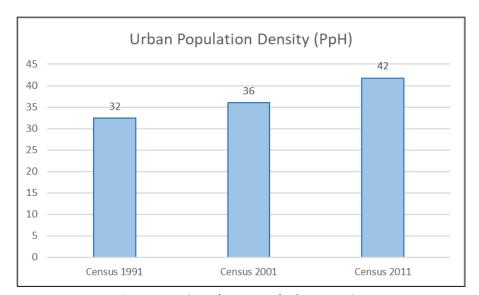


Figure 5.1-2: Urban Population Density

Source: Census of India (1991, 2001, 2011)

### **5.1.2** Literacy

Literacy rate of Moirang planning area is 82.81%, which is higher than the literacy rate of Bishnupur District (75.85%) and Manipur State (76.94%) (India, 2011). There is not much difference between the rural and urban literacy rate. Urban literacy rate is 83.93% whereas rural literacy rate is 81.69% as represented in Table 5.1-1 and Figure 5.1-3.

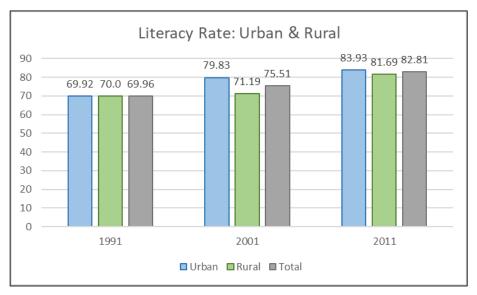


Figure 5.1-3: Literacy Rate

Source: Census of India (1991, 2001, 2011)

#### 5.1.3 Sex Ratio

Total male population of Moirang planning area is 11603, which consist of 49.78% of the total population, as per census 2011. Sex ratio of planning boundary is increased significantly since last two census year from 974 to 1008. There is a large difference in urban and rural sex ratio and its growth. Urban sex ratio is significantly increased, whereas in rural area it decreased from 1012 to 994 during the period 2001 to 2011, Figure 5.1-4.

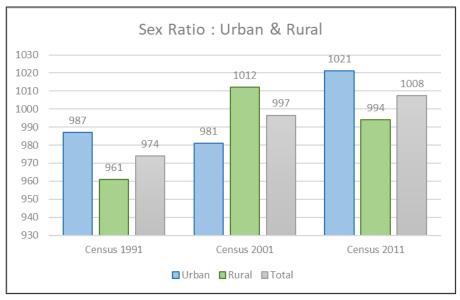


Figure 5.1-4: Sex Ratio

Source: Census of India (1991, 2001, 2011)

## 5.2 Projected Population

According to census data from 2011 shown in Table 5.2-1, the population of the Moirang Planning area is 23,407. This figure reflects a notable decrease in the growth rate compared to the previous decade, dropping from 19.53% to 16.01%. Despite this decline in growth rate, the population continued to increase steadily. Table 5.2-1, illustrate, from 2011 to 2021, the growth rate further decreased to 12.81%, indicating a slower yet consistent rise in population to 26,405 individuals. This pattern of moderated growth persisted through 2031 and 2041, with growth rates of 12.22% and 11.77% respectively, suggesting a gradual levelling off population expansion.

By 2043, while the exact growth rate remains unspecified, projections indicate a continued upward trend in population, with an estimated population of 33,853 individuals in the Moirang Planning area. This sustained growth over the decades underscores the resilience of the town's population dynamics. However, the consistent decrease in the growth rate from 20.59% in 1991 to just above 16.01% in 2011 suggests a trend of declining population growth. This ongoing decrease in growth rate has implications for the overall projected population of the town. Considering the average of the past four to five decades, the projected growth is expected to hover around 12%, highlighting the need for strategic planning and development

initiatives to accommodate this anticipated growth while ensuring sustainability and quality of life for residents.

Table 5.2-1: Population Forecast for 2043

# Population Forecast for 2043 (Average of Linear and Geometric Mean Method)

Year	Total Population (Urban + Rural)	Required Housing Units	Growth rate (%)
1991	20,297	2,468	20.59
2001	20,176	3,278	19.53
2011	23,407	4,408	16.01
2021	26,405	5,281	12.81
2031	29,632	5,926	12.22
2041	33,120	6,624	11.77
2043	33,853	6,771	

Source: Census 1991, 2001, 2011

# **Chapter 6 Land Use**

The Existing Land Use (ELU) is a basis for preparation of master plan. This chapter discuss Moirang land use preparation and its classification. The planning area is divided into various zones based on ward boundaries, road network and predominant activities. The total area refers to the area of Municipal Council and influence area round it. The settlements are also seen sometimes on the fringe areas. The existing developed area is around 15.46% of the total area. This developed area constitutes residential, commercial, industrial, mixed use, transport, public & semi- public, public utility, recreational, grassland and vegetated areas etc.

### 6.1 Land Use 2023

The land use for the year 2023 has been prepared using remote sensing data from NRSC and validated through a ground truthing survey, considering 20 classes of land use as per AMRUT standards and guidelines. To establish a rationale for the future spatial structure and land use patterns, it is essential to analyse the existing land use and identify the current spatial structure. The classes into which the existing land use has been categorized for the Moirang planning area for 2023 are presented in Table 6.1-1 and illustrated in Figure 6.1-1. The spatial distribution of land use is depicted in Map 6.1-1.

The total planning area of Moirang is 1,703.88 hectares. Table 6.1-1 demonstrates that the largest proportion of land use is under agriculture, comprising 63.58% of the total area, reflecting the predominance of agricultural activities in the peripheral areas due to limited built-up expansion. Residential land use accounts for 10.51% of the total area, concentrated primarily in the town's core and extending sparsely to the periphery. High-density residential areas are observed along NH 150 and Old Cachar Road. On the western side, residential development is constrained by the terrain.

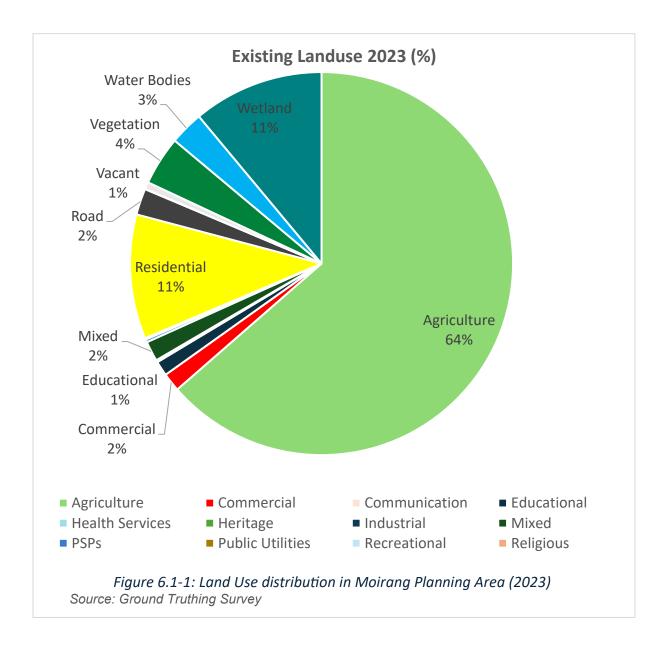
Table 6.1-1: Land use area and percentage in Moirang planning area.

S. No.	Land use	Area (Ha)	Area (%)	S. No.	Land use	Area (Ha)	Area (%)
1	Agriculture	1083.36	63.58	12	Religious	1.31	0.08
2	Commercial	26.59	1.56	13	Residential	179.01	10.51
3	Communication	0.01	0.00	14	Roads	37.82	2.22
4	Educational	21.30	1.25	15	SWM	0.20	0.01
5	Health Services	1.14	0.07	16	Transportation	0.18	0.01
6	Heritage	1.37	0.08	17	Vacant	10.10	0.59

Risk Informed GIS Based Master Plan for Moirang- 2043

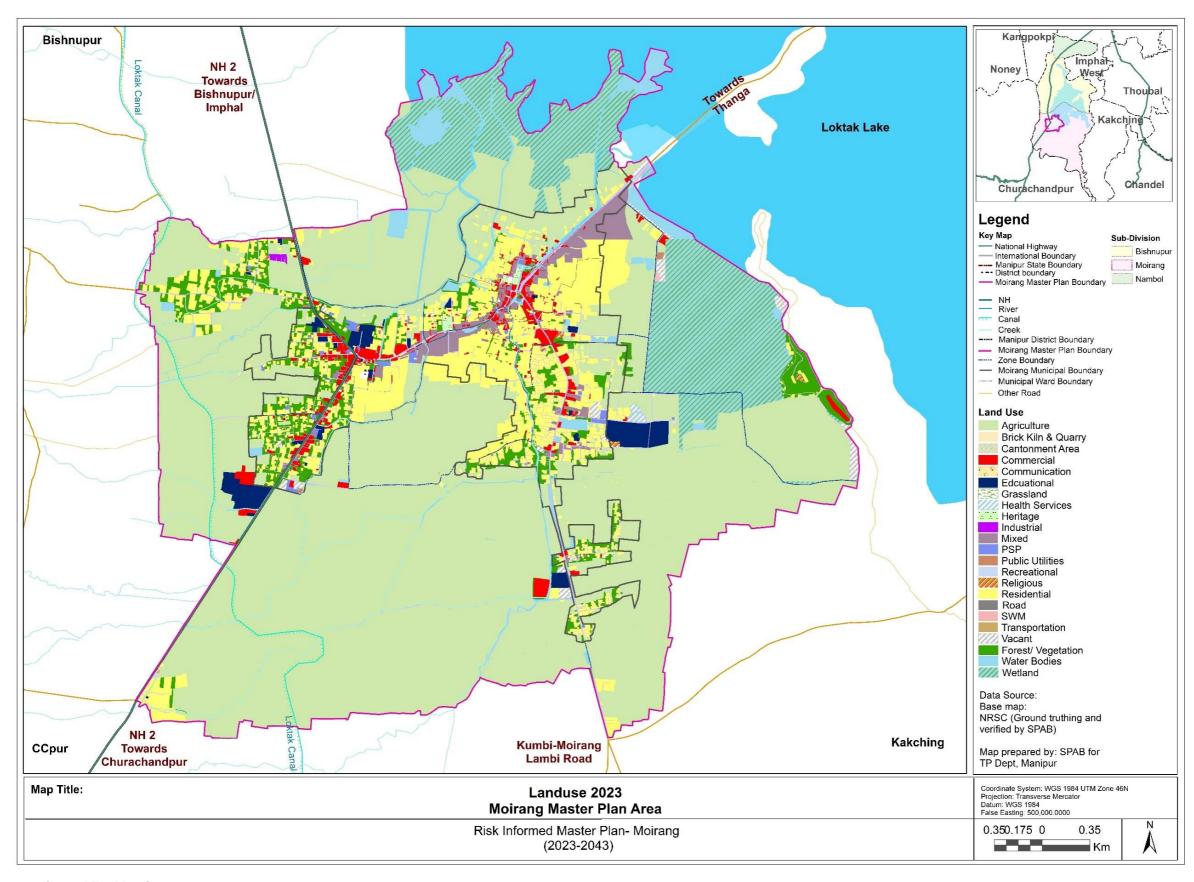
7	Industrial	0.64	0.04	18	Vegetation	70.34	4.13
8	Mixed	28.81	1.69	19	Water Bodies	48.47	2.84
9	PSPs	4.08	0.24	20	Wetland	188.41	11.06
10	<b>Public Utilities</b>	0.53	0.03		Total	1703.88	
11	Recreational	0.21	0.01				

Source: Ground Truthing Survey



This analysis highlights the dominance of agricultural land use in Moirang, with other notable land uses, including wetlands (11.06%), vegetation (4.13%), and roads (2.22%), which collectively shape the spatial structure of the planning area.

Map 6.1-1: Land use map of Moirang Planning Area



Source: Ground Truthing Survey

## 6.2 Zonal boundary

Zonal boundaries are created to understand resource allocation within the town in a spatial manner. This analysis provides a framework for the equitable distribution of resources, helping to identify areas that require targeted interventions or improvements. It also supports balanced development across the town. The division of town boundaries is based on specific land use or dominant land use patterns, enabling the identification of zone-specific infrastructure gaps and facilitating effective planning to meet future demands.

Moirang town has been divided into eight zones to better understand the spatial arrangement of infrastructure and amenities, Map 6.2-1. This zoning is based on three main criteria: i) Alignment with ward boundaries, ii) Predominant activities within the zone, and iii) Ensuring that each ward falls entirely under the jurisdiction of a single zone.

Table 6.2-1: Zone-wise area and percentage in Moirang planning area.

S. No.	Zone	Wards included (with number)	Area	%
1	Zone 1	Ward 10	231.82	13.61
2	Zone 2	Ward 1, 4 and 11	182.24	10.70
3	Zone 3	Ward 2, 3, 5,6 and 7	149.81	8.79
4	Zone 4	Ward 8, 9 and 12	98.21	5.76
5	Zone 5	None	455.62	26.74
6	Zone 6	None	214.07	12.56
7	Zone 7	None	161.30	9.47
8	Zone 8	None	210.84	12.37
	Total		1703.88	

Source: Author

The zones are classified into two distinct categories:

- i) Zones within the municipal region (Zone 1, Zone 2, Zone 3, and Zone 4)
- ii) Zones located beyond the municipal boundaries, constituting the proposed planning area (Zone 5, Zone 6, Zone 7, and Zone 8).

The distribution of wards within the municipal zones is as follows: Zone 1 includes Ward 10, while Zone 2 encompasses Wards 1, 4, and 11. Zone 3 comprises Wards 2, 3, 5, 6, and 7, and Zone 4 consists of Wards 8, 9, and 12. Zones 5 to 8 do not include any wards, as they are located in the surrounding areas beyond the municipal boundary.

Table 6.2-1 indicates that Zone 5 is the largest zone in terms of area, covering 455.62 hectares (26.74% of the total planning area). Zone 4 is the smallest zone, encompassing only 98.21

hectares (5.76% of the total area). Zones within the municipal boundary, particularly Zones 1 through 4, are characterized by higher residential density and infrastructure concentration, while Zones 5 through 8 primarily feature agricultural and undeveloped areas with potential for future expansion

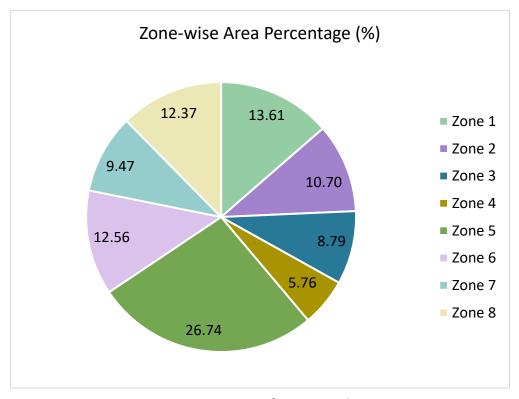


Figure 6.2-1: Zone wise area of Moirang Planning Area

Source: Author

NH 2 Towards Bishnupur Imphal Legend Key Map

National Highway
International Boundary
International Boundary
Manipur State Boundary

Moirang Master Plan Boundary
Moirang Master Plan Boundary Bishnupur — NH River Canal Creek Manipur District Boundary
 Moirang Master Plan Boundary --- Zone Boundary Moirang Municipal Boundary Municipal Ward Boundary Other Road Zones Zone 1 Zone 2 Zone3 Zone 4 Zone 5 Zone 6 Zone 7 Zone 8 Data Source: Base map: NRSC (Ground truthing and verified by SPAB) NH 2 Kakching Kumbi-Moirang Towards Map prepared by: SPAB for TP Dept, Manipur Lambi Road Churachandpur Map Title: Zonal Boundary Moirang Master Plan Area Risk Informed Master Plan- Moirang (2024-2044) 2023-2043) 0.350.175 0 0.35

Map 6.2-1: Zonal Boundary of Moirang Planning Area

Source: Author

#### 6.2.1 Zone 1 Land Use

Zone 1 occupies the western part of the Moirang Master Plan Area, with an area of 231.82 Ha, accounting for 13.61% of the total area of Moirang Master Plan. It shares boundaries with Zone 2 to the east and Zone 4 to the southeast. This zone comprises Wards 10 and 11, which are key components of its demographic and infrastructural development. The centrality of Zone 1 within the plan ensures that it plays a significant role in the region's development, especially considering its proximity to important areas in the Moirang Master Plan.

Table 6.2-2: Zone 1 land use

S.No.	Landuse	Area (in Ha)	%
1	Agriculture	158.67	68.44
2	Commercial	5.49	2.37
3	Educational	7.07	3.05
4	Industrial	0.63	0.27
5	Mixed	0.35	0.15
6	PSPs	0.47	0.20
7	Public Utilities	0.08	0.03
8	Religious	0.12	0.05
9	Residential	25.21	10.87
10	Roads	7.24	3.12
11	Vacant	0.01	0.00
12	Vegetation	23.63	10.19
13	Water Bodies	2.87	1.24
	Total	231.82	

Source: Author

The Table 6.2-2 presents the land use distribution in Zone 1 of Moirang. In this area, agriculture dominates with 68.44%, underscoring the importance of agricultural activities. Commercial spaces account for 2.37%, reflecting areas designated for small businesses. Educational spaces cover 3.05%, including St. Xavier School, Moirang and Loktak Christian High School. Industrial zones make up 0.27%, while mixed-use areas contribute 0.15%. Public utilities, religious spaces, and PSPs collectively add to the diverse urban landscape, with percentages of 0.03%, 0.05%, and 0.20%, respectively. Residential areas cover 10.87%, supporting housing needs in localities such as Khoiru Leikai and Hemam Colony. Roads occupy 3.12%, facilitating connectivity, while vegetation spans 10.19%, highlighting green spaces mainly within the residential localities. Water bodies constitute 1.24%, enhancing the natural

features of Zone 1. This comprehensive breakdown illustrated in Figure 6.2-2 and Map 6.2-2 the varied uses and functions of the land within this zone.

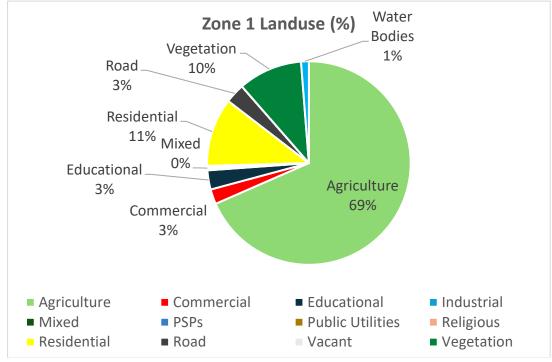
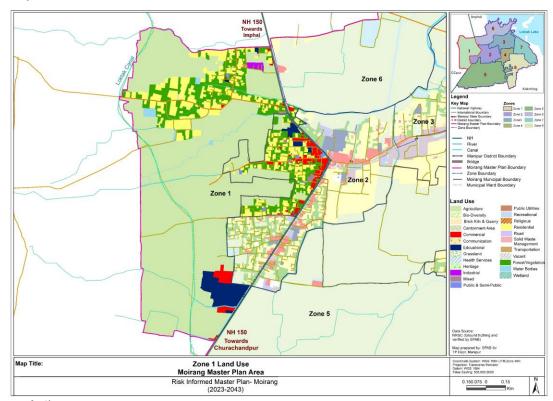


Figure 6.2-2: Zone 1 land use distribution

Source: Author

Map 6.2-2: Zone 1 land use



Source: Author

### 6.2.2 Zone 2 Land Use

Situated centrally in the Moirang Master Plan Area, Zone 2 is a key area for urban expansion and development. It is bordered by Zone 1 to the west, Zone 3 to the north, Zone 4 to the south, and Zone 7 to the east. The area of Zone 2 is 182.24 Ha, which makes up 10.70% of the total Moirang Master Plan Area. The inclusion of Wards 1, 4, and 11 within Zone 2 underscores its importance as both a residential and commercial centre. This zone's strategic location connects several other key areas of the Master Plan, positioning it as a vital area for future infrastructure projects and urban growth.

Zone 2 of Moirang town demonstrates a varied land-use pattern, with agriculture as the dominant feature, covering 42.96% of the area, highlighting its agrarian nature, Table 6.2-3. Residential areas occupy 30.39%, indicating a considerable area under residential landuse. Commercial zones account for 3.73%, reflecting economic activity, while educational up 2.20% that includes Moirang Multipurpose Higher Secondary School. Mixed-use areas contribute 4.58%, and Public Semi-public (PSPs) cover 1.29%, indicating the provision of essential public infrastructure. Roads comprise 3.64%, underlining the significance of transportation. Water bodies and vegetation, at 1.69% and 8.58%, respectively, enhance the ecological value of the zone.

Table 6.2-3: Zone 2 land use

S. No.	Landuse	Area (in Ha)	%
1	Agriculture	78.30	42.96
2	Commercial	6.79	3.73
3	Educational	4.01	2.20
4	Health Services	0.04	0.02
5	Industrial	0.00	0.00
6	Mixed	8.35	4.58
7	PSPs	2.34	1.29
8	Public Utilities	0.15	0.08
9	Recreational	0.10	0.05
10	Religious	0.26	0.14
11	Residential	55.38	30.39
12	Roads	6.64	3.64
13	Vacant	1.16	0.63
14	Vegetation	15.64	8.58
15	Water Bodies	3.08	1.69
	Sub Total	182.24	

Source: Author

This landuse breakup is represented in Figure 6.2-3 and Map 6.2-3.

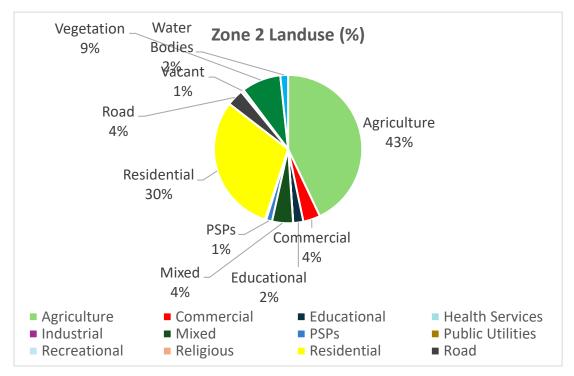
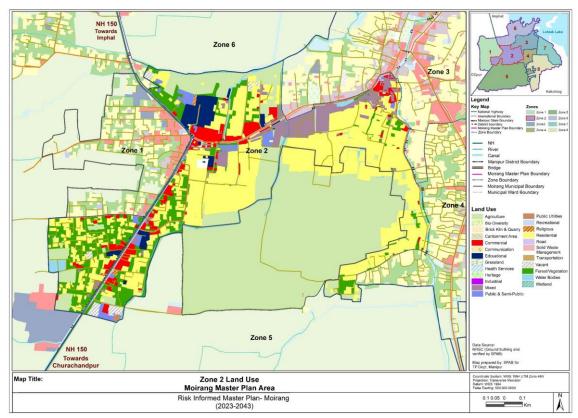


Figure 6.2-3: Zone 2 land use distribution

Source: Author

Map 6.2-3: Zone 2 land use



Source: Author

#### 6.2.3 Zone 3 Land Use

Zone 3 is in the northernmost part of the Moirang Master Plan Area, adjacent to the picturesque Loktak Lake. This zone shares boundaries with Zone 2 to the south, Zone 6 to the east, and the lake to the northeast. The area of Zone 3 is 149.81 Ha, making up 8.79% of the total Moirang Master Plan Area. Ward 3, which is fully encompassed within Zone 3, plays a central role in the zone's development. The proximity to Loktak Lake not only enhances the scenic beauty of the area but also makes it a priority for ecological conservation and sustainable urban planning. The balance between development and environmental preservation is crucial in this zone, positioning it as a model for future development that integrates natural resources with urban growth.

Zone 3 of Moirang Town exhibits a varied land-use pattern, with agriculture being one of the predominant uses, covering 34.31% of the area, highlighting the significance of this sector in the local economy. Residential areas make up 35.74%, commercial spaces contribute 5.25% as shown in Table 6.2-4, indicating economic activity such as IMA Market and other commercial activities surrounding it, while mixed-use areas account for 11.26%, enhancing the multifunctional nature of the zone located mainly along Thanga road. Vegetation and water bodies contribute 2.78% and 3.88%, respectively, underscoring the environmental focus of the area. Roads cover 4.37%, highlighting transportation infrastructure. The zone also features heritage and educational spaces at 0.92% and 0.46%, respectively, as well as PSPs at 0.34%, contributing to the zone's social and public infrastructure.

Table 6.2-4: Zone 3 land use

S.No.	Landuse	Area (in Ha)	%
1	Agriculture	51.40	34.31
2	Commercial	7.86	5.25
3	Communication	0.01	0.01
4	Educational	0.69	0.46
5	Health Services	0.01	0.00
6	Heritage	1.37	0.92
7	Industrial	0.01	0.01
8	Mixed	16.86	11.26
9	PSPs	0.51	0.34
10	Public Utilities	0.05	0.03
11	Religious	0.34	0.23
12	Residential	53.54	35.74
13	Roads	6.55	4.37
14	Transportation	0.18	0.12

15	Vacant	0.42	0.28
16	Vegetation	4.16	2.78
17	Water Bodies	5.82	3.88
18	Wetland	0.02	0.01
	Total	149.81	

Source: Author

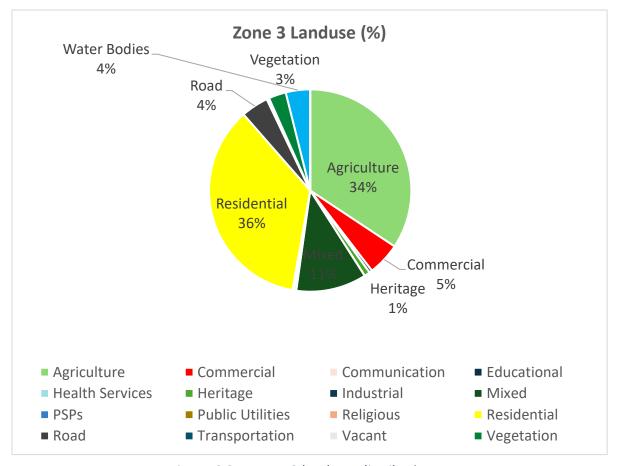
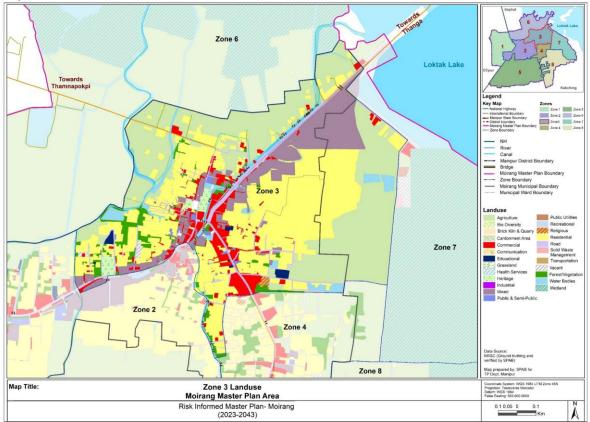


Figure 6.2-4: Zone 3 land use distribution

Source: Author

This landuse breakup is represented in Figure 6.2-4 and Map 6.2-4.



#### Map 6.2-4: Zone 3 land use

Source: Author

#### 6.2.4 Zone 4 Land Use

Zone 4 is situated in the southwestern part of the Moirang Master Plan Area, bordered by Zone 1 to the northwest, Zone 2 to the north, Zone 5 to the southeast, and Zone 8 to the south. The area of Zone 4 is 98.21 Ha, which is 5.76% of the total area of Moirang Master Plan. This zone primarily includes Ward 12, a key area for both residential and community activities. The strategic location of Zone 4 facilitates its role as a critical junction, linking various other zones within the Master Plan. The easy accessibility to Zones 1 and 2 positions Zone 4 as an important gateway area, fostering connectivity and efficient movement within the broader planning area. Its location also offers potential for diverse development projects.

Table 6.2-5 and Figure 6.2-5 for detailed land-use data. Map 6.2-5 illustrates the land use in Zone 4 of the Moirang Planning Area. The land-use distribution in Zone 4 of Moirang town reveals a well-balanced and functional landscape, with various sectors contributing to the area's overall development. Residential areas dominate the zone, covering 31.45 Ha (32.03%) of the total land, providing essential living spaces for the local population. Agriculture remains

as one of the key activities, with 30.65 Ha (31.21%) of land dedicated to agricultural use, underscoring the significance of farming in the local economy.

Table 6.2-5: Zone 4 land use

S. No.	Landuse	Area (in Ha)	%
1	Agriculture	30.65	31.21
2	Commercial	3.10	3.16
3	Educational	0.30	0.30
4	Mixed	2.76	2.81
5	PSPs	0.69	0.70
6	Religious	0.11	0.11
7	Residential	31.45	32.03
8	Roads	9.23	9.40
9	Vacant	1.61	1.63
10	Vegetation	15.45	15.73
11	Water Bodies	2.87	2.92
	Total	98.21	

Source: Author

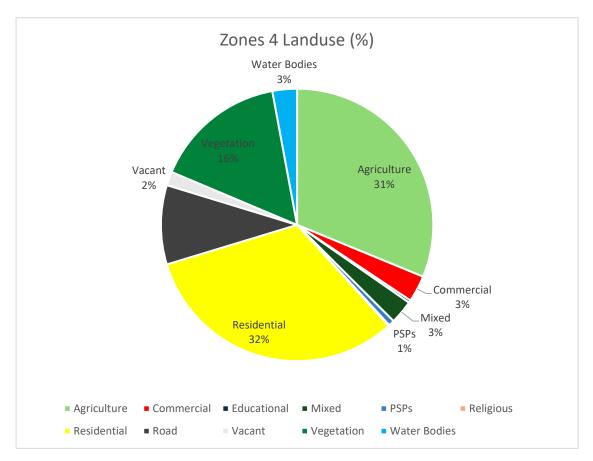


Figure 6.2-5: Zone 4 land use distribution

Source: Author

Zone 3

Zone 4

Zone 5

Zone 6

Zone 6

Zone 6

Zone 6

Zone 7

Zone 6

Zone 7

Zone 6

Zone 7

Zone 8

Zone 8

Zone 8

Zone 8

Zone 8

Zone 9

Map 6.2-5: Zone 4 land use

Source: Author

#### 6.2.5 Zone 5 Land Use

Zone 5 is the largest zone in terms of area within the Moirang Master Plan Area, covering a total of 455.62 hectares, which constitutes 26.74% of the entire master plan area. Strategically located in the southeastern corner, Zone 5 plays a crucial role in connecting and transitioning between the more densely developed areas and the less urbanized zones. While it does not contain specific wards entirely within its boundaries, it encompasses non-municipal areas that contribute to its distinctive character. Zone 5 shares borders with Zone 4 to the west and Zone 8 to the south, positioning it as a vital link for regional integration and facilitating the movement and connectivity between the surrounding zones. Despite its relatively large size, Zone 5 retains its significance in maintaining the balance between urbanization and agricultural land use, contributing to the broader development strategy of the Moirang Master Plan Area.

The land-use distribution in Zone 5 of Moirang Town reflects a dominant agricultural focus, with a limited but essential mix of other land uses to support the local community and the

region's ecological balance. Agriculture is the most prevalent land use, occupying 434.77 Ha (95.42%) of the total area. This underscores the zone's agrarian nature and the central role farming plays in the local economy and food security.

Table 6.2-6 illustrate, Residential areas, though small, account for 7.26 Ha (1.59%) of the land,

S.No.	Landuse	Area (in Ha)	%
1	Agriculture	434.77	95.42
2	Commercial	1.79	0.39
3	Educational	1.46	0.32
4	PSPs	0.01	0.00
5	Recreational	0.11	0.02
6	Religious	0.04	0.01
7	Residential	7.26	1.59
8	Roads	3.26	0.72
9	Vacant	0.91	0.20
10	Vegetation	2.27	0.50
11	Water Bodies	3.73	0.82
	Total	455.62	

indicating that there is some urban presence to support the local population. This suggests a minimal residential development amid the vast agricultural landscape. Water bodies, covering 3.73 Ha (0.82%), are a significant feature in Zone 5, contributing to the region's water resources and ecological diversity. Other features like vacant land (0.91 Ha or 0.20%) and vegetation (2.27 Ha or 0.50%) further enhance the environmental value of the area. Commercial activity, represented by 1.79 Ha (0.39%), is present but limited, indicating that Zone 5 is not yet a hub for significant economic development outside agriculture. Educational spaces, with 1.46 Ha (0.32%), contribute to the basic infrastructure needed for community development, while PSPs (0.01 Ha or 0.00%) and recreational areas (0.11 Ha or 0.02%) are minimal. The allocation for roads, at 3.26 Ha (0.72%), ensures that transportation infrastructure supports the agricultural activities, though it is limited compared to other land uses. Religious areas, at 0.04 Ha (0.01%), are small but present, catering to the spiritual needs of the community.

S.No.		Landuse	Area (in Ha)	%
1	Agriculture		434.77	95.42
2	Commercial		1.79	0.39
3	Educational		1.46	0.32

4	PSPs	0.01	0.00
5	Recreational	0.11	0.02
6	Religious	0.04	0.01
7	Residential	7.26	1.59
8	Roads	3.26	0.72
9	Vacant	0.91	0.20
10	Vegetation	2.27	0.50
11	Water Bodies	3.73	0.82
	Total	455.62	

Table 6.2-6: Zone 5 land use

Source: Author

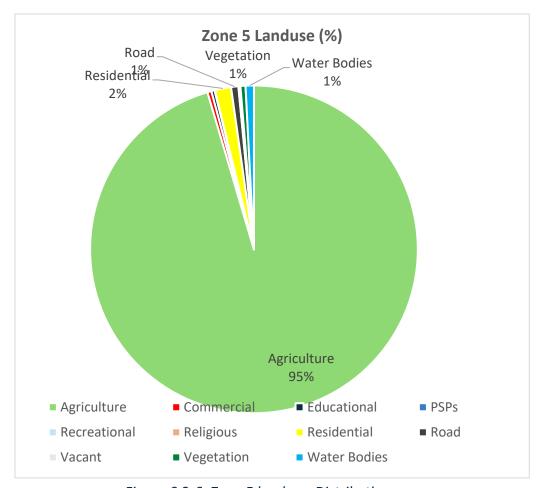
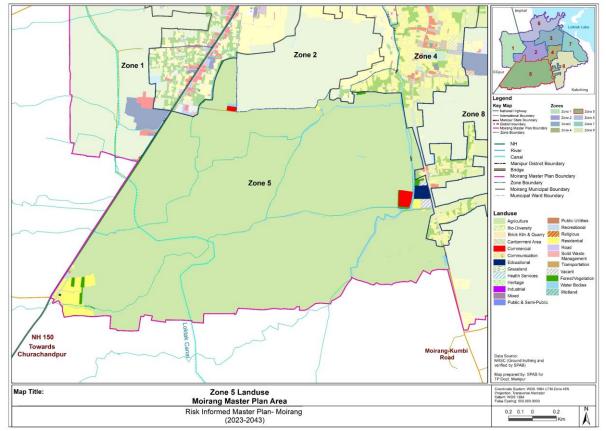


Figure 6.2-6: Zone 5 land use Distribution

Source: Author

In summary, Zone 5 is primarily dominated by agricultural land, with limited urban infrastructure, residential areas, and commercial development. The land-use pattern reflects

the zone's rural and agrarian character, while also accommodating essential services and infrastructure for the local population. For more detailed data, Figure 6.2-6 and Map 6.2-6.



Map 6.2-6: Zone 5 land use

Source: Author

#### 6.2.6 Zone 6 Land Use

Located in the eastern part of the Moirang Master Plan Area, near Loktak Lake, Zone 6 is positioned near natural features that influence its development. The area of Zone 6 is 214.07 Ha, which constitutes 12.56% of the total area of Moirang Master Plan. This zone shares boundaries with Zone 3 to the west, Zone 7 to the south, and Zone 8 to the southwest. Ward 6 is entirely situated within Zone 6, making it the central area for both residential and infrastructural development. The proximity to Loktak Lake not only enhances the environmental significance of the area but also creates opportunities for tourism and sustainable development. Zone 6's unique combination of urban potential and ecological sensitivity positions it as a key area in the Master Plan, where development must be carefully balanced with environmental conservation.

In Zone 6 of Moirang town, the land-use distribution showcases a varied landscape catering to multiple needs and functions. Table 6.2-7 illustrates, agriculture is the dominant land use, covering 105.93 Ha (49.48%), which highlights the area's strong agrarian character. This substantial portion of land reflects the importance of farming and cultivation activities in supporting local livelihoods and the economy. Commercial spaces occupy a minimal 0.33 Ha (0.16%), suggesting limited business and trade activity within the zone. Residential areas account for 1.26 Ha (0.59%), representing a small but necessary portion for housing and community development. Roads, covering 0.29 Ha (0.13%), emphasize the role of infrastructure in ensuring connectivity and access.

Table 6.2-7: Zone 6 land use

S. No.		Landuse	Area (in Ha)	%
1	Agriculture		105.93	49.48
2	Commercial		0.33	0.16
3	PSPs		0.01	0.00
4	Residential		1.26	0.59
5	Roads		0.29	0.13
6	Vegetation		0.15	0.07
7	Water Bodies		24.22	11.31
8	Wetland		81.89	38.25
	Total		214.07	

Source: Author

Water bodies play a prominent role, with 24.22 Ha (11.31%) dedicated to them, contributing to the ecological balance and aesthetic value of the zone. Wetlands, covering 81.89 Ha (38.25%), add to the region's natural richness, supporting biodiversity and environmental sustainability. There is a minimal amount of vacant land (0.91 Ha (0.20%)), which could be potential areas for future development. Vegetation, though limited at 0.15 Ha (0.07%), contributes to the natural greenery of the landscape. The detailed landuse distribution in Zone 6 is shown Figure 6.2-7 and represented in Map 6.2-7.

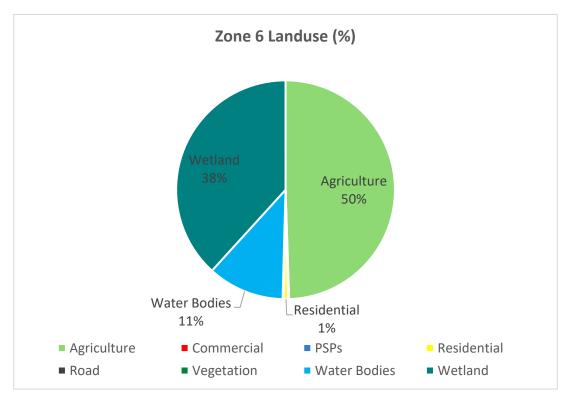
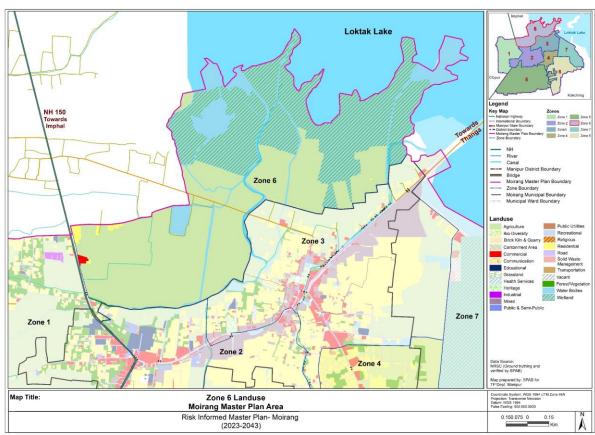


Figure 6.2-7: Zone 6 land use distribution

Source: Author

Map 6.2-7: Zone 6 land use



Source: Author

#### 6.2.7 Zone 7 Land Use

Located in the eastern part of the Moirang Master Plan Area, near Loktak Lake, Zone 6 is positioned near natural features that influence its development. The area of Zone 6 is 214.07 Ha, which constitutes 12.56% of the total area of Moirang Master Plan. This zone shares boundaries with Zone 3 to the west, Zone 7 to the south, and Zone 8 to the southwest. Ward 6 is entirely situated within Zone 6, making it the central area for both residential and infrastructural development. The proximity to Loktak Lake not only enhances the environmental significance of the area but also creates opportunities for tourism and sustainable development. Zone 6's unique combination of urban potential and ecological sensitivity positions it as a key area in the Master Plan, where development must be carefully balanced with environmental conservation.

Zone 7 of Moirang Town showcases a diverse landscape characterized by various land-use categories, each contributing uniquely to the town's overall composition. Map 6.2-8 shows the land use of Zone 7 of the Moirang planning area. Table 6.2-8 illustrates, the predominant feature is the extensive wetland, covering a substantial 96.47 Ha (59.81%), emphasizing the community's commitment to preserving essential ecosystems and fostering biodiversity. Following closely is the vacant land at 6.00 Ha (3.72%), suggesting opportunities for future development or the establishment of green spaces.

Agriculture plays a significant role in the zone, occupying 40.07 Ha (24.84%), underscoring the importance of farming activities in this region. Water bodies cover 5.00 Ha (3.10%), contributing to the scenic beauty and environmental richness of the area. Infrastructure is also well-distributed, with roads covering 2.16 Ha (1.34%), ensuring efficient connectivity within the zone. The landscape is further enhanced with 8.40 Ha (5.21%) of vegetation, adding to the natural aesthetic and supporting the overall environmental balance.

Table 6.2-8: Zone 7 land use

S. No.		Landuse	Area (in Ha)	%
1	Agriculture		40.07	24.84
2	Commercial		1.16	0.72
3	Mixed		0.49	0.31
4	<b>Public Utilities</b>		0.25	0.16
5	Religious		0.20	0.13
6	Residential		0.91	0.56

7	Roads	2.16	1.34
8	SWM	0.20	0.12
9	Vacant	6.00	3.72
10	Vegetation	8.40	5.21
11	Water Bodies	5.00	3.10
12	Wetland	96.47	59.81
		161.30	

Source: Author

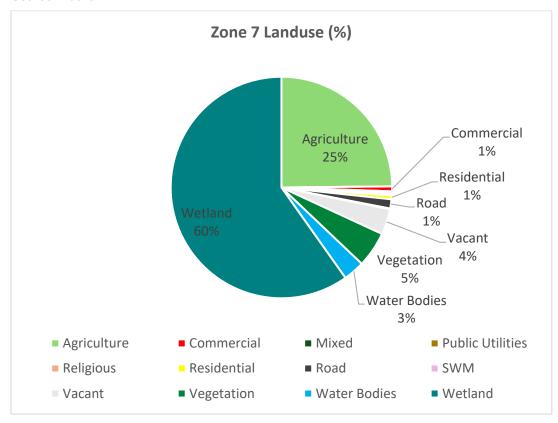


Figure 6.2-8: Zone 7 land use distribution

Source: Author

The residential and commercial sectors make up 0.91 Ha (0.56%) and 1.16 Ha (0.72%), respectively, reflecting the presence of housing and business activities within the zone. Public utilities, religious spaces, and solid waste management (SWM) areas collectively cover 0.25 Ha (0.16%), 0.20 Ha (0.13%), and 0.20 Ha (0.12%), respectively, highlighting essential services for the community. Detailed distribution of landuse is shown in Figure 6.2-8.

Zone 5

Zone 5

Zone 6

Zone 7

Loktak Lake

Map 6.2-8: Zone 7 land use

Source: Author

#### 6.2.8 Zone 8 Land Use

Zone 8 is in the southernmost part of the Moirang Master Plan Area, playing a key role in the development of Moirang's southern extension. The area of Zone 8 is 210.84 Ha, which makes up 12.37% of the total area of Moirang Master Plan. It shares boundaries with Zone 4 to the northwest, Zone 5 to the northeast, Zone 6 to the east, and Zone 7 to the north. The zone includes Wards 8 and 9, which define the residential, commercial, and community activities in the area. Zone 8's southern location makes it an important gateway to the surrounding regions, and its development will significantly enhance Moirang's overall connectivity. This strategic positioning allows Zone 8 to play a critical role in developing vital infrastructure, including roads, public services, and residential areas, contributing to the town's overall liveability and growth.

In Zone 8 of Moirang Town, the predominant land use is agriculture, covering 183.90 Ha (87.22%) of the area. This substantial allocation highlights the zone's primary role in supporting local agricultural activities. Table 6.2-9 illustrates, commercial space is minimal,

accounting for only 0.07 Ha (0.03%), reflecting a limited presence of commercial establishments within the area. Educational facilities occupy 7.76 Ha (3.68%). Health services and religious spaces cover 1.10 Ha (0.52%) and 0.24 Ha (0.12%), respectively, underscoring the zone's commitment to civic amenities and cultural considerations. Public service points (PSPs) contribute a small portion at 0.04 Ha (0.02%). Residential areas occupy 4.01 Ha (1.90%), suggesting that housing is an essential, though not dominant, function within the zone.

Infrastructure development is evident with 2.43 Ha (1.15%) of the area dedicated to roads, emphasizing the importance of connectivity within the zone. The presence of vacant land is 0.00 Ha (0.00%), showing no designated vacant spaces in this area. Vegetation covers 0.37 Ha (0.17%), and water bodies account for 0.88 Ha (0.42%), indicating a balanced approach to preserving natural elements within the urban fabric.

Table 6.2-9: Zone 8 land use

S. No.	Landuse	Area (in Ha)	%
1	Agriculture	183.90	87.22
2	Commercial	0.07	0.03
3	Educational	7.76	3.68
4	Health Services	1.10	0.52
5	PSPs	0.04	0.02
6	Religious	0.24	0.12
7	Residential	4.01	1.90
8	Roads	2.43	1.15
9	Vacant	0.00	0.00
10	Vegetation	0.37	0.17
11	Water Bodies	0.88	0.42
12	Wetland	10.04	4.76
	Total	210.84	

Source: Author

The land-use distribution in Zone 8 reflects a strong agricultural focus, with essential infrastructure and community services also thoughtfully integrated. For detailed data, Figure 6.2-9 and Map 6.2-9 shows the land use of Zone 8 of the Moirang planning area.

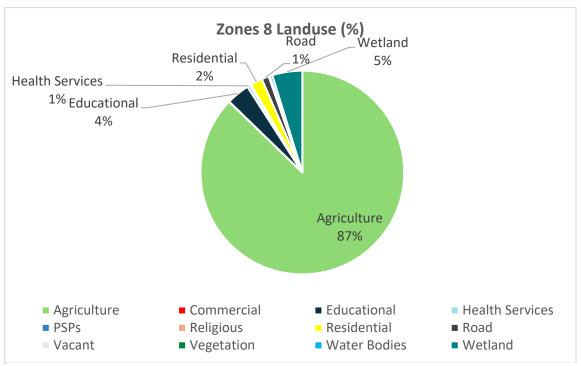
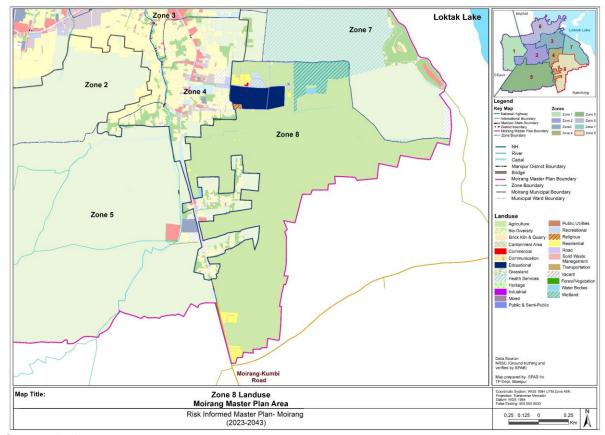


Figure 6.2-9: Zone 8 land use distribution

Source: Author

Map 6.2-9: Zone 8 land use



Source: Author

### 6.3 Issue related to Land Use

#### A. Commercial areas around main traffic junctions cause congestion.

Main market areas of Moirang are situated along the NH 150 and main traffic junction. These commercial activities attract traffic on daily basis throughout the day. This heavy vehicular incoming demands more space to park vehicles (private/public). Figure 6.3-1 shows the lack of parking facility near market areas causes congestion and obstruction in pedestrian movement.

### B. Dilapidated structures along the arterial and other major road

there are some kutcha houses and shops which are in old and in dilapidated condition. These structures are unsafe to live in. it needs an immediate intervention. Figure 6.3-1 shows these types of structures are situated along the major roads also. They are constructed on the foundation made out or Bamboo or wood which questions the stability of the structure during flash flood.

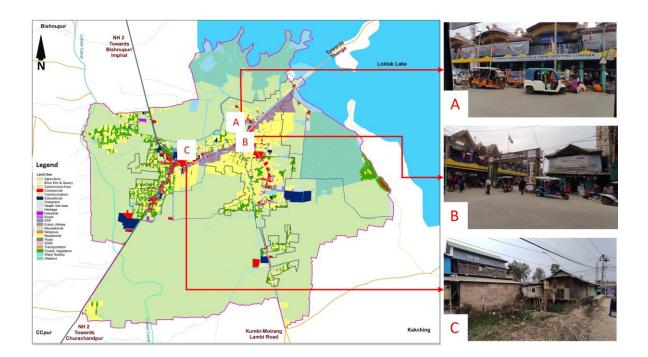


Figure 6.3-1: Location major land use issues

Source: Ground Truthing Survey

### C. Educational facilities are far and connected by single roads.

Educational facilities are connected by single transport network in the town as shown in Figure 6.3-2. There are no other pucca pavement routes to reach facilities across. This increases the pressure on major road. Traffic on these major routs could affect the timing of school and colleges.

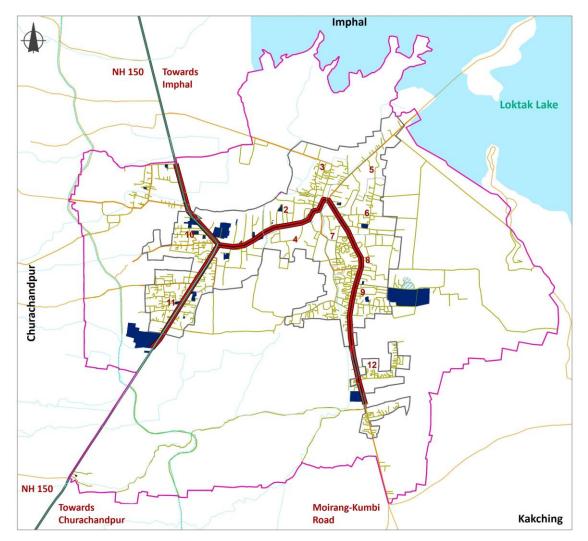


Figure 6.3-2: Single Road connectivity

Source: Ground Truthing Survey and Arc GIS Software

### D. Linear development

The town is spreading in a linear manner as shown in Figure 6.3-3. Due to the only major transport network (NH 150 and Moirang-Kumbi road) the town is forced to develop along it only. This increases the pressure on major roads and decrease the efficiency of vehicular movement on these routes.

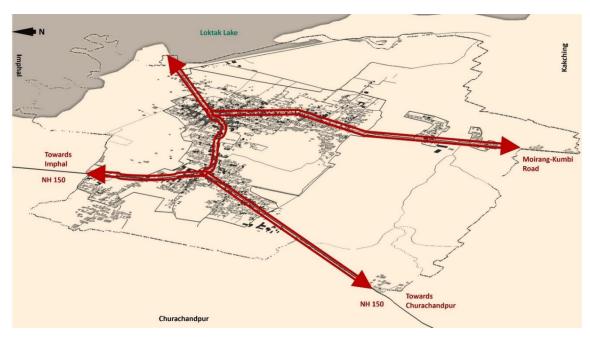


Figure 6.3-3: Linear development

Source: Ground Truthing Survey and Arc GIS Software

### E. Lack of alternate routes regionally

Regionally there is only one national highway passing through the Moirang town. All the vehicular movement towards Imphal in the North and Churachandpur in the South passing through the town and creates pressure on the road. It also attracts opportunities for the Moirang town to develop land use and increase the economy, Figure 6.3-4.

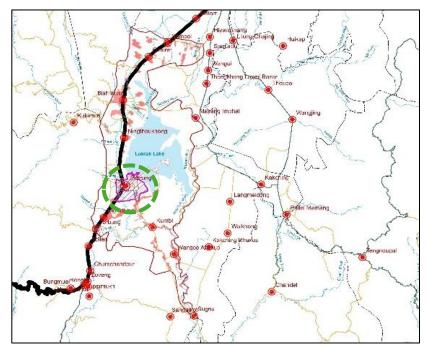


Figure 6.3-4: Heavy through movement due to influence of NH 150

Source: Ground Truthing Survey and Arc GIS Software

# F. Density at Junctions

The town is spreading linearly but also densifying at junctions. The reason for this densification could be the commercial activities at these two major junctions, Figure 6.3-5.

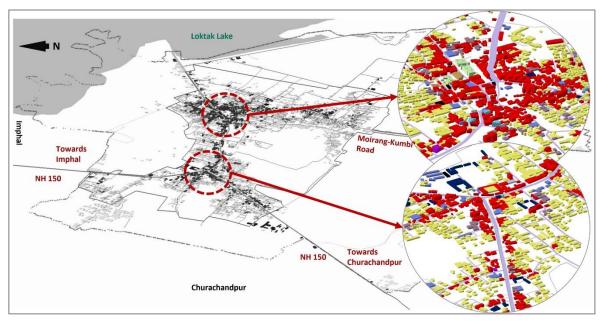


Figure 6.3-5: Building Density

Source: Author

# **Chapter 7 Building Structure in Planning Area**

# 7.1 Building Height

In Moirang, major high-rise buildings with G+2 and above floors are mainly concentrated near the main commercial area around IMA market and other commercial shops. These buildings mainly consisting of commercial complex, hospital buildings and banking facilities. Other than G+1 floor buildings are located around the traffic junction near Moirang Multipurpose Higher Secondary School.

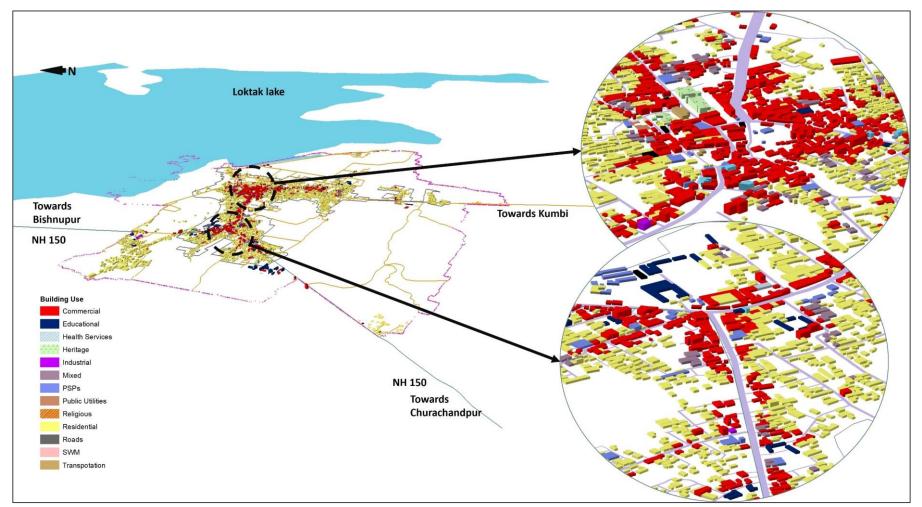
Table 7.1-1: Building Height in Moirang Planning Area

S. No.	Building Height	No. of Buildings	%
1	G	5,602	95.68
2	G+1	201	3.43
3	G+2	46	0.79
4	Above G+2	6	0.10
	Total	5,855	

Source: Ground Truthing Survey

Table 7.1-1, illustrate that, more than 95% of built ups only have ground floor, whereas G+1 floor structures are limited to only 3.43% of the total building of Moirang. Less than 1% of buildings have height G+2 floors, which are mainly located in the main commercial area near IMA Awun Keithel 'Market' in zone 3. These buildings are mainly along the Kumbi-Moirang Lambi road. Historic and heritage buildings like INA HQ memorial and INA Museum have height above G+2 floors as represented in Map 7.1-1.

Map 7.1-1: Building height in Moirang planning area.



# 7.2 Building Roof Material

Metal Sheets are the most common material for roofing in Moirang town that are used in more than two third buildings of Moirang planning area. Table 7.2-1, illustrate that, 66.56% of total buildings have metal roofs (coloured metal roofs) and are spread across in the planning boundary. Concrete as building roof material is used in only 13.27% of buildings, whereas wooden roof is used in more than 20% of buildings. Some buildings with concrete roofs are located near IMA Market area in, mainly along the Kumbi-Moirang Lambi road. Wooden roofs are very uncommon in the area/ town and only few buildings (0.4% of total buildings) have these roof types, which are in ward no. 5 as represented in Map 7.2-1.

Table 7.2-1: Building Roof Materials in Moirang planning area.

S. No.	Type of Roof material	No. of Buildings	%
1	RCC/Concrete	801	13.27
2	Wood	1,213	20.09
3	Roof Tiles	2	0.03
4	Metal	4,018	66.56
5	Bamboo	3	0.05
	Total	6,037	

Imphal West Bishnupur Towards NH 150 Bishnupur CCpur Loktak Lake Legend Key Map

National Highwa --- International Boundary
--- Manipur State Boundary
--- District boundary Moirang NH River Canal Manipur District Boundary Moirang Master Plan Boundary ---- Zone Boundary — Moirang Municipal Boundary Municipal Ward Boundary **Building Roof Material** Wood Roof Tiles Bamboo Churachandpur Base Map Agriculture Vacant Vegetation Water Bodies Wetland Data Source: NRSC (Ground truthing and verified by SPAB) **Kumbi-Moirang Towards Towards** Lambi Road Churachandpur Kakching Kakching Coordinate System: WGS 1984 UTM Zone 46N Projection. Transverse Mercator Datum: WGS 1984 False Easting: 500,000.0000 **Building Roof Material** Map Title: Moirang Master Plan Area Risk Informed Master Plan- Moirang (2023-2043)

Map 7.2-1: Building Roof Material in Moirang planning area

# 7.3 Building Wall Material

Based on the observations presented in Table 7.3-1, brick/ concrete is the most used wall material in Moirang town, accounting for 51.75% of the buildings. Most of the residential buildings that are spread in the centre part of the suggestive planning boundary have wooden walls. These are observed as old structures that may be constructed. Wood is the second most prevalent material, used in approximately 31.69% of the buildings, followed by GI bricks/concrete. Whereas metal sheet as wall material is used in more than 15% of the total building of Moirang town. Further analysis reveals that buildings with multiple floors located along NH 150 predominantly have brick or concrete walls. These buildings are primarily utilized for commercial purposes as represented in Map 7.3-1. The prominent educational institutes, including the Moirang College and St. Xavier schools are constructed using brick or concrete materials.

Table 7.3-1: Building wall materials in Moirang planning area.

S. No.	Wall material Type	No. of Buildings	%
1	Brick/Concrete	3,124	51.75
2	Metal	996	16.50
3	Wood	1,913	31.69
4	Mud	4	0.07
	Total	6,037	

Imphal West Bishnupur Towards NH 150 Bishnupur Loktak Lake Legend Key Map National H Canal ----- Manipur District Boundary Moirang Master Plan Boundary Zone Boundary — Moirang Municipal Boundary Municipal Ward Boundary **Building Wall material** Brick/Concrete Churachandpur Agriculture Vegetation Wetland Data Source: NRSC (Ground truthing and verified by SPAB) Kumbi-Moirang **Towards** Towards Lambi Road Churachandpur Kakching Coordinate System: WGS 1984 UTM Zone 46N Projection: Transverse Mercator Datum: WGS 1984 False Easting: 500,000,0000 **Building Wall Material** Map Title: Moirang Master Plan Area Risk Informed Master Plan- Moirang (2023-2043)

Map 7.3-1: Building wall materials in Moirang planning area

Source: Ground Truthing Survey and Arc GIS Software

# **Chapter 8 Housing**

# 8.1 Existing Situation

Housing is a fundamental human need that provides safety, security, and stability, serving as a cornerstone of socio-economic development. In Moirang, a town of historical and cultural significance, addressing housing needs is critical to managing its evolving urban landscape and accommodating its growing population. The existing housing scenario in Moirang reflects a blend of traditional and modern typologies, with approximately 65% of the stock comprising permanent RCC structures predominantly concentrated in urbanized zones, while semi-permanent and temporary houses remain prevalent in peri-urban and rural areas. The town faces several challenges, including inadequate infrastructure in newly developed areas, land constraints pushing development toward environmentally sensitive zones, and the affordability gap for low-income households.

Table 8.1-1: Percentage of houses in Housing Typology

S. No	о. Туре	%
1	Pucca	4.26
2	Semi-Pucca	59.29
3	Kutcha	36.44

Source: Ground Truthing Survey

The above analysis shows that in Moirang town most of the buildings can be classified as semi pucca. Only a few percent of buildings are made of pucca house material that is brick and concrete. Rest buildings may come in Kutcha house category. These buildings have metal sheets with wooden walls and are observed as very old structures.

Moirang town has 137.41 Ha of residential land that covers approximately 8.06% of total planning area. Table 8.1-1illustrate that, as per the ground truthing survey, majority of the buildings in Moirang can be categorized as semi-pucca which has steel sheet roof and brick-concrete wall. Only a small percentage are constructed with pucca house materials such as bricks and concrete as shown in Figure 8.1-1. The remaining buildings are kutcha as per the

identified construction material such as bamboo1, steel sheets, mud, etc. Some sructures are in dilapidated conditions along the Moirang road, Moirang-Kumbi road and interior part of the town. These structures are notably very old and made with metal sheets and wooden walls as represented in Map 8.1-1.

During the ground truthing survey, the data shows that 36.44% of houses are kutcha which are constructed of mud, bamboo, wood, etc. The semi-pucca houses are 59.29% which has steel sheet roofs. Total pucca houses are 4.26%. It is observed that majority of the houses are semi-pucca in which metal sheets are used in roof. Rain and flooding can be one of the major reasons that metal sheets are widely used in the town as building material. The mud wood constructed houses is situated along the Moirang road, Moirang-Kumbi road and interior part of the town which are old and in dilapidated condition.

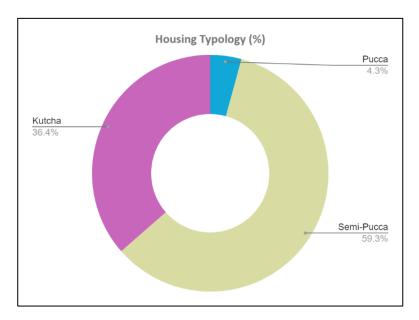
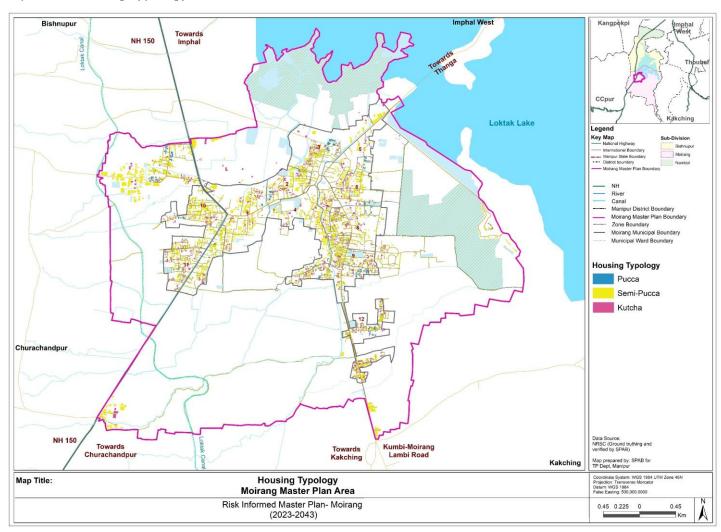


Figure 8.1-1: Percentage of houses in Housing Typology

Source: Author

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Map 8.1-1: Housing Typology



## 8.2 Housing Density

Housing density for the Moirang Municipal Council Area is 353.13 Ha as per ground truthing survey. The total houses in Moirang Planning area are 3,914. Housing density for the planning area is 17. Ward wise housing density is given in Table 8.2-1(India, 2011). Ward no. 3 and 9 has highest density. Ward no. 3 is a commercial dominated area and one of the main traffic junctions point in planning area. Heritage site such as INA Museum is also situated in this ward. Ward no. 9 is residential dominated area. Ward no. 1, 4 and 10 has lower density in all the wards as represented in Map 8.3-1. These wards are large in area which is mostly agricultural dominated. Settlement is situated along the major road only.

Table 8.2-1: Housing density in Municipal Council Area ward wise

S.No.	Ward. No.	Population Density (pph)	Housing Density (hph)
1.	Ward 1	28	4.78
2.	Ward 2	96	18.64
3.	Ward 3	147	27.01
4.	Ward 4	26	4.60
5.	Ward 5	46	9.05
6.	Ward 6	86	16.49
7.	Ward 7	111	20.78
8.	Ward 8	29	5.66
9.	Ward 9	145	28.79
10.	Ward 10	20	3.78
11.	Ward 11	52	9.89
12.	Ward 12	31	5.50

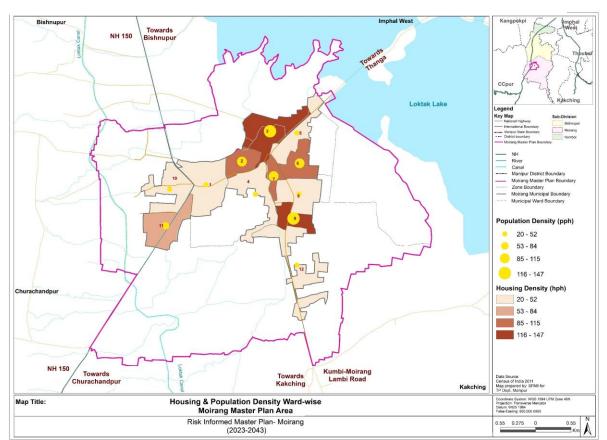
Source: Census of India 2011

## 8.3 Population Density

In Moirang, population density within the municipal boundary is distributed unevenly, with notable variations across different wards. The highest population densities are observed in Wards 3 and 9, which fall within the 116–147 pph (people per hectare) range. These wards, located near major arterial roads, are marked by the darkest shade on the map 8.3-1 and reflect highly urbanized areas with concentrated housing and infrastructure. Wards 2, 7, and 6 have moderately high densities, ranging from 85–115 pph.

These wards, also located closer to key transportation routes, highlight the strong influence of accessibility on population concentration. In contrast, Ward 11 falls in the 53–84 pph range, indicating a moderate-low density. The remaining wards, predominantly situated on the

outskirts, have the lowest population density, ranging between 20–52 pph. These areas are characterized by sparse development and a more rural environment. A clear trend emerges from the map: wards located closer to arterial roads tend to have significantly higher population densities compared to those farther away, underscoring the importance of infrastructure and connectivity in shaping settlement patterns



Map 8.3-1: Ward wise housing and population density

Source: Census of India 2011

# **Chapter 9 Transportation**

Moirang has seen rapid urban growth due to its proximity with major settlements such as Imphal, Bishnupur and Churachandpur. The growth has started clustering at centre of the town, densely populated area, along the NH 150 and Kumbi Moirang Lambi Road. Majority of the population is linearly settled along the major routes in the town and connected to each other in the same pattern. The transportation sector includes infrastructure like road network, width of the roads, intersections, etc. and services like public transport and parking spaces. The road network characteristics collected through network inventory survey such as no. of lanes, road width, etc. during GTS. Public Transport (PT) data collected through ground truthing survey and secondary survey from the concerned department includes origin and destination of PT and Intermediate Public Transport (IPT) services in the Moirang planning area.

#### 9.1 Regional Linkage

The Moirang planning area is well connected with road network through major roads, NH 150. The local travel is largely dependent upon the auto rickshaw, winger services and private vehicles.

#### G. By Air

The nearest airport to reach the city of Moirang is in Imphal city, known as Tulihal Airport at about 48 km away. It has direct flights to the cities of Kolkata, Delhi, Guwahati, Aizawl, Silchar and Dimapur.

#### H. By Rail

Moirang has no rail connectivity. However, the nearest major railway station is in Dimapur at about 250 km away. From the railway station taxis, buses are available to reach Moirang. The upcoming railway project connecting Jiribam to Imphal via Noney will provide Moirang with access to two nearby stations: i) Imphal and ii) Bishnupur.

#### I. By Road

Moirang is directly connected by good roads to Imphal city, which in turn is connected to Guwahati and Silchar in Assam. National Highway NH-150 passes through Moirang connecting it to nearby cities. Bus services are frequently available from Imphal to Moirang.

## 9.2 Regional Road Hierarchy

Road connectivity is the most important aspect of any regional integration process. A well-connected road network is needed for reaping the benefits of goods and services trade and movement of people. It also attracts investments in required areas including the promotion of trade and investment, as well as progress in other sectors of cooperation such as tourism, people-to-people contact, and cultural exchange. Transport connectivity in the master plan provides the framework for organizing a set of strategies toward realizing a shared vision of sustainability. For this reason, the road network has been divided into three categories explained in Indian Road Congress (IRC) and its hierarchy at regional level is discussed in this section as represented in Figure 9.2-1.

- I. Arterial Roads: Arterial roads are an important part of regional connectivity which comprises National and State Highways. It facilitates smooth and efficient transportation between districts and towns/areas. In the given figure, Moirang town is situated on NH 2 and along the Kumbi-Moirang Lambi road.
- II. **Collector Roads:** As per IRC Code, Collector roads collect and distribute traffic from local roads and provide access to arterial roads. In this exercise major district road (MDR) has been taken as collector road.
- III. Local Roads: As per IRC Code, local roads do not carry large volumes of traffic and majority of trips either originating or terminating from these roads. In this exercise local roads are referring to other district roads (ODR) and village roads. These roads are connected to collector roads if not directly reaching to hinterlands.

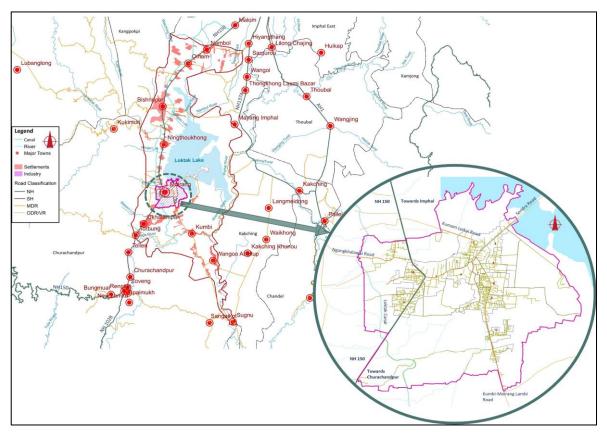


Figure 9.2-1: Road Hierarchy at regional level

Source: Google Earth Imagery

## 9.3 Hierarchy of Roads in Moirang planning area

The road length of various roads such as National Highway, State Highway, Major District Road, Other District Road, Village Roads, etc. are measured. All these roads are classified in three categories under road hierarchy as per their identification in ground truthing survey and secondary information about National Highway and other roads. The Road Hierarchy Map has been prepared to assess these three classifications of road Map 9.5-1.

### 9.4 Urban road network

The urban road network is classified as per IRC:86-2018 are as follows:

I. Arterial Roads: Arterial roads are the lifeline of urban connectivity, facilitating smooth and efficient transportation between major destinations. In Moirang town, NH 150 is an arterial road that traverses through the town and connects it to the nearby major towns such as Bishnupur and Thoubal. It has a total length of 3.18 Km in the planning area.

- II. **Collector Roads:** Collector roads act as bridge between arterial roads and the local roads connecting internal areas to the main market. It has a total length of 12.76 Km in the planning area.
- III. Local Roads: Local roads provide access to the internal part of the planning area. Most of the local roads of the planning area are in bad condition and have become a growing concern for the residents. These roads have deteriorated significantly, exhibiting a range of issues that make commuting difficult and unsafe. Potholes and cracks have formed across the surface, creating hazards for vehicles and pedestrians alike. These deteriorated roads not only impede the smooth flow of traffic but also contribute to increased travel times, vehicle damage, and accidents. The roads in internal or areas which are far away from the dense area are most of them katcha/moorum roads. It has a total length of 97.45 Km in the planning area.

Table 9.4-1: Total length of types of roads

S. No.	Type of Road	Length (Km)	%
1.	Arterial (NH+SH)	3.18	2.8
2.	Collector (MDR)	12.76	11.25
3.	Local (ODR+VR)	97.45	85.94
	Sub Total	113.39	

Source: Author

#### 9.5 Landmarks

There are signified elements in the urban areas which acts as a landmark. The landmarks which are identified in the Moirang planning area which are also performing as nodes in that specific locality shown in Map 9.5-1. These are identified as per their services provided such as government offices, industries, educational, health etc. and influence area such as whole town, ward, locality, etc.

Bishnupur Towards NH 150 Imphal Kakching Loktak Lake Legend Key Map Bishnupur INA Museum Moirang --- Manipur State Boundary
--- District boundary Moirang Police Station River Canal Ibudhou Thangjing Laishang (Temple) 4 Ngari Bazaar 7 ---- Manipur District Boundary Moirang Master Plan Boundary Moirang Municipal Boundary Municipal Ward Boundary Moirang College **Road Network Classification** Arterial Collector Local Churachandpur Data Source: NRSC (Ground truthing and verified by SPAB) Towards Kumbi-Moirang Towards Churachandpur Lambi Road Kakching Map prepared by: SPAB for TP Dept, Manipur Kakching Coordinate System: WGS 1984 UTM Zone 46N Projection: Transverse Mercator Datum: WGS 1984 False Easting: 500,000.0000 Map Title: **Road Network Classification** Moirang Master Plan Area Risk Informed Master Plan- Moirang 0.45 0.45 0.225 0 (2023-2043)

Map 9.5-1: Hierarchy of roads as per IRC classification in Moirang planning area

Source: Author

## 9.6 Major Trip Attractions

#### 9.6.1 Daily basis

#### A. Commercial 1 (Main market and IMA Market):

This is the main commercial market of Moirang including IMA market, retailer shops and hosts the major commercial shops of the town. It is located near the INA museum, Figure 9.6-1.



Figure 9.6-1: IMA Market, Moirang Source: Ground Truthing Survey

B. Commercial 2 (Near Multipurpose Higher Secondary School):

This commercial node is situated along NH 2 near Moirang Multipurpose Higher Secondary School. Most shops in this area are categorised as hotels and restaurants, small retailing shops and variety stores.

- C. Commercial 3: Located in the southern part of town along NH 2, this commercial zone features food hotels lining one side of the road, complemented by a small street vending market on the opposite side. The architectural landscape is predominantly mixed-use, combining commercial establishments with residential units.
- D. Educational 1 (Little Master's Higher Secondary School): This is a major educational node.
- **E. Educational 2 (Moirang college):** Moirang college as shown in Figure 9.6-2, is the major educational facility of the town located in front of CHC.
- **F. Health 1 (CHC Moirang):** Community Health Centre is in the Southwest part of Moirang.



Figure 9.6-2: Moirang College, Moirang Source: Ground Truthing Survey

#### G. Health 2:

This health node is present near the main commercial area of the town. It has several clinics, hospitals, and pharmacy/ medical stores.

- **H. PSP 1 (Police Station Moirang):** This node is located near Moirang Multipurpose higher secondary School. Other than this it also has a forest range office.
- I. PSP 2 (Municipal Council Office): Major PSPs like Municipal Council office, Sub Divisional Office, Sub Registrar Office, and Treasury Office are in this node.

- J. Recreational 1: Loktak lake boating, and scenic facility is one of the major recreational activities located near the town. It is managed by the Loktak Lake Inland Waterways Authority.
- K. Recreational 2 (Multipurpose Ground): This ground is in front of INA HQ Memorial,
- L. Transportation 1 (Main Bus Stop): This node is in the main market area. The population density of this area is much higher than the other part of town. Buses, taxis and auto rickshaws usually stop and originate from this area. It also has one multilevel car parking and a dedicated auto/ winger parking.
- M.Transportation 2 (Junction near Multipurpose Higher Secondary School): This node is located near Moirang Multipurpose Higher Secondary School. It has a junction that connects Kumbi Moirang Lambi road with NH 2.

#### 9.6.2 Tourism (peak season)

A. Heritage 1 (INA HQ Memorial): A historical significance of this memorial complex is that it stands at the site where the INA flag was raised for the very first time on Indian soil in April 1944. The flag was hoisted after defeating the British and reclaiming the territory of Bishnupur, Figure 9.6-3. There is a stone memorial stand at this location within the complex.



Figure 9.6-3: INA HQ Memorial,

Moirang
Source: Ground Truthing Survey

- **B.** Heritage 2 (INA Museum): This heritage site is in the main commercial area of the town. It is a major tourist attraction point in the Moirang town. There is a dedicated parking in front
  - of the museum building, which serves this museum also, Figure 9.6-4.
- C. Sendra Park and Island: Sendra park and island is full of scenic beauty. It has several major resorts and hotels on this hilly island.
- D. Sangai Ethnic Park (Moirang Khunou): Sangai Ethnic Park (see figure 10.6-6) is in Moirang Khunou, which is approximately 6 km south



Figure 9.6-4: INA Museum, Moirang Source: Ground Truthing Survey

from Moirang Town. It reflects the tribal integrity and diversity of Manipur state. It also has a multipurpose hall, which is used for various socio-cultural activities. Manipur Sangai Festival 2022 was also organised in this place. Other than this it also has shops, where local people can showcase and sell their handicrafts, art and other artifacts. Map 9.6-1 represents major activity nodes in Moirang planning area.

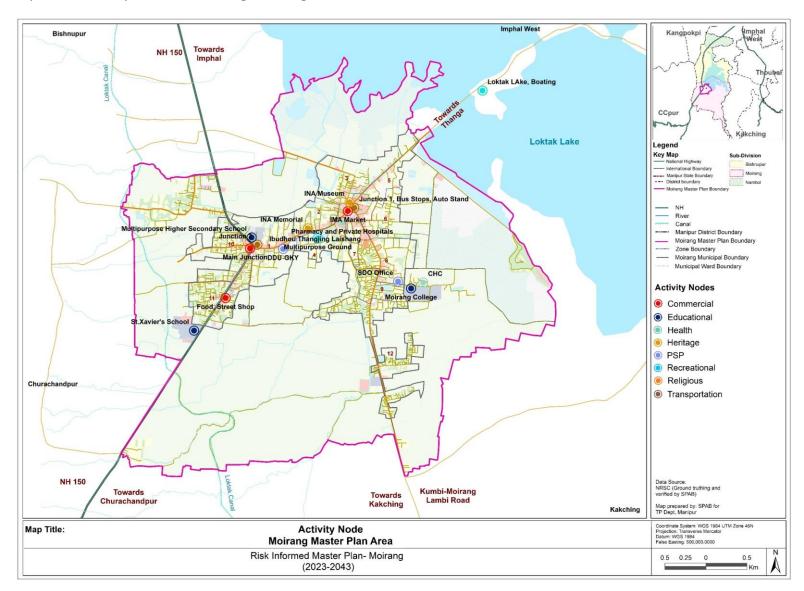


Figure 9.6-6: Sendra park and Island Source: Ground Truthing Survey



Figure 9.6-5: Sangai Ethnic Park Source: Ground Truthing Survey

Map 9.6-1: Activity nodes in Moirang Planning Area



Source: GTS

# 9.7 Parking

Moirang mainly has two dedicated parking spaces both are located near the IMA market of Moirang town. One is multilevel parking in front of the INA Museum that also serves for the tourist and museum visitors, Figure 9.7-1. Other is near the IMA Market dedicated to auto, winger, cars and E-rickshaws, Figure 9.7-4 and Figure 9.7-3. Map 9.7-1 shows all the parking facility present in Moirang planning area.



Figure 9.7-4: Dedicated Auto Parking near
Main Market area in Moirang
Source: Ground Truthing Survey



Figure 9.7-3: On-street parking of E-rickshaw in marketplace

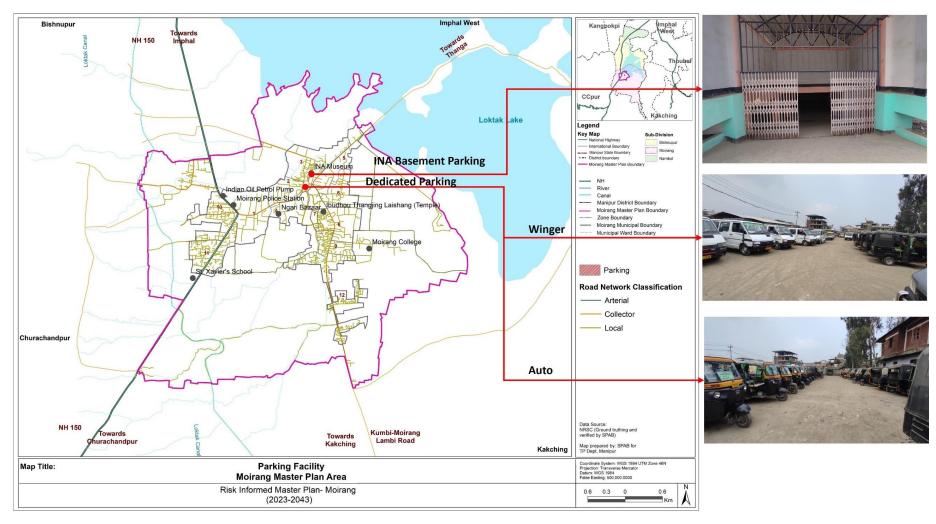


Figure 9.7-2: Multilevel parking in front of INA Museum, Moirang Source: Ground Truthing Survey



Figure 9.7-1: Dedicated Auto and Winger Parking near Main Market area in Moirang Source: Ground Truthing Survey

Map 9.7-1: Parking Facility in Moirang Planning Area



Source: Author

# 9.8 Shared Mobility

Intra- town movement within the town happened mainly through auto rickshaws, erickshaws, and winger. There is a dedicated parking for auto and winger near IMA market, but e-rickshaws generally halt and park on street, Figure 9.8-1.



Figure 9.8-1: Shared Mobility Transport

Source: Ground Truthing Survey

### 9.9 Issues related to transport and road

Moirang, strategically positioned along the intermediary route connecting Imphal and Bishnupur to Churachandpur, faces an excessive burden from through traffic originating in these towns. The linear development of the town along NH 150 and the Kumbi-Moirang Lambi road exacerbates the strain on these routes, Figure 9.9-1. This pressure is intensified by the presence of commercial and tourist nodes along these roads, leading to heightened parking demands.

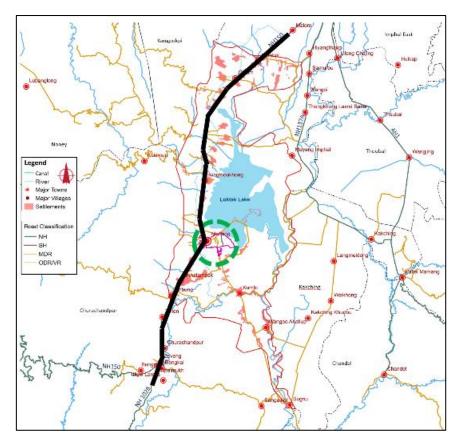


Figure 9.9-1: Single route for through movement

Source: Author

To alleviate the congestion and reduce pressure on existing roads, there is a pressing need for an alternative route. The existing collector roads have limited carrying capacities, further exacerbated by on-street parking in certain areas. Compounding the issue, many internal roads are kutcha and inadequate to facilitate the smooth movement of both people and



Figure 9.9-2: On-Street Parking Source: Ground Truthing Survey



Figure 9.9-3: Commercial activities near INA

goods. Addressing these challenges is crucial for optimizing traffic flow and enhancing the overall efficiency of Moirang's transportation network.

The concentration of major commercial activities in the vicinity of the IMA Market has resulted in a significant surge in both traffic and parking demand in this area. The elevated vehicular movement, continuous through traffic, and various activities are posing obstacles to pedestrian movement. Certain zones lack clear demarcation between pedestrian and vehicular spaces, necessitating the creation of designated pedestrian pathways in these areas, Figure 9.9-4.



Figure 9.9-4: Condition of Local Roads

Source: Ground Truthing Survey

# 9.10 Observation and Way forward

The traffic congestion along the road stretch from INA HQ Memorial to Ibudhou Thangjing Laishang is notably high, refer figure 10.10-1. This road serves as a crucial link between Imphal and Bishnupur to Kakching, resulting in a significant volume of through traffic. To address this issue, it is advisable to implement restrictions on the movement of heavy vehicles in specific

zones. Additionally, limits on shared mobility, such as e-rickshaws and autos, should be considered to a certain extent.

Currently, e-rickshaws and private vehicles are frequently parked along this road, resulting in underutilization of the right-of-way (ROW) capacity. To address this issue, regulating the parking of these vehicles to a certain extent in this zone is necessary. Once such vehicles are appropriately regulated, dedicated parking spaces should be established. These initiatives will play a crucial role in transforming the area into a more pedestrian-friendly environment, especially considering its significance as a hub for key activities like tourism, commercial establishments, and public service points.

It is imperative to identify an alternative route for heavy vehicles and through passengers to alleviate traffic congestion within the town area. Additionally, there is a need for a dedicated bus stand situated in a low-traffic zone for easy accessibility. Implementing these measures will contribute to easing traffic flow and improving the overall efficiency of transportation in the town.



Figure 9.10-1: Heavy traffic road stretch

Source: Google Earth Imagery

# **Chapter 10** Social Infrastructure

#### 10.1 Educational

#### 10.1.1 Existing Scenario

Moirang town has diverse range of government educational institutions. There is total 19 ha area dedicated to educational institutes. DIET Office, Moirang College, Moirang Multipurpose Higher Sec School (Figure 10.1-1), Loktak Christian High School, The Okshongbung Upper Primary School, St.Xavier's School (Figure 10.1-2), Moirang and New Model Public School are some of the major educational institutes present in the town. Moirang College was established on 5<sup>th</sup> May 1963 at Moirang, a small town of scenic beauty on the bank of Loktak Lake and amidst 5 assembly constituencies.





Figure 10.1-1: Multipurpose Higher Secondary School and Moirang College





Figure 10.1-2: St. Xavier School, Moirang and Advance Intermediate College, Moirang Source: Ground Truthing Survey

### 10.1.2 Gap Identification as per URDPFI Guidelines 2014

As per the URDPFI Guidelines 2014 given in Table 10.1-1 and Table 10.2-1, Moirang is deficit in pre-primary and primary schools based on population served. The town has more than required number of secondary schools which also cater for primary education. Moirang is largely dependent on Bishnupur, Imphal city and Churachandpur for educational facilities such as engineering and medical colleges.

Table 10.1-1: Gap identification as per URDPFI Guidelines 2014

URDPFI Guidelines 2015				
S. No.	Educational Facilities	Population Serves	No. of Unit	Existing
1	Pre-primary School	2,500	9	2
2	Primary School	5,000	5	2
3	Senior Secondary	7,500	3	8
4	College	1,00,000	0	1

Source: URDPFI Guidelines 2014

### 10.2 Health

#### 10.2.1 Existing

Moirang town has Community Health Centre (CHC) located near Municipal Council office. It has 20 beds with 56 staffs, with toilet facility, water supply for drinking. As per secondary data, 7 kg of medical waste is generated in this CHC, which disposed of at Shija Hospital, Langol, a common biomedical waste treatment facility in Bishnupur town.



Figure 10.2-1:Community Health Centre (Left), Moirang and Pharmacy at Moirang Bazar (right)

Table 10.2-1: Gap identification as per URDPFI Guidelines 2014

	UF	RDPFI Guidelines 2015		
S. No.	Health Facilities	Population Serves	No. of Unit	Existing
1	Dispensary	15000	2	3
2	Nursing Home	45000	1	Data not available
3	Polyclinic	100000	0	Data not available
4	Intermediate Hospital (B)	100000	0	1
5	Intermediate Hospital (A)	10000	2	0

Source: URDPFI Guidelines 2014

#### **10.3** Socio-Cultural

There are a variety of cultures that can be seen in the Town. Due to its proximity to the state capital, Imphal, people from outside of state, who come for studies and employment, also reside in the town. Town has 12 community halls present in different localities, which are used for various cultural events and activities. As per ground truthing four community associations have been identified. Moirang also has four youth clubs/ associations that are involved in various social and physical activities.

### 10.4 Other Services

**Banking:** State Bank of India with ATM, Manipur Rural Bank, Bishnupur Urban Co-operative bank, United Bank of India with ATM

**Law and Order:** Moirang Police Station is situated in ward no. 2 along NH 2, but the town lacks a session court. The closest court is the District Session Court in Bishnupur, while the High Court is in Imphal city, 45 Km away.

Table 10.4-1: Social Infrastructure in Moirang planning area.

S. No.	Social Infrastructure	Area (Ha)
1	Banks	0.21
2	Community Hall	1.72
3	Educational	19.11
4	Health Services	1.19
5	Market Shed	0.75
6	Police Station	0.58
7	Post Office	0.03
8	Public Library	0.02

9	Recreational	2.24
	Total	25.81

Source: Author

# 10.5 Observation and Way forward

Moirang has strategically concentrated most of its banking facilities in key commercial areas, particularly around the IMA Market. This centralized location makes financial services easily accessible for both residents and visitors, streamlining day-to-day transactions and fostering economic activity. The proximity to major business hubs also facilitates smoother operations for businesses in the area, promoting economic growth and stability within the town.

In terms of urban planning and service provision, Moirang has achieved a notable level of sufficiency in both educational and healthcare services, adhering to the URDPFI (Urban and Regional Development Plans Formulation and Implementation) Guidelines 2014. This reflects well on the town's ability to meet the basic needs of its residents, with adequate schools, colleges, and healthcare facilities available to serve the local population. The town is well-positioned in terms of infrastructure to support further development, ensuring a strong foundation for the future.

However, as Moirang continues to develop as a tourist destination, there is a growing need for diversification in its healthcare infrastructure. While the town may be sufficient for local healthcare needs, the influx of tourists and the demands associated with seasonal surges require more advanced healthcare facilities. Specifically, the establishment of multi-specialty hospitals and specialized clinics would provide a higher level of care for both tourists and residents. This expansion would not only address the immediate health needs of visitors but also enhance the town's overall appeal as a well-rounded destination. Improved healthcare services would contribute to a more resilient and sustainable tourism sector, ensuring that Moirang can cater to a diverse range of visitors, including those with specialized medical needs.

Map 10.5-1: Social Infrastructure in Moirang planning area



Source: Author

# **Chapter 11** Physical Infrastructure

## 11.1 Water Supply

Main source of water supply is from the surface, mainly Loktak Lake. The water distributes in the area by overhead tanks (OHT). The DI pipes are laid down along the major road and connected to the branches which are then directly connected to the HHs.

### 11.1.1 Water supply source of the town

Loktak Lake is the main water source of the town. The water from lake is supplied to the water treatment plant location shown in Map 11.1-1. Water is treated by using different methods of treatment such as screening to remove the solids found in water and transfer it to the grit chamber to remove any grease/oil. Sedimentation process helps to remove the suspended solids present in water and if the quality of water is degraded then coagulant also used. Filter and chlorine further treat the water and make it fit for domestic use.



Figure 11.1-1: Source of drinking water- Loktak Lake Source: Google Images

Moirang has three overhead tanks in which treated water stored and then distribute by the piped network to the households, Figure 11.1-2. There are some areas which are still lacking in piped water supply.







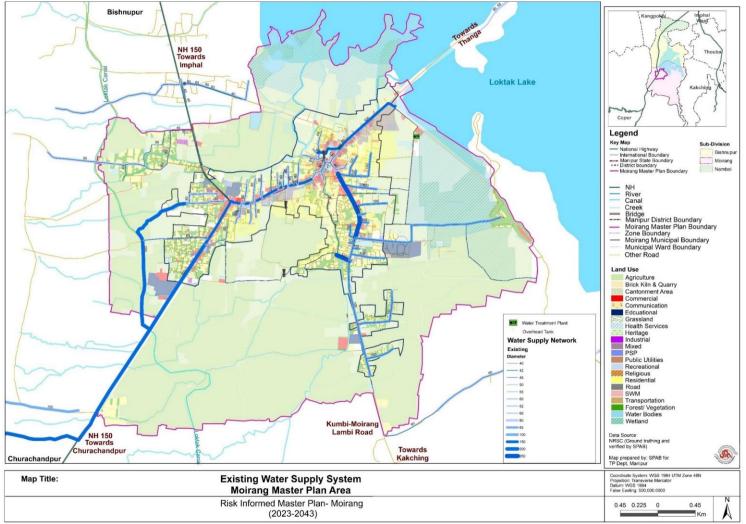
Figure 11.1-2: Overhead tanks

Source: Ground truthing Survey

### 11.1.2 Water supply Network

The water supply network in the Moirang Municipal Council area primarily consists of two categories: the main trunk line and the sub-main trunk line. The main trunk line, with pipe diameters ranging from 150 mm to 250 mm, is predominantly laid along NH 150 and the Kumbi-Moirang-Lambi road, covering a total length of approximately 11.8 km. On the other hand, the sub-main trunk line, with diameters varying from 40 mm to 100 mm, extends through various localities and connects to the main trunk lines. This sub-main network spans a total length of around 23 km. A detailed layout of the water supply network is provided in Map 11.1-1.

Map 11.1-1: Water Supply Scheme in Moirang planning area



Source: TPD, Manipur

#### 11.1.3 Issues

Water supply infrastructure of Moirang faces several issues and challenges that hinder efficient service delivery. The network does not provide 100% piped connectivity across the planning area, leaving many residents without direct access to the town's water supply. At present, it is only limited to Municipal Council area. The main trunk line, spanning 11.8 km along NH 150 and the Kumbi-Moirang-Lambi road, primarily serves areas adjacent to these routes, limiting its reach to other parts of the town. While the sub-main trunk line extends 23 km into various localities, its connectivity remains uneven, leading to disparities in water distribution. Consequently, many residents are forced to rely on alternative water sources, which are often inconsistent and inadequate. These challenges highlight the infrastructure gaps in the current system, emphasizing the need for network expansion and modernization to ensure equitable and reliable water supply for all residents.

# 11.2 Sewerage

There is no sewerage network in the town. The system used is septic tank/soak pit. However, septic tank is not favourable in those areas where ground water table is high due to the contamination of ground water by overflowing of septic tank. There is no grey water management system. All the wastewater from kitchen sinks and wash basin are flowing out in open or disposing off into drains. These drains carrying wastewater are disposing off into river, ponds and lake and polluting the marine ecosystem of respective water body.

# 11.2.1 Existing wastewater generation

Total wastewater generation in planning area as per URDPFI standard is 1.11 MLD. It needs to be treated before disposing off into water bodies or in open areas.

#### 11.2.2 Public toilet facilities

There are many public toilet facilities present in the town. Many are provided near INA Museum, IMA market and Kumbi road. As per the tourist footfall and the capacity of town to attract tourism, it needs more roadside amenities to cater floating population also.

### 11.2.3 Issues

Moirang faces significant challenges related to its sewerage infrastructure. The town currently lacks a comprehensive and integrated sewerage system, which has led to improper disposal

of sewage. This deficiency not only contributes to unsanitary conditions but also increases the risk of waterborne diseases, posing public health concern for residents. In addition to the absence of a robust sewerage system, there is also a lack of grey water management. Grey water, which includes wastewater from sinks, showers, and laundry, is typically not treated or reused, further exacerbating the town's water management issues. Without a proper system to handle and recycle this water, Moirang is missing an opportunity to reduce the strain on its water resources and minimize waste.

To address these issues, there is a pressing need for the development of a combined or separate sewerage system that can systematically manage the disposal and treatment of stormwater, grey water, and black water. Such a system would not only ensure that waste is properly treated and disposed of, but also prevent the nuisance of untreated sewage in local areas. By creating a sustainable infrastructure that effectively separates and handles different types of wastewaters, Moirang can reduce environmental hazards and improve public health outcomes. This investment in comprehensive sewerage management would also align with modern urban planning standards and enhance the overall livability of the town.

# 11.3 Solid Waste management

# 11.3.1 Generation

Total solid waste generation is calculated as per the standards given in URDPFI Guidelines. The quantity generation in existing scenario in the planning area is given in Table 11.3-1.

### 11.3.2 Solid Waste Management Facility

A Solid waste management (SWM) site located in zone 7 of town, near to proposed ecological park as represented in Map 11.1-1. Municipal council uses 3-4 vehicles for the door-to-door collection of waste. It has a segregation facility. Wet waste and Dry waste separation techniques are used to separate this solid waste. Solid waste is burnt to reduce in quantity which also causes air pollution in the vicinity.

Table 11.3-1:Generation of Solid waste in the planning area

Year	Population	Total Waste generation (kg/c/d)	4% of commercial (kg/c/d)	Total waste generation (TPD)	Area Required (Ha)	Existing SWM Site (Ha)
2011	23,407	10533.15	421.33	10.53	0.126	-
2021	26,405	11882.40	475.30	11.88	0.143	0.195

2031	29,632	13334.54	533.38	13.33	0.160	0.195
2041	33,120	14904.21	596.17	14.31	0.179	0.195

Source: URDPFI Guidelines 2014 and Author



Figure 11.3-1: Moirang Waste Management Project





Figure 11.3-2: ii) Collected Waste and iii) SWM collection vehicle.

Source: Ground Truthing Survey

Figure 11.3-1 and Figure 11.3-2 shows the solid waste management facility in Moirang planning area.

#### **11.3.3** Issues

In residential localities, the absence of community bins is creating a significant issue for waste disposal, leaving residents with limited options to properly manage their waste. This situation often leads to improper disposal practices, including the dumping of waste into drains, which contributes to clogged drainage systems. Such blockages increase the risk of flash flooding, particularly during heavy rains, as the drainage network is unable to handle the sudden influx of water. The lack of awareness among local communities about responsible waste disposal

further exacerbates the issue, as open dumping in unauthorized areas becomes commonplace. Educating residents on the environmental and health risks associated with improper waste management is crucial for fostering cleaner, healthier neighborhoods. Raising awareness among local communities about responsible waste disposal is crucial in addressing the problem of open dumping in unauthorized areas. Educating residents on the importance of proper disposal methods can help reduce the environmental impact and promote cleaner, healthier neighborhoods. Tourist activities, especially at popular establishments like Aquamarine Homestay, intensify these challenges, particularly in environmentally sensitive areas. The influx of tourists generates a significant amount of waste, further straining an already inadequate waste management system. In the absence of proper infrastructure for waste segregation and disposal, these issues are compounded. The failure to segregate waste at the source prevents the recovery of recyclable materials, reducing the potential for recycling and leading to a mixed waste stream that is harder to manage. This not only increases the environmental burden but also results in clogged drains when improperly discarded waste finds its way into the drainage system.

The lack of waste segregation at the source is another significant issue. Without proper separation of recyclable materials, waste streams become mixed, which hinders recycling efforts and makes it more difficult to recover valuable resources. This not only wastes potential recyclable materials but also places additional pressure on disposal sites. The overreliance on landfills as a primary disposal method adds to the problem, leading to land degradation and groundwater contamination, particularly in areas where waste is not managed sustainably. As landfill sites approach capacity, the urgency to implement alternative waste disposal solutions becomes paramount. Promoting sustainable practices such as waste segregation, recycling, and composting can help reduce the environmental risks associated with improper waste disposal and mitigate the hazards of clogged drains and flash flooding. Adopting a holistic approach to waste management is essential for protecting both the environment and public health while ensuring the resilience of local infrastructure. Figure 11.3-3 shows the open dumping of waste due to lack of collection facility and community bins.



Figure 11.3-3: Solid waste dump in drainage line Source: Ground Truthing Survey

# 11.4 Storm Water Drainage System

# 11.4.1 Existing Scenario

The storm water drainage infrastructure in the planning area is in a dilapidated condition on various locations. During the reconnaissance survey, it is observed that a pucca drain is constructed along NH 150 which is closed along the main market area and after that it is open. Drains on collectors and local roads are constructed in both ways, at some places these are kutcha and pucca drains but all are open which is prone to become solid waste and dead materials (eg.- stones, tree branches, etc) disposal points.

#### **11.4.2** Issues

Moirang faces several drainage challenges, including the absence of adequate stormwater drains, which causes ponding in low-lying areas and leads to flooding during heavy rains. The katcha (unlined) drains are highly susceptible to breakage and siltation, which reduces their efficiency and hampers proper water flow. Open pucca drains, especially in market areas, are exposed to solid waste disposal, which clogs the system and worsens sanitation, creating unhygienic conditions. Furthermore, many of the drains that carry waste from localities are directly connected to nallahs, leading to the pollution of natural water channels and further environmental degradation. To address these issues, Moirang needs an upgraded drainage system and better waste management to ensure improved public health, hygiene, and environmental sustainability.

The widespread presence of kutcha (unlined) drains exacerbates the problem, as they are highly prone to breakage and siltation. This reduces their efficiency, leading to obstructed water flow and heightened vulnerability to flash flooding. Open pucca drains in market areas face persistent clogging due to indiscriminate solid waste disposal, further compounding the problem. The resulting stagnation of water creates unhygienic conditions, fostering the spread of waterborne diseases and threatening public health. Additionally, many drains that carry waste from localities are directly connected to natural nallahs, leading to the pollution of these water channels and contributing to environmental degradation. This not only compromises the ecological balance but also increases the risk of overflow and contamination during heavy rainfall, endangering nearby communities.

To mitigate these risks, Moirang requires an upgraded and resilient drainage system designed to handle heavy rainfall and prevent water stagnation. Integrating advanced waste management practices is equally critical to ensure drains remain unclogged and efficient. Strengthening the drainage infrastructure will not only reduce the immediate risks of flash flooding and waterlogging but also enhance long-term public health, hygiene, and environmental sustainability.

Table 11.4-1: Physical Infrastructure facility in Moirang planning area

S. No.	Physical Infrastructure	Area (Ha)
1	Water Reservoir	0.40
2	Sub Station	0.16
3	Public Toilets	0.15
4	WTP	0.48
5	SWM	0.22
	Total	1.43

Source: Ground Truthing Survey

# 11.5 Electricity

Moirang is dependent on Bishnupur for its electricity supply. The Bishnupur Division of Manipur State Power Distribution company Limited (MSPDCL) sub-divisions viz. Bishnupur Sub-Division, Nambol Sub-Division, Moirang Sub-Division and Kumbi Sub-Division, Figure 11.5-1. NHPC Ltd. is the main provider of electricity generated by hydroelectric power, making it the primary source of electrical energy in Bishnupur Town, which further supply to the Moirang town.



Figure 11.5-1:Electricity Facility in the Bishnupur town

Source: Ground Truthing Survey

MOIRANG WASTES MANAGEMENT PROJECT MSPDCL Closed Drain WTP OHT Loktak Lake Solid Waste Management Unit NH River Canal OHT Manipur District Boundary
 Moirang Master Plan Boundary
 Zone Boundary
 Moirang Municipal Boundary Municipal Ward Boundary Road Network Classification — Arterial Water Reservoir \_ Local Physical Infrastructure //// PHED Office Water Distribution tank Public Toilet Solid Waste Dumping (Ol NH 150 Map Title: Physical Infrastructure Moirang Master Plan Area Risk Informed Master Plan- Moirang (2023-2043)

Map 11.5-1: Physical Infrastructure in Moirang planning area

Source: Author

# 11.6 Observation and way forward

Moirang needs to ensure that 100% of households receive piped water connections, addressing current disparities in water supply and improving access for all residents. Additionally, the town requires a decentralized combined or separate sewerage system to manage wastewater effectively, ensuring proper disposal and treatment of sewage. The lack of adequate solid waste disposal systems has led to unsanitary conditions, creating a nuisance in localities. To resolve this, a comprehensive waste management system is needed, where all stakeholders collaborate to maintain cleanliness and reduce waste-related problems. Furthermore, the planning area requires an effective stormwater drainage system to manage runoff during heavy rains, preventing flooding and waterlogging. This will help mitigate ponding in low-lying areas, ensuring better drainage and reducing the risk of waterborne diseases and other related hazards.

# **Chapter 12 Environment/Eco-Sensitive**

# 12.1 Green Spaces/ Eco-Sensitive Area

**Keibul Lamjao National Park:** The Keibul Lamjao National Park, located in the southeastern part of the Loktak Lake. It is the only floating National Park in the world. The park spans over 40 sqkm area. It was established in 1977. The park primarily aims to conserve the endangered brow-antlered deer, also known as the Sangai or the dancing deer, which is the state animal of Manipur. The Sangai is an exclusive species found only in this region, and its survival is crucial for maintaining the ecological balance of the area.

The park is characterized by a unique ecosystem where phumdis, or floating islands, dominate the landscape. These phumdis are masses of vegetation, soil and organic matter that float on the surface of the lake, providing a distinct habitat for various flora and fauna. Apart from the Sangai, the park is home to a diverse range of species, including hog deer, sambar, wild boar, and a variety of waterfowl. The park plays a crucial role in wildlife conservation. It also serves as a vital resource for the local communities that depend on the lake for their livelihoods. However, the delicate balance of this ecosystem faces threats from human activities, such as habitat destruction and pollution. Conservation efforts are ongoing to preserve the unique natural heritage of Keibul Lamjao National Park, ensuring the survival of the Sangai and the overall health of this exceptional floating ecosystem.

### **12.2** Recreational

Loktak Lake offers a range of recreational activities, including boating. The aquamarine homes or floating houses on the phumdi (biomass) are popular amongst both locals and tourists. In addition to these, various other tourist spots provide a diverse range of recreational activities for visitors to enjoy. A multipurpose ground is located at the centre of Moirang town in ward no. 4 of zone 2. Situated in front of INA HQ Memorial, it has a dedicated sitting area for visitors. Various sports, cultural and fairs are organized on this ground. Other than this, an Indoor stadium is in the campus of Moirang College.

### 12.3 Water bodies

**Loktak Lake:** Loktak Lake, the largest freshwater lake in Northeast India, is renowned as the "floating lake" because of the numerous phumdis—floating masses of vegetation and organic

matter—found on its surface. These phumdis remain buoyant due to decomposition at their base, creating a unique ecological feature. Loktak Lake was designated as a Ramsar Site of International Importance in 1990 and added to the Montreux Record in 1993 due to significant ecological challenges. These challenges include deforestation in its catchment area, infestation of water hyacinth, pollution, and siltation, all of which threaten the lake's delicate ecosystem (Ramsar sites information services, 2024) ( The Atlas of Loktak Lake, 2002).

In addition to the lake, the surrounding area includes several water catchment ponds that serve as vital resources for local communities, meeting their daily needs. Loktak Lake and its environs are a major ecological zone with rich biodiversity. The region supports 116 species of birds, 54 species of fish, 22 mammals, 68 reptiles and amphibians, and over 200 plant species. It also serves as a habitat for many endangered and vulnerable species, including the Brow-Antlered Deer (Sangai), Lesser Adjutant, Sarus Crane, Hooded Crane, King Cobra, Burmese Python, and Keeled Box Turtle.

The lake and its surrounding ecosystem face significant risks due to human activities and environmental changes. Water regime alterations caused by the Ithai Barrage, siltation, industrial and household pollution, the proliferation of phumdis, and habitat fragmentation due to road construction have contributed to the lake's ecological degradation. Unplanned development in the Moirang planning area has exacerbated these risks, as all the creeks within the region flow into Loktak Lake, located in the northeast part of the planning area. Settlements and haphazard development have led to improper drainage systems, increasing the town's vulnerability to flooding. Preserving these creeks is crucial to mitigate future flood risks and to maintain the ecological balance of Loktak Lake. Addressing these challenges requires integrated planning and conservation efforts, including the restoration of natural drainage systems, pollution control measures, and sustainable urban development. Protecting Loktak Lake not only preserves a vital ecological zone but also safeguards the livelihoods and well-being of local communities.

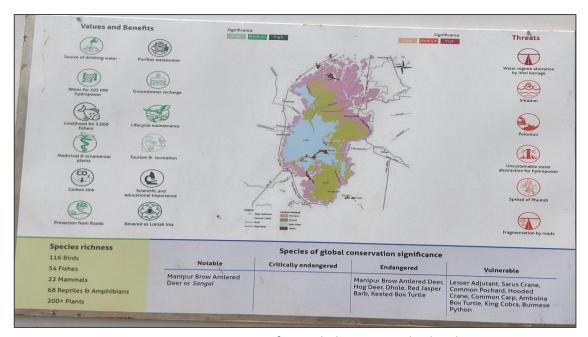


Figure 12.3-1: Benefits and Threat on Loktak Lake

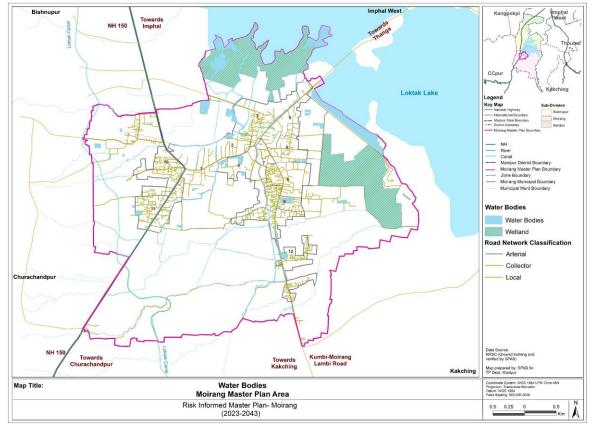
Source: Loktak Development Authority

#### **12.3.1 Conservation Efforts**

Efforts to conserve Loktak Lake are being undertaken at both the national and state levels:

- Loktak Development Authority (LDA): The LDA was established to manage and restore
   Loktak Lake's ecosystem. Projects initiated by the LDA include removing phumdis to restore
   water flow, introducing sustainable fishing practices, and controlling pollution. Loktak's
   status as a Ramsar site has brought international attention to its ecological importance,
   attracting funding and technical support for conservation projects.
- Keibul Lamjao Conservation: Protection measures for the Keibul Lamjao National Park focus
  on preserving the Sangai's habitat and enhancing phumdi stability. Awareness programs
  and habitat restoration projects aim to prevent further decline in the deer population.
- Community Involvement: Local communities have become increasingly involved in conservation through sustainable fishing, ecotourism, and awareness programs. These initiatives help integrate conservation with socio-economic development (Amoghavarsha IAS Academy, 2024).

Main threats to this eco-sensitive site are from Water regime alteration from Ithai bridge, formation of siltation, pollution by various industries and HH, spread of Phumdi and by fragmentation of roads.



Map 12.3-1: Water Bodies in Moirang Planning Area

Source: Author

# 12.4 Slope and Topography

Slope of an area describe the steepness of the ground surface. It is used to identify the elevations at different locations which helps to model landform, surface runoff, characterization of habitation and identify potential developmental sites. In Map 12.4-1, the slope of Moirang Planning area is shown, it is inferred from the map that the main market and majority of residential buildings are present are at lower slope which means these buildings are in plain areas. Moirang is a valley town therefore the slope is not steep except in the northern part of the planning area. Alluvial plains cover majority of the district area with a flat gentle regional slope towards Loktak Lake.

Bishinopur

NH 150

Towards Imphal

Lottalk Lake

Lagend

Lage

Map 12.4-1: Slope of Moirang Planning Area

Source: NRSC

# **Chapter 13** Heritage and Tourism

# 13.1 Heritage

#### 13.1.1 INA HQ Memoria

Moirang town has two major historic heritage sites located at the centre of town are i) INA HQ Memorial and ii) INA Museum. These heritage sites are directly connected to the freedom struggle of Indian independence and WWII.





Figure 13.1-1: Historic Site of INA Headquarter

Source: Ground Truthing Survey

#### **13.1.2 State Protected Monuments**

Ancient Palace Site of Moirang Kingdom: The Ancient Palace site of the Moirang Kingdom holds historical significance as a protected site under the Manipur Ancient and Historical Monument and Archaeological Sites and Remains Act, 1976. This site serves as a testament to the illustrious ancient history of Moirang, which was governed by 59 kings for nearly 2000 years. The preservation of this site is crucial in honouring and showcasing the rich heritage and legacy of the Moirang Kingdom.





Figure 13.1-2: The Ancient Palace site of the Moirang Kingdom

Source: Ground Truthing Survey

# 13.2 Tourism

Moirang, situated in the northeastern state of Manipur, India, presents itself as an interesting destination from a tourism perspective. This idyllic town is distinguished by its rich cultural heritage and captivating natural landscapes. Moirang holds historical significance as it served as the headquarters of the Azad Hind Fauj (Indian National Army) during World War II, making it a crucial part of India's struggle for independence.

Visitors to Moirang could delve into its historical importance by visiting the INA Memorial Complex and experiencing the tranquil beauty of Loktak Lake, the largest freshwater lake in Northeast India. The lake offers a serene ambiance for boat rides and birdwatching, contributing to the town's scenic allure. Additionally, Moirang boasts the renowned Keibul Lamjao National Park. The world's only floating national park, home to the endangered Sangai, or brow-antlered deer, making it a significant ecological attraction.

The town's cultural vibrancy comes alive during the annual Moirang Lai Haraoba festival, a grand celebration characterized by traditional music, dance, and rituals. Adventurous spirits can partake in trekking, camping and water sports on Loktak Lake. Moirang seamlessly blends history, culture, and natural splendour. It an indispensable destination for discerning travellers seeking to immerse themselves in the unique charm of Manipur.

# **13.2.1 Tourist Attraction Places**

**A. INA HQ Memorial:** The Indian National Army Memorial and Museum in Moirang is a place that remembers important events from the past. It is similar to the memorial in Singapore which has a big statue of Subhash Chandra Bose. Inside, you can see weapons and things used by the soldiers of the Indian National Army. They also have books, papers, and magazines about India's history and fight for freedom.

This memorial is special because it's where Subhash Chandra Bose raised the Indian flag during World War II when he led the Indian National Army. Many Indian and Japanese soldiers died in a battle in Manipur, and they managed to free a big area in Manipur for three months. This memorial is to remember these brave soldiers, and it's an interesting place to visit.



Figure 13.2-1: Historic Site of INA Headquarter

Source: Ground Truthing Survey

B. **INA Museum:** The INA Museum in Moirang is located near IMA Market, Moirang, showcasing the history of the Indian National Army and its leader, Subhash Chandra Bose. The museum displays a collection of artifacts, including weapons and documents related to India's fight for independence. It's also where Netaji Subhash Chandra Bose raised the Indian flag during World War II. The museum pays tribute to the soldiers' sacrifices and is a significant historical site for tourists interested in India's independence struggle.



Figure 13.2-2: INA Museum, Moirang

Source: Ground Truthing Survey

C. **Loktak Lake:** Loktak is a significant source of fresh water in Northeast India. The tourism facilities at Loktak Lake are taken care of and improved by the Loktak Development Authority. They also work to keep the lake clean and well-maintained. Tourists can enjoy activities like boating on the lake. There's also an Aquamarine homestay located on a floating island called Phumdi, which offers a unique and immersive experience for visitors.





Figure 13.2-3: Loktak Inland Waterways Development Authority Source: Ground Truthing Survey

- D. **Keibul Lamjao National Park:** The park is in the southwestern part of the Loktak lake. This is the last natural habitat of the brow-antlered deer (Sangai), the dancing deer of Manipur. Keibul Lamjao National Park is the only floating park in the world. A glimpse of the deer in this unique wetland ecosystem is a must for any wildlife enthusiast. Other wildlife to be seen include Hog Deer, Otter, a host of waterfowl and migratory birds, the latter usually sighted during November to March. The Forest Department of Manipur maintains watch towers and two rest houses within the park.
  - E. **Sendra Park and Island:** Sendra park and island is full of scenic beauty. It has several major resorts and hotels on this hilly island.
  - F. Sangai Ethnic Park (Moirang Khunou): Sangai Ethnic Park is in Moirang Khunou, which is approximately 6 km south from Moirang Town. It reflects the tribal integrity and diversity of Manipur state. It also has a multipurpose hall, which is used for various socio-cultural activities. Manipur Sangai Festival 2022 was also organised in this place. Other than this it also has shops, where local people can showcase and sell their handicrafts, art and other artifacts. (Refer Figure)
  - G. **Ebuthou Thangjing Temple and Its Lai Haraoba:** Moirang is believed to be a land affectionately cared by the almighty, and in ancient history, it's known as 'Kege Moirang' because of its relationship with Lord Thangjing. The temple of 'Ebuthou Thangjing'

(whose literal meaning is 'Great Grandfather Thangjing') is located 0.5 km south of Moirang Keithel. Till today, people of Moirang still remember the ancient tradition of worshiping the deity for good luck and prosperity. Though various celebrations and festivals of 'Ebuthou Thangjing' is carried throughout the year, the temple is opened continuously every day for one full month for 'Lai Haraoba' (i.e. 'rejoicing of Gods and Goddess'), which is usually in the month of May every year (i.e. 'Shajibuk tha' in Meitie calendar) since time immemorial. The 'Ebuthou Thangjing Lai Haraoba' is the biggest festival of its kind in Manipur since most of the other deities (in Meitie mythology) join the celebration as a gesture of due respect and honour of superiority.



Figure 13.2-4: Ebuthou Thangjing Temple

Source: Ground Truthing Survey

All these tourist attraction points in and around Moirang are represented in Map 13.4-1.

#### **13.2.2** Supporting Infrastructure

Moirang town has a good infrastructure facility that supports tourism. It has good interred and intra town connectivity. E-rickshaw, winger and auto/taxi services are readily available within the town that serves locals and tourists. Other than this it also has good accommodation facilities in the town and around the town, especially around these tourist spots. Sendra island, Thanga Khoiram Leikai, Thang and Phubala are some of the major locations that have good accommodation facilities. More than 20 hotels are registered on various travel e-commerce websites. It includes hotels, resorts, villas, and homestays facilities.

# 13.3 Corresponding Issues

Moirang faces several challenges related to its tourism infrastructure, with a lack of diverse supporting services for tourists, ranging from basic shelter to hospitality. The town's accommodation facilities are highly dependent on Imphal, limiting options for tourists and creating a bottleneck in the overall tourism experience.

Travel and transport services are another area of concern, as Moirang lacks the necessary infrastructure to support the movement of tourists efficiently. The absence of a reliable and integrated transport system makes it difficult for visitors to explore the area conveniently. Furthermore, there is a gap in the maintenance and management of tourism-related facilities, which affects the quality of services provided to visitors. The town also lacks a one-stop tourist information centre, which would serve as a centralized resource for visitors seeking guidance, maps or information about local attractions. Additionally, there is no integration between tourist sites, leading to missed opportunities for promoting Moirang as part of a broader tourism circuit within the region. This lack of connectivity between sites also results in limited tourist engagement with the local culture and history. This inadequacy can strain the designed capacity of essential infrastructure such as water supply, sewerage, and health services, posing health and sanitation risks. Some of the challenges are as follows:

# A) Overburdening of Hospitality Services

With insufficient accommodation facilities in Moirang, the existing infrastructure is at risk of being overwhelmed during festivals and tourist seasons. This overcapacity can lead to service breakdowns, poor visitor experiences, and even safety hazards like fire risks in overcrowded accommodations.

# B) Burdening existing Water Supply and Sewerage Systems

The influx of tourists can exceed the town's water supply and sanitation capacities, resulting in water shortages, improper sewage disposal, and contamination of water resources. This strain also increases the risk of waterborne diseases and environmental degradation, particularly in areas near tourist sites and natural water bodies like Loktak Lake.

### C) Inadequate Health Facilities

The lack of robust healthcare services poses a risk for both residents and visitors, particularly in the event of accidents, medical emergencies, or disease outbreaks. Tourists may find themselves without access to immediate medical care, which can adversely affect Moirang's reputation as a safe destination.

# D) Degradation of Tourist Sites

Without proper demarcation or buffer zones around tourist spots, key sites face overuse and damage. The degradation of these sites reduces their long-term sustainability and aesthetic appeal, negatively impacting both tourism and the environment. Poor management of visitor flow can lead to soil erosion, littering, and damage to heritage structures, further endangering the town's cultural and natural assets.

### E) Transport and Accessibility Risks

The absence of a reliable and integrated transport system makes it difficult for tourists to explore the area efficiently. This not only reduces visitor satisfaction but also increases the risk of accidents, especially during peak seasons when the roads may become congested with traffic from tourists and locals alike.

# F) Lack of Integrated Tourism Circuit

The disconnect between Moirang and other tourist destinations in Manipur results in missed opportunities for economic growth. Furthermore, it limits the town's ability to disperse tourists evenly, leading to overcrowding at certain sites while other attractions remain underutilized. This imbalance contributes to a higher risk of overuse in specific locations, escalating their vulnerability to degradation.

### G) Environmental and Health Hazards

Tourism activities without proper waste management and drainage infrastructure can pollute natural water bodies and surrounding areas, causing long-term environmental damage. Unregulated solid waste disposal and lack of drainage alignment with the proposed network (Section 17.6.3) may exacerbate flooding risks and pose hazards to local communities.

Furthermore, the absence of proper demarcation or buffer areas for tourists to interact with the respective sites has led to the degradation of key tourist spots. Without clear boundaries or controlled access, some sites are being damaged due to overuse or improper handling by

visitors. Moirang tourism sector is not well integrated with other tourism opportunities in Manipur, which limits its potential to attract a wider audience. Connecting Moirang with the broader tourism network in the state could help promote the town as an essential part of Manipur's tourism offerings, improving both visitor numbers and economic benefits.

# 13.4 Observations and Way Forward

To position Moirang as a prominent tourism centre for Manipur, leveraging its strategic location and connectivity is essential. The town's connectivity to other key areas makes it an ideal base for tourists exploring the state, and this advantage should be capitalized upon to enhance its tourism appeal. Developing supporting infrastructure for tourism services is crucial. This includes improving accommodation facilities, restaurants, and hospitality services to ensure a comfortable stay for visitors. By offering a diverse range of services, Moirang can cater to different types of tourists, from local tourist to national and international visitors. A single-window information system should be established to provide tourists with easy access to vital travel information, making their experience safer and more convenient. This system could include details on accommodation, transport, local attractions, safety guidelines and cultural insights.

Additionally, buffering around eco-sensitive areas is necessary to protect the natural environment and preserve the beauty of Moirang's tourist spots. Properly designated buffer zones will help manage tourism traffic and minimize environmental degradation. Finally, integrating tourist attractions through route mapping, such as heritage walks and nature walks, will create a more cohesive and immersive tourism experience. By linking cultural landmarks and natural sites in a well-planned route, visitors will be able to explore Moirang's rich heritage and natural beauty in a structured and sustainable way. This integration can also encourage longer stays and increased footfall in the town, benefiting local businesses and the economy.

Towards Loktak Lake Legend Canal

Manipur District Boundary

Moirang Master Plan Boundary

Zone Boundary

Moirang Municipal Boundary Municipal Ward Boundary Road Network Classification - Arterial Collector Local INA HQ Memorial INA Museum Ibudhou Thangjing Laishang Temple Keibul Lamjao National Loktak Lake Sangai Ethnic Park Sendra Park Towards **Kumbi-Moirang** Towards Kakching Lambi Road Map Title: Tourism Moirang Master Plan Area Risk Informed Master Plan- Moirang 0.45 0.225 0 0.45 (2023-2043)

Map 13.4-1:Tourism map of Moirang planning area

Source: Ground Truthing Survey, Seeker's thoughts 2024

<u>https://www.seekersthoughts.com/2018/11/sangai-festival-of-manipur.html</u>

# **Chapter 14** Agriculture and Allied

### **14.1 Overview**

Natural resources form the base of economy of Manipur. Agriculture forms the single largest source of livelihood and is the mainstay of the economy. Farming systems in Manipur can be broadly categorized into shifting cultivation or jhum (Paamlou in Manipuri language) practised in the hills and a more settled form of agriculture in the valley region, Moirang is one of them. The natural resource base of the state provides livelihood security to the entire region as well as employment to 68% of the working population.

Loktak Lake, the largest wetland of northeastern region of India, was traditionally used for agriculture and fisheries. Local people sustainably managed its rich biodiversity and derived benefits through its natural functioning. However, onslaught of unsustainable developmental activities without understanding the nature of the wetland ecosystem has led to its degradation and loss of benefits accrued from the ecosystem. The denudation of lake catchments due to jhum farming, deforestation and increasing demands for fodder, fuel and other forest products contributed to enhanced siltation and reduction of water holding capacity of the lake. Construction of hydraulic structures for irrigation and hydropower generation further compounded the problems of lake siltation, nutrient enrichment and reduced migration of fish fauna (The Atlas of Loktak Lake, 2002).

# **14.2 Primary Activities**

There is no designated Agriculture Produce Market Committee (APMC) Mandi located in the town. However, farmers in the area sell their produce at the Bishnupur market either through intermediaries (traders) or by directly negotiating with consumers. Occasionally, traders also purchase agricultural produce directly from the farmers' farms.

A) Fishing: Loktak supports the livelihoods of over 100,000 people who depend on it for fishing. Fish caught in the lake are sold in local markets and contribute significantly to the economy of the surrounding regions. Traditional fishing methods using athaphums (circular phumdis used as fishing enclosures) are commonly practiced.

B) Agriculture: During dry seasons, parts of the lakebed are used for cultivating crops such as rice and vegetables. Local farmers adapt their practices based on water availability, and the lake's seasonal changes shape their agricultural activities (Amoghavarsha IAS Academy, 2024).

# 14.3 Supporting Infrastructure (Agriculture Goods)

- A) Lack of designated place to sell agriculture produce (mandi).
- B) Lack of transportation facilities to transport agricultural produces.

# 14.4 Supporting Infrastructure (Loktak Canal)

Loktak Canal, located in Moirang Town in the Bishnupur district of Manipur, India, serves as a crucial irrigation canal that supports agricultural activities in the region. It is particularly significant in a state where agriculture is the primary livelihood for a large portion of the population. The canal takes its name from Loktak Lake, a prominent wetland in Manipur,



Figure 14.4-1: Loktak Canal

Source: Google Maps, October 2021

known for its floating islands (phumdis), which are unique to the region. The canal is a part of Loktak project, situated in Bishnupur Sub-Division. The water from the Loktak Lake flows through the canal, benefiting the nearby agricultural fields as shown in Figure 14.4-1.

### 14.4.1 Importance of Loktak Canal for Irrigation

The Loktak Canal plays a pivotal role in the irrigation of vast agricultural fields in Moirang and surrounding areas. The region's economy heavily relies on agriculture, with rice being the primary crop grown. The canal provides water during the dry season, when natural rainfall is insufficient, ensuring that farmers can cultivate their crops year-round. This irrigation infrastructure is vital for sustaining the livelihoods of local farmers and ensuring food security. Nearly 80% of the population in Moirang depends on agriculture, with the Loktak Canal serving as an essential water source for the paddy fields. The canal significantly enhances agricultural productivity by maintaining adequate water levels in the fields, especially during the rabi (winter) season, when water availability becomes critical for the sowing of crops such as wheat, pulses, and mustard.

### 14.4.2 Environmental and Ecological Impact

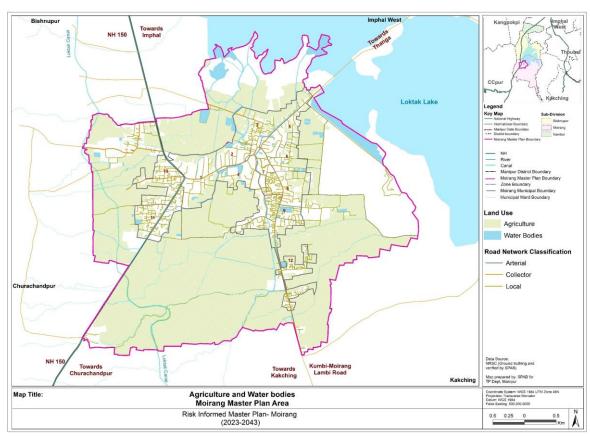
The Loktak Canal is directly linked to the health of the Loktak Lake, which is designated as a Ramsar Wetland of International Importance. The canal helps in regulating the flow of water from the lake, but its usage needs to be managed carefully to avoid over-extraction, which can lead to environmental degradation. The lake itself has experienced environmental stress due to encroachments, siltation and the impacts of climate change. Any disruption to the lake's ecosystem, including the canal's operation, could negatively affect both agriculture and biodiversity in the region.

### 14.4.3 Challenges

While the canal serves as a vital source of irrigation, several challenges persist. The siltation of the canal has reduced its water-carrying capacity, affecting the efficiency of irrigation. The rapid urbanization of Moirang and the surrounding areas has led to encroachments along the canal, further impeding its flow. Addressing these issues requires better management practices, including dredging and the restoration of natural water flow patterns.

Government agencies have recognized the need for improvements in the canal's infrastructure. The state government has initiated programs to upgrade irrigation systems in the region, with an emphasis on sustainable water management and maintenance of the canal. The Loktak Development Authority (LDA) is also involved in efforts to protect and preserve the wetland ecosystem, which indirectly benefits the agricultural sector by ensuring the continued functioning of the canal (Authority, 2023).

The Loktak Canal is an essential resource for the farmers of Moirang Town and surrounding areas, ensuring reliable irrigation for agriculture. As a critical component of the region's irrigation system, it plays a fundamental role in supporting the agricultural economy and improving food security. However, ongoing efforts to maintain and improve the canal's infrastructure, while also protecting the Loktak Lake ecosystem, are crucial to ensuring its long-term sustainability. Continued research, policy interventions and community participation are necessary to address the challenges facing the canal and secure its benefits for future generations.



Map 14.4-1: Agriculture Field in Moirang Planning Area

Source: Author

# **Chapter 15** Risk Management Plan

# 15.1 Methodology for RIMP

The Risk Informed Master Plan (RIMP) methodology is designed to systematically identify hazard exposures and vulnerable risk areas, focusing on the uncertainty associated with disasters and hazards. This approach is crucial for informed decision-making and enables the formulation of measures to effectively mitigate potential risks.

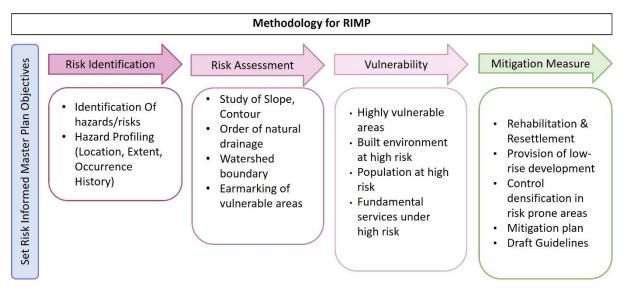


Figure 15.1-1: Methodology of RIMP

Source: Author

The preparation of the RIMP begins with the creation of a hazard profile for the study area. This involves compiling information on the history of hazards, identifying patterns, establishing a timeline of periodic hazards, determining their extent, and pinpointing risk-prone areas. Risk assessment is then conducted by analysing the physiography, slope, contours, drainage, and watershed characteristics of the area. To address future risks, specific vulnerable areas are earmarked.

Vulnerability assessment is a key component, involving three criteria: i) evaluation of built environments at high risk, ii) identification of population and areas at high risk, and iii) assessment of fundamental services (such as food, shelter, communication, and transportation) that are at high risk. This comprehensive study of various parameters provides insights into the necessary measures for mitigating the impact of potential risks.

The outcomes of the assessment guide the formulation of appropriate actions, including rehabilitation and resettlement efforts where needed. Additionally, the methodology emphasizes the importance of regulating building norms, particularly in risk-prone areas. This involves implementing measures such as promoting low-rise development, controlling densification in vulnerable areas, and restricting built ups in high-risk and eco-sensitive zones. The final steps of the methodology involve preparing a mitigation plan, drafting guidelines, and establishing frameworks to effectively address and tackle future risks.

### **15.2** Identification of Risk

Identification of risk or hazard is a crucial step in the risk management process. It involves recognizing and understanding potential threats or dangers that could impact the area. The goal is to assess and address these risks to minimize their negative effects. The risks identified in the Moirang planning area stem from historical occurrences in the vicinity and the proximity of hazards. Given its location near Loktak Lake, the town is particularly vulnerable to flooding. Earthquakes and flooding have been the most frequent hazards experienced within or near the planning area.

# 15.3 Risk Profiling

Risk profiling in disaster management involves assessing and categorizing potential risks based on various factors such as probability, impact, vulnerability, and resilience. It aims to identify, analyse, and prioritize potential hazards and their potential consequences to inform mitigation, preparedness, response, and recovery efforts. The goal is to create a comprehensive profile for each identified risk or hazard, enabling better-informed decision-making in risk management. The process of risk profiling includes:

### **15.3.1** History of Hazards

The history of risks/hazards is coiled with the developmental activities and the identification of threats posed by various elements in the environment. Hazards can take many forms, including natural disasters, industrial accidents, and other events that have the potential to cause harm. An overview of the history of risks/hazards which are identified in Moirang is summarized:

### **15.3.1.1** *Earthquake*

As per National Centre for Seismology (NCS), Manipur state comes under earthquake zone V that includes areas that are highly susceptible to earthquakes as shown in Map 15.3-1. This data was analysed by Bureau of Indian Standards to prepare a Probabilistic Seismic Hazard Zonation Map of India. Buildings in this zone are required to be designed and constructed to withstand the highest level of seismic activity.

Manipur is in seismic zone V, the most susceptible region to earthquakes in the world (Seismic Zones -India 2001). It continues to experience small tremors off and on. Based on the past trend, seismologists have predicted that a major earthquake in the north-east region of India is almost overdue. Low to moderate intensity earthquakes are reported regularly here. The state of Manipur has weathered dozens of major earthquakes, the 1988 M7.2 earthquake being the strongest in recent times as shown in Table 15.3-1. In western Manipur, most earthquakes are shallow. But some have larger depths, especially those reported in the eastern parts and along and across the Myanmar border. Areas in central Manipur are especially vulnerable to damage during earthquakes. Bishnupur district is one of the highly susceptible districts of Manipur, as per the map prepared based on the data of NCS between 2011-2023.

**INDIA** Earthquake Hazard Map (showing faults, thrusts and earthquakes of magnitude ≥ 5)<sub>o</sub> 0 BAY OF BENG 0 6.1 -7.0 ARABIAN SEA ///// Sub-surface Fault Strike slip Fault INDIAN OCEAN Zone V : Very High Damage Risk Zone (MSK IX or more)
Zone IV : High Damage Risk Zone (MSK VIII) **bmlpc** Zone III: Moderate Damage Risk Zone (MSK VII)
Zone III: Low Damage Risk Zone (MSK VI or less)

Map 15.3-1: Earthquake hazard map of India

Source: BMTPC: Vulnerability Atlas

Table 15.3-1: Earthquake occurrence history

S. No.	Date/ Time	Region/ Remark	Intensity (on Richter scale)
1.	Aug 01, 2011, 00:26 UTC	4 Km East of Moirang. The depth was 38km.	3.8 (ML)
2.	Oct 08, 2011, 03:00 UTC	22 Km west-southwest of Moirang. The depth was 13 Km.	3.1 (ML)
3.	June 15, 2013 00:10 UTC	22 Km west of Moirang. The depth was 7 Km.	3.5 (ML)
4.	Oct 15, 2014 13:46 UTC	23 Km west-southwest of Moirang. The depth was 27 Km.	3.8 (ML)
5.	July 21, 2015 08:21 UTC	14 Km southwest of Moirang. The depth was 7 Km.	3.7 (ML)
6.	Sept 17, 2016, 02:46 UTC	7 Km southeast of Moirang. The depth was 50 Km.	4.1 (ML)
7.	Jan 04, 2017, 13:40 UTC	10 Km southwest of Moirang. The depth was 81 Km.	3.5 (ML)
8.	Feb 24, 2017, 12:02 UTC	38 Km southwest of Moirang. The depth was 20 Km.	4.9 (ML)
9.	Aug 02, 2017 18:18 UTC	33 Km west- southwest of Moirang. The depth was 89 Km.	5.2 (ML)
10.	Aug 08, 2017, 00:35 UTC	27 Km southwest of Moirang. The depth was 72 Km.	4.2 (ML)
11.	Sept 21, 2017, 22:35 UTC	33 Km west-southwest of Moirang. The depth was 59 Km.	3.2 (MW)
12.	March 15, 2018, 02:26 UTC	16 Km southwest of Moirang. The depth was 85 Km.	4.6 (MW)
13.	Apr 04, 2018, 07:10 UTC	8 Km west-southwest of Moirang. The depth was 36 Km.	3.8 (MW)
14.	March 25, 2019, 12:41 UTC	44 Km west-southwest of Moirang. The depth was 13 Km.	4.6 (Mb)
15.	Nov 05, 2019, 10:19 UTC	29 Km southwest of Moirang. The depth was 59 Km.	3.8 (MW)
16.	May 24, 2020, 20:25 IST	39 Km west-southwest of Moirang. The tremors were also felt in other parts of Northeast such as Guwahati and other parts of Assam, Meghalaya, Nagaland, Manipur, Mizoram.	5.4 Magnitude
17.	May 24, 2020, 20:25 IST	39 Km west-southwest of Moirang	2.9 Magnitude
18.	Oct 10, 2020, 23:08 IST	Near Tamenglong District, Manipur. The epicenter of the earthquake was 24.69 N and 93.47 E with a focal depth of 28 km. The epicenter was about 40 km East-Northeast of Imphal and 30 km West-Northwest of Bishnupur.	5.3 Magnitude
19.	Dec 17, 2020, 22;03 IST	36 Km south of Moirang, Lat. 24.15 degree and long 93.74 degrees.	3.2 Magnitude
20.	Sept 22, 2022, 8:15 IST	13 Km south-west of Moirang	4.5 Magnitude
21.	Sept 22, 2022, 8:28 IST	20 Km south-west of Moirang	2.6 Magnitude

22.	Oct 20, 2022,	75 Km ESE of Moirang. The depth of earthquake	4.4 Magnitude
	21:30 IST	was 10 km below the ground.	
23.	March 20, 2023	60 Km ESE of Moirang	3.8 Magnitude
		Lat. 24.34 degree and long 94.35 degrees.	

Source: National Centre for Seismology (NCS)

During the past 20 years within 50km radius of this earthquake location, two earthquakes of M:5.0 and above occurred on 3rd Jan 2016 (M:6.6) and on 2nd Aug 2017 (M:5.2). During this period, about 10 earthquakes occurred in the magnitude range of 4.0 and 4.9. The list of the past earthquakes within a 50km radius of the present earthquake is given in Table 15.3-1.

The town is highly vulnerable to earthquake due to its history that shows that the earthquakes are frequent in Moirang subdivision of Bishnupur District. Entire area of planning boundary of Moirang falls under very high risk of about 5 earthquakes occurred in the magnitude range of 4.5 and 5.5, whereas the nearest earthquake occurred 13 km south-west of Moirang.

#### 15.3.1.2 Flood

Some major flood occurred in Bishnupur district are listed in Table 15.3-2.

*Table 15.3-2: Flood occurrence history* 

S. No.	Time Period	Region/ Remark	Intensity/ Impact
1.	June-July 1966 and October 1966	Flood occurred in the Valley. In some of the areas such as Hiyanglam, Sugnu, Arong, Nongmaikhong, Wangoo, Tanjeng were inundated from June to October. Breach of embankment took place at 60 places.	
2.	June-July 2001	Breach of embankment of Nambol River took place at Nambol, Kongkham: inundating Kongkham, SabalLeikai, Maibam and Naorem.	Flood of low magnitude occurred in some parts of Manipur Valley.
3.	August 2002	Due to incessant rain in the catchments, all the rivers flowing in and around Imphal, Thoubal and Bishnupur districts were rising from August 11, 2002. On August 13, 2002, the water levels in all major rivers/streams in Manipur valley were rising alarmingly crossing the R.F.L on the same day.	A severe flood occurred in Manipur valley. About 10,000 houses and 20,000 hectares of paddy fields were affected.
4.	July- August 2015	All main major rivers were overflowed causing havoc and washing away connecting bridges, breaching of embankments, cutting off many villages from the mainland.	The intensity of the flood was severe. About 34,960 hectares were affected and

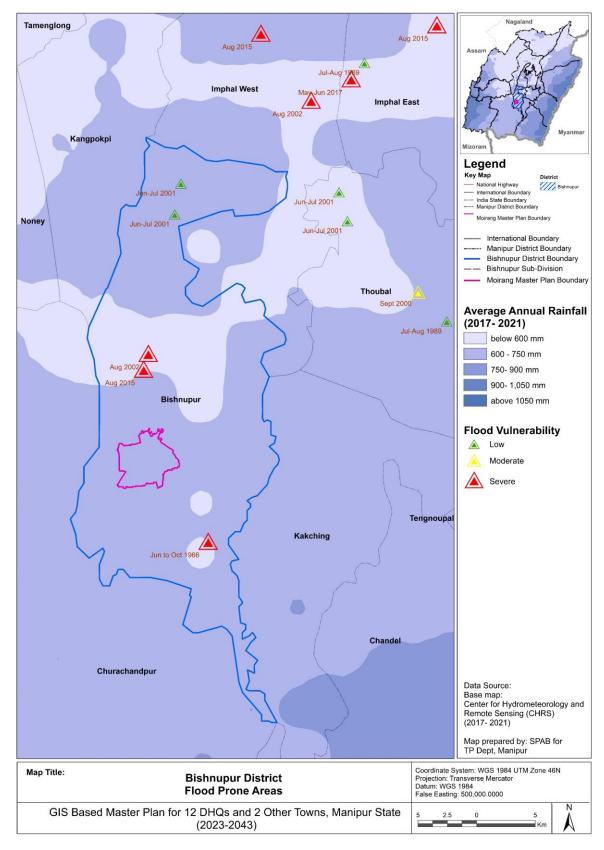
thousands were left
homeless

Source: CHRS and State Disaster Management Report 2017-2018 (Manipur)

During the monsoon season, floods pose a significant natural hazard in the area, causing damage to crop and properties of the residents. Almost every year, flash floods occur, primarily attributed to inadequate drainage conditions. The primary factors contributing to flooding in the Manipur Valley include substantial runoff and reduced infiltration in degraded watersheds situated in the upper reaches of the rivers during the rainy seasons in the valley. Bishnupur district is one of the highly flood susceptible districts of Manipur. Since 2000, many areas of the district are affected by flood. As per CHRS data, average rainfall between 2017-2021 of Bishnupur district is 500-750 mm (Refer Map 16.2-3). Moirang town Average rainfall in Moirang planning area lies between 2017-2021 is 600-750 mm.

The floods occurred in the vicinity of the Moirang master plan boundary have been notably severe, with the most recent major flood occurring in August 2015. The districts most adversely affected by this event were Bishnupur, Imphal East, Imphal West, Churachandpur, Thoubal, and Chandel. Adding to the vulnerability, the Loktak catchment area is situated in the northeast and eastern part of Moirang, which is in proximity and characterized by lowlying terrain. This geographical arrangement further increases the town's susceptibility to floods.

Map 15.3-2: Flood Vulnerability



Source: CHRS and State Disaster Management Report 2017-2018 (Manipur)

### 15.4 Risk Assessment

Risk assessment is a fundamental process to understand the impact of risk on people and environment in a broad perspective. While closely related, they serve distinct purposes in evaluating and addressing potential threats. The outputs of hazard and risk assessments inform decision-making processes, helping organizations allocate resources, implement controls, and prioritize actions to manage potential threats effectively. A detailed analysis by overlaying various factors such as hydrology, built environment, topography, history of reoccurrence, etc. These factors are discussed below:

#### **15.4.1 Contours**

Moirang town, situated in the valley region of Manipur State, exhibits a predominantly flat and plain topography, essential considerations in the formulation of the Moirang Master Plan. The strategic location of Loktak Lake to the Northeast holds significant influence over the town's topographical features. Contour map is used to describe the Uphill and Downhill of an area as elevations above sea means of contour lines. It provides information which can help to study the nature of the terrain, to determine the catchment area of a drainage basin and to find intervisibility between two or more specific landuse locations.

The contours within the planning area vary in the range of 10-20 m, with the region abutting Loktak Lake slightly lower in elevation compared to its western and southwestern counterparts as marked in Map 15.4-1. These are low lying areas and are mainly categorized as wetlands. Specifically, the contours in these areas measure around 760 m, while in other sections, they hover around 780 m. Additionally, the planning area encompasses a singular hillock, positioned at the easternmost part of the town, where elevations rise to 800 m. As town planners, recognizing and navigating these nuances in topography becomes imperative to ensure thoughtful and effective urban development, embracing the natural features while optimizing the town's overall spatial functionality. Areas are marked which are vulnerable to flood.

Bishinupur

NH 150

Towards Imphal West

Loktak Lake

Lok

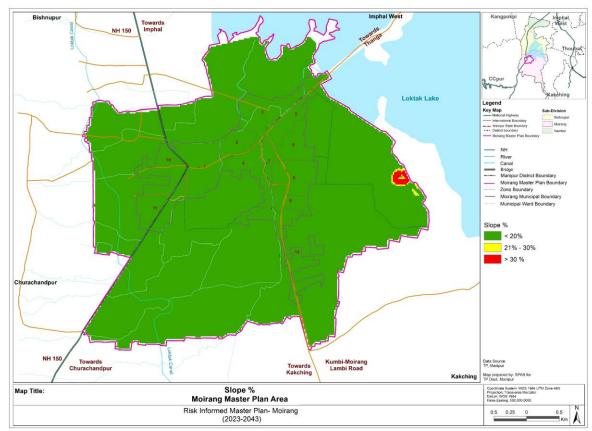
Map 15.4-1: Contours at 1m, 5m and 10m of the Moirang Planning Area

Source: Town Planning Department, Manipur

# 15.4.2 Slope

The slope gradient within the Moirang Master Plan area generally ranges from 0 to 24 degrees, indicating a relatively even topography across the north-south and east-west axes. However, there are specific pockets within the area where the slope increases to 13-18 degrees. Notably, the hillock situated in the easternmost part of the town exhibits a more pronounced slope variation, reaching up to almost 24 degrees (>30% slope) as represented in Map 15.4-2. Understanding these variations in slope is crucial for comprehensive urban planning, allowing for tailored strategies that accommodate the diverse topographical features and contribute to the overall functionality and aesthetics of Moirang.

Manipur exhibits two clearly defined physical regions – the hilly and valley areas. Understanding these variations in slope is crucial for comprehensive urban planning, allowing for tailored strategies that accommodate the diverse topographical features and contribute to the overall functionality and aesthetics of Moirang.



Map 15.4-2: Slope of the Moirang Planning Area

Source: NRSC

# 15.4.2.1 Level Ground (<20%)

The slope gradient within the Moirang Master Plan area generally ranges from 0 to 20 %, indicating a relatively even topography across the north-south and east-west axes.

### 15.4.2.2 Moderate Slope (21-30%)

Minor parts of the town in the eastern direction shows moderate slope.

# 15.4.2.3 Steep Slope (>30%)

The hillock situated in the easternmost part of the town exhibits a more pronounced slope variation.

# 15.4.3 Natural Drainage and Watershed Boundary

## 15.4.3.1 Natural Drainage

A connected set of lines which represent the surface-water drainage, oriented in the direction of flow. This drainage network prepared using digital elevation model (DEM) in GIS tool. In the Map 15.4-3, the drains are arranged in an order with reference to the sequence of network. This order of drainage networks represents the information regarding upstream complexity. Headwater streams, from where flow initiates, are classified as 1st order stream. If two streams of the same order converge, the downstream channel is designated with the next higher order which is 2nd order stream.

# 15.4.3.2 Watershed Boundary

The area of land that collects surface runoff and other flowing water and drains to a common outlet or pour-point location defines a watershed. Watersheds are divided into various sizes based upon the naturally arranged in a hierarchy of surface water drainage patterns. The physical barriers make up the watershed boundary.

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Towards Imphal West

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Map 15.4-3: Drainage order and Watershed Boundary

Source: NRSC and Author

#### 15.4.3.3 Elevation

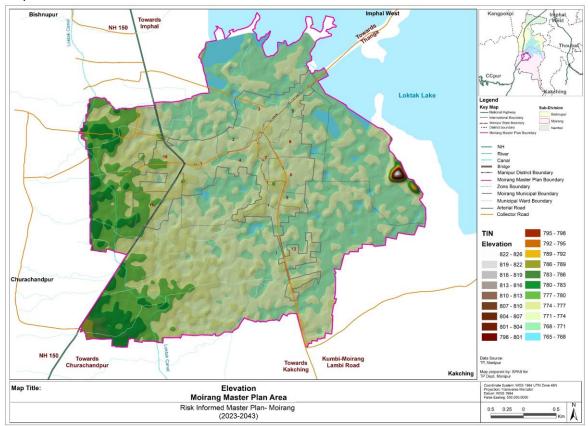
Elevation maps provide a visual representation of the land's topography, helping to identify low-lying areas, drainage patterns, and potential flood-prone zones. This information is essential for effective flood risk assessment, mitigation planning, and disaster management. Elevation map plays crucial role in identifying the low-lying areas which are prone to flash flooding. Elevation provides the information about the topography of the land. It uses contour lines to represent points of equal elevation above a reference point, which is mean sea level. Areas with lower elevations are more prone to flooding as water tends to flow towards these lower points. These areas are prone to flash flooding.

Elevation maps provide information about the slope of the land. Elevation maps are used in hydrological modelling to simulate water flows across the landscape. By incorporating rainfall patterns and terrain elevation, hydrological models can predict potential flood scenarios and identify vulnerable areas. In Map 15.4-4, it is shown that the height of ground is decreasing from west to east direction. The Loktak lake and the nearby wetland are the depression points in the region.

### **Integration with GIS (Geographic Information System):**

Elevation data is often integrated into GIS platforms, allowing for the overlay of additional information such as land use, infrastructure, and population density. GIS analysis with elevation data helps in identifying not only the topography but also the human and built environment's vulnerability to flooding.

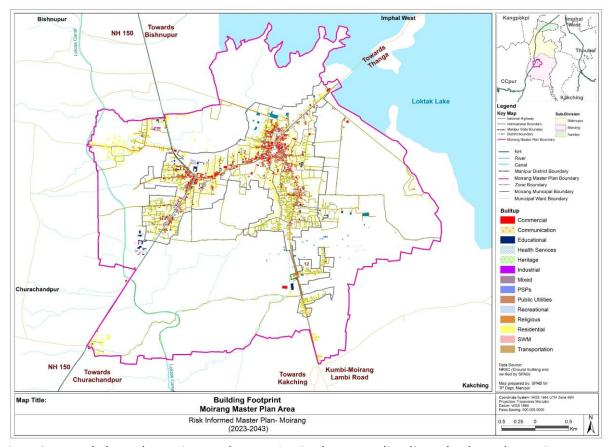
Map 15.4-4: Elevation



Source: NRSC & TPD, Manipur

# 15.4.3.4 Built environment/ Building footprint with material-based classification.

Building footprint map is prepared by digitizing the building in Google earth imagery. These digitized built ups were then specified with their respective built use by ground truthing survey. Map 15.4-5 shows the various classes in which these built ups have been divided, for example residential, commercial, educational, etc. Commercial built ups are concentrated at



Map 15.4-5: Building footprint in Moirang Planning Area

junctions and along the major roads. Housing is also spreading linearly along the major routes.

Source: Ground Truthing Survey

# 15.5 Earmarking of vulnerable areas/risk prone areas

Earmarking flood-prone areas involves the identification and delineation of regions that are susceptible to flooding. This process is crucial for effective urban planning, disaster management, and risk reduction. The key steps involved in earmarking flood-prone areas:

# 15.5.1 Methodology

Identifying flood-prone areas involves a comprehensive analysis that considers various factors, including contours, proximity to water bodies, built environment, and flow direction. The process of identifying risk prone areas for flood as follows:

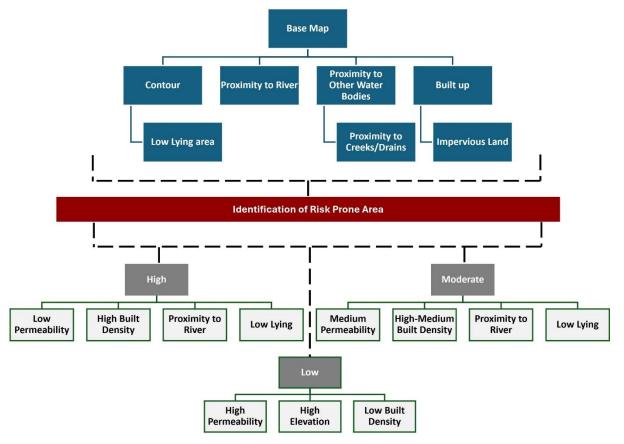


Figure 15.5-1: Methodology of Flood risk prone areas

### 15.5.2 Earmarking of Flood Prone Areas

#### 15.5.2.1 Contours:

Closed contours, as they may indicate depressions or basins where water accumulate during heavy rainfall. Analyse the contour patterns to identify areas with steep slopes, as these regions may experience rapid runoff during heavy rainfall. Contour lines at lower elevations, especially those close to water bodies are more susceptible to flash flooding. Low-lying areas with closely spaced contours also be prone to flooding as shown in Map Map 15.5-1.

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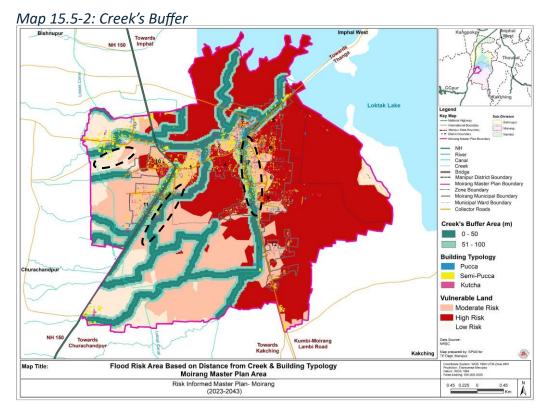
Map 15.5-1: Low lying areas

Source: TPD, Manipur

#### 15.5.2.2 Proximity to Water Bodies:

Areas close to riverbanks and streams are at higher risk of flooding. The elevation of the land in proximity to these water bodies, considering both the main channel and potential overflow areas during floods. Low-lying areas near lakes and ponds may also be susceptible to flooding as per the elevation.

In Map 15.5-2shows the location of creeks and water bodies other than rivers and areas susceptible to flooding because of impervious land around it. The more built density, the more impervious ground become. This reduces the infiltration of rainwater and increases the runoff over surface which further leads to flash flooding in neighbourhood areas. When this runoff travel through the town, it collects the waste and toxic materials and dispose off into the outlet point, which are lakes, creek and ponds.

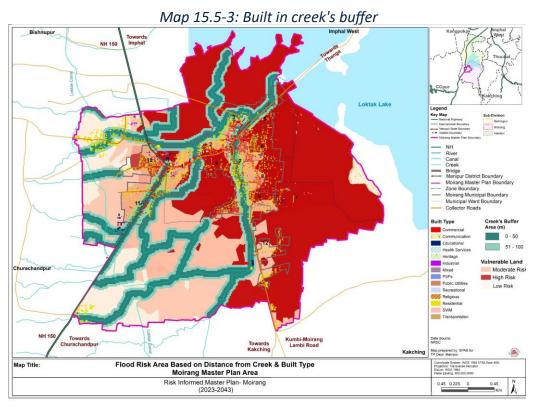


Source: Ground Truthing Survey

In Map 15.5-3 shows the location of creeks and water bodies other than rivers and areas susceptible to flooding overlaying built up. This help in identifying susceptible and suitable land for further development. Also, it shows the type of landuse under high-risk areas such as along the NH150 and Moirang-Kumbi road, there is nallah which overflows during heavy rain. Due to the present of commercial buildings along these routes, they are highly susceptible and prone to flooding. This can cause damage to the local economy and goods supply on daily basis.

In Map 15.5-4, the water bodies within the planning area are clearly depicted. These areas are already submerged, preventing runoff water from infiltrating the land. Consequently, when rainfall or excessive water accumulates, the runoff has no natural outlet, leading to water overflow. This overflow exacerbates the risk of urban flash flooding, especially in nearby low-lying areas. The lack of proper drainage infrastructure and the saturation of the land further contribute to the rapid accumulation of water, causing significant flooding in the vicinity. This scenario not only disrupts daily activities but also poses serious risks to public safety and property. The situation calls for urgent measures to address water management,

including better stormwater drainage systems and sustainable urban planning practices to mitigate such flooding risks.



Source: Ground Truthing Survey & Loktak Atlas

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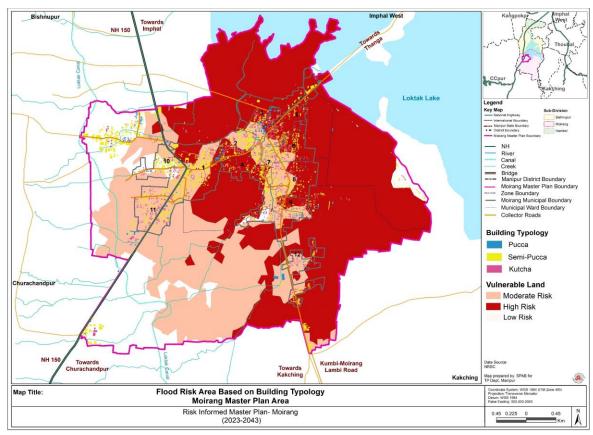
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Map 15.5-4: Other water bodies

Source: Google Earth Imagery & Loktak Atlas

#### 15.5.2.3 Built Environment:

Assess the type of structures and infrastructure in the area. Urbanized or densely developed regions with impervious surfaces may experience increased runoff, leading to flash floods. Evaluate the design of drainage systems and stormwater management infrastructure. Poorly designed or overloaded drainage systems can contribute to flooding. In Map 15.5-5 shows areas in high risk which has dense built ups. The concrete surfaces have negligible infiltration capacity which causes flow of rainwater on the surface and accumulate at depression points which could be near residential or market areas. These depressions can only hold water till its capacity, then overflow and cause flooding.



Map 15.5-5: Built environment

Source: Ground Truthing Survey and Author

#### 15.5.2.4 Flow Direction:

The flow direction of a flood is determined by the natural topography and the hydraulic characteristics of the area affected by flooding. Identify the natural flow paths of water in the area. Contour lines can help determine the direction in which water would naturally flow during rainfall. Analyse the slope of the land to understand how water would move across the

terrain. Low-lying areas with slopes that direct water towards them may be more prone to flooding. When a region experiences a flood, water follows the path of least resistance, flowing downhill and seeking lower elevations. There are some key factors which assess the flow direction of water:

- A) **Topography:** Water flows from higher elevations to lower elevations. Low-lying areas, plains, and river valleys are more susceptible to flooding, and water tends to accumulate in these regions.
- B) **River:** The direction of flow is determined by the river's course and the gradient of the land.
- C) **Drainage Pattern:** Stormwater drains can influence the flow direction of rain water. However, if these systems overwhelmed or blocked, they may contribute to localized flooding.
- D) Land Use Pattern: Changes in land use, such as deforestation or urbanization, can impact the natural flow patterns. Densely built areas also block the natural flow of water.
- E) **Urban Infrastructure:** Urban areas with impermeable surfaces (such as roads and buildings) can alter natural drainage patterns. Floodwaters may follow streets and flow towards lower-lying areas within the urban landscape.
- F) Understanding the flow direction of floodwaters is crucial for effective flood risk assessment, emergency response planning, and infrastructure development. This knowledge allows communities to implement measures to mitigate the impact of floods, such as constructing levees, improving drainage systems, and establishing early warning systems to protect lives and property.
- G) **Natural Drainage Paths:** Identify the natural flow paths of water in the area. Contour lines can help determine the direction in which water would naturally flow during rainfall.
- H) **Surface Slopes**: Analyse the slope of the land to understand how water would move across the terrain. Low-lying areas with slopes that direct water towards them may be more prone to flooding.

#### 15.5.2.5 Historical Flood Data:

A) **Flood Records:** Consult historical flood data and records for the area to understand past flooding events and their extents. This information can help identify recurring flood-prone zones.

**B)** Remote Sensing and GIS: Satellite Imagery and GIS: Utilize satellite imagery and Geographic Information System (GIS) data to overlay information about contours, water bodies, and land use. These tools can aid in visualizing and analysing flood risk factors.

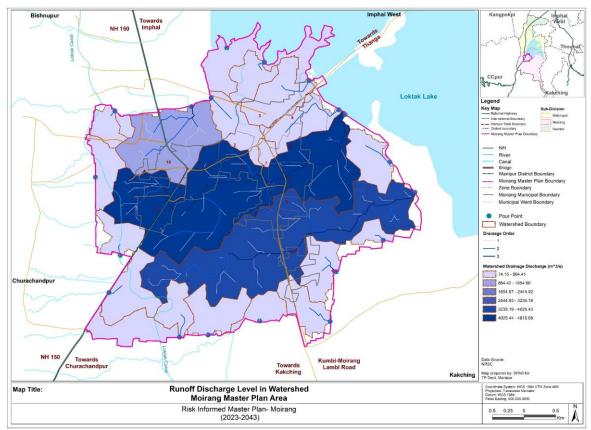
#### 15.5.2.6 Rainfall Discharge

A watershed is an area of land that drains all the streams and rainfall to a common pour point known as outlet. Each watershed has its own pour point which could be merging point of lower order drain into higher order drain or drain merging into river. Watershed can be small or large as per given contour, flow of natural drain and outflow point. To understand more about the hydrology of each watershed rainfall and runoff water plays crucial role. Watershed plays important role to identify the obstruction in natural flow of water due to landuse activities and water quality of the outflow channels.

Watershed runoff is an important factor to know at what level the area is dealing with the heavy rainfall. It is pivotal to understand the relation between built environment and open spaces. In the Map 15.5-6, all order drains are flowing the slope and contour of the area and merging at one point. the pour points are denoting the outflow point of all the surface water of each watershed. In some areas where rivers are flowing, the surface runoff is disposing off into those rivers.

Watershed area helps to identify the growth of built up and if it is obstructing the natural flow of water because of its the non-porous nature then it is also crucial to calculate the runoff of rainfall water in each watershed. Impervious strata lead to low infiltration capacity of rainfall water in watershed area. Obstruction of natural flow also causes stagnancy in water and causes ponding in the vicinity in a small scale. In case of heavy rainfall, this ponding can become the catalysts to the urban flooding. It is important to identify the areas where built is disturbing the flow and make required arrangements. This also helps to make provisions in building byelaws for future development which will ensure no obstruction in flow of water and give certain buffer to protect water bodies. Areas with darker shades in the Map 16.5-6 showing high discharge of runoff which means maximum rainfall water is flowing over the surface which also means there is heavy built up in the respective watershed area. Low porosity of ground and heavy rainfall can cause hazard like situation as flooding. The average rainfall intensity is taken 113 mm/hr.

To ensure the reduction in risk of flooding, it needs to make watershed areas more porous and protect the buffer zone of rivers and other water bodies. The construction of new built ups should be based upon building byelaws. Also, there should be provision for making artificial recharge at neighbour level to collect rainwater at depression points. These recharging pits can also be used for



Map 15.5-6: Runoff capacity of watershed

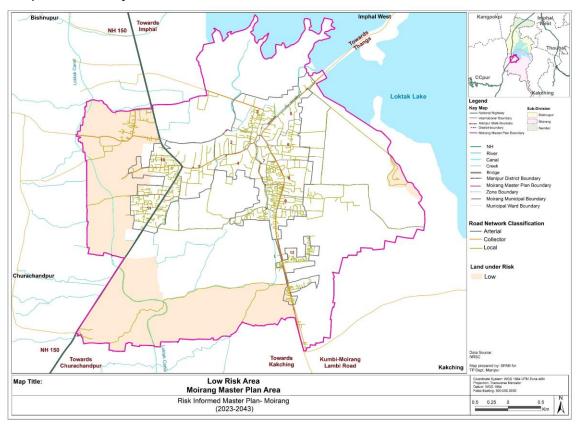
Source: Flood Hazard Report, Manipur & Manipur Disaster Management Plan 2017-18 Report of Manipur Vision 2030

#### 15.5.3 Flood Prone Areas

By systematically earmarking flood-prone areas, authorities can make informed decisions about land use, infrastructure development, and disaster preparedness. It also facilitates the implementation of measures to mitigate the impact of floods, protecting both lives and property.

#### 15.5.3.1 Low Flood Risk

Areas with low flood risk are those with sparse development that does not obstruct natural drainage patterns, particularly found in regions with elevated or moderately sloped contours, ensuring effective water flow. In Map 15.5-7 shows areas those are well-connected watershed networks that efficiently channel water away from settlements. Situated at a considerable distance of at least 500 meters from rivers and strategically located far from wetlands and other water bodies, they minimize the risk of inundation. These areas are identified as low risk areas based on the above-mentioned parameters. Additionally, the infrastructure in these zones primarily consists of pucca and semi-pucca constructions, reducing the potential for structural damage during floods. As a result of meticulous study and analysis, it has been discerned that the West, South-West and Southern part within the Moirang planning area exhibit these characteristics, signifying them as low-risk areas with regards to flooding.

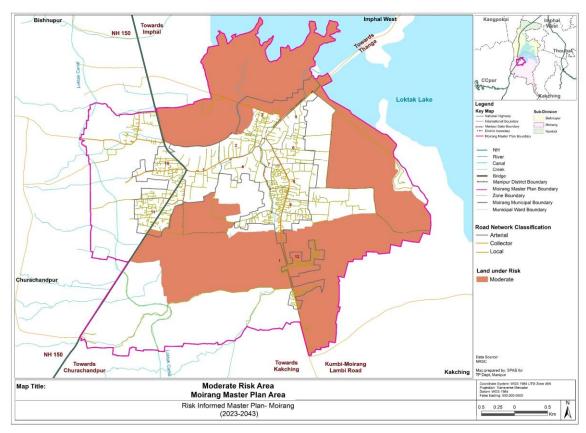


Map 15.5-7: Low flood risk area

Source: Author

#### 15.5.3.2 Moderate Flood Risk

Moderate flood risk areas in the Moirang planning area are characterized by a moderate built density that doesn't overly obstruct natural drainage. They feature medium-contoured terrain and well-connected watershed areas yet remain vulnerable to flooding during heavy rainfall due to their lower lying positions. Map 15.5-8 shows, despite being at least 500 meters away from rivers and distant from wetlands, these areas are at moderate risk due to their semi-pucca and kutcha type constructions, which are less flood resistant. Additionally, their medium runoff discharge, caused by the impervious nature of the surface, contributes to their susceptibility. Identified mainly in the North, Northeast, East and South-east with a small belt in southern central part of planning area.



Map 15.5-8: Moderate flood risk area

Source: Author

#### 15.5.3.3 High Flood Risk

High flood risk areas in the Moirang planning area are characterized by dense development that obstructs natural drainage, compounded by low-contoured terrain. With poorly

connected watershed areas and proximity to rivers and water bodies, these zones are highly vulnerable to flooding, especially during heavy rainfall. Predominantly comprised of kutcha type constructions, they lack flood resilience. The impervious surface further escalates runoff discharge, exacerbating the risk. In Map 15.5-9, it shows that the high flood risk areas primarily lie in the central part of the Moirang planning area, with a smaller high-risk zone in the east. These regions highlight the substantial threat of flooding due to a combination of environmental and developmental factors.

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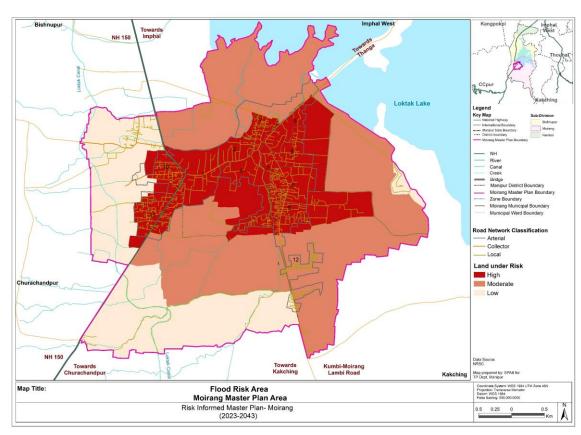
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Map 15.5-9: High flood risk areas

Source: Author

The holistic analysis of flood-prone areas, as illustrated in Map 15.5-10, provides a comprehensive understanding of flood risks by integrating factors such as built-up density, geographical features and hydrological patterns. Built-up density is the primary parameter in identifying flood risk, with densely populated areas being more susceptible to flooding due to the impediment of water runoff by infrastructure. The central part of the planning area, characterized by high population density and significant urban development, is identified as a high-risk zone because the increased obstacles to water flow elevate the likelihood of flooding

or flash flooding. In contrast, the northern, eastern and central southern areas, which are near Loktak Lake and contain some built-up regions, are classified as moderate-risk zones. These areas still have natural features that can absorb or channel water, but their proximity to the lake and existing urban development increase the risk of flooding. The western and southern parts of the planning area are classified as low-risk areas, as they are less developed, have more natural vegetation and are better able to absorb water or facilitate natural drainage. This comprehensive analysis helps prioritize flood mitigation efforts and urban planning, ensuring that areas at higher risk receive the necessary attention while encouraging sustainable development in less vulnerable zones.



Map 15.5-10: Flood prone areas

Source: Author

# 15.5.4 Mitigation Plan for Flood Risk Reduction

In developing and implementing a flood mitigation plan, it is essential to involve various stakeholders, including government agencies, local communities, NGOs, and experts in relevant fields. An integrated and collaborative approach is key to the success of flood risk reduction efforts.

Creating an effective flood mitigation plan for flood-prone areas involves a combination of structural and non-structural measures aimed at reducing the impact of flooding. Following is a comprehensive guide for developing a flood mitigation plan, Figure 15.5-2:

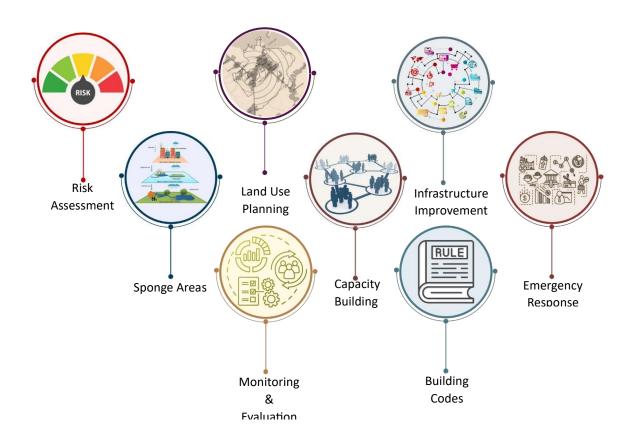


Figure 15.5-2: Mitigation Measure for Risk Reduction

Source: Author

#### 15.5.4.1 Risk Assessment:

Risk assessment helps to identify areas prone to flooding and assess the potential severity of floods. Consider historical flood data, topography, built use, proximity to water bodies and natural drainage to understand the vulnerability of the area.

## 15.5.4.2 Zoning and Land Use Planning:

Implement and enforce zoning regulations that restrict construction in high-risk flood zones. Encourage and enforce land use planning that promotes sustainable development and minimizes the impact of urbanization on drainage patterns.

#### 15.5.4.3 Infrastructure Improvement:

Upgrade and maintain drainage systems to ensure efficient water flow and reduce the risk of flash flooding at locality level. Build or improve storm water drains to mitigate the impact of floods.

## 15.5.4.4 Green Infrastructure:

Promote the use of green infrastructure, such as permeable surfaces and urban green spaces to absorb rainwater and reduce the runoff. Protect and restore natural buffers like wetlands and forests that can act as natural flood barriers.

### 15.5.4.5 Capacity Building of Stakeholders:

Raise awareness about flood risks, evacuation procedures, and preparedness measures. Provide resources and training to the community on emergency response and evacuation plans.

## 15.5.4.6 Emergency Response Planning:

Develop and regularly update comprehensive emergency response plans that include evacuation routes, emergency shelters, and coordination with emergency services.

Conduct drills and exercises to ensure that residents and response teams are familiar with emergency procedures.

#### 15.5.4.7 Monitoring and Evaluation:

Establish a monitoring system to assess the effectiveness of mitigation measures. Regularly review and update the mitigation plan based on new information and changing conditions

#### 15.5.4.8 Flood Emergency Access

Design roads and pathways with materials and gradients that can withstand temporary inundation.

# 15.5.4.9 Early Warning Systems:

Establish an early warning system to provide timely alerts to residents and authorities. Ensure effective communication channels for disseminating warnings and evacuation instructions.

### 15.5.4.10 Building Codes and Standards:

Enforce and update building codes to ensure that new constructions in flood-prone areas are designed to withstand floods. Encourage elevated structures, flood-resistant materials, and proper building elevation. Provisions in building byelaws as per topography (Refer slope and elevation map) of the area. On the uphill side of a building on a sloping site, drainage requires special consideration. Suitable lined or unlined drains shall be provided all around the building to get proper drainage. Built activities should happen in such a way that rainwater does not find way to ingress in ground excessively and moves away quickly to surface drains or away on adjoining hill surface towards natural streams. (Source: IS:14243-2 1995)

The object of the storm water drainage is to collect and carry, for suitable disposal, the rainwater collected within the premises of the building complex. Drainage shall avoid all possibilities of slope failure due to ingress of water. Fundamental requirement of efficient drainage is that rainwater should move away from the site as early as possible without stagnation.

## 15.5.5 Earmarking of Earthquake Prone Areas

## 15.5.5.1 Methodology

The process of preparing an earthquake zoning map begins with the collection of earthquake data spanning from 1960 to 2023, sourced from the National Centre for Seismology. This data, including magnitude, depth, and location, is then subjected to thorough analysis using GIS software. The software aids in assessing the magnitude and depth of each earthquake, allowing for the visualization of intensity and the creation of a spatial representation of affected areas. Subsequently, these impacted areas are categorized into low, moderate, and high-risk zones based on the severity of earthquakes. A detailed risk assessment is then conducted, considering geological and structural vulnerabilities. The result is a comprehensive earthquake zoning map, demarcating risk-prone areas, which serves as the foundation for the development of building guidelines and restrictions. These regulations are designed to enhance seismic resilience and guide construction practices in each zone. Furthermore, the zoning map aids in the effective allocation of resources for mitigation measures, directing attention to high-risk areas. Detailed methodology for earmarking of earthquake prone areas is shown in *Figure 15.5-3*.

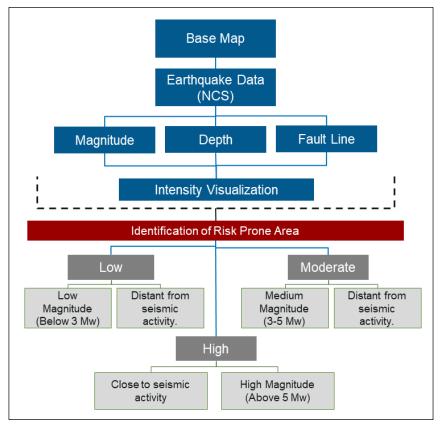


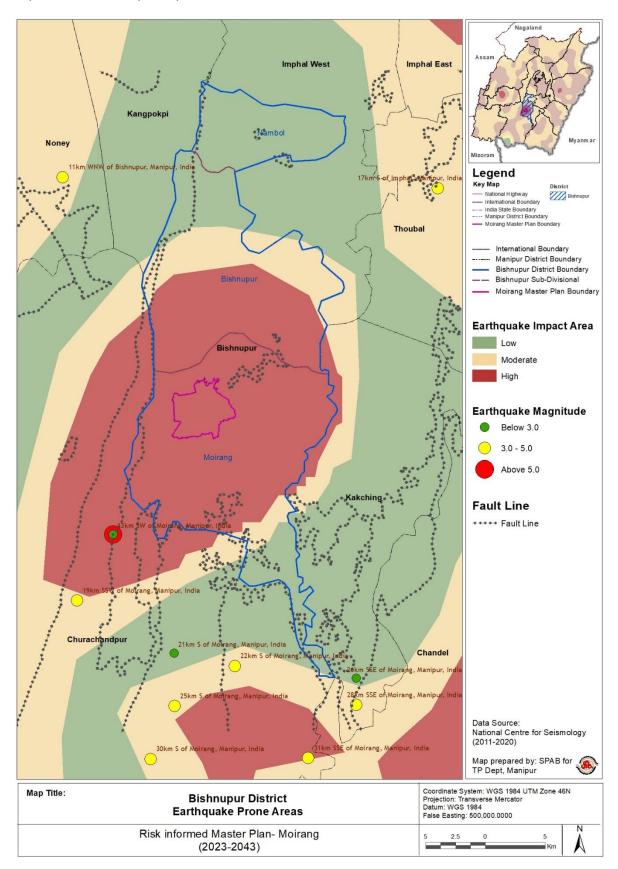
Figure 15.5-3: Methodology for earmarking earthquake prone areas

Source: Author

### 15.5.5.2 Earthquake Prone Area

The classification of earthquake risk zones is crucial for understanding and mitigating seismic hazards. These zones, categorized based on seismic activity and potential damage, provide insights into the varying levels of earthquake risk. The details of these zones—low-risk, moderate-risk, and high-risk—are outlined below and illustrated in Map 15.5-11.

Map 15.5-11: Earthquake prone area



Source: National Centre for Seismology

- A. **Low-risk zones:** These areas typically experience mild earthquakes, ranging from 0 to 3 on the Richter scale, and are located far from frequent seismic activity, reducing the likelihood of significant damage, refer map 16.5-11.
- B. **Moderate zones:** Moderate-risk areas encounter earthquakes of medium magnitude (3-5), posing a moderate level of risk. They may or may not be close to regions with frequent seismic events, refer map 16.5-11.
- C. **High-risk earthquake areas:** These regions face a heightened risk due to earthquakes exceeding magnitude 5. They're often close to areas with frequent seismic activity, increasing the likelihood of severe damage and future earthquakes, refer map 16.5-11.

## 15.5.6 Mitigation plan for Earthquake

#### 15.5.6.1 Risk Assessment:

Risk assessment helps to identify areas prone to earthquakes and assess the potential severity of seismic events. Consider historical earthquake data, fault lines, soil composition and building vulnerability to understand the vulnerability of the area.

#### 15.5.6.2 Zoning and Land Use Planning:

Implement and enforce zoning regulations that restrict construction in high-risk seismic zones. Encourage and enforce land use planning that promotes earthquake-resistant building designs and minimizes the impact of urbanization on vulnerable areas.

## 15.5.6.3 Infrastructure Improvement:

Upgrade and retrofit existing infrastructure to meet seismic safety standards. Improve building codes and construction practices to ensure structures can withstand earthquakes. Strengthen critical infrastructure such as bridges, dams, and lifeline systems to minimize damage and disruption.

## 15.5.6.4 Green Infrastructure:

Promote the use of green infrastructure, such as parks and open spaces, to reduce the density of buildings in high-risk areas and provide safe zones during earthquakes. Preserve natural features like hillsides and vegetation that can stabilize soil and reduce landslides triggered by earthquakes.

# 15.5.6.5 Capacity Building of Stakeholders:

Raise awareness about earthquake risks, evacuation procedures, and preparedness measures. Provide resources and training to the community on emergency response and first aid. Collaborate with local authorities and organizations to ensure effective coordination during earthquake emergencies.

### 15.5.6.6 Emergency Response Planning:

Develop and regularly update comprehensive emergency response plans that include evacuation routes, emergency shelters, and coordination with emergency services. Conduct drills and exercises to ensure that residents and response teams are familiar with emergency procedures.

## 15.5.6.7 Monitoring and Evaluation:

Establish a monitoring system to assess the effectiveness of mitigation measures. Regularly review and update the mitigation plan based on new information and changing seismic conditions.

## 15.5.6.8 Earthquake Emergency Access:

Design roads and pathways with materials and gradients that can withstand seismic activity and ensure access for emergency vehicles. Implement measures to clear debris quickly and restore access to affected areas.

### 15.5.6.9 Early Warning Systems:

Establish an early warning system to provide timely alerts to residents and authorities. Ensure effective communication channels for disseminating warnings and evacuation instructions, including sirens, text alerts, and public announcements.

### 15.5.6.10 Building Byelaws and Standards:

Enforce and update building bylaws to ensure that new constructions in earthquake-prone areas are designed to withstand seismic forces. Require adherence to seismic building codes, including proper foundation design, structural reinforcement, and use of earthquake-resistant materials. Incorporate provisions in building byelaws based on the seismic risk and soil conditions of the area.

# 15.6 Suitability of areas as per slope gradient

The permission for building construction based upon slope gradient is typically governed by local building byelaws and regulations. Different regions and municipalities may have specific guidelines regarding the acceptable slope gradients for construction. Various suitability factors considered for suitability of areas as per slope gradient is shown in Figure 15.6-1.



Figure 15.6-1:Suitability Factors

Source: Author

### 15.6.1 Building Codes and Regulations

Building byelaws often include provisions related to slope gradients and construction. These are designed to ensure the safety and stability of structures. Regulations may specify the maximum allowable slope for construction and may have requirements for structural design, foundation types, and other considerations based on slope gradient.

Some areas with steep slopes or specific geological characteristics may have restrictions on construction to protect the environment, prevent erosion, and maintain the stability of the terrain.

#### 15.6.2 Site-Specific Assessments

Local authorities may require site-specific assessments, including geotechnical studies, to evaluate the stability of the land. Engineers may assess the soil composition, drainage conditions, and slope stability to determine whether the proposed construction is feasible and safe.

#### 15.6.3 Environmental Impact Assessment

Construction on steep slopes may cause harm for which environmental impact assessments required to evaluate potential effects on the surrounding ecosystem, including soil erosion, habitat disruption, and water runoff. Authorities may require mitigation measures to minimize environmental impact.

#### **15.6.4 Public Safety Considerations**

Steep slopes may pose challenges in terms of stability, drainage, and potential landslide risks, leading to careful consideration of construction permissions. It's essential for property owners and developers to consult with local planning departments and building authorities to understand the specific regulations and requirements related to slope gradients in their area. Identification of steep slopes

#### 15.6.5 Provisions for low rise development

When planning for low-rise development in flood-prone areas, it's crucial to implement measures that mitigate the risk of flooding and ensure the safety and resilience of the structures. Here are some provisions and considerations for low-rise development in flood-prone areas:

#### 15.6.5.1 Elevation

Adequate elevation helps minimize the risk of flood damage to buildings and reduces the likelihood of flooding reaching habitable areas.

#### 15.6.5.2 Flood-Resistant Construction Materials

Encourage or mandate the use of flood-resistant construction materials that can withstand exposure to water and minimize damage in the event of flooding. Consider materials that are resistant to mould, decay, and corrosion.

#### 15.6.5.3 Vented Foundations

Design foundations with vents to allow floodwaters to pass through, reducing the potential for structural damage. Vented foundations can help equalize hydrostatic pressure and prevent buoyancy during flooding.

### 15.6.5.4 Flood-Resistant Design

Implement flood-resistant design principles, such as allowing for the free flow of water around and beneath structures.

Avoid designs that trap or channel water towards buildings, increasing flood risk.

#### 15.6.5.5 Setback Requirements

Establish setback requirements from water bodies to create buffer zones that can absorb floodwaters and provide space for natural drainage.

Setbacks help protect both the structures and the surrounding environment.

#### 15.6.5.6 Floodplain Regulations

Enforce regulations that restrict or control development within designated floodplain areas.

## 15.6.5.7 Stormwater Management

Implement effective stormwater management practices to reduce runoff and control water flow during heavy rainfall. Incorporate features such as retention basins and permeable surfaces to help manage water on-site.

## 15.6.5.8 Infrastructure Resilience

Design infrastructure, such as utilities and drainage systems, to be resilient to flooding. Consider elevated utility installations and flood-proofing measures for critical infrastructure.

Incorporating these provisions into planning and development processes helps create resilient and sustainable low-rise structures in flood-prone areas, minimizing the impact of floods on

both property and public safety. Collaboration between local governments, developers, and community stakeholders is essential to implementing effective flood risk mitigation strategies.

# **Chapter 16** Recommendations & Proposals

Allocating land parcels for the Moirang Master Plan 2024 involves a comprehensive consideration of several key factors to ensure effective urban development and sustainable growth:

## **16.1 Considerations**

### **16.1.1 Mobility**

Concept of connectedness is easy to achieve with an efficient transportation system. A better road connectivity acts as catalyst in urban growth. It transports the opportunities from one to another.

#### **16.1.2** Nodes

Identifying strategic locations for activity nodes such as commercial centres, residential areas, recreational spaces, and industrial zones to facilitate efficient urban functionality and promote economic activity. Moirang Master Plan area is known for its eco-tourism characteristics with identifies cultural economic nodes. Leveraging these nodes to structure the land use pattern is important to ensure successful master plan. The major nodes are INA, Efficient transport network is very important to connect these nodes with service level infrastructures to capture the growth.

#### **16.1.3 Structural Specifications**

Ensuring adherence to structural specifications regarding building codes, zoning regulations, and urban design principles to maintain safety, aesthetics, and functionality within the designated land parcels.

# 16.1.4 Conceptual development

The land use pattern proposed in master plan is the detailing of the conceptual plan for the area. It is based upon following concepts of urban planning such as connectivity, protecting natural areas, promote tourism for economic growth of the area, integration of urban services, etc.

## 16.1.5 Holistic Land Use Planning

Integration of various sectors of master plan acts as key in holistic planning. Identification of developable areas and non-developable areas is a crucial task which needs special attention to details. Non-developable area is falls under environmentally protected zones. Land in proximity to natural features and potential risk on water bodies or eco sensitive areas, those land also put into non-developable areas. These can only be used as buffer zones or land to be used for green infrastructure.

# **16.1.6 Zoning**

The concept of zoning is important in master plan to distribute urban services effectively. Land use in each zone represents the activities has predominant effects on adjacent zones. It also helps in identifying the risk prone areas at small level and put land under use of specific activities not vulnerable to risk.

#### 16.1.7 Risk Assessment

It is an important step in master planning to identify vulnerable areas prone to hazards. Activities like recreational can be given in high-risk areas with low possible damage. Built demand can be assessed in low-risk areas to reduce the risk impact.

## **16.1.8 Infrastructure Demand Assessment**

Estimating the infrastructure requirements such as social-physical infrastructure, transportation networks, housing, and other utilities to support the projected population growth and development needs, ensuring adequate provision of essential services.

By considering these factors in the land allocation process, the Moirang Master Plan 2024 aims to create a well-planned, resilient, and sustainable urban environment that meets the needs of its residents while promoting economic growth and enhancing overall quality of life.

In envisioning the future landscape of Moirang town in 2043, a comprehensive land use plan has been meticulously devised to accommodate the evolving needs of its inhabitants while preserving its cultural heritage and fostering sustainable development. With a total area of 113.83 hectares, the proposed land use allocation reflects a thoughtful balance between residential, commercial, institutional, and recreational spaces.

Table 16.1-1: Total area of activities proposed

S. No.	Proposal	Total Area (Ha)
1	PSP	4
2	Recreational	45.15
3	Educational	3.57
4	Health Services	0.43
5	Mixed	12.16
6	Public Utilities	1.69
7	Residential	41.62
8	Road	1.03
9	Transportation	4.18
10	Total	113.83

Source: Author

To promote community cohesion and economic vitality, 81.08 hectares are designated for mixed-use developments bu giving buffer of 50m and 75 m from the centre of the major roads (NH150, Moirang Road and Moirang-Kumbi Road), fostering vibrant neighbourhoods where residents can live, work, and socialize. Additionally, 41.62 hectares are designated for residential areas, providing comfortable living spaces for Moirang's growing population.

Anticipating the need for efficient transportation, 4.18 hectares are allocated for parking areas and bus stand facilities and 1.03 hectares for new roads connections facilitating seamless connectivity within and beyond the town limits.

Finally, embracing the importance of leisure and recreation in enhancing quality of life, a substantial 45.15 hectares are dedicated to recreational spaces, offering residents ample opportunities for relaxation, exercise, and cultural enrichment.

## 16.2 Proposed Land use

This chapter describes the land use plan for to regulate future growth. The major considerations for proposed land use plan are existing land use, terrain, estimated population, existing and proposed transport network and risk assessment. The proposed land use plan also includes designation of land for public amenities as indicated in Chapter 11 & 12. To allocate land uses it is important to understand the requirement of specific land use activity which is going to be proposed. Predominantly Residential areas should be proposed far from industry area and near to commercial and transport facility, parks should be proposed near residential areas, eco-sensitive areas should be preserved from built activities, etc.

# 16.3 Identification of Land parcels

The identification of land parcels for proposals is guided by the following challenges:

- 1. Linear Development Causing High Trip Length and Overall High Costs: Moirang town's linear development along a single axis, such as NH 150, leads to longer travel distances for residents to access various services and amenities. This linear pattern not only increases trip lengths but also contributes to higher overall costs for residents and the municipality alike. Longer trip distances result in increased fuel consumption, higher transportation expenses, and added wear and tear on vehicles. Additionally, maintaining infrastructure along the linearly developed areas may require more resources, further escalating costs for the local government.
- **2.** Watershed/Waterlogged Areas: Certain localities within Moirang town may experience issues related to watersheds and waterlogging. This could be due to poor drainage systems, inadequate stormwater management, or natural topographical features that lead to water accumulation during rainfall. Waterlogged areas pose risks to property, infrastructure, and public health, necessitating targeted interventions for mitigation.
- **3.** Unhygienic Open Natural Drains: Along arterial roads, the presence of unhygienic open natural drains contributes to environmental pollution and public health concerns. These drains may serve as breeding grounds for disease vectors and pollutants, posing risks to residents' well-being. Addressing this challenge involves improving drainage infrastructure, implementing proper waste management practices, and promoting environmental stewardship.
- **4. Risk Assessment for Identifying Low-Risk Areas:** Conducting a risk assessment is crucial for identifying areas within Moirang town that are prone to various hazards, such as flooding, landslides, or other natural disasters. By identifying low-risk areas, urban planners can prioritize development in safer zones, minimizing potential damage and ensuring the resilience of the built environment.

Despite facing challenges, Moirang town has various opportunities and strategies to guide its future development. These options help identify suitable land parcels and promote sustainable growth and resilience. Following approaches are taken care of to address the various challenges.

- **1. Radial/Circular Growth with Linear Development:** Despite the linear development along NH 150, embracing radial or circular growth patterns alongside it offers a promising opportunity. This approach optimizes land use and infrastructure, easing pressure on main roads and fostering efficient urban layout.
- **2. Developing Land Parcels Along Corridors:** The identification and development of land parcels along strategic corridors provides clear pathways for future growth. By guiding expansion away from sensitive areas, such as waterlogged zones, this approach ensures sustainable urbanization and efficient land use planning.
- **3. Regulating Land Use to Restrict Built Footprint:** Implementing zoning regulations to control development density is crucial. This approach protects sensitive ecosystems and aligns development with the town's long-term vision, preserving natural and cultural heritage.
- **4. Restricting and Regulating Risk-Prone Areas:** Proactive identification and regulation of risk-prone areas minimize vulnerability to natural hazards. Comprehensive risk assessments inform zoning regulations and mitigation measures, safeguarding public safety and infrastructure.
- **5. Preserving Natural Features:** The preservation of natural features, such as Loktak Lake and surrounding hills, is paramount. Integrating these elements into urban planning initiatives ensures their protection while enhancing recreational and ecological opportunities, maintaining the town's unique identity and environmental sustainability.

Table 16.3-1: Proposed Land Use distribution

Landuse	Existing		Proposals (Sector Based)	Total Pro	<b>Total Proposed</b>	
	Area (Ha)	Area (%)	Area (Ha)	Area (Ha)	Area (%)	
Agriculture	1076.91	63.2	-	1011.57	59.37	
Commercial	37.67	2.21	-	37.67	2.21	
Communication	0.06	0	-	0.06	0	
Educational	21.36	1.25	3.57	24.93	1.46	
Forest/ Vegetation	81.52	4.78	-	81.52	4.78	
Health Services	1.22	0.07	0.43	1.65	0.1	
Heritage	1.47	0.09	-	1.47	0.09	
Industrial	0.7	0.04	-	0.7	0.04	
Mixed	5.61	0.33	12.16	17.77	1.04	
PSPs	4.6	0.27	4	8.6	0.5	
Public Utilities	0.99	0.06	1.69	2.68	0.16	
Recreational	2.38	0.14	45.15	47.53	2.79	
Religious	1.43	0.08	-	1.43	0.08	
Residential	137.41	8.06	41.62	179.03	10.51	
Roads	47.05	2.76	1.03	48.23	2.83	
SWM	0.2	0.01	-	0.2	0.01	
Transportation	0.21	0.01	4.18	4.39	0.26	
Vacant	48.66	2.86	-		0	
Water Bodies	68.91	4.04	-	68.91	4.04	
Wetland	165.54	9.72	-	165.54	9.72	
Total	1703.88		113.83	1703.88		

Source: Ground Truthing Survey and Author

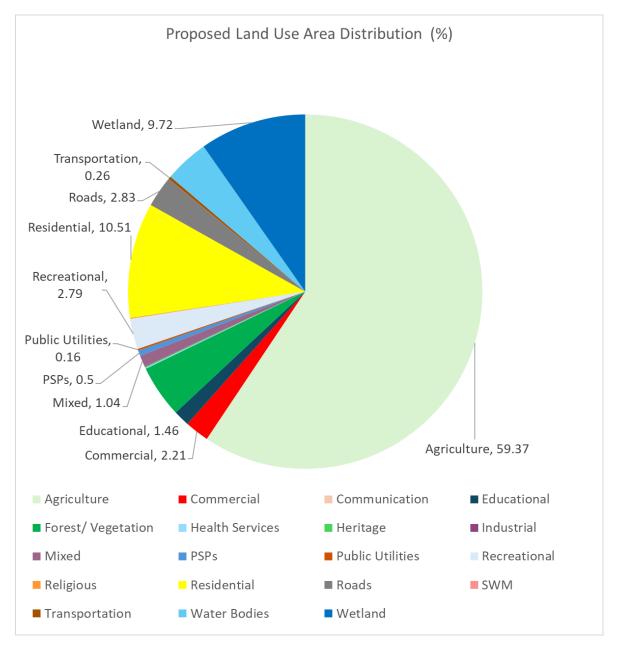
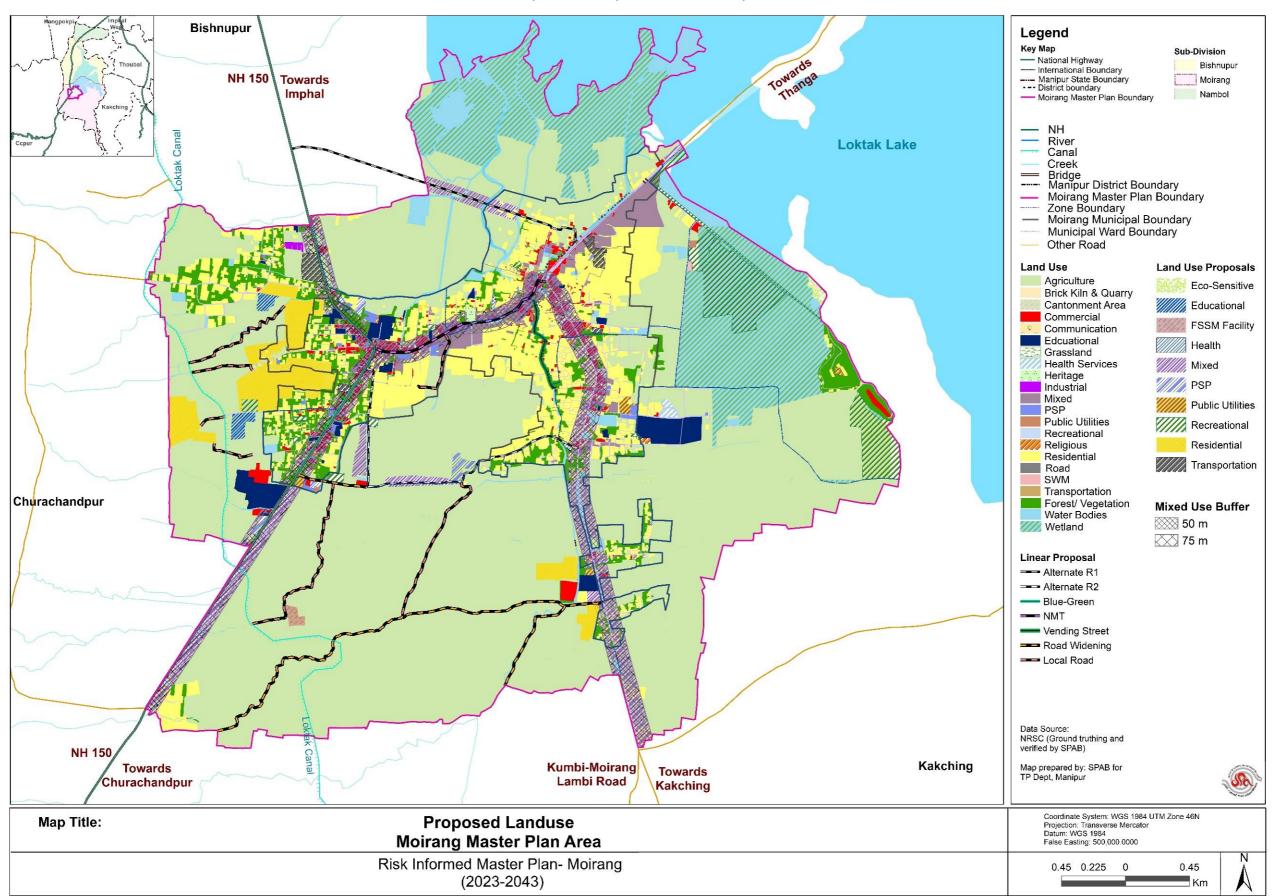


Figure 16.3-1: Proposed Land Use Area Distribution

Source: Author

Map 16.3-1: Proposed Land Use Map



# 16.4 Transportation

#### 16.4.1 Alternate Routes

Moirang town relies heavily on its arterial roads, notably NH 150 and the Kumbi-Moirang Lambi road. Linear settlement along these routes has led to increased congestion and overall costs for the town. Key commercial zones, such as the IMA market, are situated along these roads, intensifying local activities throughout the day. Additionally, the presence of the INA HQ Memorial and INA Museum in the vicinity contributes to the continuous flow of visitors. The Kumbi-Moirang Lambi road serves as a crucial link to tourist attractions like Loktak Lake, Keibul Lamjao National Park, and Sangai Ethnic Park, attracting a significant influx of tourists. Moreover, NH 150 and Kumbi-Moirang Lambi road facilitate regional connectivity between Imphal, Bishnupur, Churachandpur town, and Kakching town, further increasing traffic pressure.

To address these challenges, Moirang town has identified two alternative routes. The first, named Alternate Route 01, connects to Thamnapokpi village via Kuman Leikai Road in the northern part of the planning area, spanning a length of 2.2 km as represented in Map 16.4-1. The other option, Alternate Route 02, is situated in the central part of the planning area and links NH 150 with the Kumbi Moirang Lambi road, spanning a length of 2.5 km. The cross-section for these two identified alternate routes is given in Figure 16.4-1. Developing these routes is expected to alleviate some pressure and minimize traffic congestion in the main commercial area of the town. The implementation of these two alternative routes will provide the town with the opportunity to expand both radially and in a more circular manner.

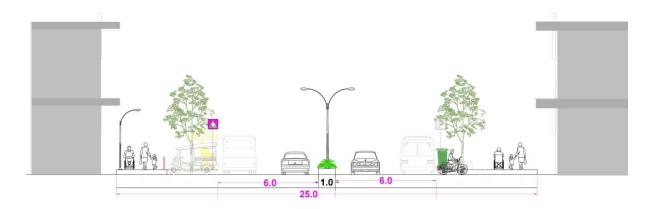


Figure 16.4-1: Alternate routes cross-section

Source: Author

# 16.4.2 Proposed New Roads

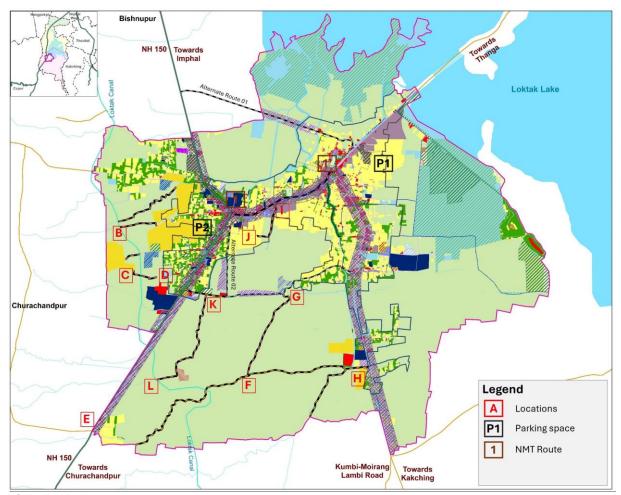
Improving existing roads is important in terms of easy movement of people, goods and services. Kutcha roads connected to roads along the creek and Loktak canals need to be strengthened as most residential/ housing is proposed towards it. Table 17.4-1 illustrates the roads that are identified as new road networks:

Table 16.4-1: Proposed new roads specifications

S. No.	Road	Width	Purpose
1.	Interconnecting roads	15- 20 m	Access to Residential/ Housing
	Point, A, B, C to D		
2.	Point E to F	20-25 m	Access to Residential/ Housing
3.	Point F to G	15- 20 m	Access to Residential/ Housing
4.	Point F to H	20-25 m	Access to Residential/ Housing
5.	Point I to J	15-20 m	Access to Commercial/ Mix
6.	Point K to L	15-20 m	Access to Proposed Commercial/ Mix

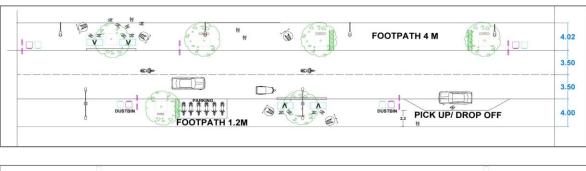
Source: Author

Map 16.4-1: New Road Alignment, Proposed Parking Spaces and NMT route



Source: Author

The strengthening of roads is necessary, with dead-end streets intended for improvement into continuous circular roads to enhance connectivity and infrastructure resilience. Identify these roads across various localities and proceed with their conversion into circular routes. Certain localities identified are: i) Kumam Leikai, ii) Pukhram Leikai, iii) Khoiru Leikai and iv) Hemam Colony, localities recommended for the conversion of dead-end roads into circular roads with at least two-way entry points. This modification aims to enhance safety and accessibility during hazards. Guidelines for road development should explicitly state that future roads must avoid dead ends, ensuring continuous connectivity. Additionally, emphasis should be placed on incorporating circular road designs to promote seamless traffic flow and accessibility. In instances where missing links are necessary, it is advised to allocate a width of 15 -25 meters to accommodate both vehicular traffic and pedestrian-friendly streets. This width ensures adequate space for safe passage while promoting a pedestrian-friendly environment. To illustrate, a typical road section is provided in Figure 16.4-2.



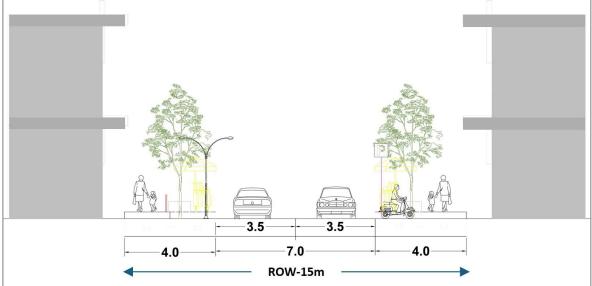


Figure 16.4-2: Proposed new roads plan and cross section

Source: Author

### 16.4.3 Zero Emission Zone (NMT)

Zero emission zones are defined as areas which prohibit motorized vehicles and only zero emission vehicles such as electric cart/vehicle in the identified zones are allowed as shown in Figure 16.4-3 and represented in Map 16.4-1. The purpose is to decarbonize the route by reducing carbon intensity transport. The NMT proposal (marked as 1-1' in Map 16.4-1) is recommended to combat congestion on Moirang road especially during festival and peak tourist time with alternate route recommendation as discussed in section 17.4.1. It provides safe pedestrian movement, accessibility, improves the environment and improves quality of life.

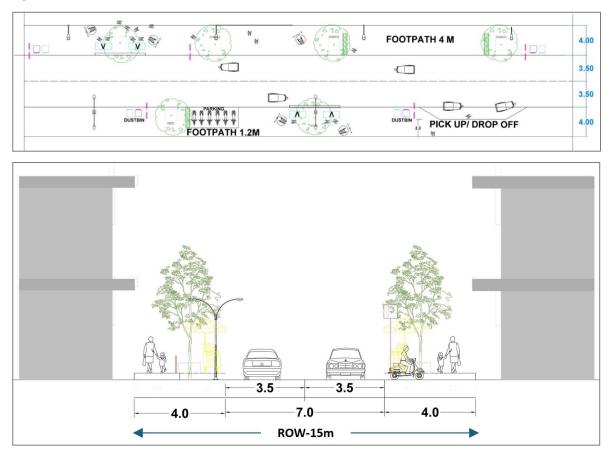


Figure 16.4-3: Proposed Zero emission zone (NMT Stretch) plan & cross-section

Source: Author

In response to the heavy traffic and parking demand on arterial roads, an NMT (Non-Motorized Transport) zone has been identified. NMT refers to the mode of transport which depends on human power not fossil fuels. Spanning approximately 1.4 km, this stretches initiates from the junction near Multipurpose Higher Secondary School and extends to

encompass the entire main commercial market area. Along this route lie prominent landmarks such as the INA HQ Memorial, IMA Market, and INA Museum.

The primary objective of establishing this NMT zone is to alleviate traffic congestion and promote the use of e-vehicles powered by green energy sources to reduce pollution. Additionally, NMT zones offer various other major advantages. They provide spaces for vending markets, allowing for economic activity and vibrant street life. Furthermore, these zones create pedestrian-friendly streets, enhancing safety and accessibility for all road users.

Regulating this stretch is essential to prevent unnecessary on-street parking and ensure that existing parking spaces adequately meet the demands of this bustling area. By implementing NMT zones, Moirang town aims to create more sustainable and livable urban environments while addressing pressing transportation challenges. There is an opportunity to develop this stretch as smart road, bicycle friendly road, pedestrianized street, etc. The loading/unloading activities of goods in commercial shops should be in nighttime to reduce the obstruction in traffic during daytime.

Prioritizing non-motorized transport (NMT) involves several key strategies aimed at enhancing pedestrian and cyclist infrastructure and safety:

- **1. Ensuring Sufficient Footpath Space:** Allocate sufficient space for footpaths along residential streets and roads with commercial activities. This ensures pedestrians have safe and comfortable areas to walk.
- 2. Distributing Activities Uniformly Across the Town: To mitigate the risk of over-congestion and infrastructure overload, similar commercial and economic activities should be distributed evenly across other parts of Moirang. This decentralization will reduce footfall and population density in the busiest areas, minimizing the likelihood of bottlenecks and associated hazards during peak times.
- **3. Reclaiming Footpaths:** Take action to remove encroachments and obstructions from footpaths, such as parked vehicles or street vendors. Clearing these obstacles ensures pedestrians can use footpaths without obstruction.
- **4. Designating Road Space:** Allocate specific lanes or areas on roads exclusively for pedestrian and cyclist use. This separation from motorized traffic enhances safety for non-motorized transport users.

- **5. Implementing Grade Separation:** Create infrastructure solutions that provide safe passage for pedestrians and cyclists through grade separation methods. Examples include cycle tracks, and traffic calming measures like speed bumps. These measures enhance safety by reducing interactions between non-motorized and motorized traffic.
- **6. Strengthening Drainage Systems:** Improve stormwater management within the NMT zone to mitigate flooding risks. Proper drainage infrastructure ensures that streets remain safe and accessible even during heavy rainfall, reducing the risks of waterlogging and associated hazards.
- **7. Enhancing Emergency Response Accessibility:** Design the NMT zone to allow for easy access by emergency response vehicles. By reducing congestion and creating clear pathways, the town can better respond to incidents like medical emergencies or fires, mitigating risks during peak hours or adverse conditions.

### **16.4.4 Proposed Parking**

The proposed alternate routes and NMT zone are expected to redirect traffic to other areas of the town, facilitating a more uniform distribution of traffic across all roads. By restricting and regulating motorized vehicles within the NMT zone, there will be an increased demand for parking along these two proposed alternate routes. Hence, identified land along these routes can be utilized for parking when necessary. These spaces are also essential for commuting within the NMT zone, especially when other modes of transport are not permitted. This approach aims to optimize traffic flow and improve accessibility while promoting sustainable transportation options in the town.

Parking spaces are proposed near both the proposed alternate routes 1 and 2, Map 16.4-1. Parking space (P2) with an area around 0.48 Ha, is located along NH 150 to facilitate the NMT zone. Another parking space (P2) is near alternate route 2, having an area of 1.5 Ha, Map 16.4-1. Both the parking spaces are proposed to facilitate proper functioning of NMT zone, where certain types of vehicles will be restricted to minimize traffic congestion.

### 16.4.5 Vending Street

The National Policy on Urban Street Vendors, 2004, defines a street vendor as an individual offering goods or services for sale in temporary spaces, including pavements, public areas, or private spaces, often utilizing movable stalls, pushcarts, cycles, or even baskets. Street vending

plays a vital role in the urban supply chain and local economy by providing affordable goods and promoting self-employment. Furthermore, street vending significantly contributes to tourism by showcasing and selling locally made products, enhancing cultural and economic value. The street vendor's definition has been provided in the National Policy on Urban Street Vendors, 2004, Department of Urban Employment & Poverty Alleviation, MUPA, Government of India as, "A street vendor is a person who offers goods or services for sale to the public without having a permanently built structure occupying a temporary space on pavements or any public or private area, establishing a movable stall, or they could be mobile, move from place to place carrying their products on pushcarts, cycles, baskets, or in moving buses. (National policy on Urban Street Vendors, 2004, 2004)

The proposed street vending zone shown in Figure 16.4-4, spanning approximately 600–700 meters along Moirang Road, is strategically located to leverage its proximity to key tourist attractions, such as the INA Museum, INA HQ Memorial, Ebuthou Thangjing Temple and Its Lai Haraoba, Oktak Lake, and Keibul Lamjao National Park. The stretch, with access points from the Moirang-Kumbi Road along its eastern direction, is designed to facilitate the promotion of local products while enhancing opportunities for vendors within and beyond the planning area.

Street vending is an integral part of urban supply chain and local economy. It provides local and inexpensive products. In terms of tourism, street vending is a prominent place to promote locally made products. It provides a great opportunity to advertise and sell locally made products. It also promotes self-employment for the local people. The stretch is given around 600-700m from the Moirang road. This proposed vending street has access from the Moirang-Kumbi road as well throughout the length in eastern direction as shown in Figure 16.4-4.

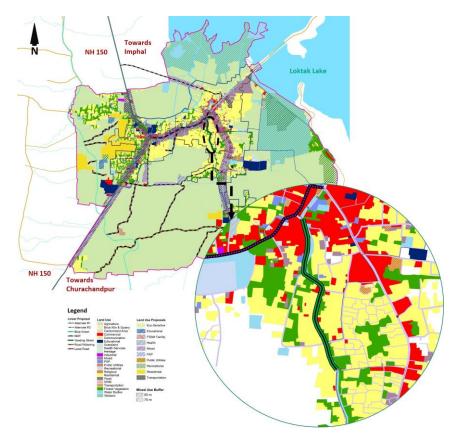


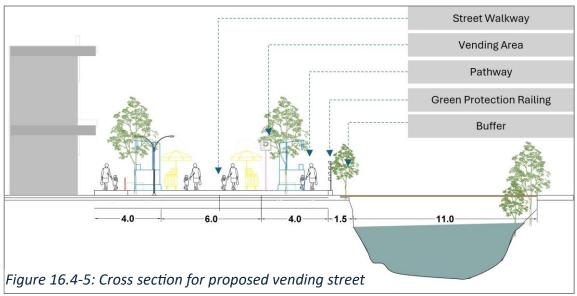
Figure 16.4-4: Vending Street location in planning area

Source: Author

The Deendayal Antyodaya Yojana-National Urban Livelihoods Mission (DAY-NULM) seeks to address facilitating access to suitable spaces for vending. DAY-NULM sets out the strategy and operational guidelines which can be followed by the respective authorities. The implementation would also require coordination between several authorities including Urban Local Bodies, Development Authorities and Town Planning Agencies, Land and Revenue Departments and District Collector offices (DAY-NULM, 2013).

The recommended cross section for vending street is given in Figure 16.4-5. The proposed vending street is directly connected to the Moirang road and located near major tourist attraction places such as INA Museum, INA HQ Memorial, Ebuthou Thangjing Temple and Its Lai Haraoba, oktak lake, Keibul Lamjao National Park as mentioned in section 14.2.1 of the report. This makes it more under the influence of tourism and increases the opportunities for the local and vendors coming from outside the planning area. It also has potential to influence the market off other areas of the planning boundary. Parking areas provided near vending streets to facilitate restricting the motorized vehicles. As per the identified potential of the

area, one parking space is available near INA Museum and for surplus demand during festivals, the spot is marked on Moirang-Kumbi road as shown in Figure 16.4-6.



Source: Author

The traffic management and regulation on market days or at certain times of the day, arrangements for lighting, water, sanitation and waste disposal in street vendor market areas shall be taken into consideration to avoid disruptions. Activities such as recreational, hawkers, cane product market, specific Manipur product shops for tourists, etc. only such activities shall be promoted which will not harm the course of nearby water body and its aquatic environment as shown in Figure 17.4-6.



Figure 16.4-6: Various Street Vending Potential Activities

Source: Author

This proposal can be implemented at ward level with the help of MMC. The basic infrastructure facilities such as water supply, electricity, pavement retrofitting, public toilet, waste collection and disposal, etc. shall be provided for the ease of vendors and create a safe environment for tourists. These amenities are essential to ensure the comfort, safety, and convenience of both vendors and visitors alike. By providing such facilities, the market areas can effectively cater to the needs of the community, foster a conducive environment for commerce, and enhance the overall quality of the market experience. Additionally, these provisions align with urban development goals focused on improving infrastructure and enhancing the livability of public spaces within the community.

### 16.4.5.1 Environmental and Aesthetic Integration

A. Protection of Environmentally Sensitive Natural Creeks

The proposed vending street is located near a natural creek, identified as one of the primary stormwater discharge channels leading to Loktak Lake. This proposal ensures the preservation and protection of this environmentally sensitive waterway. By aligning the drainage plan with the proposed network in Section 17.6.3, the creek can efficiently manage stormwater runoff, preventing flooding and waterlogging while maintaining its ecological integrity. Proper drainage infrastructure, including sediment traps and waste management measures, will safeguard the creek from contamination caused by solid waste and pollutants from vending activities.

B. Aesthetic Improvements

The vending street will be designed to enhance the overall aesthetics of the area. Organized stalls, uniform vendor setups, and landscaped surroundings will create an inviting atmosphere for tourists and locals alike. Paved pathways, shaded areas, and seating arrangements will improve the usability and visual appeal of the space, making it a vibrant urban hub.

C. Tourism and Market Synergies

Given the vending street's proximity to prominent tourist destinations, it has the potential to influence and support other markets within the planning area. This synergy can create a ripple effect, spreading economic benefits and reducing pressure on specific market zones. Additionally, parking areas near the vending street, including the existing facility at INA Museum and an overflow spot on Moirang-Kumbi Road for festival seasons, will regulate motorized vehicles, enhancing pedestrian accessibility and reducing vehicular congestion.

D. Drainage Integration and Creek Alignment
The natural creek in this area is critical for stormwater management, serving as a major
channel to Loktak Lake. Proper alignment of the vending street's drainage system with
the proposed network in Section 17.6.3 will ensure seamless water flow, reduce the risk
of waterlogging, and prevent adverse impacts on the creek. This alignment will also
contribute to preserving the lake's health by minimizing sedimentation and pollutant
inflow.



Figure 16.4-1: Basic amenities for vendors and visitors

Source: NIUA

### 16.5 Social Infrastructure

### 16.5.1 Educational

Educational institutes and facilities play a crucial role in society, serving as centres for learning and growth within society. The proposed landuse of educational institutes prioritizes their proximity to residential areas, ensuring easy access for both students and communities. Additionally, these institutes are strategically positioned on higher contour sides to reduce their vulnerability to natural disasters such as floods and earthquakes. This careful selection of locations aims to safeguard the safety of students and staff while promoting uninterrupted learning even during challenging times. Recognizing the critical role of educational institutions, a considerable portion of land earmarked for educational purposes is focused in the western and southwestern regions of the planning area. The required classification of educational institutes is outlined in Table 16.5-1:

Table 16.5-1: Demand for educational facilities as per URDPFI Guidelines 2014

Educational	<b>Units Required for</b>	<b>Units Required for</b>	Total area	Total area
<b>Facilities</b>	2043 (as per	2043 after deducting	required in	required in
	URDPFI)	existing	2023	2043

Pre primary	11	13	0.80	0.96
<b>Primary School</b>	7	8	2.40	2.80
Senior	2	2	1.80	1.80
Secondary				
College	1(Present)	0	0.00	0.00
Professional	1	1	1.50	1.50
College				
	Total		6.50	7.06

Source: URDPFI Guidelines 2014

### 16.5.2 Health

Health services and facilities are vital pillars of society, providing essential care and support for individuals' well-being. They are strategically positioned primarily around residential areas to ensure easy accessibility for residents and communities. Moreover, these facilities are often situated on low and moderate risk areas to reduce vulnerability to natural disasters such as floods and earthquakes. These social infrastructure facilities are one that requires the most during the disaster and hazard period. The proposed landuse of health infrastructure is carefully coordinated to ensure accessibility from all areas of the town, particularly during emergencies. Recognizing the critical need for timely access to healthcare services, these facilities are strategically positioned to serve the entire community efficiently. A significant portion of land designated for health services is concentrated in the western and southwestern sectors of the planning area, optimizing accessibility, and ensuring prompt medical assistance when needed most. Table 16.5-2 shows the specified classification of health services required within the planning area:

Table 16.5-2: Demand for health facilities as per URDPFI Guidelines 2014

S. No.	Health Facilities	No. of Unit required in 2023	No. of Unit required for 2043	Total area required in 2023 (in Ha)	Total area required in 2043 (in Ha)
1.	Dispensary	11	13	0.22	0.26
2.	Health Sub centre	9	11	0.60	0.74
3.	Family Welfare Centre	5	7	0.25	0.35
4.	Maternity Centre	2	2	0.10	0.10
5.	Nursing Home	9	11	0.68	0.83
6.	PHC (25-50 beds)	1	2	0.21	0.42
7.	Veterinary	26	33	2.60	3.30

Total	4.66	5.99
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Source: URDPFI Guidelines 2014

#### 16.5.3 Recreational

In the Moirang planning area, although steep slopes are not prevalent, the gradual change in contours creates undulating terrain, leading to occasional waterlogging, particularly during heavy rainfall. Adjacent to Loktak Lake in the northeast, the land should ideally be permeable with high porosity to accommodate its marshy nature, which remains wet throughout the year. Preserving these lands is paramount, and any construction that could reduce their porosity should be avoided, as they are classified as high-risk areas prone to flooding. To regulate development in such areas, the promotion of recreational activities that endorse blue-green infrastructure and soft built-up structures is recommended. Activities shown in Figure 16.5-2 are some examples of such infrastructures that can support the recreational activities as well as maintain the eco-system.

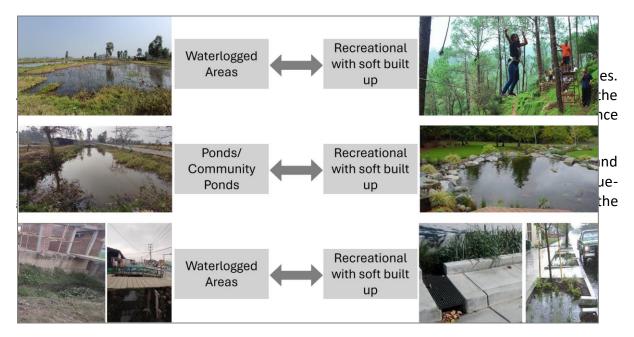


Figure 16.5-2: Approaches for Recreational spaces

Source: www.erinrockery.com

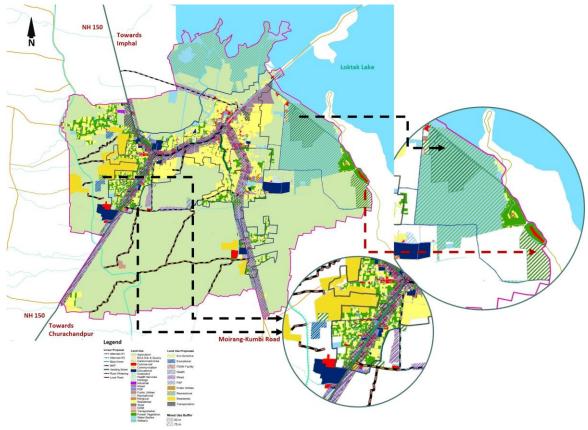


Figure 16.5-3: Proposed Recreational areas

Source: Author

# 16.6 Physical Infrastructure

This section describes the demand assessment and provision of land reservation for physical infrastructure comprising of water supply, sewerage and drainage and solid waste management in the planning area.

### 16.6.1 Water Supply

Moirang town relies heavily on the Loktak Lake as its major water source. The existing water supply network primarily follows the NH-2 and Kumbi-Moirang-Lambi road to meet the demands of densely populated areas. The network layout is characterized by dead-end systems and limited coverage, with key localities like INA Headquarters Memorial, Moirangthem Leikei (Ward 2), Hemam Leikei (Ward 1), and Kumam Leikai (Ward 3) receiving water supply through this system. Challenges such as discontinuity, numerous break points, and vulnerability during hazardous conditions are prevalent. The proposed water supply network aims to address these issues, ensuring reliable and continuous water supply across

Moirang town, enhancing coverage for areas both inside and outside the municipal boundary. The physical infrastructure for water supply is to be designed for at least 30 years as per CPHEEO Manual. The proposed land use of complete area has been identified and based on the land use the demand has been calculated.

The manual of water supply and treatment, issued by CPHEEO (Central Public Health and Environmental Engineering Organization), Ministry of Urban Development, and Government of India has recommended the domestic water demand of 70 lpcd for towns with piped water supply but without sewerage facility. The URDPFI guidelines, issued by Ministry of Urban Affairs and Employment, Government of India, have also prescribed the same standards as CHEEPO norms as given in Table 16.6-1.

Table 16.6-1: Water Supply Demand and Wastewater Generation till 2043

Year		WATER SUPPLY				
	Population	Water Demand (MLD)	UFW @15%	Total Water Demand (MLD)	Land Required for WTP(URDPFI)	
2011	23,407	1.64	0.25	1.39		
2021	26,405	1.85	0.28	1.57	0.03	
2031	29,632	2.07	0.31	1.76	0.04	
2041	33,120	2.32	0.35	1.97	0.04	

Source: URDPFI Guidelines 2014

#### 16.6.1.1 Water Supply Scheme Planning

Designing a spatially optimized water supply scheme/network on GIS in a master plan involves integrating topography, population density, land use, and existing infrastructure to ensure sustainable and efficient water distribution. Below is a stepwise process methodology for planning and mapping a water supply scheme with a focus on trunk lines, sub-main lines, water treatment plant (WTP) locations, and pumping stations.

#### 16.6.2 Process Methodology for Spatial Water Supply Scheme Using GIS

#### **Step 1: Baseline Data Required**

- Topography: DEM or contour maps to analyse elevation and slope for gravitational flow.
- Population Distribution: Use census data to map current and projected population density.

- Land Use and Zoning: Map residential, commercial, and industrial zones from the master plan.
- Existing Infrastructure: Map current water supply pipelines, storage tanks, WTPs, and pumping stations.

### **Step 2: GIS Data Layers**

- Base map (roads, administrative boundaries).
- Elevation data (contours, DEM).
- Land use and zoning.
- Water bodies and sources.
- Existing water supply network.

Use GIS to overlay population density with existing and proposed land use for spatial demand distribution.

#### Step 3: Aligning Trunk Lines and Sub-Main Lines

#### 1. Trunk Line:

- Align along roads or open spaces to minimize disruption.
- Follow gravity flow by analysing elevation gradients using DEM.

#### 2. Sub-Main Lines:

- Map along secondary roads to connect neighbourhoods.
- Optimize the shortest and least-cost paths.
- Ensure redundancy in critical areas (looping system).

#### **Step 4: Location of Water Treatment Plant (WTP)**

- Proximity to Water Sources: WTPs should be located close to raw water sources to reduce pumping costs.
- Land Availability: Identify low-value, non-residential areas with adequate space.
- Topography: Prefer locations upstream of the service area for gravity-fed distribution.
- Environmental Considerations: Maintain a buffer zone (500m) from residential areas as per CPCB guidelines.

### **Step 5: Placement of Pumping Stations**

- If required, identify areas where natural gravity flow is not feasible.
- Elevation: Locate in low-lying areas near trunk pipelines.
- Accessibility: Ensure road access for maintenance.

### **Step 6: Distribution System/ Network**

- Lay pipelines in loops for redundancy.
- Avoid crossing major roads or utility lines to reduce construction challenges.

### **Step 7: Environmental and Social Safeguards**

- Overlay pipeline routes and WTP locations with environmentally sensitive zones
- Avoid wetlands, floodplains and forests.
- Ensure minimal displacement or disruption in residential areas.

#### **Step 8: Final Mapping and Documentation**

- 1. GIS maps with layers:
  - Trunk and sub-main pipelines.
  - WTP and pumping station locations.
- 2. Export GIS maps for integration into RIMP

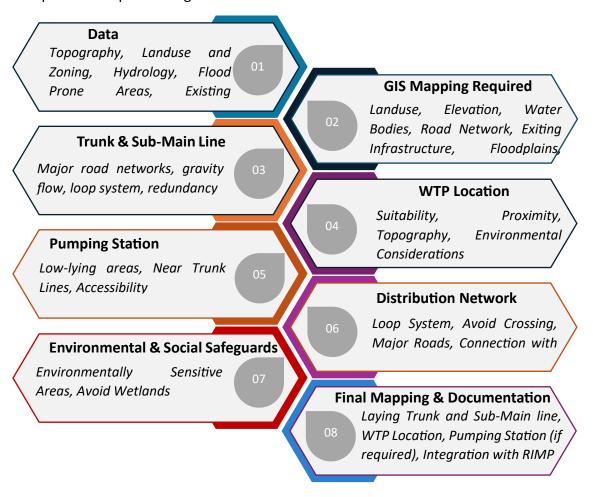


Figure 16.6-1: Process Methodology for Water Supply Mapping using GIS

Source: Author

#### 16.6.2.1 Proposed Water Supply System for Moirang Planning Area

The proposed water supply network for Moirang aims to address the limitations of the existing system while ensuring robust and continuous distribution infrastructure. The proposed network not only improves the reliability and efficiency of water supply within the municipal boundary but also extends its coverage to areas outside the jurisdiction, thereby ensuring comprehensive access for all residents.

The proposed extension of the water supply network significantly enhances coverage by including areas previously excluded from the municipal supply system. Localities outside the

municipal boundary, such as Thoya Leikai and Kumbi in Ward 12, are now integrated into the network. This expansion ensures that residents in these peripheral areas, who previously faced challenges in accessing reliable water supply, will now benefit from consistent and adequate service. Within the municipal boundary, the proposal focuses on strengthening the existing infrastructure to make the network more robust and efficient. Improvements include ensuring comprehensive connectivity across all wards, addressing areas with inadequate water supply, and creating a more balanced distribution network. Alternate routes are also established to maintain supply continuity during emergencies, ensuring reliability. The proposal for water supply system in planning area has been prepared based on the risk factor of urban flooding in the region as described in section 15.5.

Strategic enhancements include the addition of trunk lines to bolster the system's capacity and reach. A main trunk line from the Water Treatment Plant (WTP) to Moirang College is proposed, ensuring improved supply to educational institutions and surrounding areas. Additionally, a trunk line connecting NH 2 near Hemam Colony (Ward 10) to Kumbi in Ward 12 is planned, supporting future development and activities along this corridor as rwpresented in Map 16.6-1. The proposed network also incorporates disaster-resilient features to ensure uninterrupted water supply in critical situations. By integrating dual-tapping points and interconnected loops, the system is designed to maintain supply during natural disasters or system breakdowns, enabling rapid restoration of service to vital localities.

Coordinate System: WGS 1984 UTM Zone 46N Projection: Transverse Mercator

0.45

Datum: WGS 1984 False Easting: 500,000.0000

0.45 0.225 0

# Risk Informed Master Plan for Moirang- 2043

Legend Key Map

National Highway

International Boundary

Manipur State Boundary

District boundary

Moirang Master Plan Boundary Sub-Division Bishnupur Moirang Towards Imphal River Loktak Lake Creek
Bridge
Manipur District Boundary
Moirang Master Plan Boundary
Zone Boundary
Moirang Municipal Boundary
Municipal Ward Boundary Other Road Land Use **Land Use Proposals** Agriculture Brick Kiln & Quarry Eco-Sensitive Cantonment Area Commercial Communication Edcuational Health Grassland Health Services Mixed Heritage PSP Industrial Mixed Public Utilities Public Utilities //// Recreational Recreational Residential Religious Residential Road Transportation Transportation
Forest/ Vegetation Mixed Use Buffer 50 m Water Bodies Wetland ∑ 75 m Linear Proposal Churachandpur - Alternate R1 PS Pumping Station - Alternate R2 - Blue-Green --- NMT Existing - Vending Street - Road Widening - Local Road Data Source: NRSC (Ground truthing and verified by SPAB) Kumbi-Moirang Towards Towards Lambi Road Map prepared by: SPAB for TP Dept, Manipur Kakching Churachandpur

**Proposed Water Supply System** 

Moirang Master Plan Area
Risk Informed Master Plan- Moirang

(2023-2043)

Map 16.6-1: Proposed Water Supply System of Moirang Planning Area

Source: TPD Manipur and Author

Map Title:

### 16.6.2.2 Methodology for Proposed Water Supply Network

The proposed water supply network for Moirang town has been designed with a comprehensive methodology that focuses on enhancing the existing infrastructure, improving coverage, and ensuring reliable and resilient water distribution. The methodology involves a careful alignment with the existing network to ensure seamless integration while addressing the challenges of the current system.

### 1. Assessment and Mapping of Existing Network:

The first step in the methodology involves a detailed assessment of the existing water supply network, including a thorough mapping of the main trunk lines, sub-mains, and dead-end connections. This mapping identifies areas with gaps in coverage, break points, and vulnerable sections that need improvement. Key localities with inadequate access to water supply, such as Thoya Leikai and Kumbi in Ward 12, were also identified for expansion.

#### 2. Design of Circular Loop System:

To improve the robustness, resilience, and reliability of the network, a circular loop design is proposed. This system ensures that each locality is connected by more than one water supply route, allowing for redundancy. In the event of a disruption in one part of the network, water supply can be maintained through alternative paths. The circular loop concept minimizes the risk of water shortages during emergencies or hazardous conditions. Additionally, the network is designed with disaster-resilient features, such as dual-tapping points and interconnected loops. These features ensure that critical localities maintain water supply even during natural disasters or other emergencies. The circular design enhances the flexibility and responsiveness of the system, allowing for rapid restoration of service if one part of the network experiences failure.

### 3. Alignment with Existing Network:

The proposed water supply network is carefully aligned with the existing infrastructure to ensure minimal disruption and cost-effective implementation. The main trunk lines and submains are laid along similar routes as the existing network, particularly along NH-2 and Kumbi-Moirang-Lambi road, which have been identified as high-demand corridors. New pipelines are laid in parallel to these existing routes to create a more robust and continuous network, strengthening the existing supply system.

# 4. Incorporation of New Trunk Lines:

To further enhance the network, additional trunk lines are proposed, including an alternate main trunk from the Water Treatment Plant (WTP) to Moirang College. This new line will improve the capacity and stability of the system, ensuring that the network can accommodate future demand and provide more efficient distribution. Additionally, a new trunk line connecting NH-2 near Hemam Colony (Ward 10) to Kumbi in Ward 12 is proposed to cater to new development activities and improve water access in these areas.

### 5. Strengthening of Existing Connections:

The proposed network will strengthen the existing dead-end connections by connecting them to the new trunk lines, forming a continuous and interconnected network. Areas with isolated sections, such as Moirangthem Leikei and Kumam Leikai, will be integrated into the expanded system to eliminate supply interruptions. This process ensures a continuous water flow across the entire town and reduces the frequency of breakdowns due to disconnected network sections.

#### 6. Improved Coverage:

The proposed network aims to extend water supply coverage to areas previously underserved by the existing infrastructure. Special attention is given to localities on the periphery, including Thoya Leikai and Kumbi, to ensure equitable water distribution across both the urban and rural parts of the planning area. This expansion is essential for meeting the increasing water demand of Moirang's growing population.

#### 7. Incorporation of Disaster Resilience Features:

The proposed network is designed with disaster-resilient features, such as dual-tapping points and interconnected loops. These features ensure that critical localities maintain water supply even during natural disasters or other emergencies. The circular design enhances the flexibility and responsiveness of the system, allowing for rapid restoration of service if one part of the network experiences failure.

#### 16.6.3 Sewerage

Disposal of human and animal wastes contributes to surface water pollution leading to the spread of water borne diseases. Under Nirmal Bharat Programme (Total sanitation for all) sanitation is 'a system that promotes appropriate disposal of human wastes, proper use of toilets. To minimize the adverse effects of open discharges of effluents from the individual septic tanks, pits and likely health hazards from the absence of sewerage system (Manipur Vision 2030). The proposal for sewerage system in planning area has been prepared based on the risk factor of urban flooding in the region as described in section 15.5.

The sewage generation is assumed as prescribed in CPHEEO manual and URDPFI Guidelines 2014. While working out sizes of collection system and capacity of sewage treatment plant, provision has been kept for 20% infiltration through sewer lines as per guidelines. Accordingly, the sewage generated, capacity of STP and tertiary treatment plants required has been worked out and shown in Table 16.6-2.

Table 16.6-2: Water Supply Demand and Wastewater Generation till 2043

Year		WASTEWATER		
	Population	Wastewater generation @ 80% (MLD)	Land Required for WTP(URDPFI)	
2011	23,407	1.11		
2021	26,405	1.26	0.88	
2031	29,632	1.41	0.99	
2041	33,120	1.58	1.10	

Source: URDPFI Guidelines 2014

## 16.6.3.1 Proposal for Faecal Sludge and Septage Management (FSSM) model

Faecal Sludge and Septage Management (FSSM) model is very popular in India in recent times. It is gaining popularity because of its low costing and applicability in hilly areas since smaller number of households are connected to sewerage and most of them have independent soak pit/septic tank system. In Moirang Planning Area, it is implementable due to the high ground water table which causes the overflow of septic tank. There is a need of an institutional mechanism where authority provide the assistance in timely emptying the onsite sanitation. The Ministry of Urban Development, Government of India (GoI) included FSSM as a key

component under AMRUT, the Atal Mission for Rejuvenation and Urban Transformation. (IRC Wash, 2017)

There is a model made based upon Odisha FSSM Model which has been proved one of the best in India (Odisha FSSM, 2022). In all the stages of FSSM process, SHGs can play an important role of handling the management effectively. After training and upgradation of SHGs about the techniques used in FSSM, they can spread awareness in their respective groups/areas. Transporting wastewater needs special care and skill to handle due to its toxicity nature. Therefore, whenever there is a need of desludging of septic tank, people inform the SHG before it overflows.

### 16.6.3.2 Work methodology of FSSM Model

FSSM value chain divided in various stages which possibly manage human excreta safer and more efficient way. The stages are shown in Figure 16.6-2 and explained as follows:

- A) Containment: The human excreta go into the soak pit/septic tank and stored as per the capacity. Generally, the tanks are designed for 5 and 3 years for soak pit and septic tank respectively as per CPHEEO Manual. If the tanks are designed for less storage, then people need to inform the authority to clean it in time.
- B) Desludging & Transporting: Desludging of tanks is important before it overflows and create nuisance in the vicinity. After removing wate from the tank it cleaned and ready to use for another 3-5 years. Transport all the waste with proper care to the treatment facility.
- C) Treatment: When waste reach to the treatment facility it shall be treated as per standards given in CPHEEO Manual and URDPFI Guidelines. A Septage Treatment Plant (SeTP) or Faecal Sludge and Septage Treatment Plants (FSTP) shall be setup in the planning area. The treatment unit shall provide at the higher elevation of the ground.
- D) Disposal & Reuse: Treated waste transform into re-usable material such as treated wastewater shall be used in agriculture fields or to curb industrial water demand after treating as per standards. Although the concept of wastewater reuse is acknowledged in the water policy, encouraging reuse of grey water and giving incentives to industries for recovery of industrial pollutants, it does not address agricultural irrigation. Therefore, current use of wastewater in agricultural irrigation is done primarily indirectly in an

unplanned manner (Manipur Vision 2030, 2019). Wastewater which flows from drain to the discharge points, which is Loktak Lake, harming the ecosystem of the and needs to be protected. Solid by product of waste shall be used as manure. Reuse of waste has a potential to generate revenue for the providing facility.

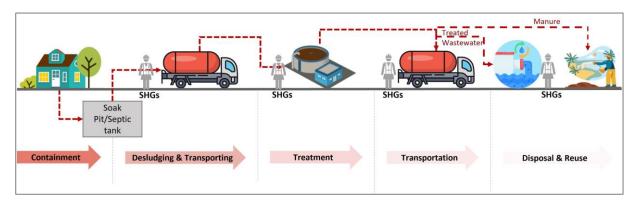


Figure 16.6-2: FSSM Model for sewerage management

Source: Odisha FSSM by NIUA

FSSM model has its own mechanism and framework described in National Policy on Faecal Sludge and Septage Management (National Policy on Faecal Sludge and Septage Management (FSSM), 2017) which shall be followed for an efficient management of waste.

All the stakeholders such as ULBs, operators, SHGs/community groups, planning authority, state government, funding agencies, etc. needs to involve organizing capacity building programs time to time to share information and update the knowledge for an efficient management of FSSM process.

#### 16.6.3.3 Sewerage Network Planning

Designing a spatially optimized sewerage network in a master plan involves integrating topography, population density, land use, soil characteristics, and existing infrastructure to ensure sustainable and efficient wastewater management. Below is a stepwise methodology for planning and mapping a sewerage network, with a focus on trunk sewers, branch sewers, sewage treatment plant (STP) locations, and pumping stations:

### 16.6.3.4 Process Methodology for Sewerage System Using GIS

#### **Step 1: Baseline Data Collection and Mapping**

1. Data Requirements:

- Topography: Digital Elevation Models (DEM) or contour map to assess gradients.
- Land Use and Zoning: Landuse map with activity-based zoning.
- Population/HH Density: Demographic data to estimate wastewater generation.
- Existing Infrastructure: Existing utility and road network.

# **Step 2: GIS Data Layers:**

- Topography (DEM/Contours)
- Land Use
- Drainage and water bodies
- Road and utility networks

Overlay land use and population density layers to identify wastewater generation nodes.

#### Step 3: Trunk Line and Sub-Main Line Alignment

#### 1. Trunk Line:

- Align along roads or natural drainage paths to minimize disruption. Avoid crossing built-up areas unless necessary.
- Use DEM to ensure natural flow, maintaining a slope of 0.3-0.6% for self-cleansing velocity (CPHEEO Manual, 2013).

#### 2. Sub-Main Line:

- Map along secondary roads or lanes to connect households or smaller clusters.
- Ensure junctions with trunk lines are at accessible points (manholes or chambers).

#### 3. Considerations:

- Avoid ecologically sensitive zones like wetlands, riverbeds, or forested areas.
- Minimize pipeline crossings of major roads or waterbodies.

### **Step 4: Selection of STP Location**

- Land Availability: Distant from built areas.
- Proximity to Water Bodies: Maintain a buffer (minimum 500m) as per CPCB norms.
- Gradient: Select sites downstream of the city for gravity flow.
- Environmental Clearance: Avoid flood-prone and environmentally sensitive zones.

#### **Step 5: Location of Pumping Stations**

- Identify areas where natural gradient is insufficient.
- Locate near trunk or sub-main lines.
- Accessible by roads for O&M.
- Adequate buffer distance from residential areas to minimize odour impact.

### **Step 6: Distribution System/Network**

- Laying of pipelines in loops for redundancy.
- Avoid crossing major roads or utility lines to reduce construction challenges.

#### **Step 7: Environmental Considerations**

Check for proximity to wetlands, groundwater recharge zones and ecologically sensitive areas.

#### **Step 8: Final Mapping and Documentation**

- Trunk and sub-main lines.
- STP and pumping station locations.
- Export GIS maps for integration into RIMP

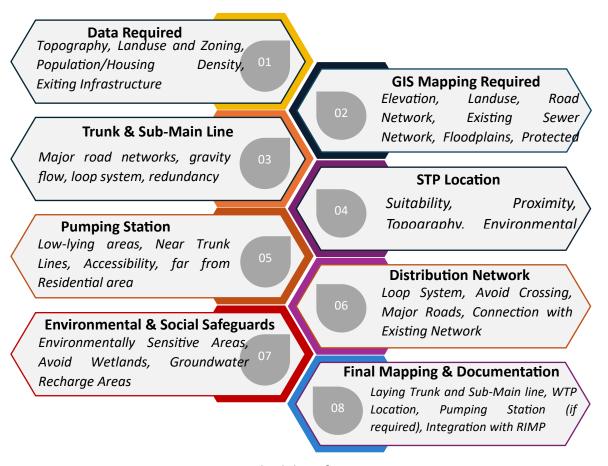


Figure 16.6-3: Process Methodology for Sewerage Mapping using GIS

Source: Author

## 16.6.3.5 Methodology for proposed sewerage network

Since there is no existing sewerage network in Moirang Town, the proposed alignment has been designed from the ground up, considering the town's topography, road network, and settlement patterns to ensure comprehensive sanitation coverage. The methodology for determining the alignment is as follows:

# 1. Topographical Analysis

A detailed study of the town's contour, with a slope difference of approximately 10
meters from west to east, was conducted to facilitate gravity-based flow for the
sewerage system.

 Loktak Lake, located at the lowest contour, serves as a natural drainage basin, influencing the overall alignment of the sewerage network.

### 2. Strategic Trunk Line Alignment

- Main Trunk Line: The primary sewerage trunk line is aligned along the arterial roads.
- **Sub-Main Line Design:** Sub-main lines branch out perpendicularly from the main trunk, extending up to settlements.

#### 3. Circular Network Configuration

- A circular loop design is adopted to interlink the trunk and sub-main lines, providing redundancy and resilience.
- This configuration ensures uninterrupted sewage transport by allowing alternative routes in case of disruptions.

### 4. Pumping Stations

 To address the elevation challenges, three pumping stations are strategically placed at critical points. These stations facilitate sewage movement from higher elevations to the southern treatment facility.

#### 5. Integration with FSSM Facility

- The sewerage network culminates at the proposed FSSM (Faecal Sludge and Septage Management) facility in the southern planning area, ensuring proper treatment and disposal of wastewater.
- Peripheral areas not directly connected to the network will rely on decentralized treatment options integrated with the FSSM facility.

### 16.6.3.6 Proposed Sewerage Network for Moirang Planning Area

The sewerage network proposal for Moirang Town aims to address the sanitation needs of the urban population while considering the town's topography and geographical features. The proposal focuses on providing comprehensive sewerage coverage for the municipal council area and complementing it with an FSSM (Faecal Sludge and Septage Management) facility located in the southern part of the planning area. Moirang Town exhibits a contour difference of approximately 10 meters, ranging from its westernmost to easternmost parts. Loktak Lake,

located on the lower side of the contour towards the town's left, poses a natural drainage basin for the area. The sewerage design leverages this natural slope while ensuring minimal environmental impact. The sewerage network consists of several primary components as follows:

- A) Main Trunk Line: The Main Trunk Line is aligned along arterial roads, connecting key junctions such as the Main Traffic Junction in wards 10 and 1, the IMA Market Junction in ward 5, Kumbi in the southern part of ward 5, and the FSSM facility as represented in Map 16.6-2. This line functions as the backbone of the sewerage network, efficiently transporting sewage from major junctions and arterial areas to the treatment facility.
- B) Sub-Main Trunk Line: The Sub-Main Trunk Line extends its coverage to various localities, ensuring an integrated sewerage system. In the southern localities, it serves areas such as Ngangkhalawai, Khoiru Leikai, and Hemam Colony. In the eastern localities, it covers areas around the IMA Market in ward 3, CHC Moirang near ward 8, Moirang College, and nearby residential settlements. This line plays a vital role in connecting smaller localities to the main trunk line, ensuring seamless transportation of sewage to the FSSM facility.
- C) Strategic Pumping Stations: To accommodate the slope and contour of Moirang's planning area, three pumping stations are proposed at strategic locations. These stations will ensure effective sewage flow toward the FSSM facility and overcome challenges posed by varying elevations.
- D) Integration with FSSM Facility: The proposed sewerage network is designed to comprehensively cover the entire planning area. For regions that fall outside the coverage of this network, sewage will be treated at the existing FSSM facility located in the southern part of the planning area, Map 16.6-2. The FSSM unit has been strategically situated on the opposite side of Loktak Lake, ensuring that there is no risk of any adverse impact on the lake's delicate ecosystem. This carefully planned approach guarantees that the sanitation requirements of all areas within the town are adequately addressed, providing a sustainable solution for the entire community.

Bishnupur Legend Sub-Division National Highway
 International Boundary
 Manipur State Boundary
 District boundary
 Moirang Master Plan Boundary Bishnupur Moirang NH 150 Nambol Towards Imphal Loktak Lake Canal Creek Creek
Bridge
Manipur District Boundary
Moirang Master Plan Boundary
Zone Boundary Moirang Municipal Boundary Municipal Ward Boundary Other Road Land Use Land Use Proposals Agriculture Eco-Sensitive Brick Kiln & Quarry Educational Cantonment Area Commercial FSSM Facility Communication Edcuational ///// Health Grassland ///// Mixed Health Services Heritage Industrial Mixed Public Utilities Public Utilities Recreational Religious Residential Residential Road SWM Transportation Mixed Use Buffer Forest/ Vegetation 50 m Water Bodies 75 m Wetland Linear Proposal Churachandpur --- Alternate R1 - Alternate R2 - Blue-Green - NMT - Vending Street - Road Widening - Local Road Proposed Sewerage Main Trunk Line Sub-main Line Proposed Sewerage Unit Location + FSSM Unit PS: Pumping Station Data Source: NRSC (Ground truthing and verified by SPAB) Kakching Kumbi-Moirang **Towards** Towards Lambi Road Map prepared by: SPAB for TP Dept, Manipur Churachandpur Coordinate System: WGS 1984 LITM Zone 46N Projection: Transverse Mercator **Proposed Sewerage Network** Map Title: Moirang Master Plan Area Risk Informed Master Plan- Moirang 0.45 0.225 0 0.45

(2023-2043)

Map 16.6-2: Proposed Sewerage Network of Moirang Planning Area

Source: TPD Manipur and Author

### 16.6.4 Drainage

The drainage of the area is water flowing north to south. As shown in Map 16.5-9 areas under high risk of flooding needs to have a good drainage system pass the rainwater runoff. There is a need to construct storm water drains along the roads in high density areas mainly municipal council area. Other areas are sparsely settled where land has more infiltration capacity. Paved surfaces have low infiltration rate hence causes flooding during heavy rainfall. There is need to provide green spaces in urban land which helps to infiltrate rainwater into ground and reduce the runoff. To understand this scenario, the watershed boundary has been created as per drainage flow. High discharge watershed should be in the priority areas as shown in map 16.4-3 and map 16.5-6.

# 16.6.4.1 Proposed Drainage Network for Moirang Planning Area

To ensure a resilient stormwater management system in Moirang Planning Area, an integrated approach of combining manmade and natural drains is proposed. This system leverages the natural terrain and existing watercourses while incorporating modern drainage infrastructure to mitigate waterlogging and flooding risks.

### A) Manmade Drains

Manmade drains form the backbone of the proposed drainage network. These drains are strategically aligned along arterial and sub-arterial roads to collect and convey stormwater effectively. A circular loop network is planned wherever feasible, allowing localities to be connected to multiple drainage lines discharge points. This redundancy ensures a smoother flow and minimizes dependency on single outlets. The locations of major manmade drains in the area have been marked on the map and include the following:

- i. Drains along NH 2, serving as primary drainage routes for the region.
- ii. Drains along the Kumbi-Moirang-Lambi road, ensuring wastewater management in the vicinity.
- iii. Drains running along local roads in the eastern part of the localities, supporting wastewater flow in these areas.
- iv. Drains located near NH 2, particularly in localities such as Ngangkhalawai and Hemam Colony.

v. Drains in localities near the Kumbi-Moirang-Lambi road, providing additional drainage infrastructure for these regions.

In the western part of the planning area (west of NH 2), localities such as Ngangkhalawai, KhoiruLeikai, and Hemam Colony (southern part) are provided with robust drainage systems due to their susceptibility to waterlogging. These drains connect to the NH-2 drains, which in turn discharge stormwater into either natural drains or directly into Loktak Lake. Similarly, localities in the east of Kumbi Moirang Lambi Road are connected to drains.

# **B)** Natural Drains

The planning area features three major natural drains, which are proposed to be enhanced to manage increased stormwater volumes effectively:

- i. Ngangkhalawai Natural Drain: This drains discharge stormwater directly into Loktak Lake in the north, serving as a crucial outlet for the area's stormwater management.
- ii. NH2 Drain near Hemam Colony: This drain connects to Loktak Lake via the INA HQ Memorial through the Ngangkhalawai Natural Drain, ensuring effective stormwater flow along the NH2 corridor.
- iii. Kumbi Natural Drain: Originating from Kumbi, this drains flows along the Kumbi-Moirang-Lambi road and discharges into Loktak Lake near the IMA Market Junction. It can be further developed in conjunction with the proposed vending street project near the IMA Market to enhance drainage capacity and urban functionality.

These natural drains are buffered with tree plantations and soft landscaping, creating an ecologically friendly and visually appealing drainage system while minimizing erosion and pollution.

Natural drainage systems offer a multitude of benefits, enhancing both environmental sustainability and community well-being. By integrating natural elements like vegetated swales, retention ponds and landscaped buffers, these systems improve the aesthetics of urban and suburban environments, transforming functional infrastructure into visually appealing and recreational spaces as represented in Figure 16.6-4. They play a crucial role in improving stormwater runoff quality by filtering pollutants, trapping sediments, and promoting infiltration, which helps replenish groundwater and reduce the burden on water treatment facilities.



Figure 16.6-4: Illustration of trees plantation and landscaping along natural drains

Source: By Michael F. Bloom, P.E., CFM, 2017

Additionally, natural drainage systems contribute to the health of nearby waterways and water bodies by regulating water flow, preventing erosion, and maintaining ecological balance, ensuring cleaner and more stable aquatic ecosystems. These systems also enhance ecosystem services by creating habitats for diverse wildlife, fostering biodiversity, and connecting fragmented natural areas. This holistic approach supports a thriving environment, benefiting both human and ecological communities while addressing the challenges of urbanization and climate change. The proposal for stormwater drainage system in planning area has been prepared based on the risk factor of urban flooding in the region as described in section 15.5.

# 16.6.4.2 Key features of Proposed drainage network

### 1. Topography-Informed Design

The planning area's natural slope from east to west is leveraged to use gravitational force for efficient water conveyance. All manmade and natural drains are designed to converge at

Loktak Lake, located at the eastern edge of the town. This design eliminates the need for complex pumping systems and ensures a cost-effective flow.

### 2. Maintenance and Upkeep

- Regular maintenance is essential to keep the drainage system functioning efficiently. Both
  manmade and natural drains will be cleaned periodically to prevent blockages caused by
  debris and silt. Damaged sections of drains will be repaired promptly to avoid water
  stagnation and flooding.
- Public participation is vital for maintaining the drainage network. Educational campaigns
  will encourage residents and businesses to avoid dumping waste into drains and to support
  conservation efforts.

#### 3. Aesthetic and Functional Enhancements

- Natural drains will be enhanced with tree-lined buffers and soft landscaping along their beds. These features not only improve aesthetics but also stabilize the soil, reduce erosion, and support biodiversity.
- Manmade drains will include sediment traps and filters to prevent pollutants from reaching Loktak Lake. Permeable materials will be used in certain sections to facilitate groundwater recharge and reduce surface runoff.

#### 16.6.4.3 Methodology for Providing Drainage Network

The following methodology is proposed to implement the drainage network:

#### 1. Contour and Slope Consideration:

Ensure that the contour and slope of the planning area are thoroughly analyzed to facilitate gravity-based drainage flow and reduce dependency on mechanical systems.

# 2. Circular Loop Drain Design:

- Plan drains in a circular loop pattern where feasible, ensuring that each locality is connected to the network at multiple points.
- This redundancy enhances resilience and mitigates risks during system overload or blockages.

#### 3. Integration with Natural Drains:

- Integrate manmade drainage systems with natural watercourses to utilize existing flow paths and enhance efficiency.
- Modify natural drains where necessary to handle increased stormwater volumes, ensuring seamless flow and ecological integrity.

#### 4. Material Selection and Construction:

- Use robust, eco-friendly materials for constructing manmade drains, focusing on durability and minimal maintenance.
- Include features like permeable surfaces and vegetative swales to aid groundwater recharge.

#### 5. Monitoring and Maintenance:

- Establish a systematic monitoring framework to assess the performance and condition of drains periodically.
- Schedule regular cleaning and repairs to prevent blockages and ensure long-term functionality.

# 16.6.4.4 Provision of Rainwater Harvesting and Recharging wells

Areas characterized by low elevation and dense urban development, along with impermeable surfaces or inadequate drainage infrastructure, face significant vulnerability to flooding. To mitigate overflow, it is imperative to establish artificial channels as shown in Figure 16.6-3, for efficient runoff water discharge, directing it to nearby water bodies and canal. Additionally, implementing rainwater harvesting systems can help alleviate the burden on drainage systems by collecting and storing rainwater for later use as shown in Figure 16.6-4. This collected rainwater can be discharged into designated channels or used for non-potable purposes, reducing the strain on existing drainage infrastructure, and minimizing the risk of flooding. Furthermore, future construction should be limited to areas where natural drainage pathways are prone to obstruction. This approach helps to minimize the risk of flooding in the future.

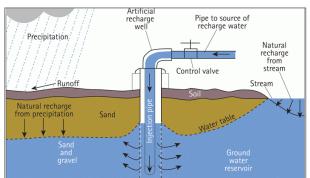




Figure 16.6-3: Recharge well

Figure 16.6-4: Rainwater harvesting

Source: www.ntotank.com

### 16.6.5 Solid Waste Management

#### 16.6.5.1 Municipal Solid waste:

The main sources of Municipal Solid Waste (MSW) generation are residential areas, commercial areas, hotels, institutional areas, markets and other such areas. Wastes from industries and hospitals are not part of MSW; these are called Industrial or hazardous wastes and Bio-medical wastes respectively. MSW can be classified into four broad categories such as:

- A. **Organic Waste:** Waste, which is biodegradable in nature such as food, kitchen waste, green waste (vegetables, flowers, leaves, fruits), leaf litter etc. which can be convert into manure after composting.
- B. **Recyclable Waste:** Waste which can be recycled or put in other uses after respective treatment such as paper, glass, bottles, cans, metals, certain plastics, etc.
- C. **Hazardous Waste:** Waste which are toxic and harmful to the environment such as electronic, medical waste, paints, chemicals etc. needs to be treated separately with their respective treatment process mentioned in Solid Waste Management Rules, 2016

The Ministry of Environment, Forests and Climate Change (MoEFCC) has separate rules for the management of Municipal Solid Waste, Bio-Medical Waste (BMW), Hazardous Wastes, Electronic waste and Construction and Demolition (C&D) waste.



Figure 16.6-5: Segregation of solid waste

Source: Teachoo, 2020, Research Gate

#### 16.6.5.2 Stages of SWM

There are five main stages in solid waste management process which are summarized below:

#### A. Waste Generation

This stage starts at sources such as households, commercial facilities, industrial sectors, etc.

#### **B.** Collection

The next step in the waste management process is waste collection. During waste collection, garbage trucks from local authority come go to localities and collect the waste from garbage from community bins, household level.

#### C. Transportation

A vehicle from the local authority which collects wastes from each bins transport it to the treatment facility where other actions imposed on waste discussed further.

### D. Segregation

This stage can be performed at source or after collection of waste. In this stage all type of mixed solid waste segregate based on their characteristic such as organic waste, inorganic

waste, hazardous waste, e-waste, etc. this stage is crucial because it will ensure the type of treatment each type of waste needed.

#### J. Treatment

Solid waste management plant has various types of treatment facilities as per the suitability of type of waste as mentioned in point B. for instance all the organic waste turn into manure by composting, plastic waste can be recycled, hazardous and e-waste treat separately due to their toxicity nature which can harm environment and public health.

#### K. Disposal

Organic waste can be used as manure in agriculture sector. Other type of waste can be recycled as per uses. Other than mentioned methods, land disposal is the most common

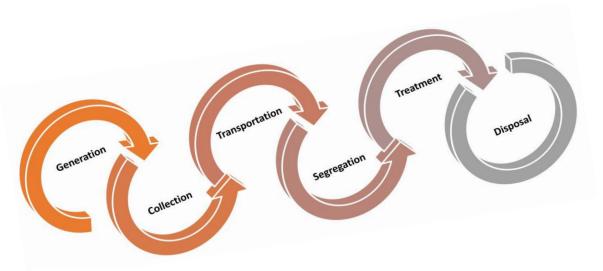


Figure 16.6-6: Solid Waste Management Process

management strategy for municipal solid waste. Refuse can be safely deposited in a sanitary landfill, a site which is selected by considering various parameter such as away from populated areas, designed, constructed, and operated to protect the environment and public health. One of the most important factors relating to landfilling is that the buried waste never meets surface water or groundwater. Recycling should be promoted to reduce the quantity of refuse which end up dumping into landfill. Figure 16.6-6shows the detailed solid waste management process.

Source: Author

## 16.6.5.3 Estimation of Solid Waste Generation

The population projections made in this report and as per capita waste generation rates of 0.45 kg per capita for residential and 4% of total waste generation as commercial waste given in URDPFI Guidelines 2014 used for estimating future waste generation trends. The rate of

waste generation throughout the horizon year of 2043 is considered uniform i.e. 0.45 kg per capita per day for residential and 4% of the total generation for commercial. The Table 16.6-3 shows the projected quantity of waste generated. As per the projections, the total population in the year 2043 will be 33,120 hence the quantity of waste generation will be around 14.31 tons per day.

Table 16.6-3: Solid waste generation quantity

Year	Population	Total Waste generation (kg/c/d)	4% of commercial (kg/c/d)	Total waste generation (TPD)	Area Required (Ha)	Existing SWM Site (Ha)
2011	23,407	10533.15	421.33	10.53	0.126	-
2021	26,405	11882.40	475.30	11.88	0.143	0.195
2031	29,632	13334.54	533.38	13.33	0.160	0.195
2041	33,120	14904.21	596.17	14.31	0.179	0.195

Source: URDPFI Guidelines 2014

Local body shall frame byelaws and prohibit citizen from littering wastes on the streets and give strict direction to the tourists not to dispose any waste such as paper, water bottles, liquor bottles, soft drink canes, tetra packs, any other plastic or paper waste on the streets instead direct to deposit such waste in the litter bins that shall be placed by the local body at all tourist destinations. Local body may levy solid waste management charge from the tourist at the entry point to make the solid waste management services sustainable (Solid Waste Management Rules, 2016). SWM Rule 2016 also promote the waste segregation at source.

There is also a proposal for upgrading the existing solid waste management facilities in the Moirang Planning Area as per requirement which aims to achieve comprehensive waste management and environmental sustainability. Key components of the proposal include:

- i. Ensuring 100% collection and segregation of waste to enhance efficiency.
- ii. Establishing recycling centres capable of processing all recyclable waste and catering to nearby settlements.
- iii. Implementing strategies to reduce landfill waste by 20-30% from current levels.
- iv. Converting existing landfills into engineered/scientific landfills to mitigate environmental impacts.
- v. Developing marketing campaigns to promote compost and other reusable/recycled products.

### 16.6.6 Methodology For Identification of Landfill Sites

There are stringent criteria for selection of landfill site. The site should be as far as possible from residential areas or built areas. There should be proper considerations taken about contamination of ground water. Proper lining of the site is required. Stop to open burning of waste in localities or landfill sites. The waste reduced by at least 80% only dumped into landfill. Solid Waste Management Rules, 2016 has provisions in terms of types of wastes, its segregation, collection and treatment process. It also states the site selection criteria for treatment plant and landfill site such as construction of landfill on the hill shall be avoided. A transfer station at a suitable enclosed location shall be setup to collect residual waste from the processing facility and inert waste. A suitable land shall be identified in the plain areas down the hill within 25 km for setting up sanitary landfill. In case of non-availability of such land, efforts shall be made to set up regional sanitary landfill for the inert and residual waste.

#### **16.7** Tourism

Moirang, a popular tourist destination, experiences a significant daily influx of visitors, with the floating population ranging from 2,000 to 2,500 people. To cater to this fluctuating number of tourists, it is crucial to have well-developed infrastructure and services in place to ensure a seamless experience for both locals and visitors. Key infrastructure requirements include reliable transportation systems such as buses, taxis and well-maintained roads to handle the increased traffic. Additionally, the provision of adequate accommodation, including hotels, guesthouses and homestays, is essential to meet the demand for lodging. Public amenities such as clean restrooms, waste management systems and drinking water stations must also be in place to ensure hygiene and convenience. Furthermore, proper signage, information centres and security services are vital to guide tourists, ensure safety and improve their overall experience. Such infrastructure amenities not only enhance the appeal of Moirang as a tourist destination but also contribute to the smooth movement of people and maintain the balance between tourism and local life. To accommodate this influx of tourists and ensure smooth movement of people, necessary infrastructure services are proposed:

#### **16.7.1 Tourist Information Centre**

This centralized hub will serve as an information centre, providing visitors with guidance on local attractions, accommodations, and activities. Additionally, it can offer amenities such as

rest areas, refreshments, and restroom facilities, enhancing the overall tourist experience. Figure 16.7-1 shows the function of tourist information centre.



Figure 16.7-1: Tourist Information Centre

Source: Author

#### 16.7.2 Upgradation of Existing Multipurpose Ground

The current multipurpose ground, primarily utilized for cultural and sports events, requires significant improvements. While it currently provides basic amenities like seating and lighting, further upgrades are essential to accommodate various festivals, cultural events, and tourism activities. Enhancing the infrastructure of this ground will not only attract more tourists but also extend the scope of nighttime activities, encouraging visitors to stay longer and explore the town's offerings. Figure 16.7-2 illustrates the uses of a multipurpose ground and the facilities that will be developed to achieve its intended objectives.



Figure 16.7-2: Upgradation of multipurpose ground

Source: Deshgujarat, hindustantimes.com and alphahousing.vn

#### 16.7.3 Promotion of Local Vending Streets

To enrich the tourist experience and showcase the local culture, art, and craft, designated streets can be allocated for local vendors. These vending areas can operate during both day and night, offering tourists an opportunity to immerse themselves in the authentic cultural offerings of Moirang. This initiative not only supports local artisans and vendors but also adds vibrancy to the town's streetscape, enticing tourists to explore and engage with the local community.

# **16.7.4 Integration of Tourist attractions**

A cohesive network that links tourist attractions within Moirang and extends beyond its boundaries.

- To facilitate easy navigation for tourists, allowing them to move between attractions seamlessly.
- To enhance the overall tourism experience by providing clear directions and information about nearby attractions.

### 16.8 Residential

Residential land parcels have been strategically allocated within low-risk areas, predominantly situated in the western vicinity of Moirang town. This allocation process has been informed by meticulous population projections, augmented by considerations of growth factors and potential. Notably, this strategic planning has resulted in a notable increase of 2.5%, shifting from 8.06% to an estimated 10.51% of the total planning area, Table 16.3-1. These parcels have been meticulously integrated into the existing fabric of settlements, fostering a seamless spatial expansion towards low-risk areas. It's noteworthy that this expansion has been consciously discouraged away from Loktak Lake's peripheries, with a concerted effort to mitigate any adverse environmental impact and curtail potential future encroachment towards the lake as represented in Figure 16.8-1. By juxtaposing the proposed residential land use with the current allocation, it is anticipated that approximately 180 Ha will be allocated to residential purposes, ensuring a uniform and planned development.

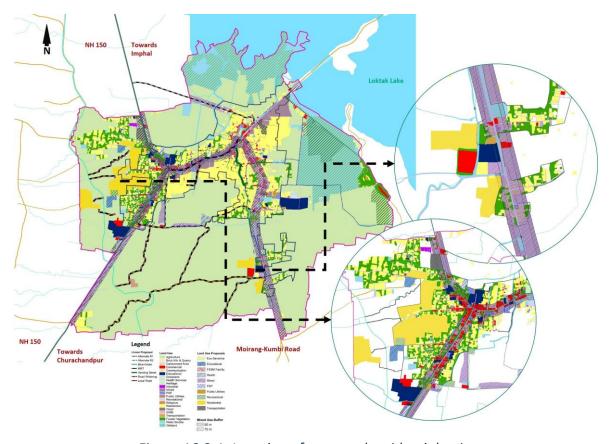


Figure 16.8-1: Location of proposed residential units

Source: Author

#### 16.9 Mixed Land Use

In considering mixed land use, its imperative not to segregate it from commercial and residential zones. A nuanced understanding of socio-economic factors reveals Manipur's high female work force participation, largely in informal sectors. Therefore, mixed land use is predominantly encouraged along arterial roads across the town with buffer given ranging from 50m to 75m based on specific need and considering the significant risk zone of the area. There are some pockets also identified as future potential for mixed land use development along the new alignment. This approach ensures efficient utilization of space while accommodating diverse activities. The proposed land use plan, encompassing 17.77 hectares of total land area of Moirang master plan which around 1% of total area as depicted in Table 16.3-1.

Identified mixed-use areas and commercial streets on the map shall allow variety of activities to enhance community engagement and local vibrancy while also considering restrictions where necessary. Routes and areas can be marked accordingly:

- A. **Culinary Experiences:** Designate areas within mixed-use zones for culinary experiences such as food tours, cooking classes, and gastronomy festivals to showcase local cuisine and promote cultural exchange.
- B. Local Cafés and Restaurants: Encourage the establishment of neighbourhood cafés, restaurants, and eateries along commercial streets, providing opportunities for social interaction and culinary diversity.
- C. **Shared Workspaces:** Allocate spaces within mixed-use areas for shared workspaces or coworking hubs to support remote workers, freelancers, and small businesses, fostering collaboration and innovation.
- D. **Family-Friendly Attractions:** Identify zones within mixed-use areas for family-friendly attractions like playgrounds, splash pads, and recreational facilities, creating opportunities for outdoor play and community bonding while considering noise and safety regulations.

Certain activities may need restrictions, such as limiting noise levels near residential zones or maintaining adequate pedestrian access along commercial streets to ensure safety and accessibility for all residents and visitors. Recommended mixed land use activities are crucial for boosting tourism is given in Figure 16.9-1.

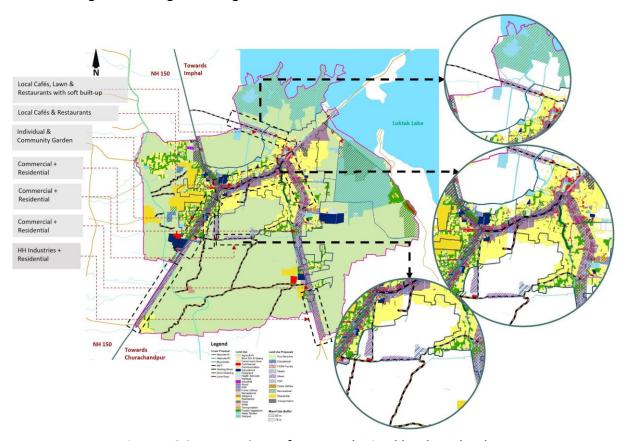
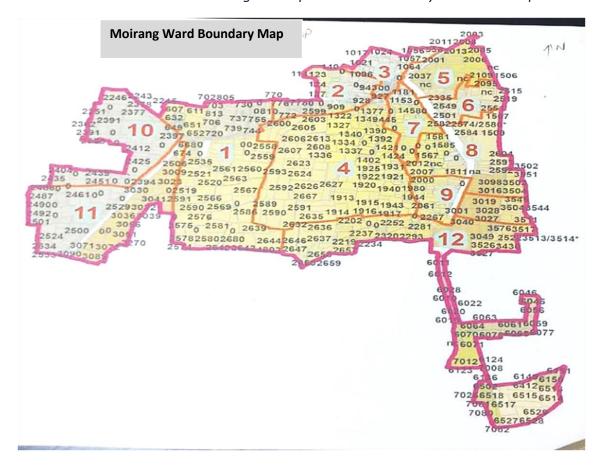


Figure 16.9-1: Locations of proposed mixed land use land area

Source: Author

### **Annexure**

Annexure 1: Moirang Municipal Council Boundary and Ward Map



#### Annexure 2: Survey instruction sheet

#### Instruction Sheet for Observation Recording during Land-Use Survey

- . Ground truthing surveyors are expected to record observations for every element visible in the map printed and made available
- Elements include majorly constructed elements (buildings, roads, overhead tanks, surface drains and other such structures).
- order such soluctures).

  Ground truthing surveyors are also expected to remove any structures from the map by putting a cross (X) on the element that is actually not found on the ground.
- on the element that is actually not found on the ground.

  For roads the widths are to be indicated approximately, if actual measurement is not possible. This may be done by measuring one's footsteps when validing. (Walk a few steps, take the measurement, to arrive at an average distance) knowing one's average footsteps one may walk across the road to measure the width of the carriageway or the R.O.W.

  Tick Y on building it polygon on the grid may whenever you complete filling details of it in the table so that you would be able to understand which of them have been done.

Clarifications regarding Column Titles (indicated in the survey record sheet as Serial numb

Please identify the lowest value of element ID in the grid and enter it in the first column first row. Different row are to be entered with details of different element but sequentially (for example, 40.1 should be followed by 402, 403, and 404 in succession). The building/element you are observing, try to locate it on the map given on the left of the page, see the number and enter that number in the table. Take the help of the landmarks located on the map to guide you to the nearby areas. Kindly ensure that you are observing the correct element on ground which is marked on the map. In circumstances where the element is continuing in another grid please enter both the grid numbers in this column. If any element is not available on the ground the element Id is required to be entered in the appropriate row with a comment that not found on the ground.

#### Building Classification by type of Material:

Please identify the building by roof and wall material used. Match the material from the table and enter the code. If other material is used which is not mentioned in the table than write that material in the table given in the survey sheet.

(3a) Roof Material Type	Code	(3b) Wall Material Type	Code
Cement-Concrete	01	Cement-Concrete Blocks	10
Galvanized Iron Sheet (G.I.)	02	Brick	11
Wood	03	Wood	12
Roof Tiles	04	Wall Tiles	13
Metal	05	Glass	14
Bamboo	06	Bamboo	15
Mud	07	Mud	16
Grass/Leaves	08	Grass/Leaves	17
Roof Stones	09	Stones	18

Building Height (no. of floors):
Please identify number of floors in each building/element and write it. The ground floor should be entered separately and start counting the floor above the ground floor. For example, if there is a 3 floor building you are observing then write as G+3 in this column. Or write only 3 but do not count the ground floor.

#### 4. Building use based on no. of floor:

suionig use oasea on no. or noor: Please identify the building/element is under multiple uses and if the number of maximum floor is under one land use then write it in the Major (Column Sa). For example- If, in a 3 floor building 2 floors are using for commercial and 1 for residential then commercial will come under Major (Column Sa) and residential will come under Minor (Column Sb).

Note: If any element/building is using for one purpose only or there is no sign of mixed land use then the element/building will enter into Major (Column 5a) category and Minor (Column 5b) category will be left

Road stretch ld:

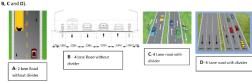
Take a road stretch on the basis of width of the road which will be the same to the certain length of the road. It is shown in the map also. Write that id number and cross check it by you. If there is a change in width of the road then mark that area of road on the map and also give it a different id number. Take approximate value of difference in width by measuring it with your feet.

If you find any road id missing in any grid map and the road characteristics are changing than the previous one in the other grid then try to locate it on map and give a different number to it by yourself and then write the details of that road stretch in the table.

write the details of that road stretch in the table.

Number of lane:

Plases identify the number of lane present in the road you are presently observing. The standard one land road is 3.8 m (11.48 ft) wide, it could be only one way or two way road, and then observes that the present road has how many lanes. The lane could also be differentiating by the chevrons (white strips) painted in the middle of the road to separate traffic lanes. Also mention, if it has a median/divider between the lanes. Below are the examples of roads having different number of lane with their codes (A, B, C and D).



regit or way (NOW): Right of way (ROW): Please write the approximate value of the present ROW by measuring it with your feet wherever the road width is changing or with respect to the road ld. It is the land taken for the road from one off of the margin to the other end. It consists of Road/Carriageway and extra margin given for the future expansion

or load. (neter rigure: 1)
Note: Sometimes encroachment also can be seen in this margin area and if there is any
encroachments are visible then mark it on the map in the respective road.

ease observe if there is any drain present in the given road stretch. It is constructed along the roa ngth on the side of road. It let out the rain water from the road and also the household wastewat

sal site or at one place. Below are the examples of how drain along the road look like with their codes (E,F,G and H)









round drain



#### Surface of Road:

Please identify the roads by looking at the materials used in road construction. Road surface are of two

Hard surrace:

Bitumen/ Asphalt/Black tar road, Cement-Concrete road, Pavored Block road and combination of

Pavored and Cement-Concrete road are type of hard surface road. Below are the images their

codes (I, J, K and I,)











L-Pavored Road

#### b) Soft Surface

Loose Gravel/Moorum road and Katcha road are the soft surface roads. Below are the examples with their codes (M and N)





10. Parking: there are two types of parking. On street parking is that where people parked their vehicles on road and cause traffic. Off-street parking is that where there are areas provided on the sides of road for parking of vehicle. Both are shown in images with their codes (O and P).





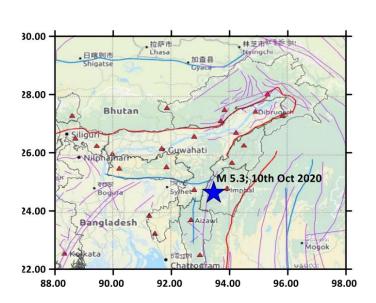
3 | Page 4 | Page

### Annexure 3: Press release by Manipur state related to earthquake on 10<sup>th</sup> October 2020

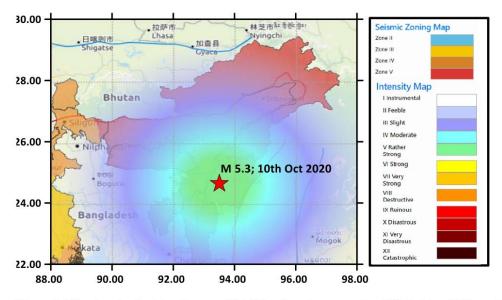
# A Brief Report on Earthquake (M:5.3) occurred on 10<sup>th</sup> October 2020 in Tamenglong District, Manipur

- 1. An earthquake of magnitude M:5.3 occurred on 10<sup>th</sup> Oct 2020 at 23 hrs 08 min 00 sec (IST), near Tamenglong District, Manipur. The epicentre of the earthquake is 24.69°N and 93.47°E with a focal depth of 28 km. The epicentre was about 40 km East-North-East (ENE) of Imphal and 30 km West-North-West (WNW) of Bishnupur, and the epicentral area lies in Zone-V as per seismic zoning map of India. The epicentre location and intensity map of the earthquake are given in Figure 1 and 2.
- 2. The epicentre of the earthquake lies in the vicinity of Churachandpur Mao Fault (CMF), which is N-S trending strike-slip fault and runs from approximately 22.1°N, 93.1°E to 26.0°N, 93.6°E. The preliminary fault-plane solution obtained from waveform inversion suggests that the dominant strike-slip mechanism for the event and confirm the CMF is the causative source of the event.
- 3. During the past 20 years within 50km radius of this earthquake location, two earthquakes of M:5.0 and above were occurred on 3<sup>rd</sup> Jan 2016 (M:6.6) and on 2<sup>nd</sup> Aug 2017 (M:5.2). During this period, about 10 earthquakes occurred in the magnitude range of 4.0 and 4.9. The list of the past earthquakes within a 50km radius of the present earthquake is given in Table-1.
- 4. Felt responses reported are in the range of II to III on the scale of Modified Mercalli Intensity (MMI) within 18 hours at a distance from 30 to 190 km from the epicentre (Figure 3).

1

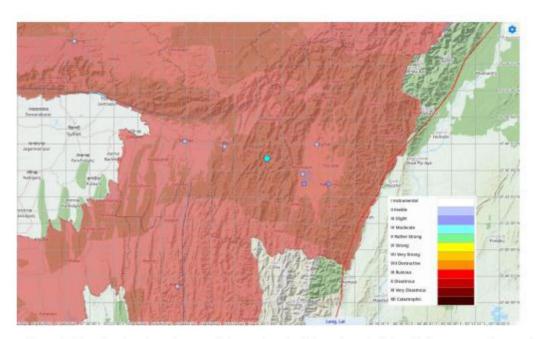


**Figure 1:** Map showing the location of the earthquake of M:5.3 (Blue Star) occurred on 10<sup>th</sup> October 2020 near Tamenglong district, Manipur State. Seismological stations of NCS in NE region of the country are also shown as Red colour triangle. The continuous thin blue and red thick lines are the major fault and plate boundary in the epicentral region respectively.



**Figure 2**: Map showing the intensity map of M:5.3 earthquake occurred on 10<sup>th</sup> October 2020 near Tamenglong District of Manipur State.

2



**Figure 3:** Map showing the epicentre of the earthquake (blue colour circle) and felt responses (squares) received within 18 hours from the occurrence of the earthquake.

**Table-1:** The list of past earthquakes of Magnitude 3.0 and above occurred within the 50 km of radius during the past 20 years (01st March 2000 to 31st March 2020) are as follows:

Date Day-mm-yr	Time (UTC) Hr:mn:sec	Latitude ( <sup>O</sup> N)	Longitude (°E)	Depth (km)	Magnitude	Location
18-03-2000	16:38:35	24.85	93.79	33	3.5[MC]	15km WNW of Imphal, Manipur, India
05-11-2004	21:15:40	24.70	93.53	33	4.8[MB]	24km WNW of Bishnupur, Manipur, India
27-12-2005	16:19:11	24.89	93.10	87	4.6[MB]	72km WNW of Bishnupur, Manipur, India
07-12-2007	06:56:42	24.70	93.71	97	4.7[ML]	9km NW of Bishnupur, Manipur, India
22-07-2008	02:20:48	24.66	93.56	33	3.3[ML]	20km W of Bishnupur, Manipur, India
12-12-2010	01:40:02	24.89	93.49	33	4.8[MB]	39km NW of Bishnupur, Manipur, India
01-08-2011	00:26:14	24.50	93.82	38	3.8[ML]	4km E of Moirang, Manipur, India
08-10-2011	03:00:40	24.43	93.57	13	3.1[ML]	22km WSW of Moirang, Manipur, India
26-02-2012	15:55:31	24.69	93.75	65	4.4[ML]	6km N of Bishnupur, Manipur, India
04-03-2012	04:55:06	24.71	93.35	29	3.1[ML]	42km WNW of Bishnupur, Manipur, India
24-04-2012	18:11:11	24.72	93.47	30	3.0[ML]	30km WNW of Bishnupur, Manipur, India
26-04-2012	07:28:31	24.93	93.69	11	3.1[ML]	27km WNW of Imphal, Manipur, India
31-05-2012	06:37:22	24.72	93.88	30	3.4[ML]	12km SSW of Imphal, Manipur, India
04-07-2012	05:24:09	24.90	93.89	19	3.3[ML]	10km NNW of Imphal, Manipur, India
24-07-2012	03:26:54	24.64	93.85	22	3.2[ML]	9km E of Bishnupur, Manipur, India
11-09-2012	18:09:46	24.65	93.73	13	3.8[ML]	3km NW of Bishnupur, Manipur, India
12-10-2012	23:16:16	24.65	93.69	37	4.1[ML]	7km WNW of Bishnupur, Manipur, India
04-03-2013	20:15:53	24.96	93.70	35	3.8[ML]	28km WNW of Imphal, Manipur, India
15-06-2013	00:10:32	24.54	93.55	7	3.5[ML]	23km W of Moirang, Manipur, India

Date Day-mm-yr	Time (UTC) Hr:mn:sec	Latitude ( <sup>O</sup> N)	Longitude (°E)	Depth (km)	Magnitude	Location
24-10-2013	01:23:07	24.65	93.34	32	3.0[ML]	42km W of Bishnupur, Manipur, India
26-02-2014	20:58:53	24.59	93.68	19	4.0[ML]	9km WSW of Bishnupur, Manipur, India
06-10-2014	13:46:03	24.40	93.57	27	3.8[ML]	23km WSW of Moirang, Manipur, India
22-05-2015	20:11:36	24.69	93.29	16	3.8[ML]	47km W of Bishnupur, Manipur, India
21-07-2015	08:21:41	24.40	93.69	53	3.7[ML]	14km SW of Moirang, Manipur, India
03-01-2016	23:05:20	24.84	93.47	28	6.6[Mb]	37km NW of Bishnupur, Manipur, India
04-01-2016	09:00:00	24.80	93.48	77	3.6[ML]	34km WNW of Bishnupur, Manipur, India
28-03-2016	15:42:48	24.68	93.40	9	3.4[ML]	36km W of Bishnupur, Manipur, India
31-08-2016	01:26:47	24.70	93.39	11	3.2[ML]	38km W of Bishnupur, Manipur, India
17-09-2016	02:46:24	24.44	93.82	50	4.1[ML]	7km SE of Moirang, Manipur, India
15-11-2016	14:27:16	24.60	93.66	38	3.2[ML]	10km WSW of Bishnupur, Manipur, India
04-01-2017	13:40:31	24.43	93.70	81	3.5[ML]	10km SW of Moirang, Manipur, India
24-02-2017	12:02:47	24.30	93.46	20	4.9[ML]	38km SW of Moirang, Manipur, India
29-07-2017	22:01:23	24.70	93.90	70	3.1[ML]	13km SSW of Imphal, Manipur, India
02-08-2017	18:18:08	24.38	93.47	89	5.2[ML]	33km WSW of Moirang, Manipur, India
08-08-2017	00:35:37	24.33	93.58	72	4.2[ML]	27km SW of Moirang, Manipur, India
21-09-2017	22:35:55	24.34	93.50	59	3.2[MW]	33km WSW of Moirang, Manipur, India
15-03-2018	02:26:03	24.41	93.65	85	4.6[MW]	16km SW of Moirang, Manipur, India
21-04-2018	07:10:58	24.46	93.70	36	3.8[MW]	8km WSW of Moirang, Manipur, India
24-05-2018	14:17:01	24.90	93.29	5	3.1[ML]	56km WNW of Bishnupur, Manipur, India
25-03-2019	12:41:23	24.33	93.38	13	4.6[Mb]	44km WSW of Moirang, Manipur, India
05-09-2019	16:52:54	24.64	93.40	14	3.3[MW]	36km W of Bishnupur, Manipur, India
05-11-2019	10:19:34	24.31	93.57	59	3.8[MW]	29km SW of Moirang, Manipur, India
20-12-2019	09:38:32	24. 72	93.58	31	3.4[ML]	20km WNW of Bishnupur, Manipur, India

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