Risk Informed Master Plan-2043

Draft Report

Moirang Town

Prepared for

Town Planning Department, Government of Manipur

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A. Table of Contents

List of Tables

List of Figures

List of Maps

Annexes

List of Abbreviations

%	Percent
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	Hectares
HHs	Households
IPT	Intermediate Public Transport
Km	Kilometre
m	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

Chapter 1: Introduction

1.1 Background

Moirang is a town in Bishnupur district, which is one of the four valley districts of Manipur and is situated in the central region of the state. Moirang is a tier III city as per census town classification with more than 20,000 population *(Source: Census of India, 2011).* The two main characteristics that defines the town are:

- Town's History, which is associated with World War II
- Natural feature such Loktak Lake and Keibul Lamjao national park, only floating national park in the world *(Source: Census of India, 2011).*

Moirang, situated in the cultural tapestry of Manipur, is at the cusp of a transformative journey. This impending shift is encapsulated in a master plan set for the horizon year 2043, steering the town towards a sustainable and vibrant future. At its core, Moirang envisions a trajectory that harmonizes urban living with the vibrancy of tourism. The contours of this plan unfold against the rich historical backdrop and cultural significance of the town, encapsulating a commitment to preserving natural beauty, fostering cultural legacy, and engaging the community. This introduction sets the stage for a nuanced exploration of Moirang's evolution, outlining a trajectory that transcends conventional urban development, guiding the town towards a future that echoes the aspirations of its residents and beckons visitors to partake in its unique charm.

Figure 1.1-1: Beauty of Moirang- Loktak Lake
Source: India Today NE

Moirang Town in Manipur 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 HQ memorial and Loktak Lake, is central to Moirang'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.

Infrastructure development takes precedence, focusing on transportation, water supply, and waste management to support the town's burgeoning population. Simultaneously, the plan emphasizes sustainable tourism management, preserving key attractions while fostering economic growth.

Urban design prioritizes community-centric residential areas, incorporating green spaces and amenities. Environmental conservation measures safeguard ecologically sensitive areas, contributing to Moirang's unique natural beauty.

Community engagement is integral, involving residents in the planning process to reflect their aspirations. The master plan envisions a resilient Moirang that serves as a model for inclusive and balanced development by 2043, embodying the town's identity and values.

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 (Figure 1.2-1). It has a total area of 22327 sqkm. It lies between 230 49’ 45.530” N to 25o 42’ 1.456” N latitude and 920 58’ 23.422” E to 94o 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.

Moirang town is in Moirang sub-division of Bishnupur district 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.

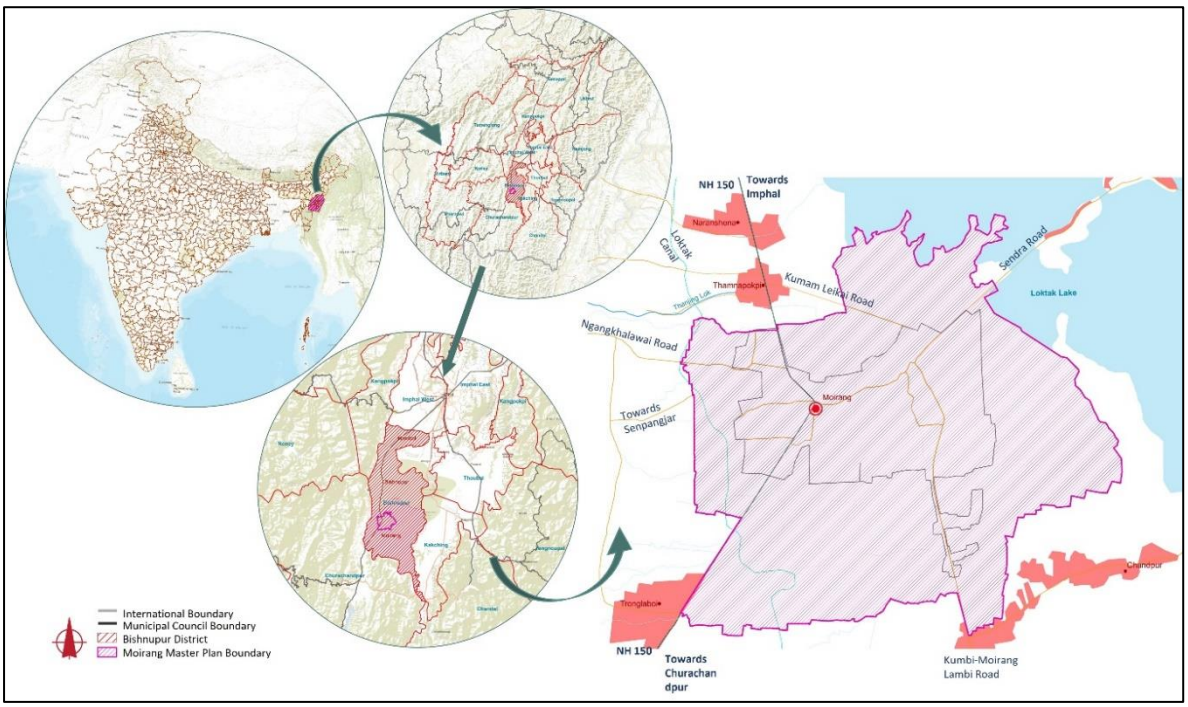


Figure 1.2-1: Location map of Moirang Planning Area
Source: Survey of India

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. Many, including Britishers, believed that it was one of the most challenging and brutal fights. 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, and it is only about 45 km away from the State Capital Imphal. Loktak lake, which is a major source of freshwater in Manipur state is in North-East from Moirang town. The total planning boundary

area is 688.15 Ha, whereas Moirang Municipal Boundary area is 476.06 Ha. Topography of the town is mainly flat and varies from 10-30 m in height. It has several water catchment areas or ponds. Loktak lake is surrounded by small hills such as Sendra hills, Phubala, Thanga, Thanga Khoiram Leikai etc., but these hills are not part of the planning area.

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". Other than this, 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 of Meitie community and their facial look is of Mongoloid/South-East Asian type. 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 presents the existing profile of the project area. It describes its location, regional connectivity and transport infrastructure.

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 Connectivity

2.2.1. 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.

2.2.2. Intra State

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.

Bishnupur DHQ town is situated at an approximate distance of 47.2 km from the bus station of Imphal city (as depicted in Figure 2.2-1). 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.

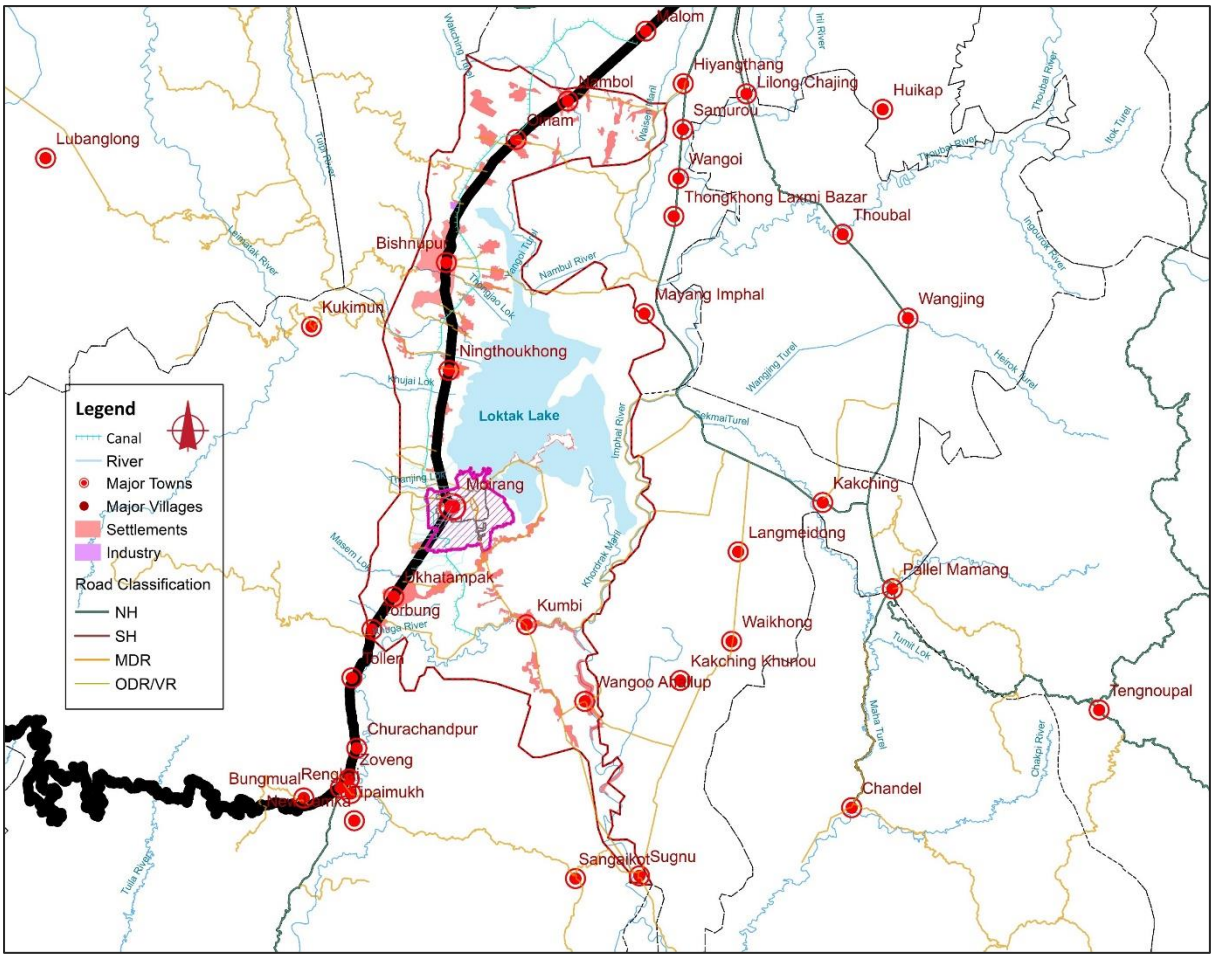


Figure 2.2-1: Settlements influenced by NH 150
Source: Google Earth Imagery

2.2.2.1. 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. (Refer Figure 2.2-2)

2.2.2.2. 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.

Other Services: 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)

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.

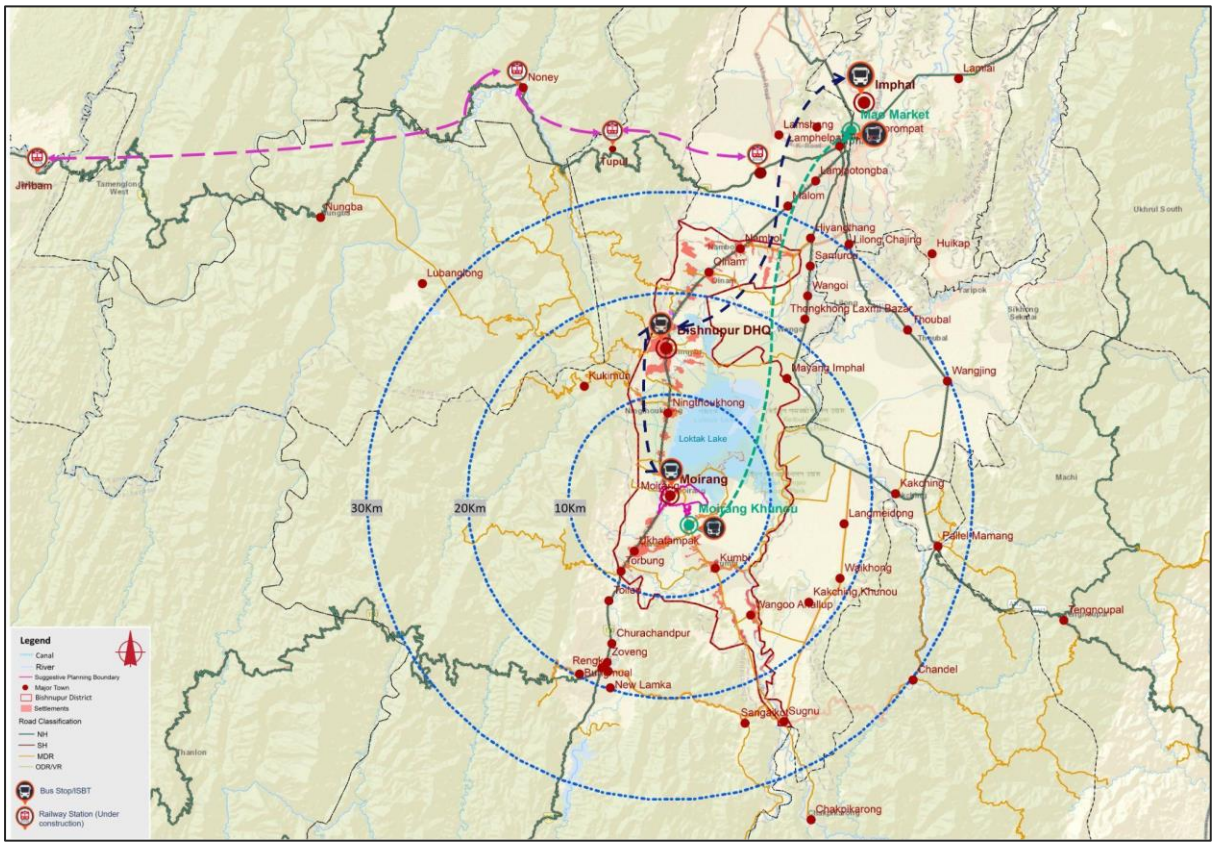


Figure 2.2-2: Intra State connectivity of Moirang Planning Area
Source: Google Earth Imagery

Chapter 3: Physical Environment

The chapter provides details of physiography such as topography, rainfall, soil conditions, climate, etc.

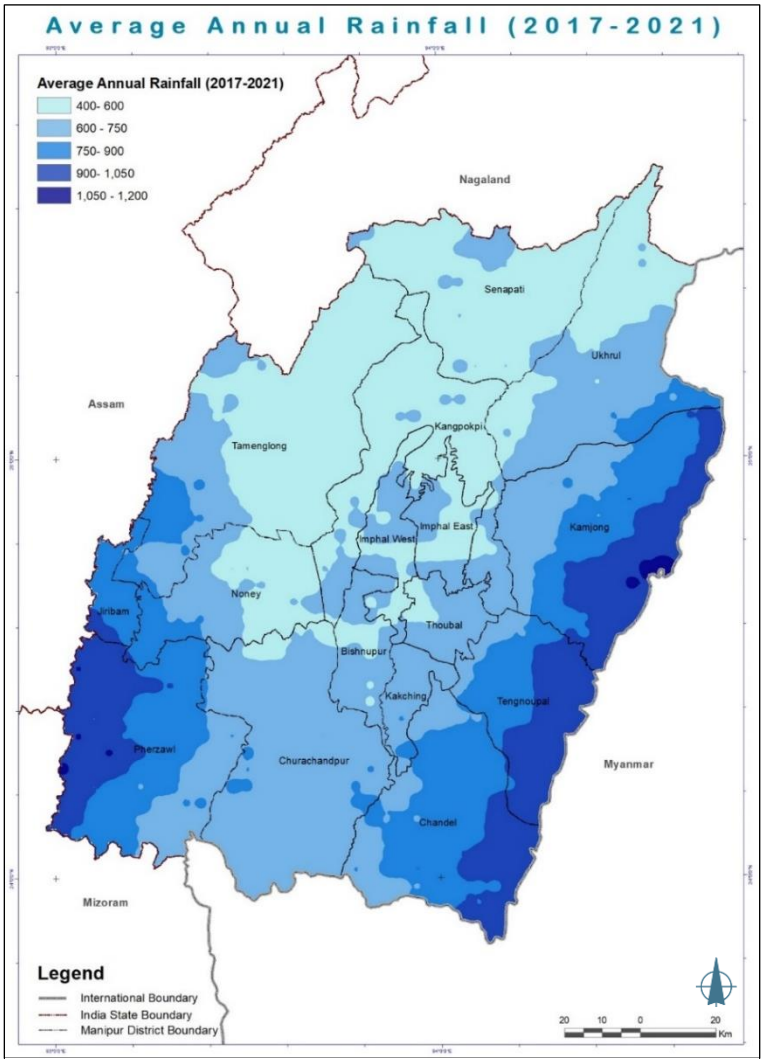
3.1 Physiography

Physio-graphically Manipur can be characterised in two distinct physical regions – an outlying area of rugged hills and narrow valleys, and the inner area of flat plain, with all associated landforms. Moirang lies in the valley region of the state, it is shown that the contours of the planning area vary from 750 to 800 m. Loktak lake is in the North-West part of the planning area. It is the major source of fresh water in the state.

3.2 Rainfall Data

Average annual map shows that five district of Manipur state experienced high rainfall in comparison to rest of the districts. Bishnupur experiences a moderate rainfall varies from 400-750 mm. Rainfall in Moirang town is limited to 500-750 mm during the period 2017-2021, as per CHRS. (Refer Map 3.2-1)

Map 3.2-1: Average Annual rainfall in the Manipur State



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

3.3 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. (Refer Figure 1.1-1)

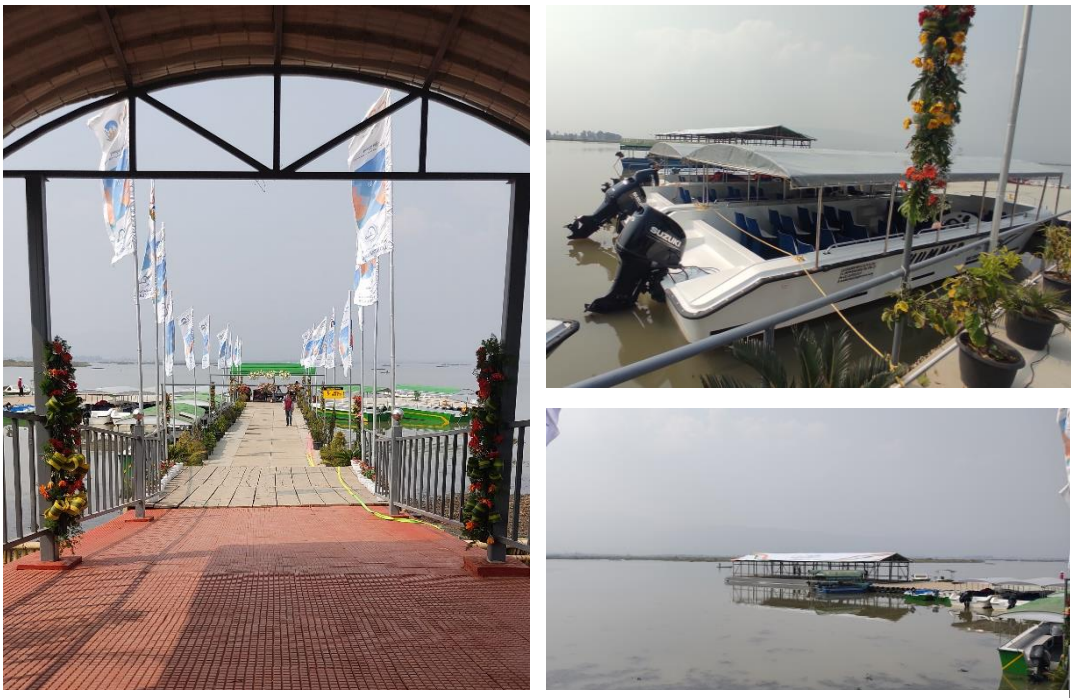


Figure 3.3-1: Loktak Lake Development Authority
Source: Ground Truthing Survey

3.4 Natural Vegetation and Biodiversity

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. (Refer Figure 3.3-1)

Figure 3.4-1: Vegetation and Habitation-Loktak Lake
Source: Google Images

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. (Refer Figure 3.4-1)

3.5 Climate and Topography

Figure 3.4-2: Keibul Lamjao National Park Safari
Source: Google Images

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.

3.6 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. 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.

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.

3.7 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.

Chapter 4: Delineation

4.1 Moirang Municipal Council Area

Moirang Municipal boundary area is 476.06 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 4.1-1. 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.

Source: Moirang Municipal Council

Map 4.1-1: Moirang Municipal Boundary

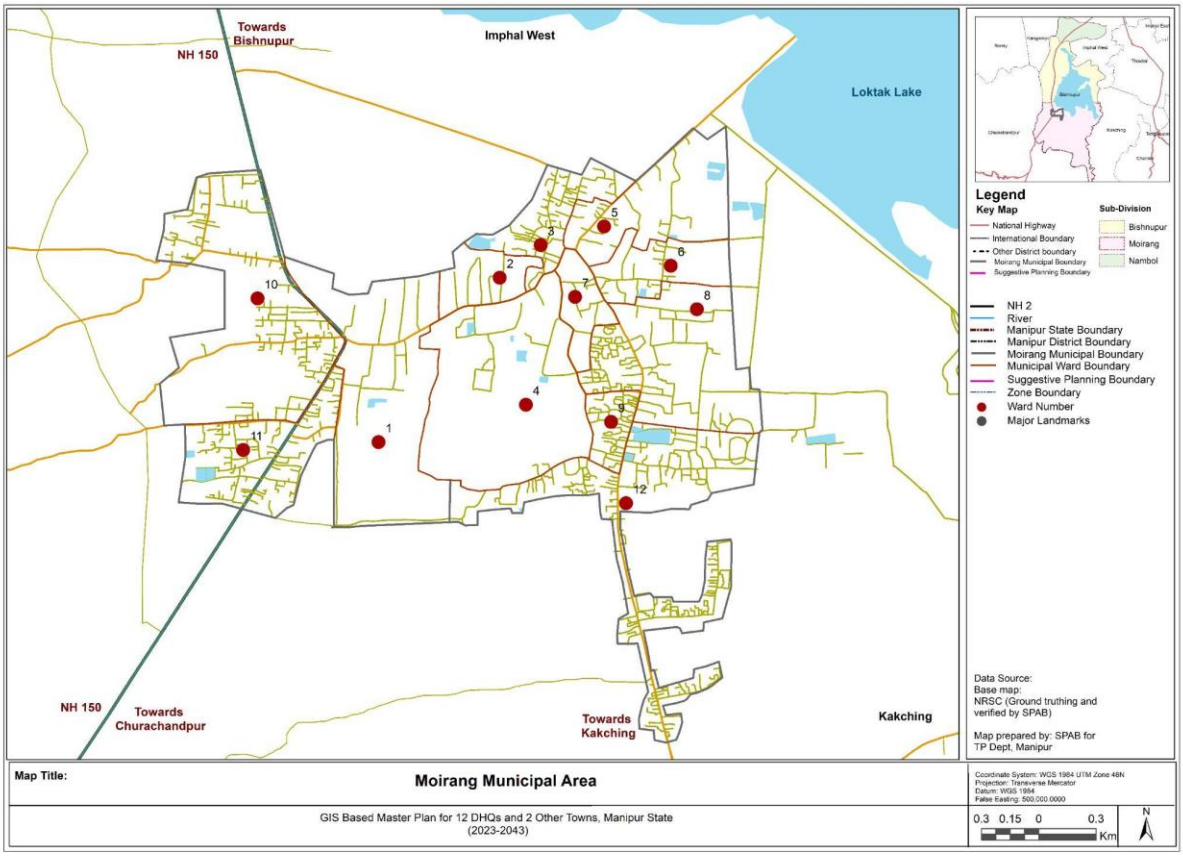


Table 4.1-1: Moirang Municipal Area specifications

cS. No.	Specifications	
1	Area	476.06 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

4.2 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 (Refer Figure 4.2-1).

The total area of Moirang planning area is 1703.88 Ha (Refer Map 4.2-1). It includes the abutting land of Loktak lake towards North-East. 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

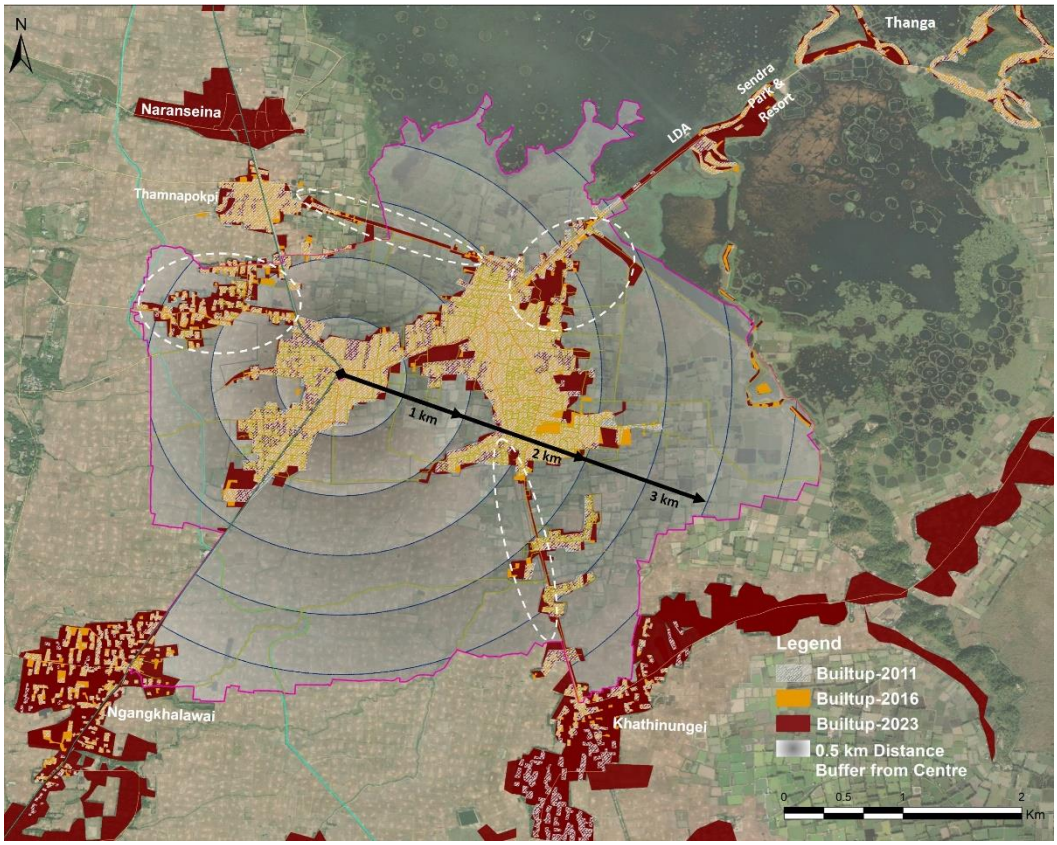
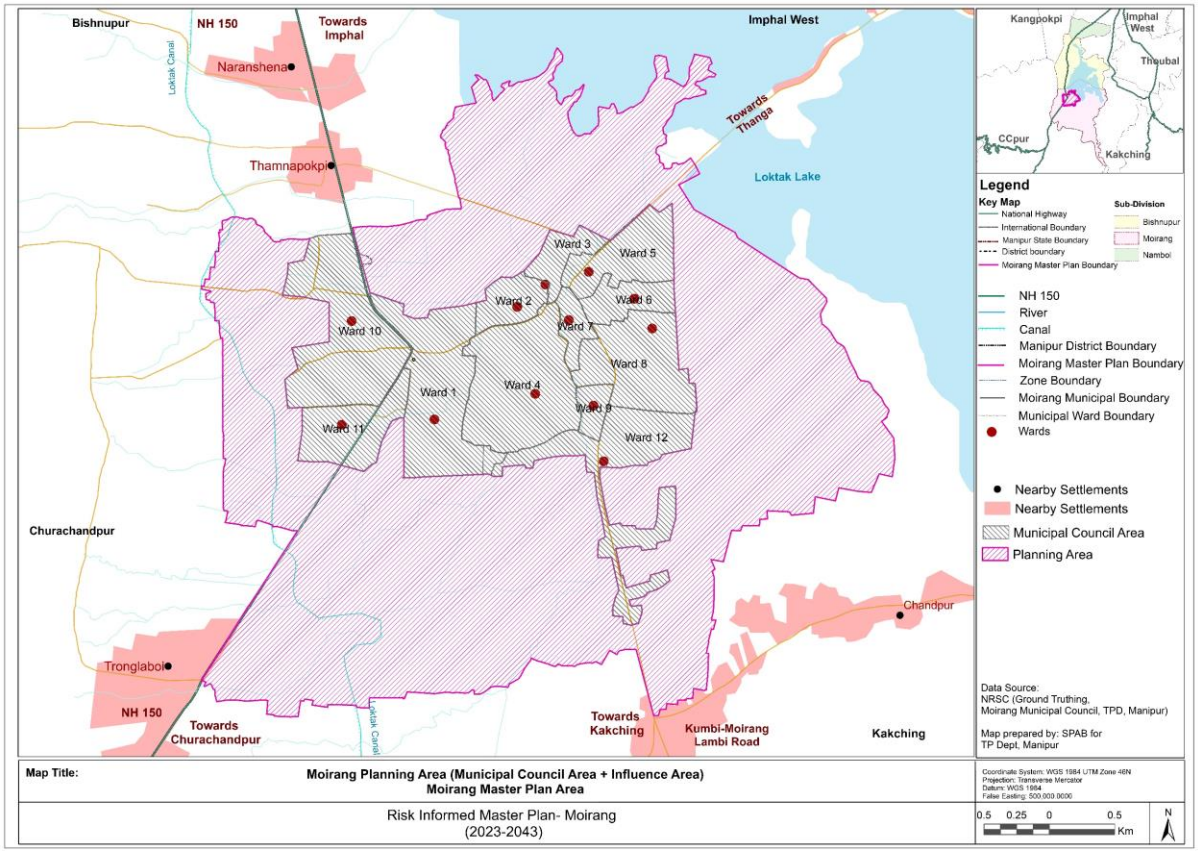


Figure 4.2-1: Spatial growth in and around Moirang Town in years
Source: Google Earth Imagery

adjacent to Loktak lake. Thirdly, the delineation seeks to establish contiguity between the new settlement and the existing town along the highways. Lastly, it endeavors 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 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, neighboring communities, and ecological aspects for a holistic and sustainable approach to town development.

Map 4.2-1:Additional area in Moirang Master Plan Boundary



Source: Moirang Municipal Council & TPD, Manipur

Chapter 5: Goals, Methodology & Approach

5.1 Vision

The vision is to "Foster a Sustainable-Vibrant tourism and Risk Resilient environment for Moirang".

5.2 Goals

1. To create an environmentally sustainable town that provides a healthy environment for its citizens and is adaptable towards addressing impacts of climate change.
2. To develop a future-ready town that offers good quality, affordable and safe living environment with efficient mobility systems.
3. To develop into a vibrant destination that stimulates economic, creative, and cultural growth through tourism.

5.3 Objectives

1. Prioritizing Environmental Sustainability –To prioritize environmental concerns for the development 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.
2. Strengthening Heritage, Culture, and Public Engagement– Safeguarding and enriching the cultural legacy, establishing robust economic connections, and fostering opportunities for cultural immersion, tourism, and vibrant public experiences.
3. Development of diverse supporting infrastructures for tourism such as shelter, hospitality, transportation, and its management.
4. Developing Resilient Physical Infrastructure –To promote a sustainable approach towards use of resources like water and energy, facilitate adequate and uninterrupted services so that the city is ready in terms of digital infrastructure and resilience to risk and disasters.

5.4 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.

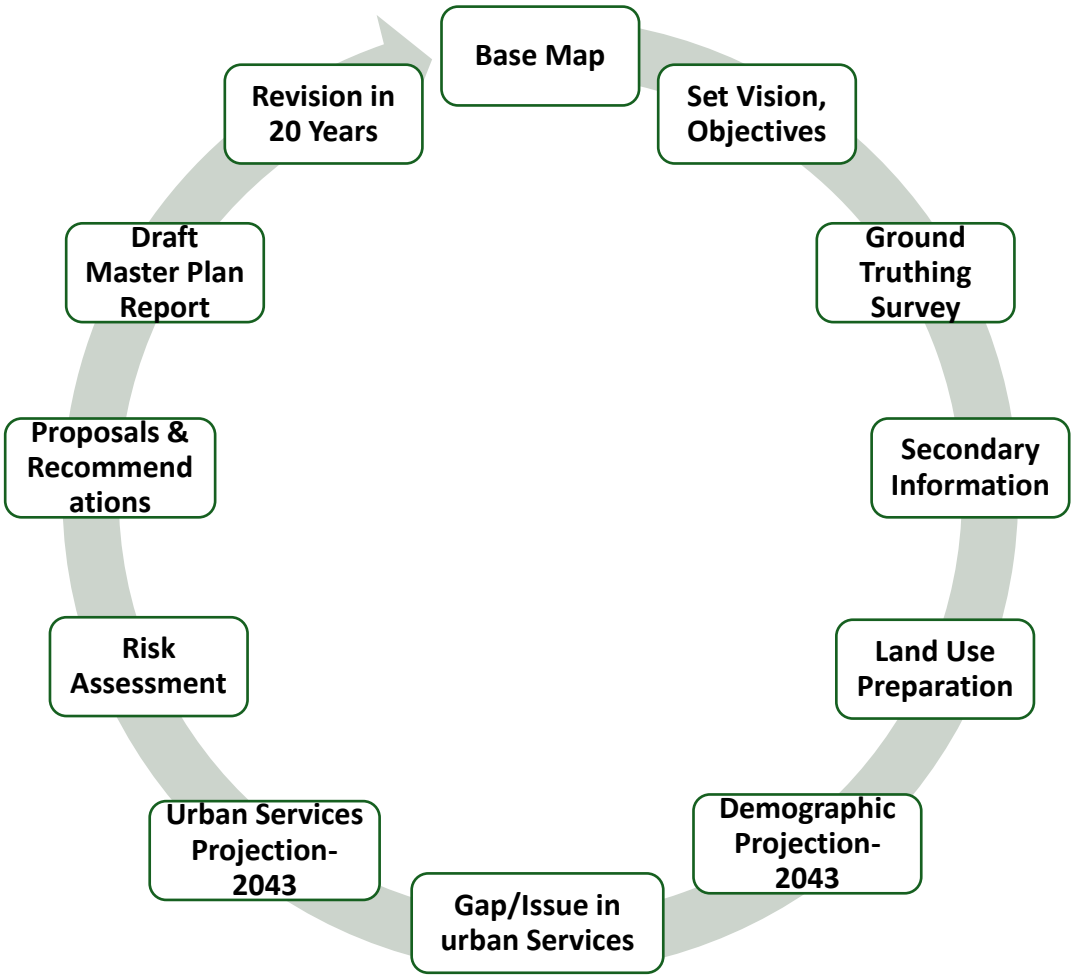


Figure 5.4-1: Methodology for Master Plan

Chapter 6: Demography

The chapter explains the current demographic characteristics of the area.

6.1 Demographic profile

As per census 2011, Total population of Moirang Municipal Council (MMC) area is 19893 with population density of 43 persons per hectare. The total area of MMC is 476.06, 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 6.1-1: Demography of Moirang Planning Area

	Moirang MCL	Moirang Planning Area
Number of Ward/Census Town/Out-Growth/Villages	12 wards	12 wards with 1 Villages
Total Area (Ha)	476.06	1703.88
Total Population	19893	23308
Male Population	9841	11603
Female Population	10052	11804
Total Households	3723	4408
Population Density (pph)	43	14
Literacy Rate (%)	83.93	79.51
Sex Ratio	1021	1017

Source: Census of India 2011 and Author

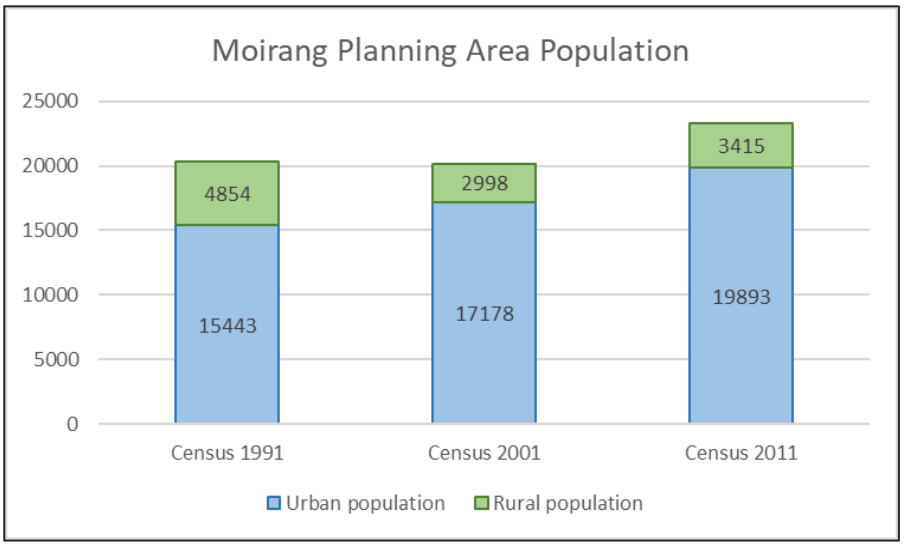


Figure 6.1-1: Moirang Planning Area Population (Urban-Rural)

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% in 2011.

6.1.1. Population Density

As per census 2011, Population density of urban area is 42 pph, which is significantly increased since 1991 from 32 pph.

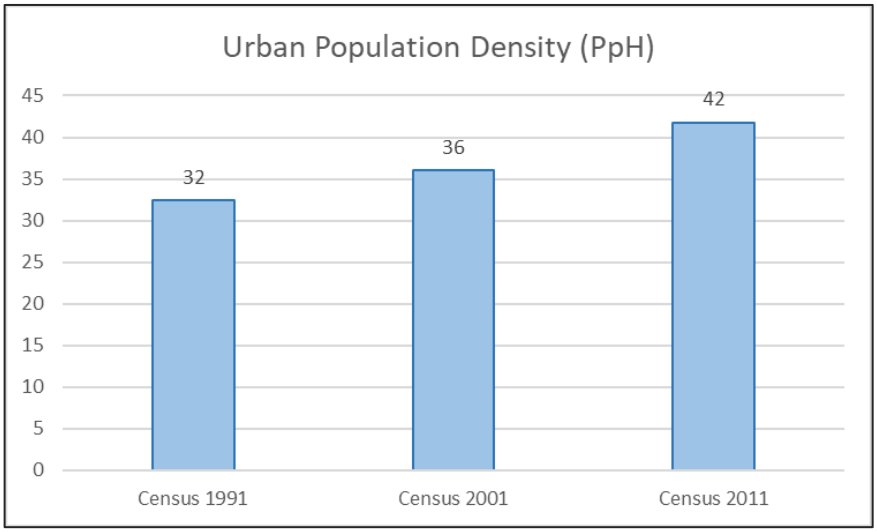


Figure 6.1-2: Urban Population Density

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

6.1.2. 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%) *(Source: Census of 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%.

6.1.3. 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.

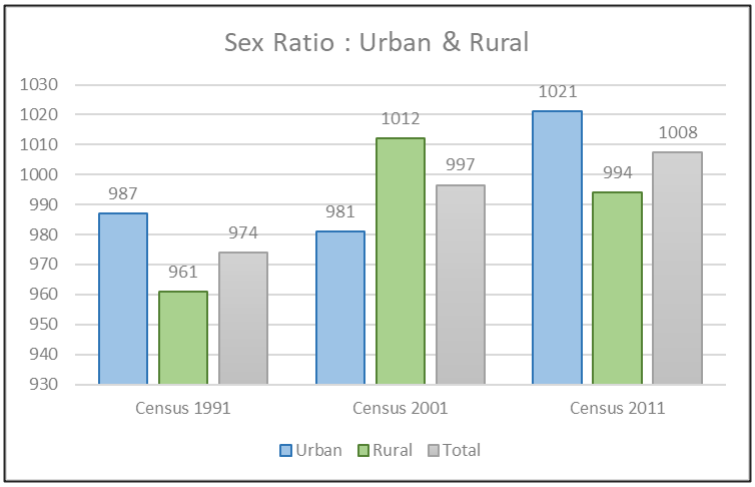


Figure 6.1-3: Sex Ratio
Source: Census of India (1991, 2001, 2011)

6.2 Projected Population

According to census data from 2011, 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 6.2-1 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 leveling off of 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.

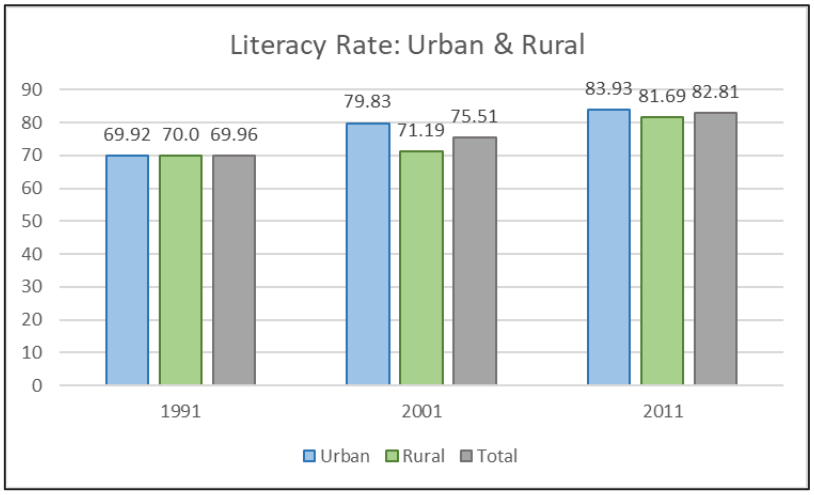


Figure 6.2-1: Literacy Rate
Source: Census of India (1991, 2001, 2011)

Table 6.2-1: 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	20297	2468	20.59
2001	20176	3278	19.53
2011	23407	4408	16.01
2021	26405	5281	12.81

2031	**29632**	**5926**	**12.22**
2041	**33120**	**6624**	**11.77**
2043	**33853**	**6771**	

Source: Census 1991, 2001, 2011

Chapter 7: 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.

7.1 Land Use 2023

The land use for the year 2023 is prepared through the remote sensing data from NRSC and validated through ground truthing survey on 23 classes of land-use as per AMRUT standards and guidelines. To arrive at a rationale for future spatial structure and land use patterns, it is necessary to study the existing land use to identify the existing spatial structure. The classes in which existing land use has been divided for Bishnupur planning area for the year 2023 is given in Table 7.1-1 and shown in Figure 7.1-1. The spatial distribution of land use is shown in Map 7.1-1.

The total planning area of Moirang is 1703.88 Ha. The Table 7.1-1 illustrate that maximum percentage of land use is under agriculture (34.86%) as peripheral areas of municipal corporation have not experiences built up expansion yet. It covers almost two third area of Moirang planning boundary. Whereas residential landuse consisting of 8.06% of the total landuse area of Moirang planning area. Residential spread across the core of the town (MMC boundary) and sparsely on the peripheral areas. Highly dense areas can be seen along the NH150 and Old Cachar road. In the western side residential areas are restricted by the terrain.

Table 7.1-1: 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	1076.91	63.2	12	Recreational	2.38	0.14
2	Commercial	37.67	2.21	13	Religious	1.43	0.08
3	Communication	0.06	0	14	Residential	137.41	8.06
4	Educational	21.36	1.25	15	Roads	47.05	2.76
5	Forest/ Vegetation	81.52	4.78	16	SWM	0.20	0.01
6	Health Services	1.22	0.07	17	Transportation	0.21	0.01
7	Heritage	1.47	0.09	18	Vacant	48.66	2.86
8	Industrial	0.70	0.04	19	Water Bodies	68.91	4.04
9	Mixed	5.61	0.33	20	Wetland	165.54	9.72
10	PSPs	4.60	0.27		Total	**1703.88**	
11	Public Utilities	0.99	0.06				

Source: Ground Truthing Survey

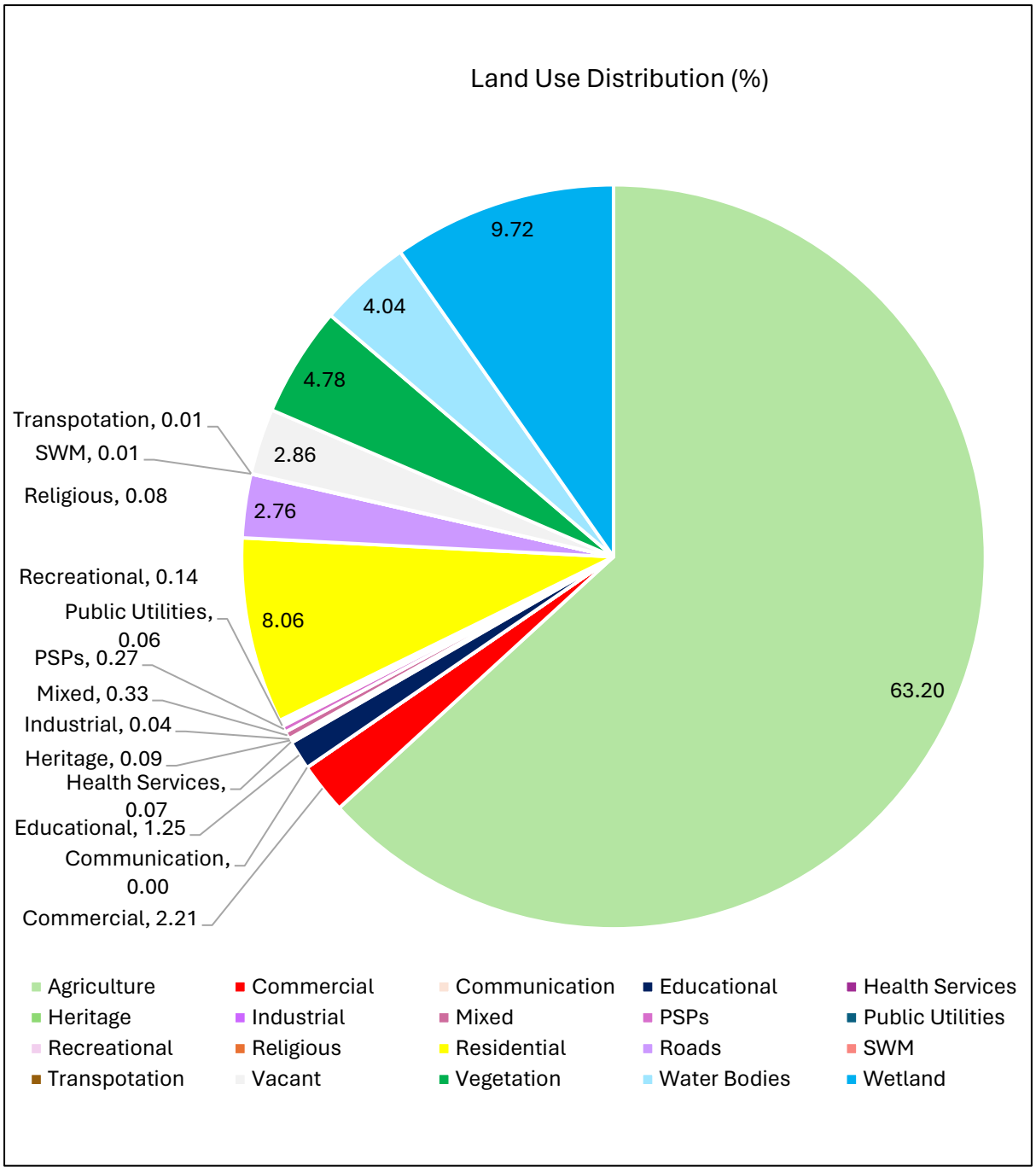
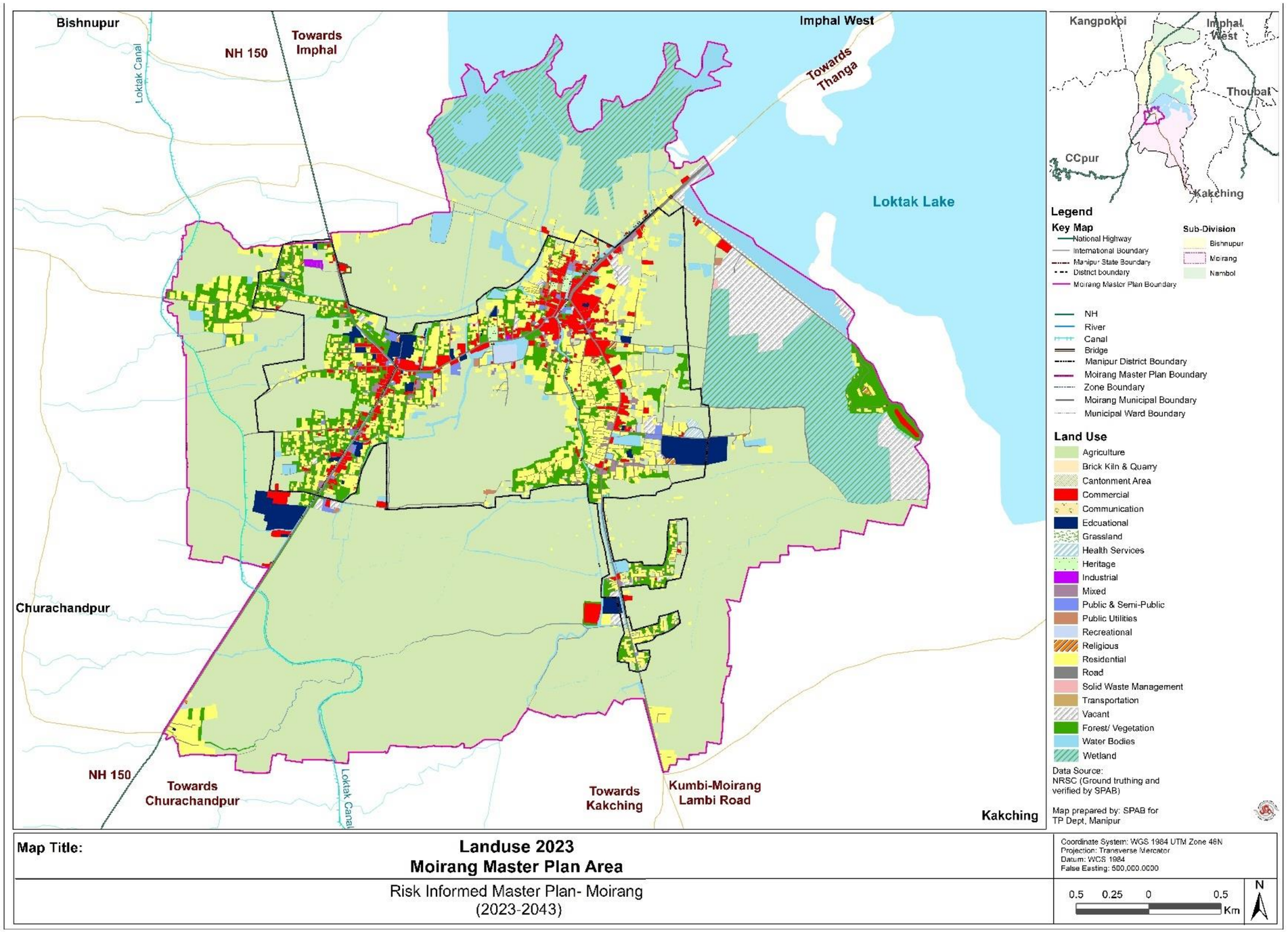


Figure 7.1-1: Land Use distribution in Moirang Planning Area (2023)
Source: Ground Truthing Survey

Map 7.1-1: Land use map of Moirang Planning Area



Source: Ground Truthing Survey

7.2 Zonal boundary

This analysis can aid in the equitable distribution of resources, identifying areas that require specific interventions or improvements, and promoting balanced development across the town. Land use specific or land use dominance-based division of suggestive town boundaries has been done. This will help in identifying zone specific infrastructure gaps and will assist in fulfilling future demands.

Moirang town has been divided into nine zones for better understanding of spatial arrangement of infrastructure and amenities (Map 7.2-1). This zoning is based on mainly three criteria: i) based on the ward boundary (alignment with ward boundary), ii) based on the predominant activity of the zone, and iii) each ward should come under the jurisdiction of only one zone.

Table 7.2-1: Zone-wise area and percentage in Moirang planning area.

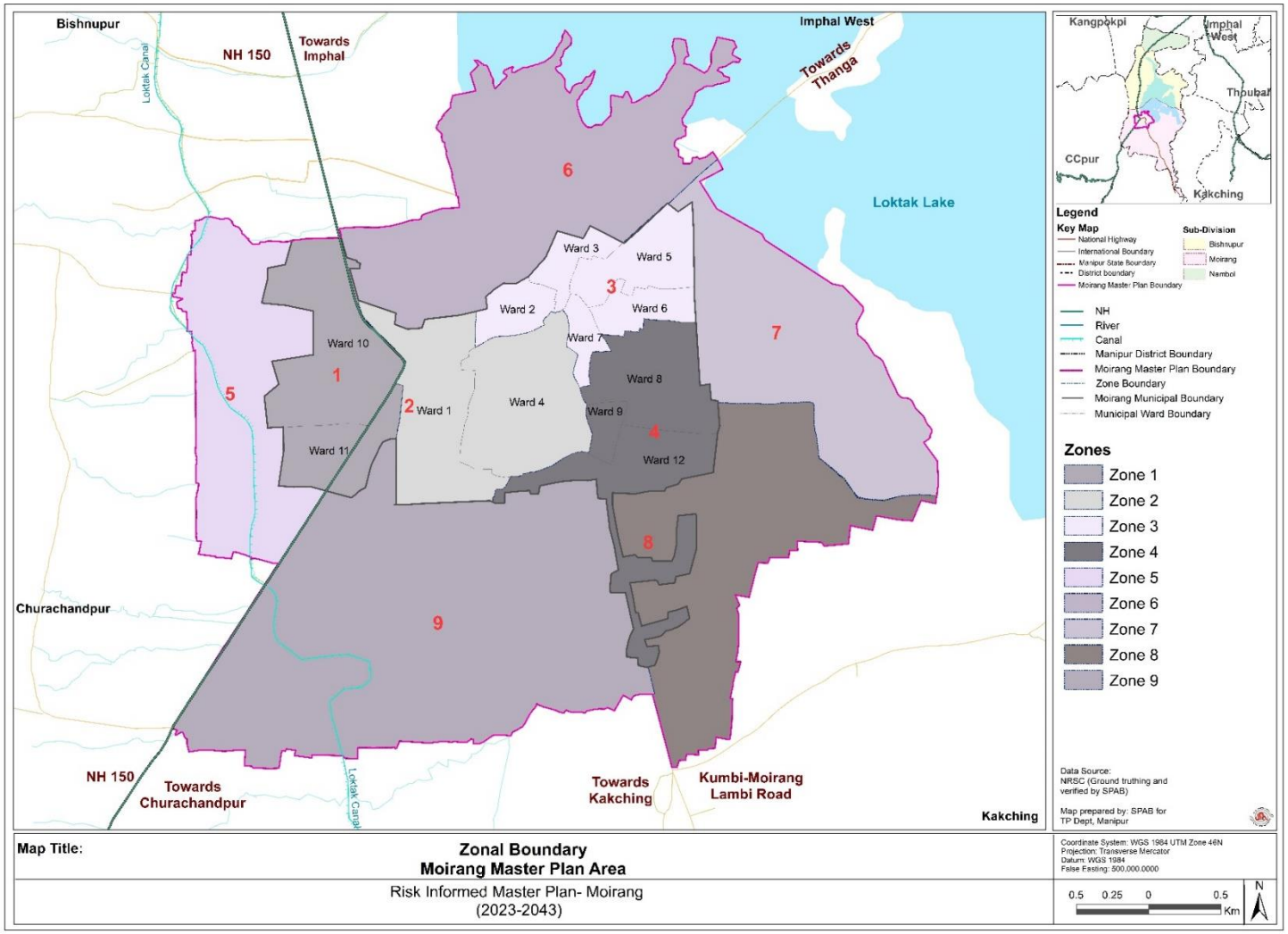
S. No.	Zone	Wards included (with number)	Area	%
1	Zone 1	Ward 10 and 11	113.52	6.66
2	Zone 2	Ward 1 and 4	145.44	8.54
3	Zone 3	Ward 2, 3, 5, 6 and 7	93.48	5.49
4	Zone 4	Ward 8, 9 and 12	123.40	7.24
5	Zone 5	None	149.77	8.79
6	Zone 6	None	246.87	14.49
7	Zone 7	None	180.47	10.59
8	Zone 8	None	198.24	11.64
9	Zone 9	None	452.52	26.56
	Total		**1703.88**	

Source: Author

The zones can be classified into two distinct categories: i) areas encompassing the municipal region and ii) areas situated beyond the municipal boundaries. Municipal zones include Zone 1, 2, 3, and 4, while areas falling outside the municipal jurisdiction, constituting the proposed planning area, encompass Zone 5, 6, 7, 8, and 9.

Table 7.2-1 illustrate that, Zone 9 is the largest zone in terms of area, which covers 26.56% of total and it falls completely outside the Moirang municipal boundary. Whereas zone 3 is the smallest that covers only 5.49% of the planning area boundary with 93.48 Ha of area and covers the main commercial area of the town (Table 7.2-1).

Map 7.2-1: Zonal Boundary of Moirang Planning Area

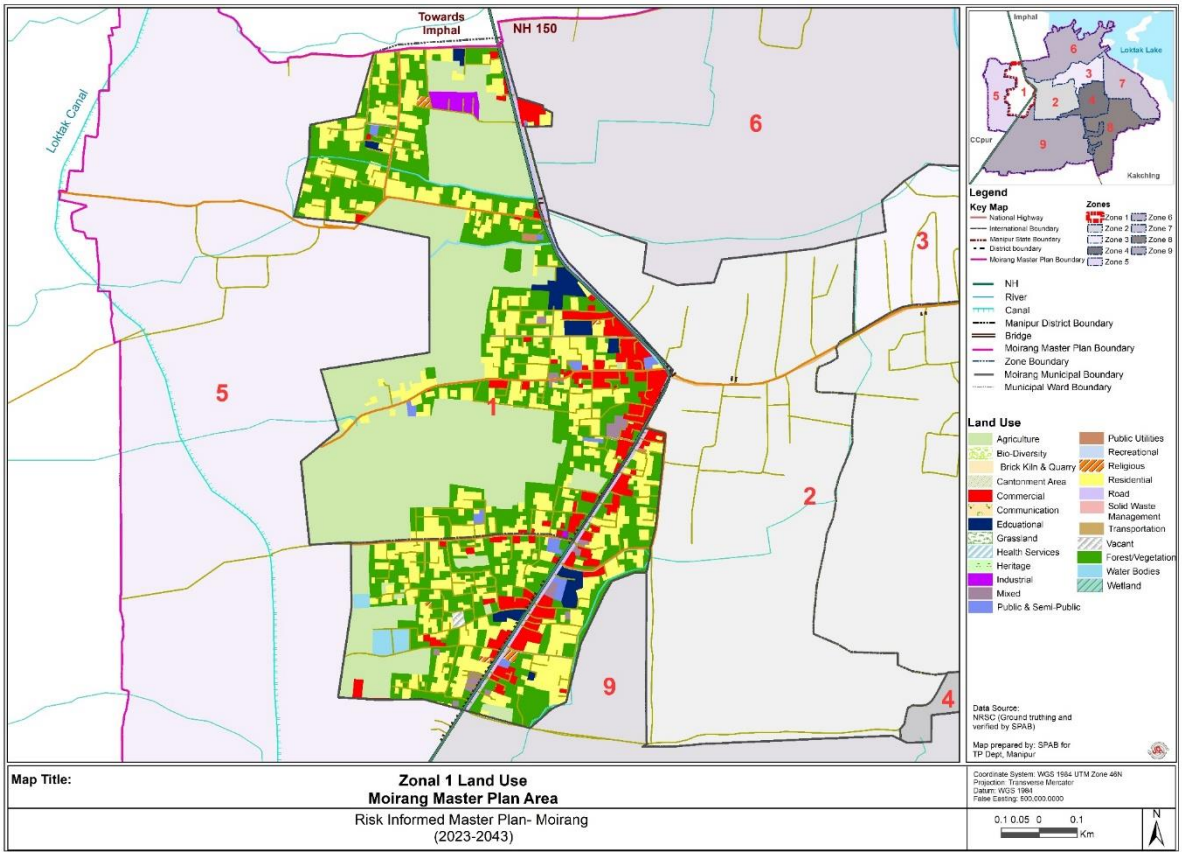


Source: Author

7.2.1. Zone 1 Land Use

The table presents the land use distribution in Zone 1 of Moirang. In this area, agriculture dominates with 41.43%, reflecting the significance of agricultural activities. Commercial spaces make up 6.82%, indicating areas designated for businesses. Educational spaces are at 1.99%, highlighting the presence of schools or educational institutions. Industrial zones cover 0.63%, while mixed-use areas, public utilities, religious spaces, and residential areas collectively contribute to the diverse urban landscape. Roads account for 8.53%, facilitating connectivity. There's a small percentage of vacant land, and vegetation covers a substantial 26.66%, showcasing green spaces. Water bodies contribute 1.71%, adding to the natural features of Zone 1 in Moirang. This breakdown offers insights into how the land is utilized, reflecting the varied activities and purposes within this specific zone.

Map 7.2-2: Zone 1 land use



Source: Author

Table 7.2-2: Zone 1 land use

Land Use Classification	Area (Ha)	Area (%)
Agriculture	41.43	36.50
Commercial	6.82	6.00
Educational	1.99	1.76
Industrial	0.63	0.55
Mixed	0.77	0.68
PSPs	0.83	0.73
Public Utilities	0.10	0.09
Religious	0.28	0.25
Residential	23.66	20.84
Roads	8.53	7.51
Vacant	0.12	0.10
Vegetation	26.66	23.48
Water Bodies	1.71	1.50
Total	113.53	

Source: Author

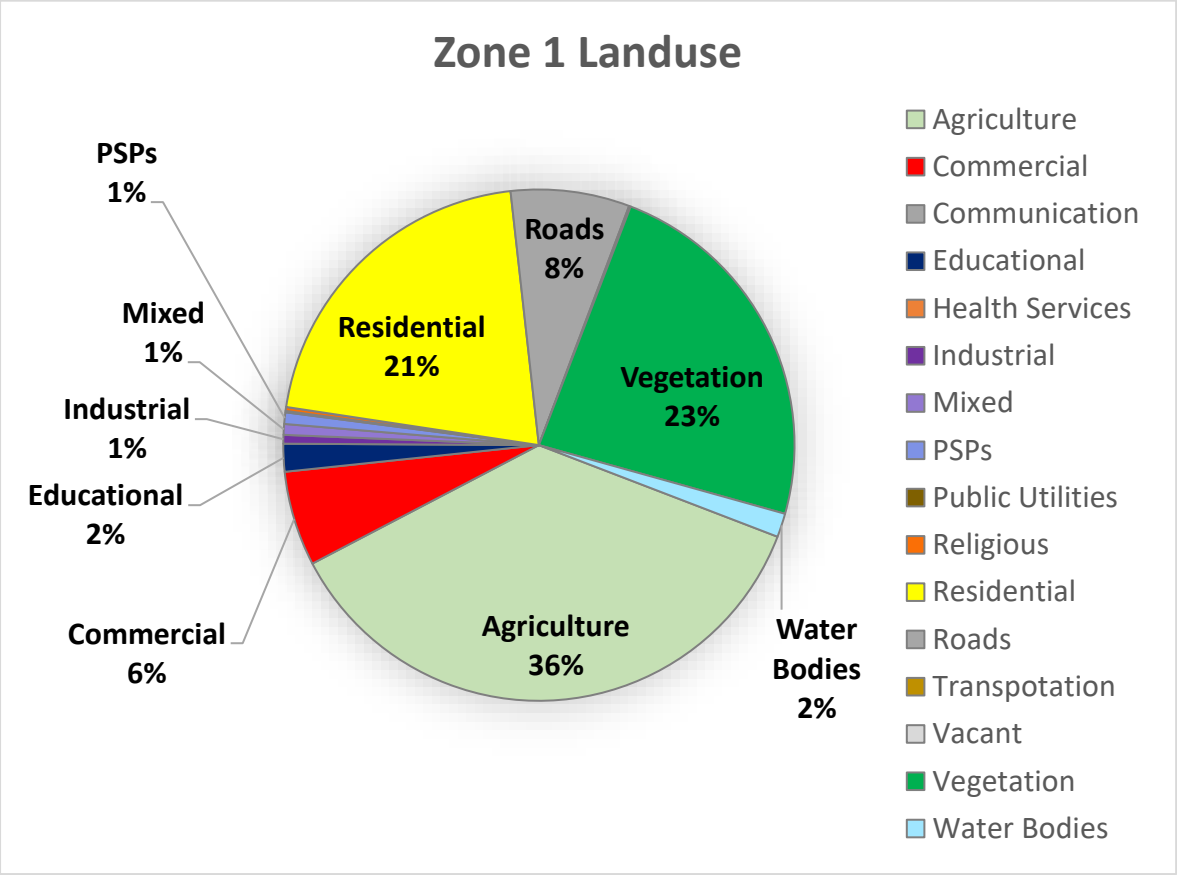


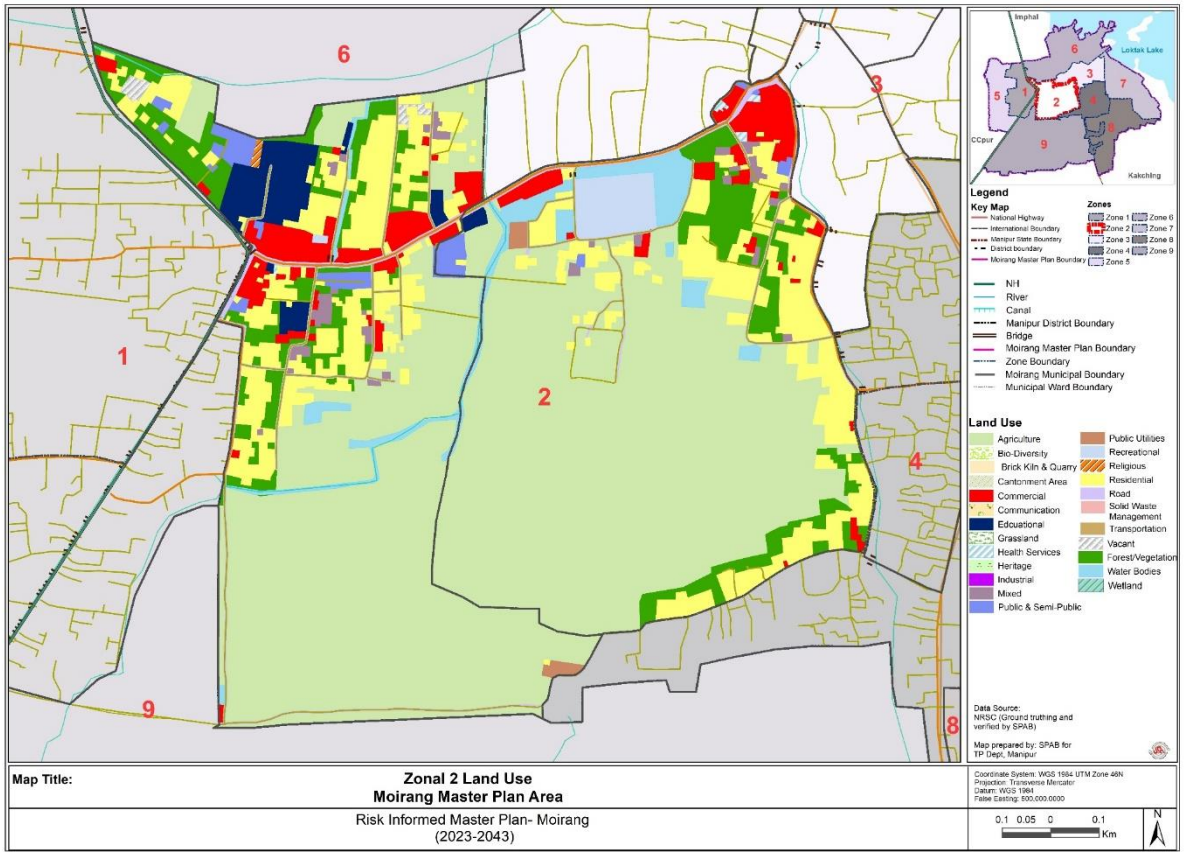
Figure 7.2-1: Zone 1 land use distribution

Source: Author

7.2.2. Zone 2 Land Use

Zone 2 of Moirang town exhibits diverse land uses, with agriculture dominating the landscape at 59.86%, emphasizing its agrarian character. Residential areas cover a significant portion at 14.87%, indicating a substantial population presence. Commercial spaces contribute 4.42%, suggesting economic activity, while educational and health services make up 2.26% and 0.08%, respectively. Recreational spaces and mixed-use areas add vibrancy to the zone, constituting 1.42% and 0.87%, respectively. Public Service Providers (PSPs) account for 1.27%, reflecting public infrastructure. The presence of roads at 3.80% emphasizes the importance of transportation, and water bodies and vegetation contribute 2.97% and 7.59%, respectively, enhancing the environmental appeal.

Map 7.2-3: Zone 2 land use



Source: Author

Table 7.2-3: Zone 2 land use

Land Use Classification	Area (Ha)	Area (%)
Agriculture	87.07	59.86
Commercial	6.43	4.42
Educational	3.28	2.26
Health Services	0.12	0.08
Mixed	1.27	0.87
PSPs	1.85	1.27
Public Utilities	0.42	0.29
Recreational	2.06	1.42
Religious	0.09	0.06

Residential	21.63	14.87
Roads	5.53	3.80
Vacant	0.34	0.23
Vegetation	11.04	7.59
Water Bodies	4.32	2.97
Total	**145.45**	

Source: Author

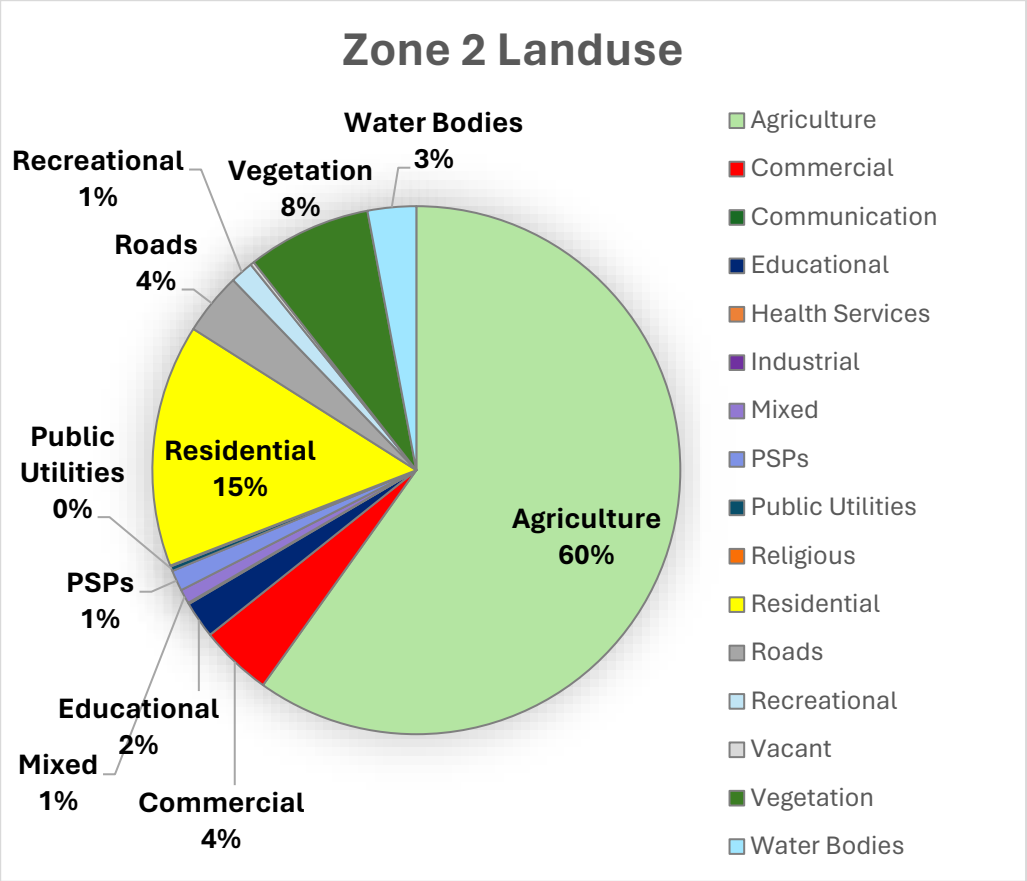


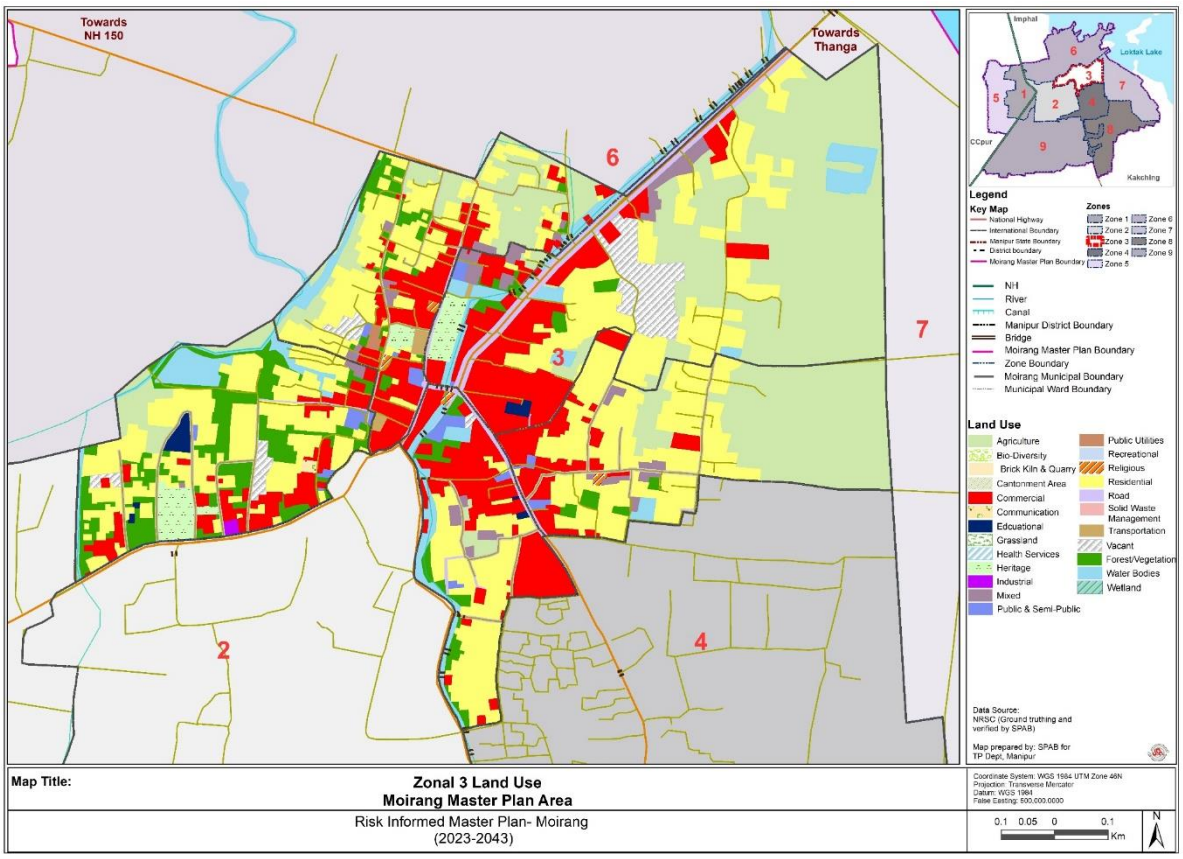
Figure 7.2-2: Zone 2 land use distribution

Source: Author

7.2.3. Zone 3 Land Use

Zone 3 of Moirang Town exhibits a diverse land use pattern, with a total area of 93.49%. The predominant land use in this zone is agriculture, covering 29.84% of the area, highlighting the importance of this sector in the local economy. Residential areas constitute a significant portion at 29.10%, reflecting the presence of a substantial population in this zone. The town also emphasizes commercial activities, with 15.57% of the land designated for commercial purposes, showcasing economic development and urbanization. Other notable land uses include vegetation at 6.15%, emphasizing a commitment to green spaces, and roads at 6.81%, indicative of a well-connected and accessible infrastructure. Additionally, the presence of heritage and educational areas at 1.57% and 0.44%, respectively, underscores the cultural and educational aspects of Zone 3.

Map 7.2-4: Zone 3 land use



Source: Author

Table 7.2-4: Zone 3 land use

Land Use Classification	Area (Ha)	Area (%)
Agriculture	27.9	29.84
Commercial	14.56	15.57
Communication	0.06	0.06
Educational	0.41	0.44
Heritage	1.47	1.57
Industrial	0.07	0.07
Mixed	1.71	1.83
PSPs	0.81	0.87
Public Utilities	0.09	0.10
Religious	0.17	0.18
Residential	27.21	29.10
Roads	6.37	6.81
Transportation	0.21	0.22
Vacant	2.43	2.60
Vegetation	5.75	6.15
Water Bodies	4.27	4.57
Total	**93.49**	

Source: Author

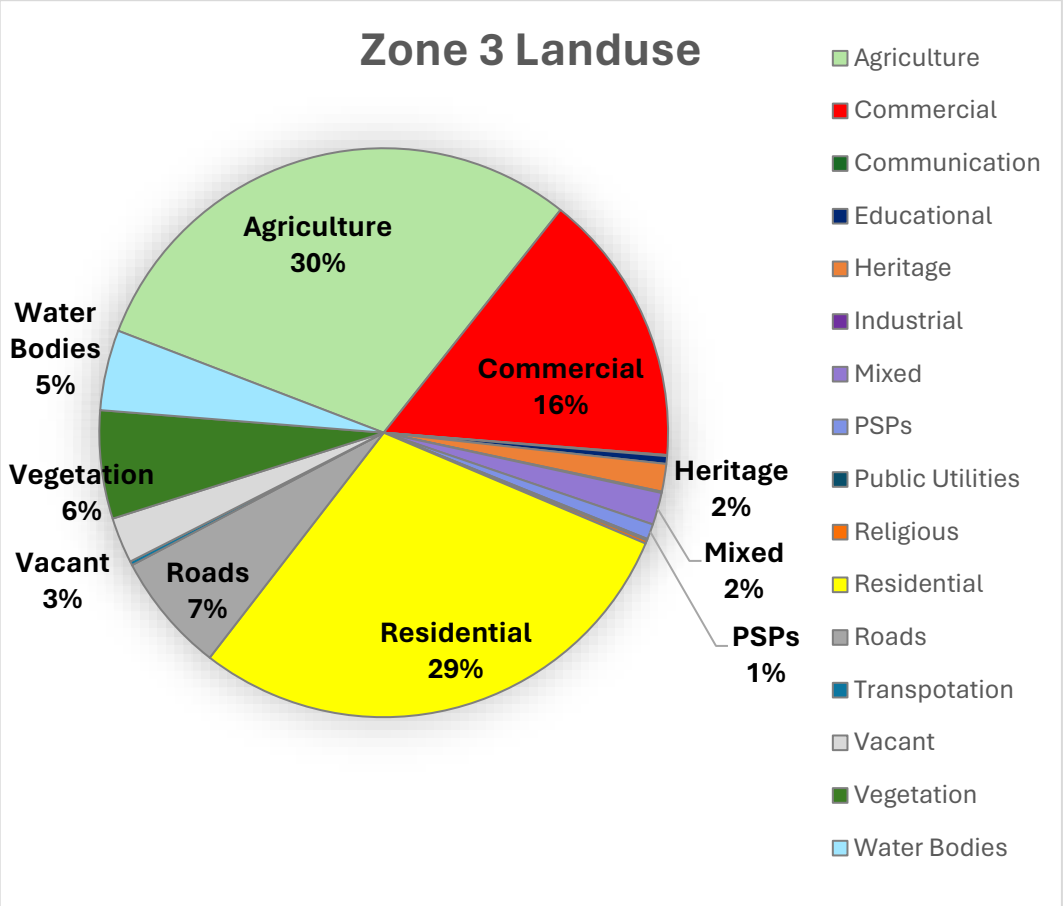


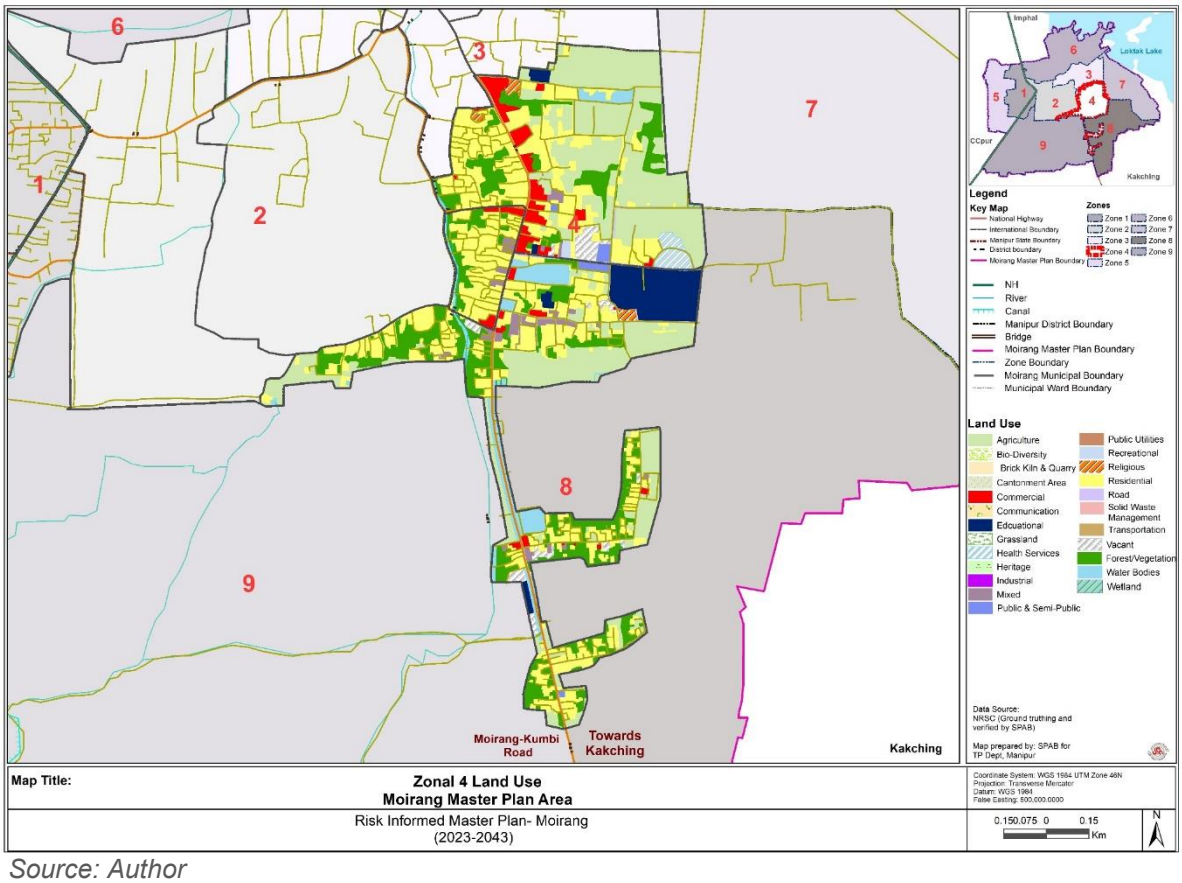
Figure 7.2-3: Zone 3 land use distribution

Source: Author

7.2.4. Zone 4 Land Use

The land-use distribution in Zone 4 of Moirang town reveals a diverse landscape, encompassing various sectors that contribute to the overall development and functionality of the area. Residential areas dominate the zone, constituting 27.21% of the total land, providing living spaces for the local population. Agriculture plays a significant role, covering 30.05% of the land, highlighting the importance of the agrarian sector in sustaining the community. The presence of commercial spaces at 3.21% reflects a small yet vital aspect of economic activities within the zone. Educational and health services collectively occupy 4.99% and 0.89%, respectively, emphasizing the provision of essential facilities for the well-being and education of the residents. The inclusion of mixed, PSPs, recreational, religious, and vacant spaces demonstrate a thoughtful urban planning approach, catering to various community needs. Additionally, the presence of vegetation at 15.34% contributes to the environmental balance, while water bodies and wetlands at 3.99% and 0.06% contribute to the ecological diversity of the zone. Finally, the allocation of 9.93% for roads indicates a well-connected infrastructure, facilitating smooth mobility within the zone. Overall, the land-use distribution in Zone 4 showcases a harmonious blend of residential, agricultural, commercial, and public spaces, reflecting a comprehensive and sustainable urban planning strategy in Moirang town.

Map 7.2-5: Zone 4 land use



Source: Author

Table 7.2-5: Zone 4 land use

Land Use Classification	Area (Ha)	Area (%)
Agriculture	37.1	30.05
Commercial	3.96	3.21
Educational	6.16	4.99
Health Services	1.1	0.89
Mixed	1.86	1.51
PSPs	0.69	0.56
Recreational	0.19	0.15
Religious	0.59	0.48
Residential	33.59	27.21
Roads	12.26	9.93
Vacant	2.02	1.64
Vegetation	18.94	15.34
Water Bodies	4.92	3.99
Wetland	0.07	0.06
Total	**123.45**	

Source: Author

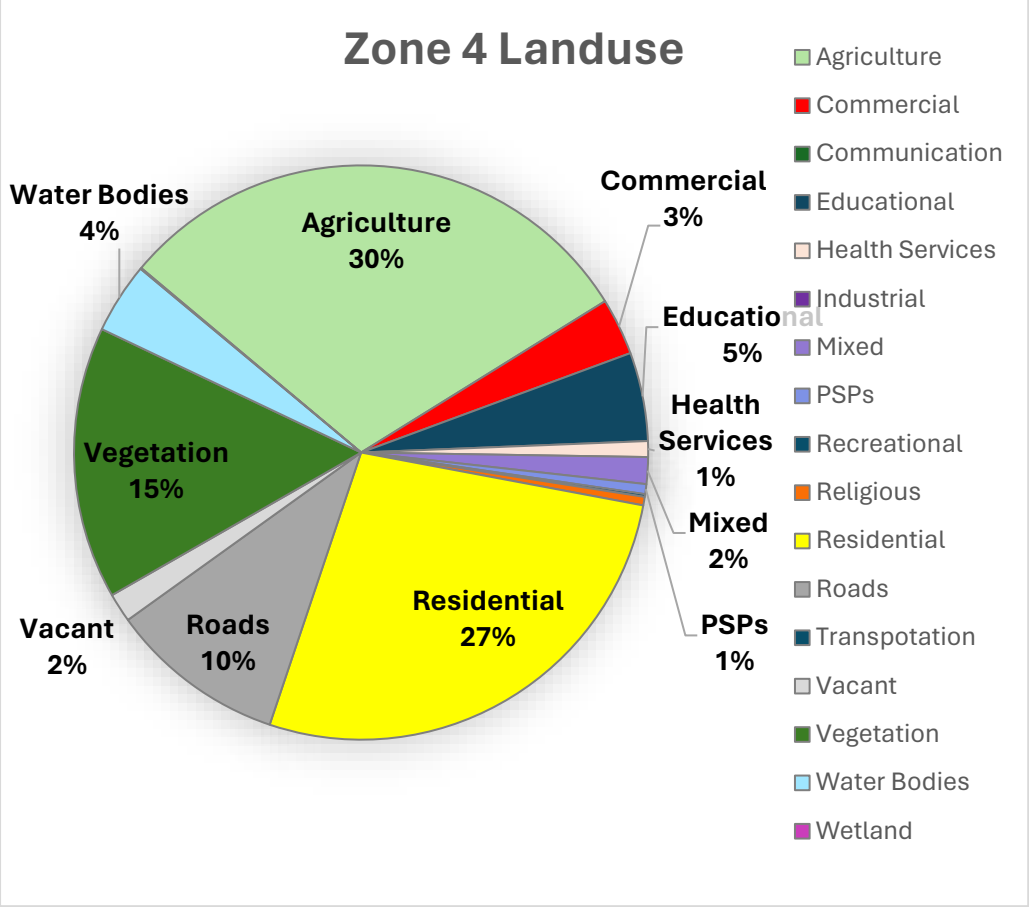


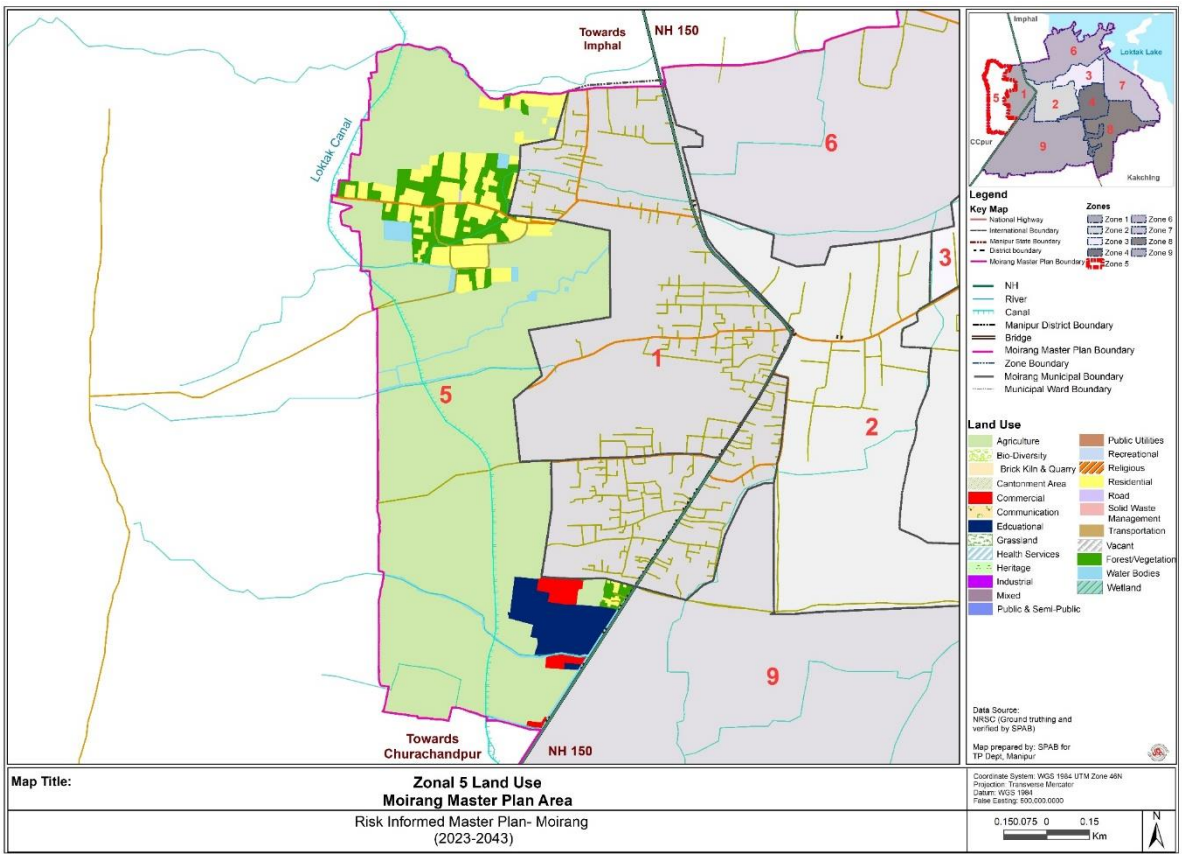
Figure 7.2-4: Zone 4 land use distribution

Source: Author

7.2.5. Zone 5 Land Use

The land-use distribution in Zone 5 of Moirang Town exhibits a diverse pattern reflecting the multifaceted needs and activities within the area. With a predominant focus on agriculture, constituting 78.74% of the total land area, Zone 5 sustains a significant agrarian presence. This underscores the agricultural importance of the region, likely supporting local livelihoods and contributing to the town's food security. Additionally, residential areas occupy 7.79% of the land, indicating a substantial residential presence and suggesting a balanced mix of urban and rural elements within the zone. Educational spaces cover 3.89%, highlighting the town's commitment to educational infrastructure and fostering a learning environment. Commercial zones, comprising 1.19%, suggest modest commercial activities contributing to the economic vitality of Zone 5.

Map 7.2-6: Zone 5 land use



Source: Author

Table 7.2-6: Zone 5 land use

Land Use Classification	Area (Ha)	Area (%)
Agriculture	117.93	78.74
Commercial	1.78	1.19
Educational	5.83	3.89
Residential	11.67	7.79
Roads	1.95	1.30
Vegetation	7.75	5.17
Water Bodies	2.87	1.92

	Total	**149.78**

Source: Author

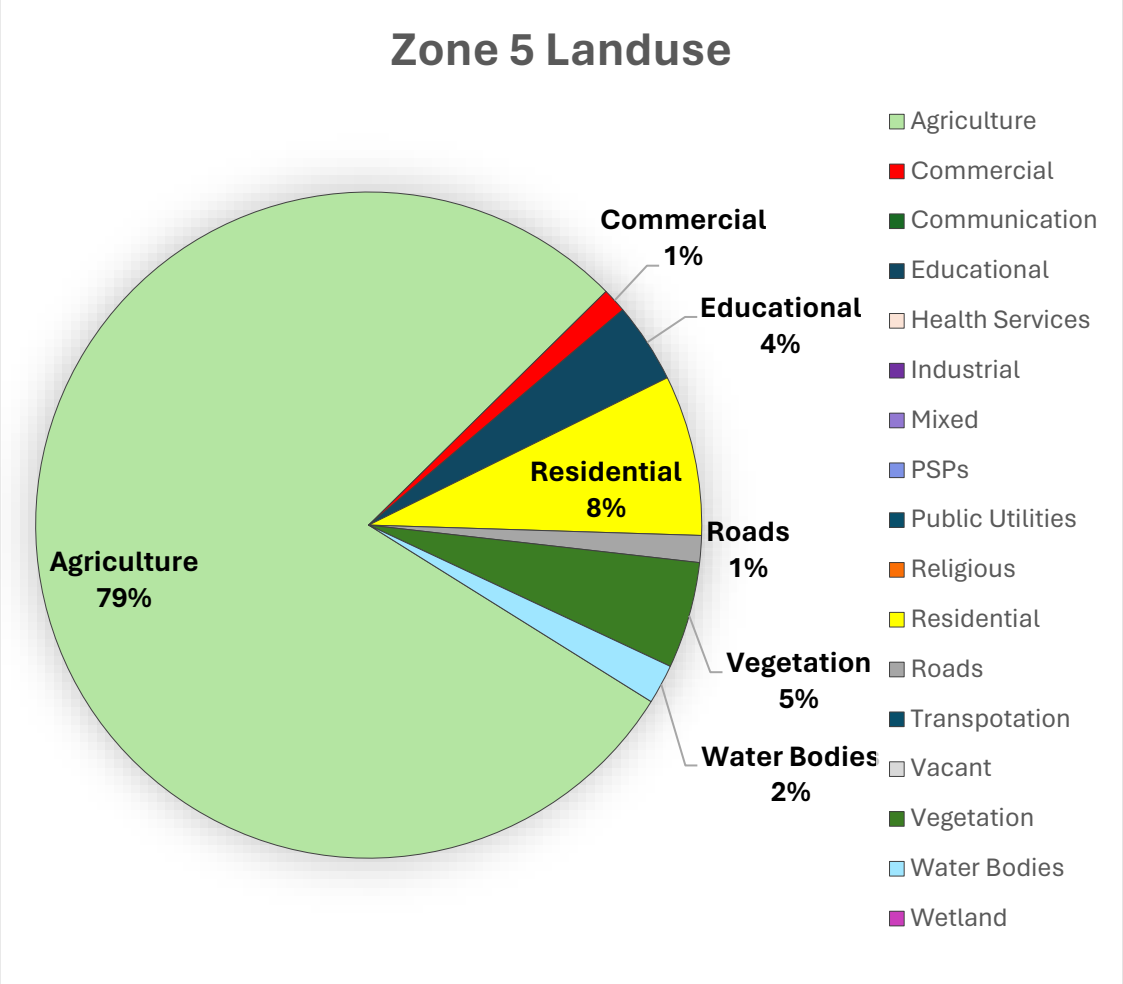


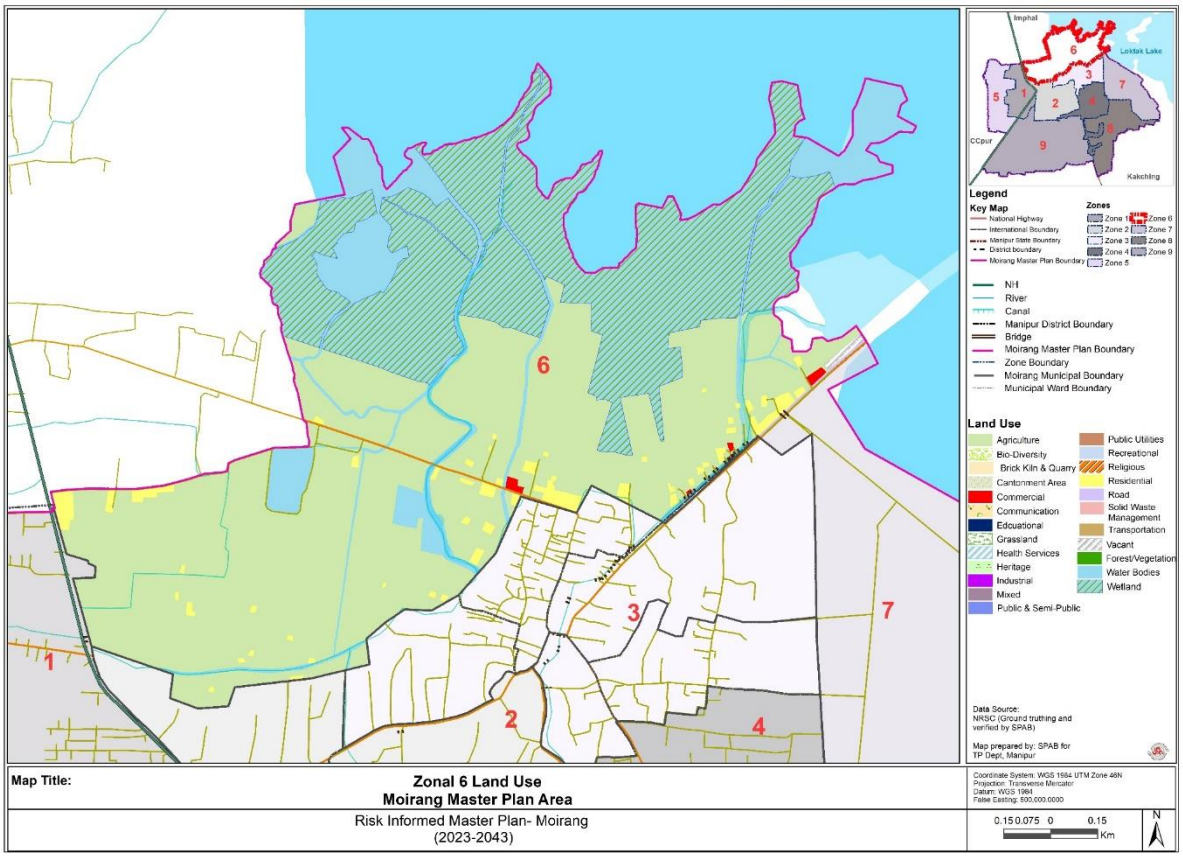
Figure 7.2-5: Zone 5 land use Distribution

Source: Author

7.2.6. Zone 6 Land Use

In Zone 6 of Moirang town, the land use distribution reflects a diverse landscape catering to various needs and functions. Agriculture dominates the area, covering a substantial 54.06% of the zone, indicative of the region's focus on farming and cultivation activities. Commercial spaces occupy a minimal 0.18%, suggesting a limited presence of business and trade within this particular zone. Residential areas account for 2.08%, signifying a modest but integral portion designated for housing and community development. Roads cover 0.65%, emphasizing the importance of infrastructure for connectivity and accessibility. Vacant lands, at 0.15%, represent potential areas for future development or open spaces. Vegetation, though minimal at 0.00%, adds a touch of greenery to the landscape. Water bodies encompass a significant 10.68%, highlighting the presence of lakes or ponds, contributing to the aesthetic and ecological aspects of Zone 6.

Map 7.2-7: Zone 6 land use



Source: Author

Table 7.2-7: Zone 6 land use

Land Use Classification	Area (Ha)	Area (%)
Agriculture	133.47	54.0627
Commercial	0.44	0.178224
Residential	5.14	2.081983
Roads	1.61	0.652139
Vacant	0.36	0.14582

Vegetation	0.01	0.004051
Water Bodies	26.36	10.67725
Wetland	79.49	32.19783
	Total	**246.88**

Source: Author

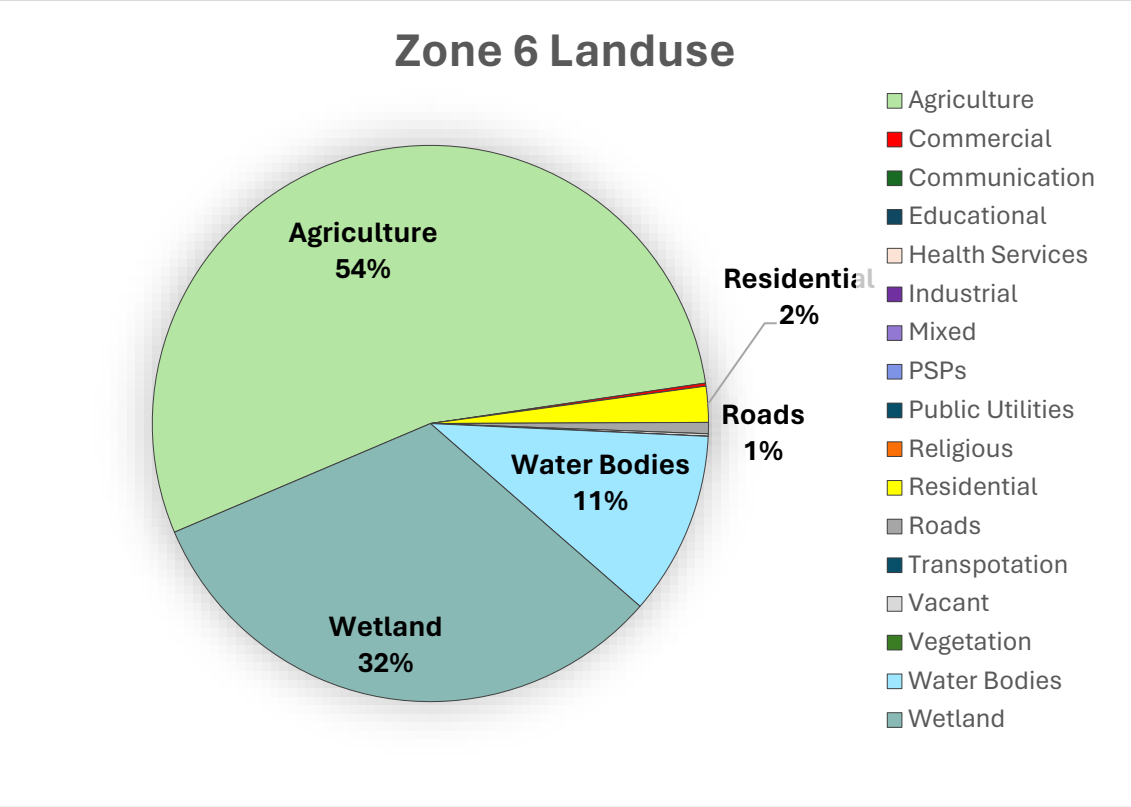


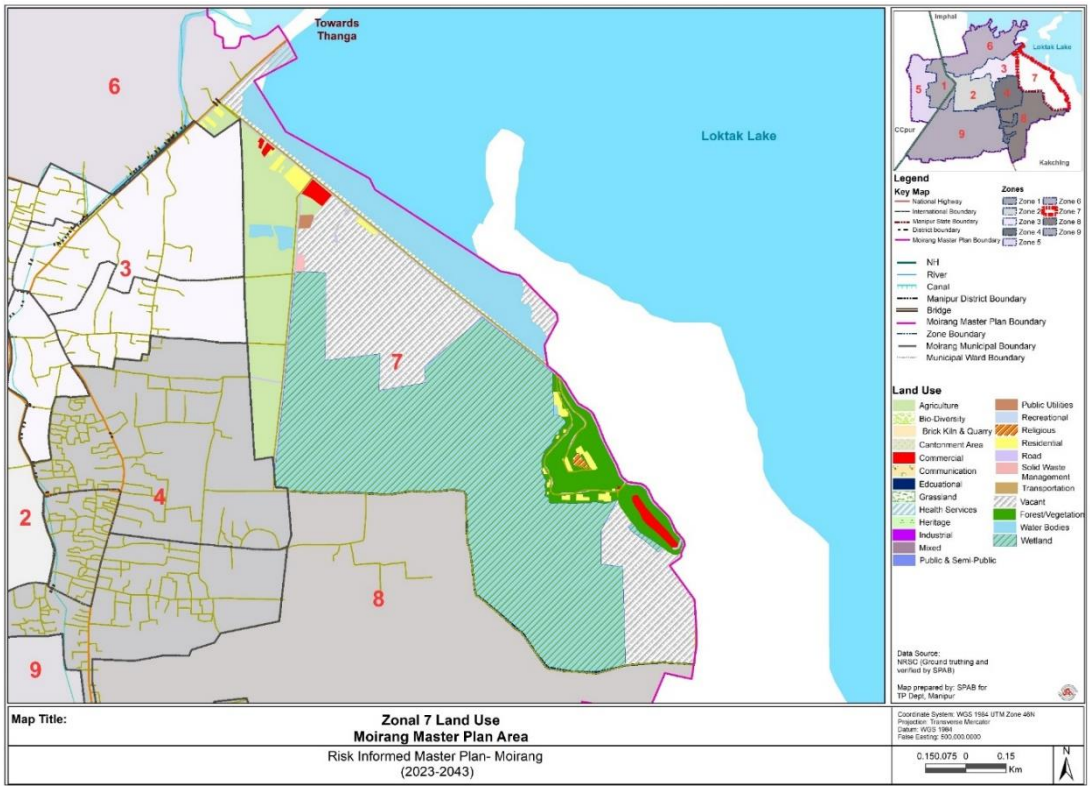
Figure 7.2-6: Zone 6 land use distribution

Source: Author

7.2.7. Zone 7 Land Use

Zone 7 of Moirang Town showcases a diverse landscape characterized by various land-use categories, each contributing uniquely to the town's overall composition. The predominant feature is the extensive wetland, covering a substantial 85.96% of the area, emphasizing the community's commitment to preserving essential ecosystems. Following closely is the sizable vacant land at 42.16%, suggesting opportunities for future development or the establishment of green spaces. Agriculture plays a significant role, occupying 18.45% of the zone, highlighting the importance of farming activities in this region. Water bodies, comprising 16.86%, contribute to the scenic beauty and environmental richness. Infrastructure is also well-distributed, with roads covering 3.76% of the area, ensuring efficient connectivity within the zone. The landscape is adorned with vegetation at 8.83%, further enhancing the natural aesthetic. Residential and commercial sectors make up 2.23% and 1.52% respectively.

Map 7.2-8: Zone 7 land use



Source: Author

Table 7.2-8: Zone 7 land use

Land Use Classification	Area (Ha)	Area (%)
Agriculture	18.45	10.22614
Commercial	1.52	0.842479
Public Utilities	0.25	0.138566
Religious	0.2	0.110852
Residential	2.23	1.236005
Roads	3.76	2.084026
SWM	0.2	0.110852
Vacant	42.16	23.3677
Vegetation	8.83	4.894136
Water Bodies	16.86	9.344862
Wetland	85.96	47.64439
Total	**180.42**	

Source: Author

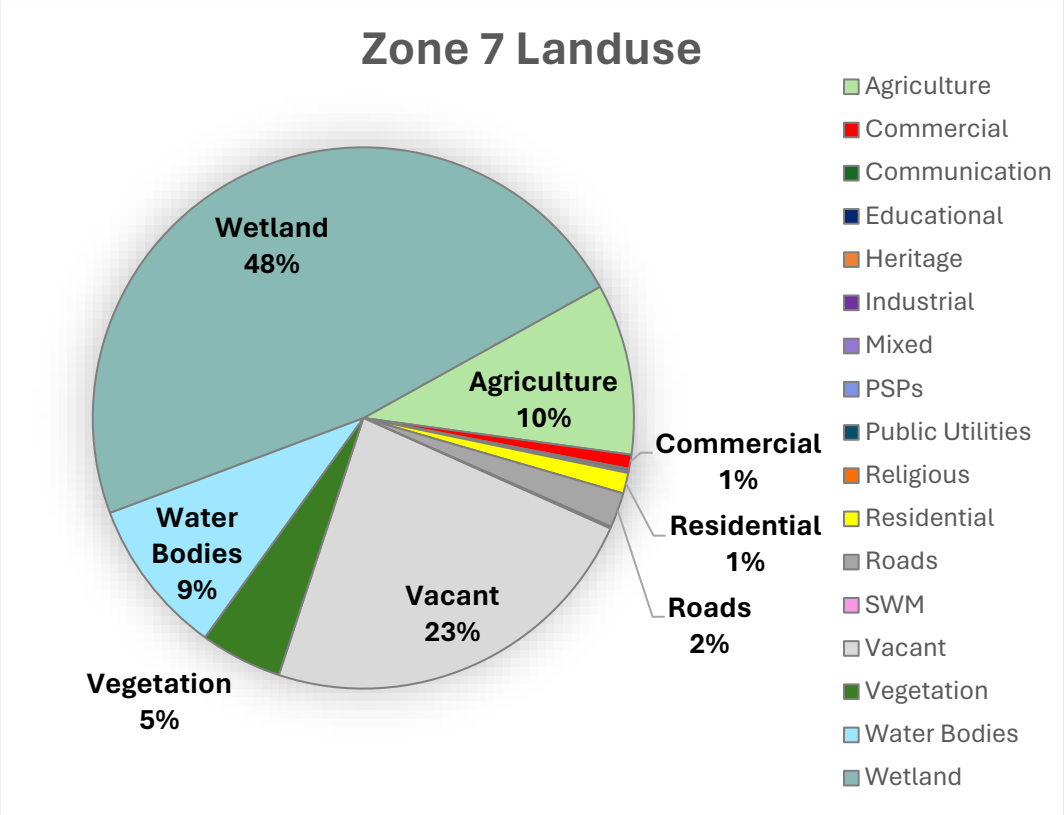


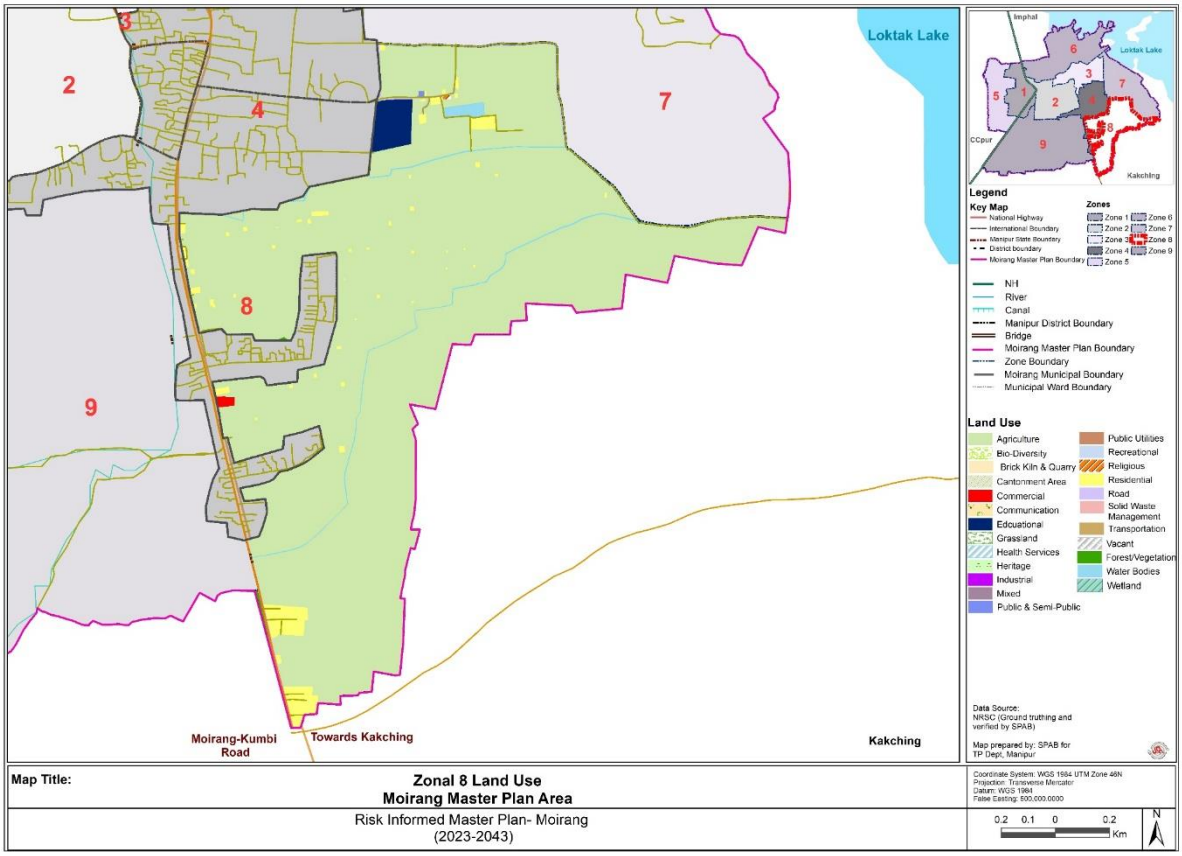
Figure 7.2-7: Zone 7 land use distribution

Source: Author

7.2.8. Zone 8 Land Use

In Zone 8 of Moirang town, the predominant land use is agriculture, covering 94.44% of the area, totalling 187.21 Ha. This substantial allocation emphasizes the zone's primary role in supporting local agricultural activities. Commercial space is minimal, accounting for only 0.12%, indicating a limited presence of commercial establishments. Educational facilities claim 1.24%, reflecting a modest yet intentional allocation for learning spaces within the community. Public service points (PSPs) and religious spaces collectively make up 0.02% and 0.03%, respectively, underscoring the zone's commitment to civic amenities and cultural considerations. Residential areas cover 2.33%, suggesting a significant portion of the zone is designated for housing the local population. Infrastructure development is evident with 1.06% dedicated to roads, emphasizing the importance of connectivity. The presence of vacant land (0.01%), vegetation (0.13%), and water bodies (0.63%) indicates a conscientious effort to preserve natural elements within the urban fabric.

Map 7.2-9: Zone 8 land use



Source: Author

Table 7.2-9: Zone 8 land use

Land Use Classification	Area (Ha)	Area (%)
Agriculture	187.21	94.44
Commercial	0.24	0.12
Educational	2.46	1.24
PSPs	0.04	0.02
Religious	0.05	0.03
Residential	4.61	2.33
Roads	2.1	1.06
Vacant	0.02	0.01
Vegetation	0.26	0.13
Water Bodies	1.25	0.63
Total	**198.24**	

Source: Author

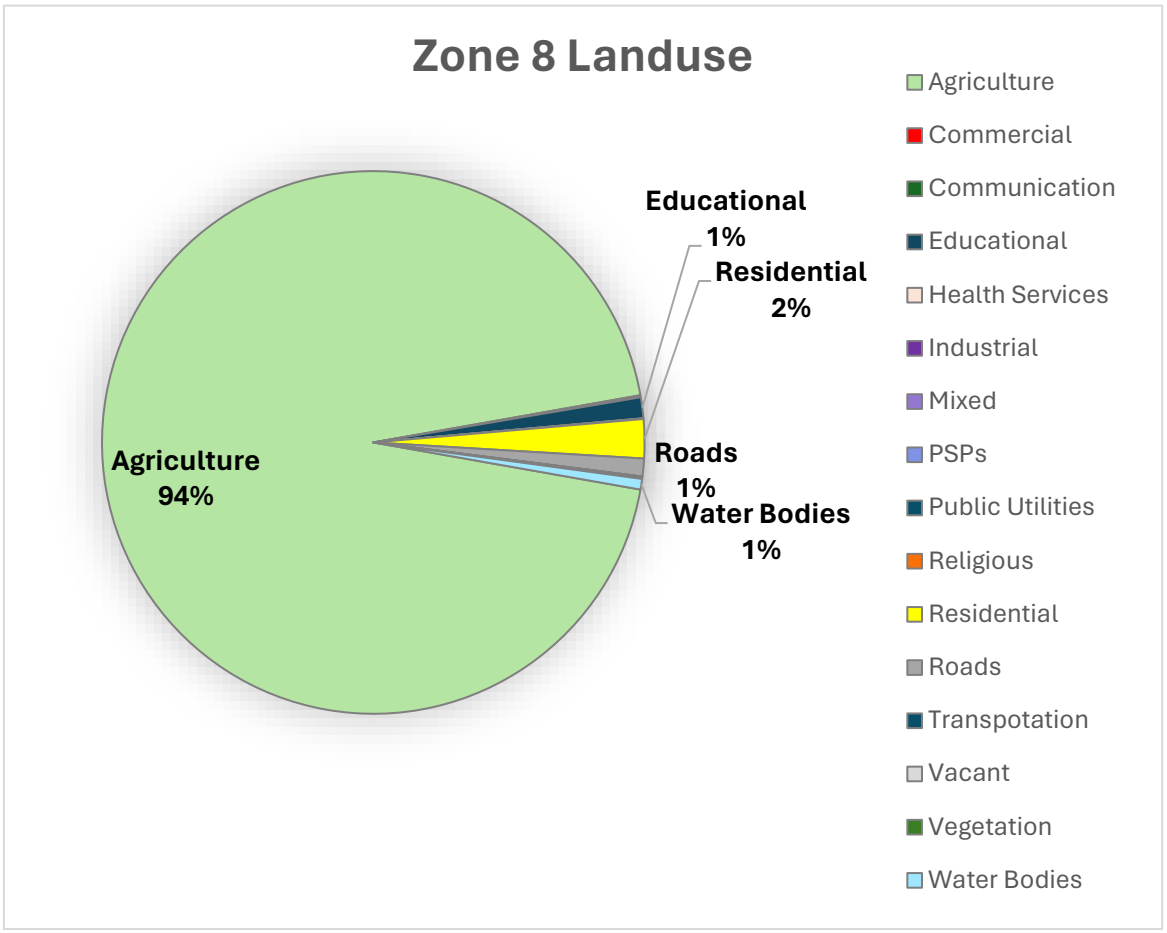


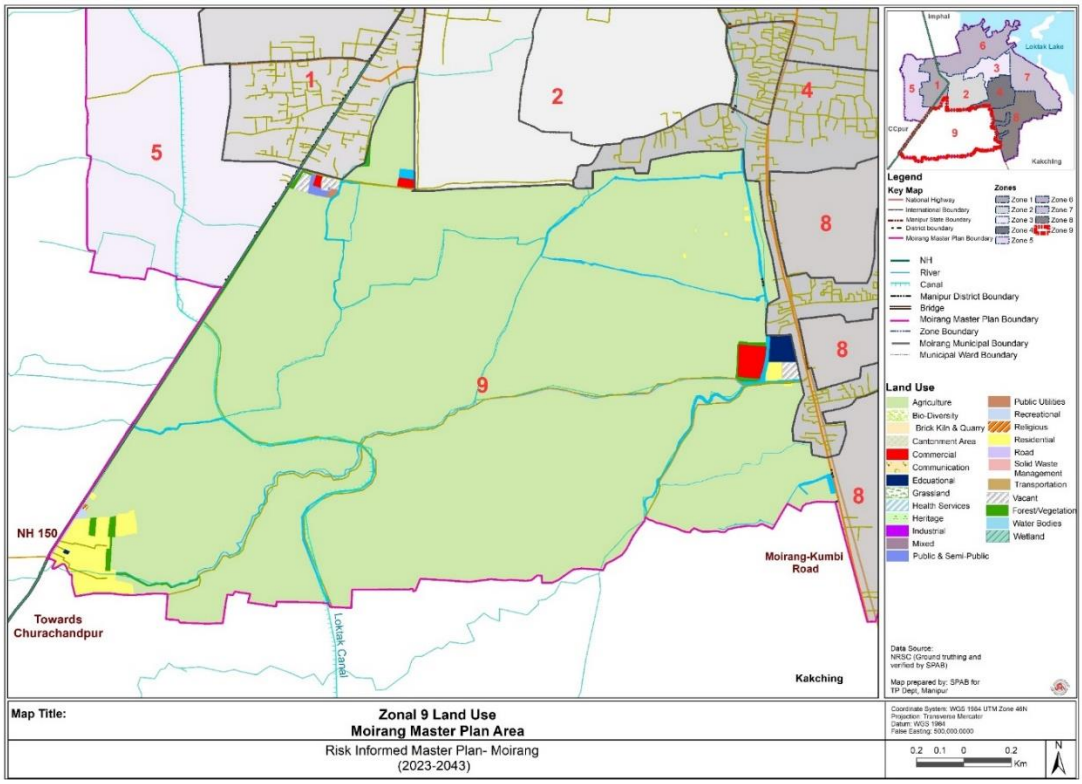
Figure 7.2-8: Zone 8 land use distribution

Source: Author

7.2.9. Zone 9 Land Use

Zone 9 in Moirang town is predominantly agriculture with 94.19%, covering an extensive area of 426.26 Ha. This significant allocation underscores the zone's pivotal role in supporting local agricultural farmers. Commercial spaces are limited, accounting for only 0.43%, indicating a restrained presence of business establishments. Educational facilities, at 0.27%, and public utilities, at 0.03%, contribute modestly to the overall land use, reflecting a measured approach to community services and learning spaces. The allocation of 0.08% for public service points (PSPs) highlights a commitment to civic amenities. Residential areas cover 1.69%, suggesting a deliberate effort to provide housing for the local population. Infrastructure development is evident with 1.09% dedicated to roads, emphasizing the importance of connectivity within the zone. Additionally, the presence of vacant land (0.27%), vegetation (0.50%), and water bodies (1.40%) reflects a thoughtful approach to preserving natural elements within the urban environment.

Map 7.2-10: Zone 9 land use



Source: Author

Table 7.2-10: Zone 9 land use

Land Use Classification	Area (Ha)	Area (%)
Agriculture	426.26	94.19
Commercial	1.93	0.43
Communication	0	0.00
Educational	1.23	0.27
Health Services	0	0.00
Industrial	0	0.00
Mixed	0	0.00
PSPs	0.38	0.08

Public Utilities	0.12	0.03
Recreational	0.14	0.03
Residential	7.66	1.69
Roads	4.95	1.09
Religious	0.04	0.00
Vacant	1.23	0.27
Vegetation	2.28	0.50
Water Bodies	6.35	1.40
Total	**452.57**	

Source: Author

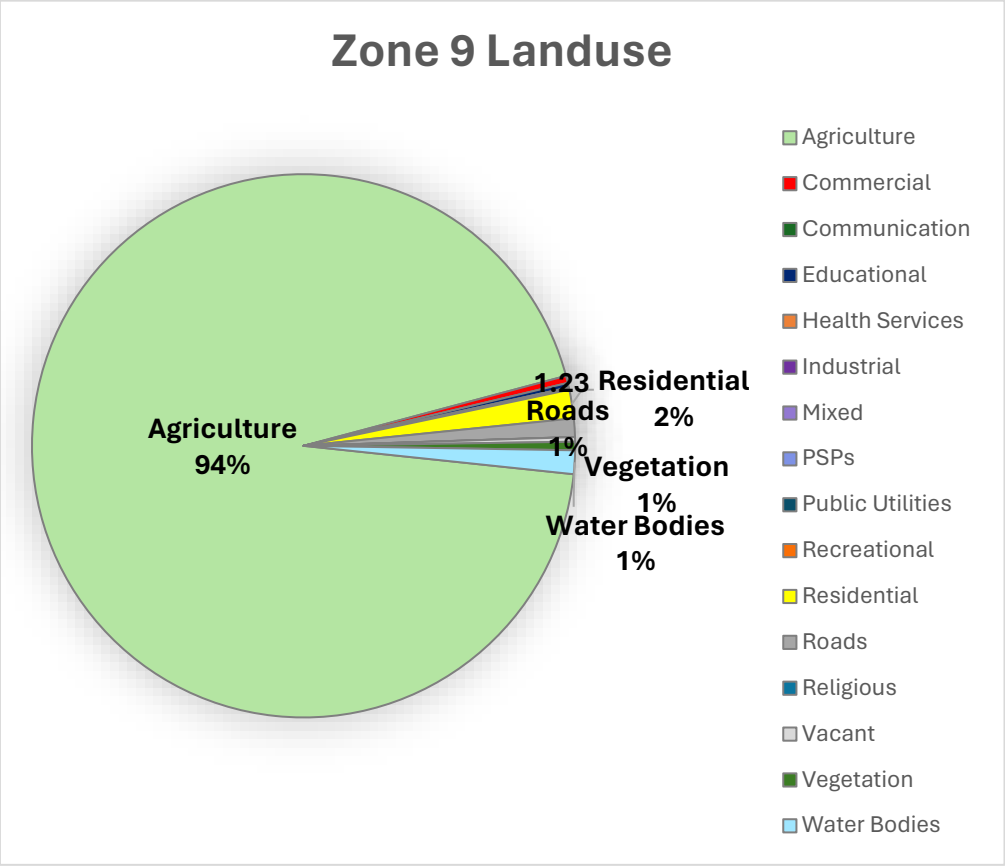


Figure 7.2-9: Zone 9 land use distribution

Source: Author

7.3 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 7.3-1 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 7.3-1 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.

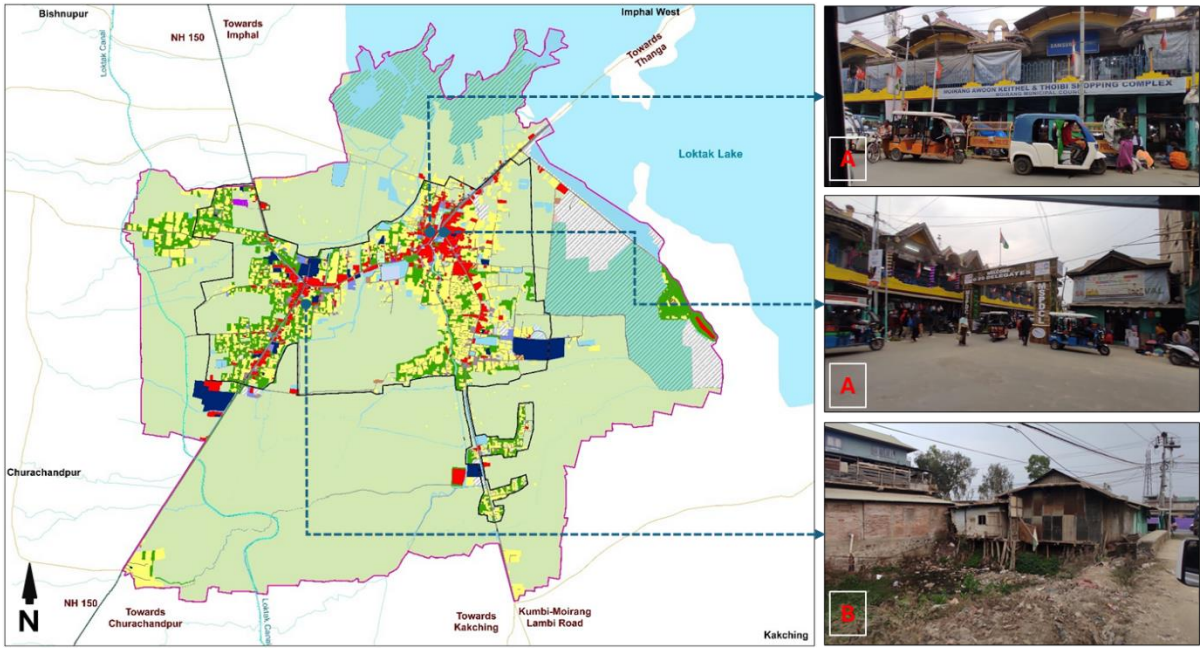


Figure 7.3-1: Location major land use issues
Source: Ground Truthing Survey

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 7.3-1). 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.

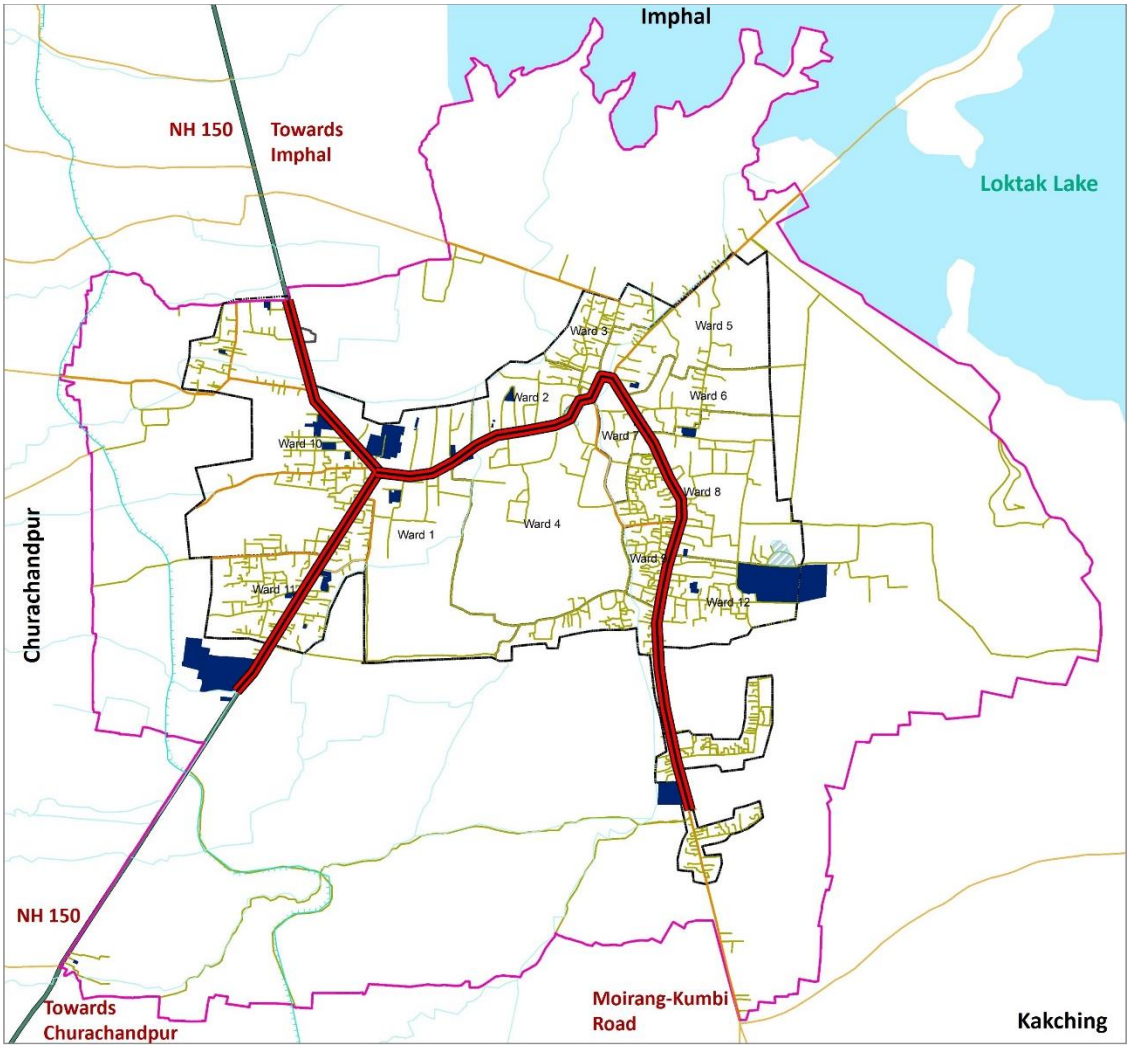


Figure 7.3-2: Single Road connectivity
Source: Ground Truthing Survey and Arc GIS Software

D. Linear development

0The town is spreading in a linear manner as shown in Figure 7.3-3. 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.

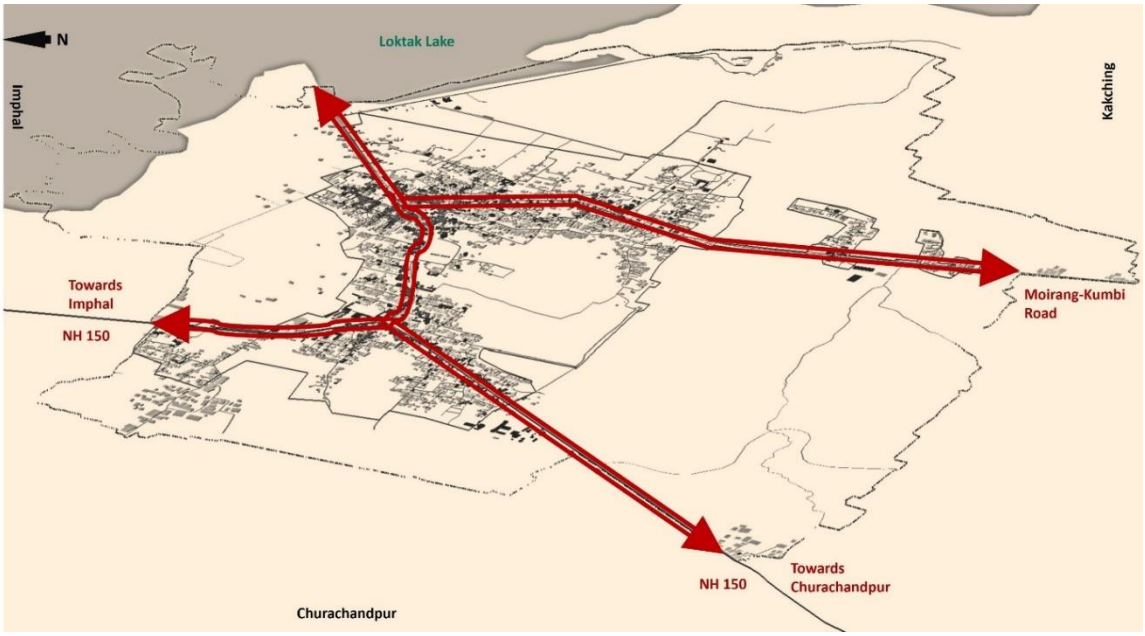


Figure 7.3-3: Linear development
Source: Ground Truthing Survey and Arc GIS Software

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. (Refer Figure 7.3-4)

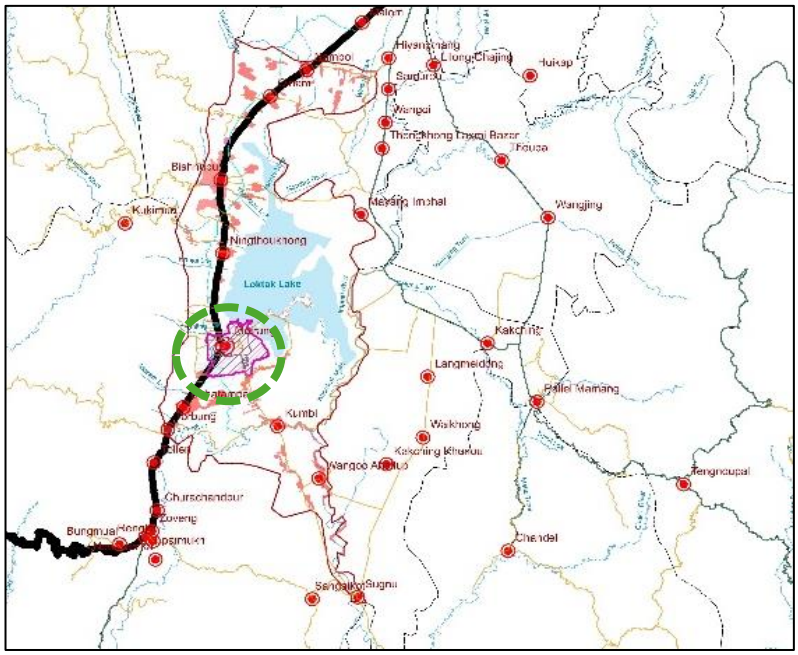


Figure 7.3-4: Heavy through movement due to influence of NH 150
Source: Ground Truthing Survey and Arc GIS Software

E. 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.

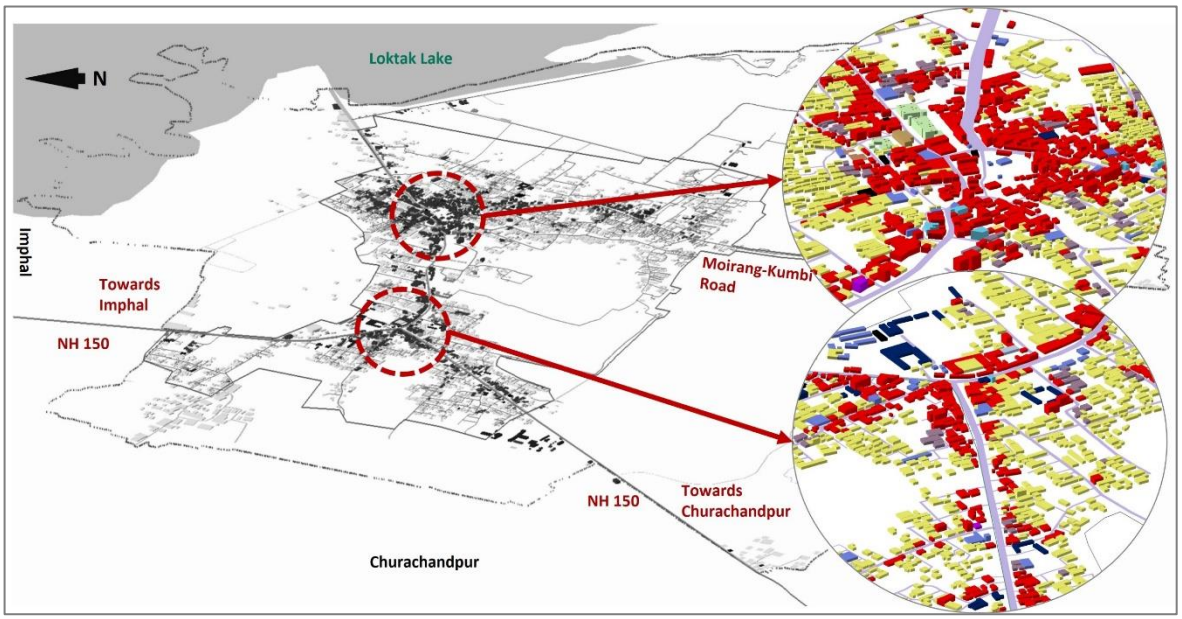


Figure 7.3-5: Building Density

Source: Author

Chapter 8: Building Structure in Planning Area

8.1 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.

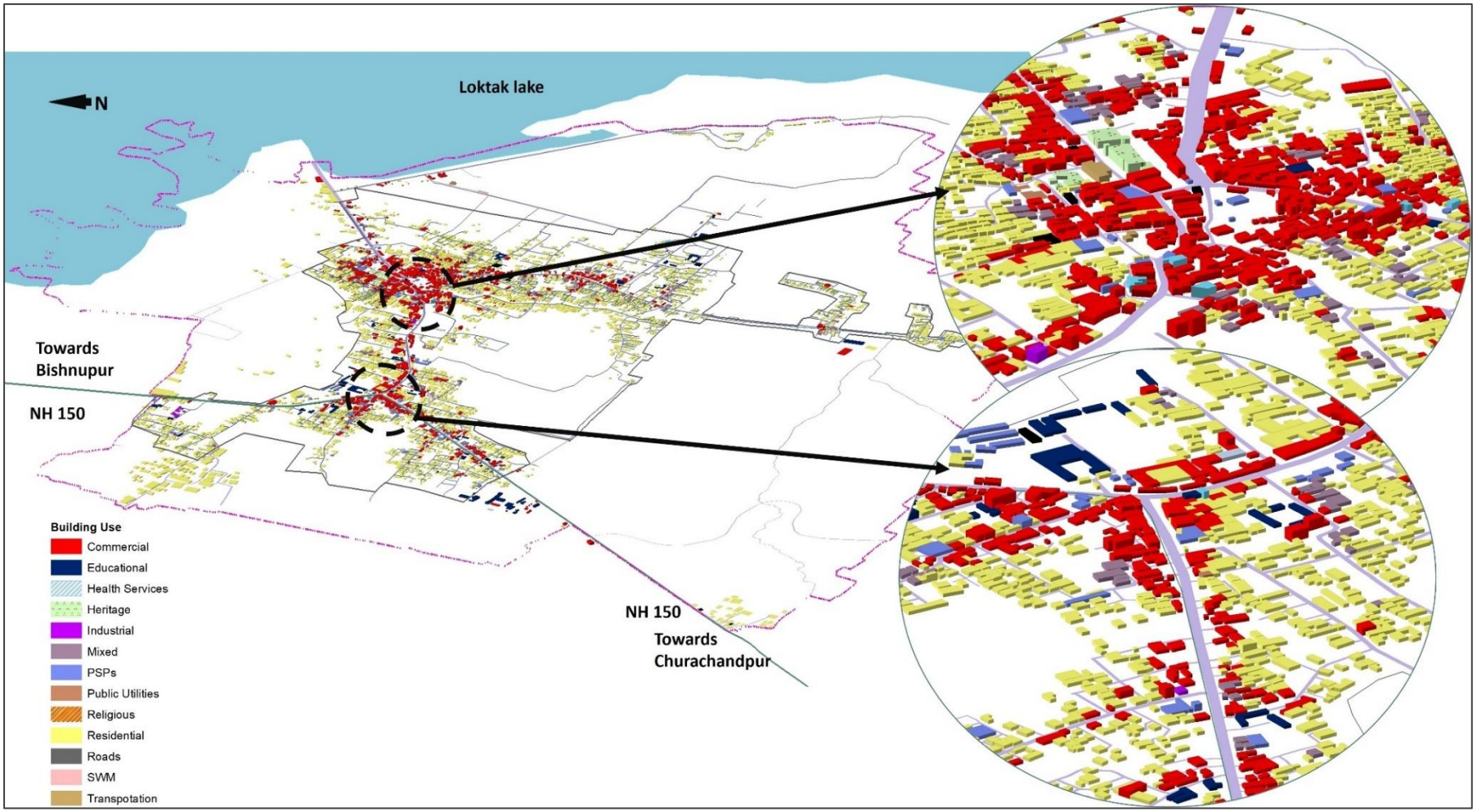
Table 8.1-1: Building Height in Moirang Planning Area

S. No.	Building Height	No. of Buildings	%
1	G	5602	95.68
2	G+1	201	3.43
3	G+2	46	0.79
4	Above G+2	6	0.10
	Total	**5855**	

Source: Ground Truthing Survey

Table 8.1-1 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. (Map 8.1-1)

Map 8.1-1: Building height in Moirang planning area.



Source: Ground truthing Survey and Arc GIS Software

8.2 Building Roof Material

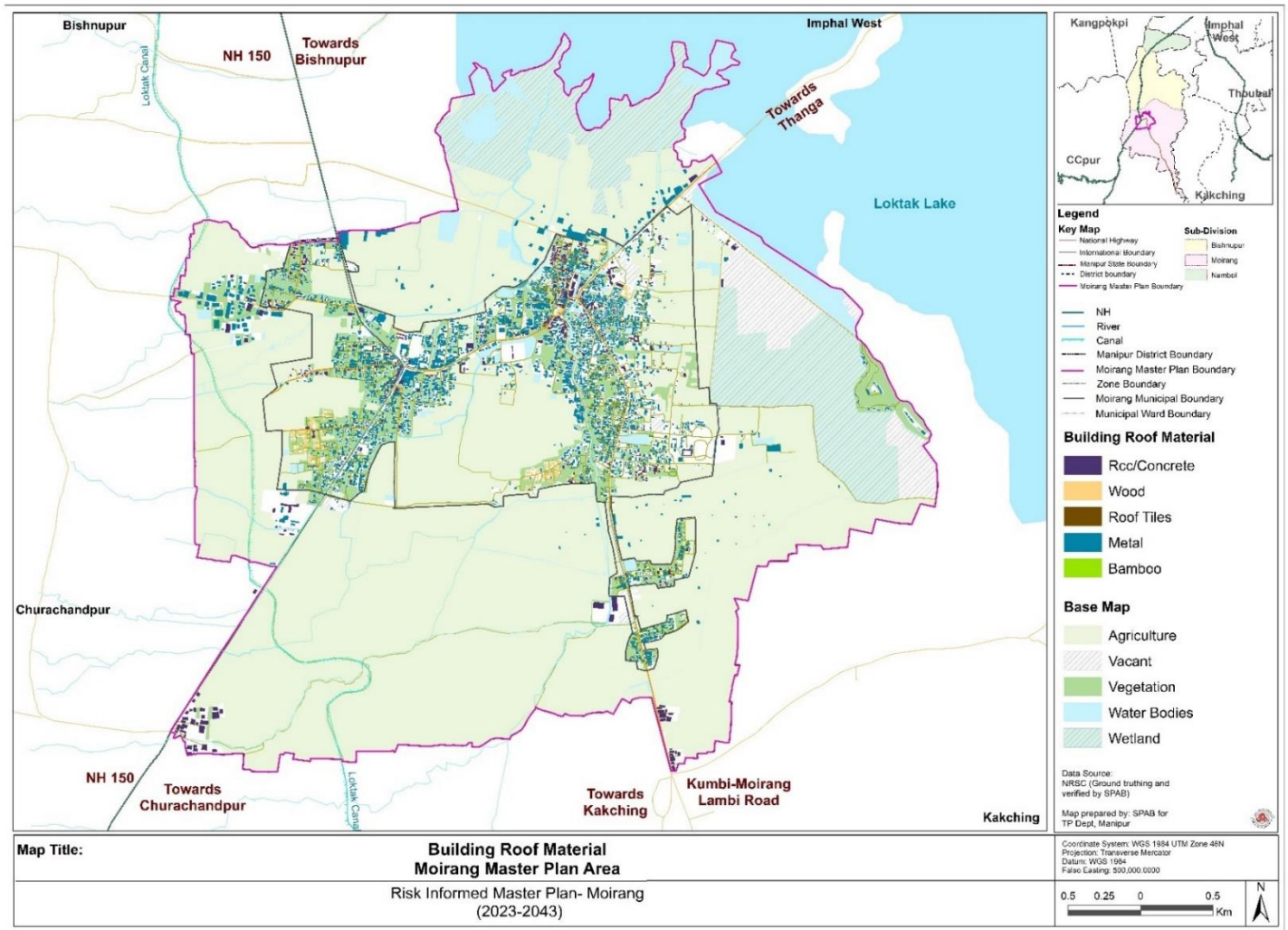
Metal Sheets are the most common material for roofing in Moirang town that are used in more than two third buildings of Moirang planning area. Table 8.2-1 illustrate that, 66.56% of total buildings have metal roofs (coloured metal roofs) and are spread across in the planning boundary. Concrete as building 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 (Refer Map, 8.2-1).

Table 8.2-1: Building Roof Materials in Moirang planning area.

S. No.	Type of Roof material	No. of Buildings	%
1	RCC/Concrete	801	13.27
2	Wood	1213	20.09
3	Roof Tiles	2	0.03
4	Metal	4018	66.56
5	Bamboo	3	0.05
	Total	**6037**	

Source: Ground Truthing Survey

Map 8.2-1: Building Roof Material in Moirang planning area



Source: Ground Truthing Survey and Arc GIS Software

8.3 Building Wall Material

Based on the observations presented in Table 8.3-1, 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. (Map 8.3-1)

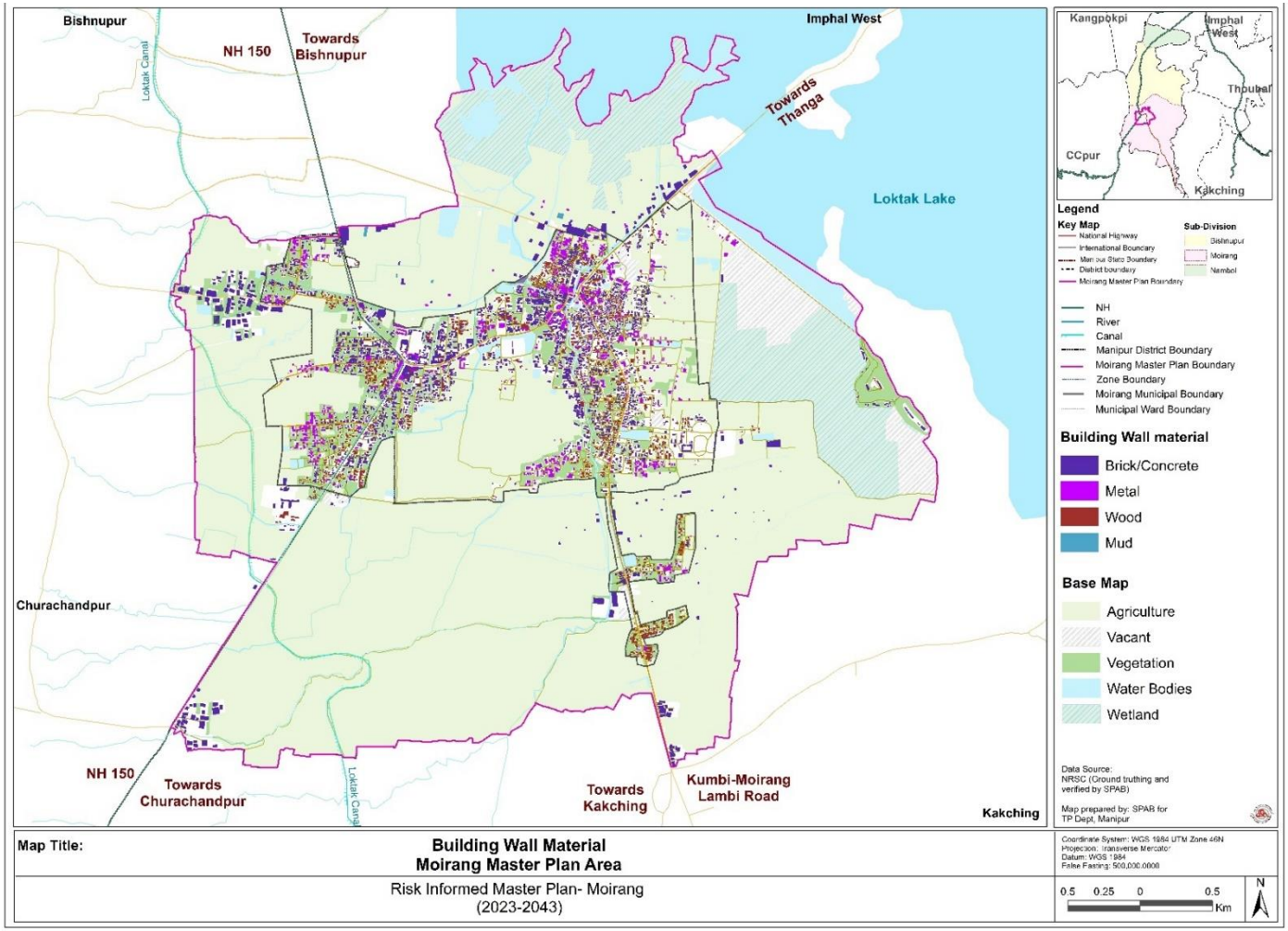
The prominent educational institutes, including the Moirang College and St. Xavier schools are constructed using brick or concrete materials.

Table 8.3-1: Building wall materials in Moirang planning area.

S. No.	Wall material Type	No. of Buildings	%
1	Brick/Concrete	3124	51.75
2	Metal	996	16.50
3	Wood	1913	31.69
4	Mud	4	0.07
	Total	**6037**	

Source: Ground Truthing Survey

Map 8.3-1: Building wall materials in Moirang planning area



Source: Ground Truthing Survey and Arc GIS Software

Chapter 9: Housing

9.1 Existing Situation

Shelter is the most basic need of human being after food and clothing that needs to be addressed on priority. It not only provides shelter to a household but also fulfils all basic utilities and needs of each member of the family. Since Imphal is the most important urban centre in Manipur, the need of the rapidly growing population in Greater Imphal is of great concern in and around the major working centres. This chapter examines the present housing scenario, housing need, housing structure, housing issues and related strategies.

Table 9.1-1: Percentage of houses in Housing Typology

S. No.	Type	%
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 9.1-1 illustrate 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 9.1-1. The remaining buildings are kutcha as per the identified construction material such as bamboo[1], 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.

[1]Wall and Roof material codes as per instruction sheet of ground truthing survey

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.

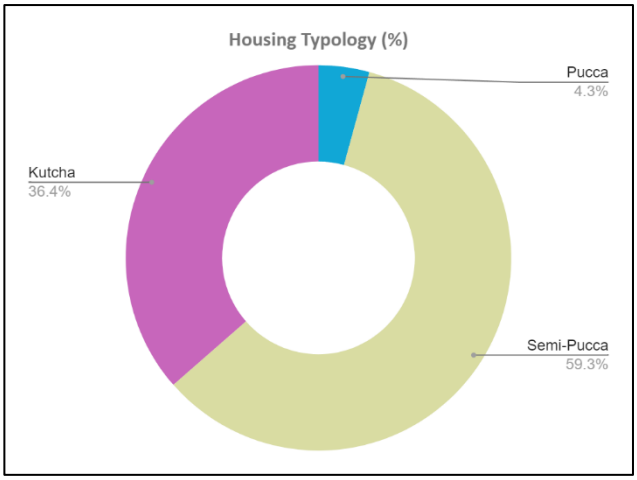
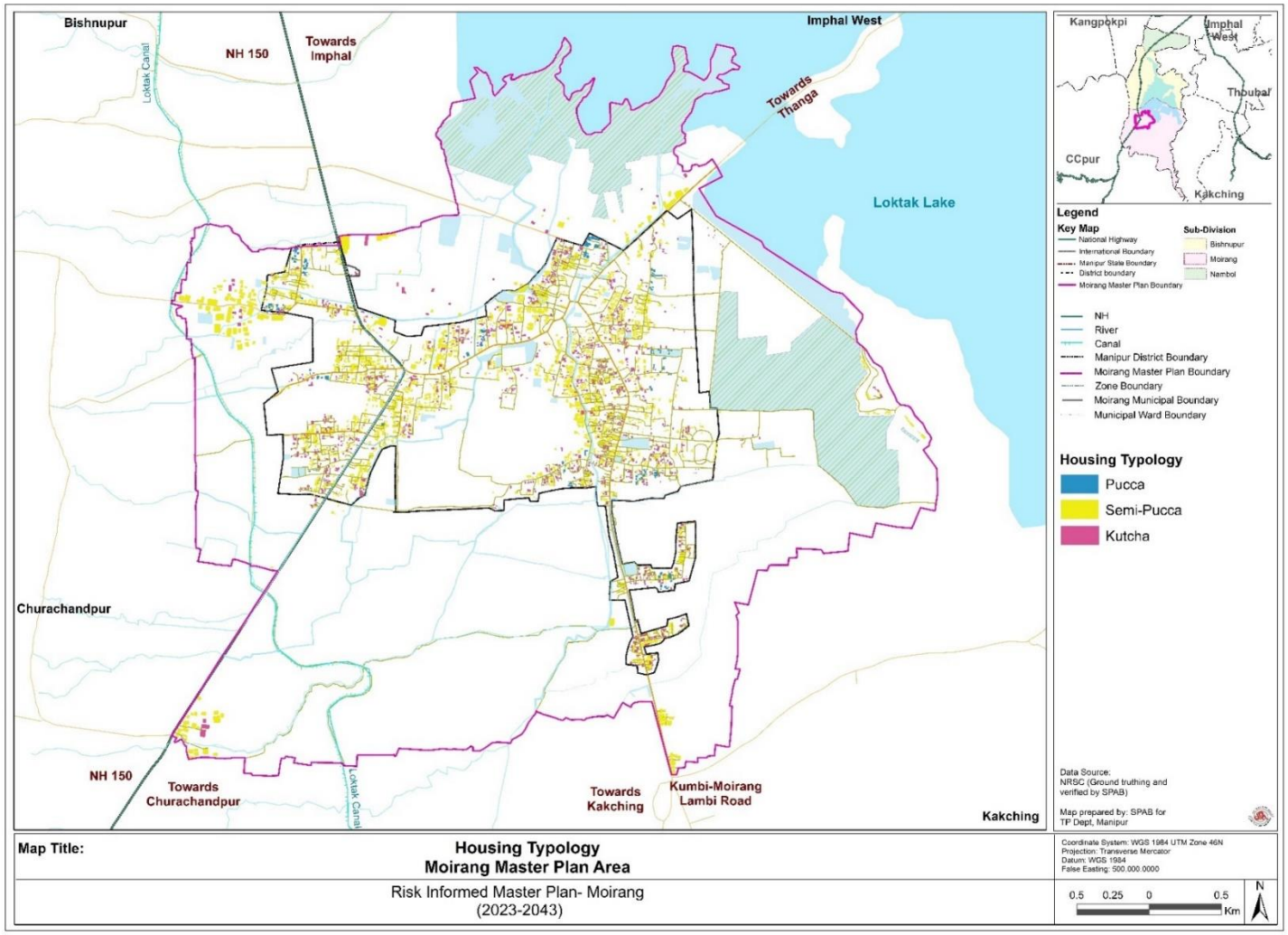


Figure 9.1-1: Percentage of houses in Housing Typology

Map 9.1-1: Housing Typology



Source: Ground Truthing Survey and Arc GIS Software

9.2 Housing Density

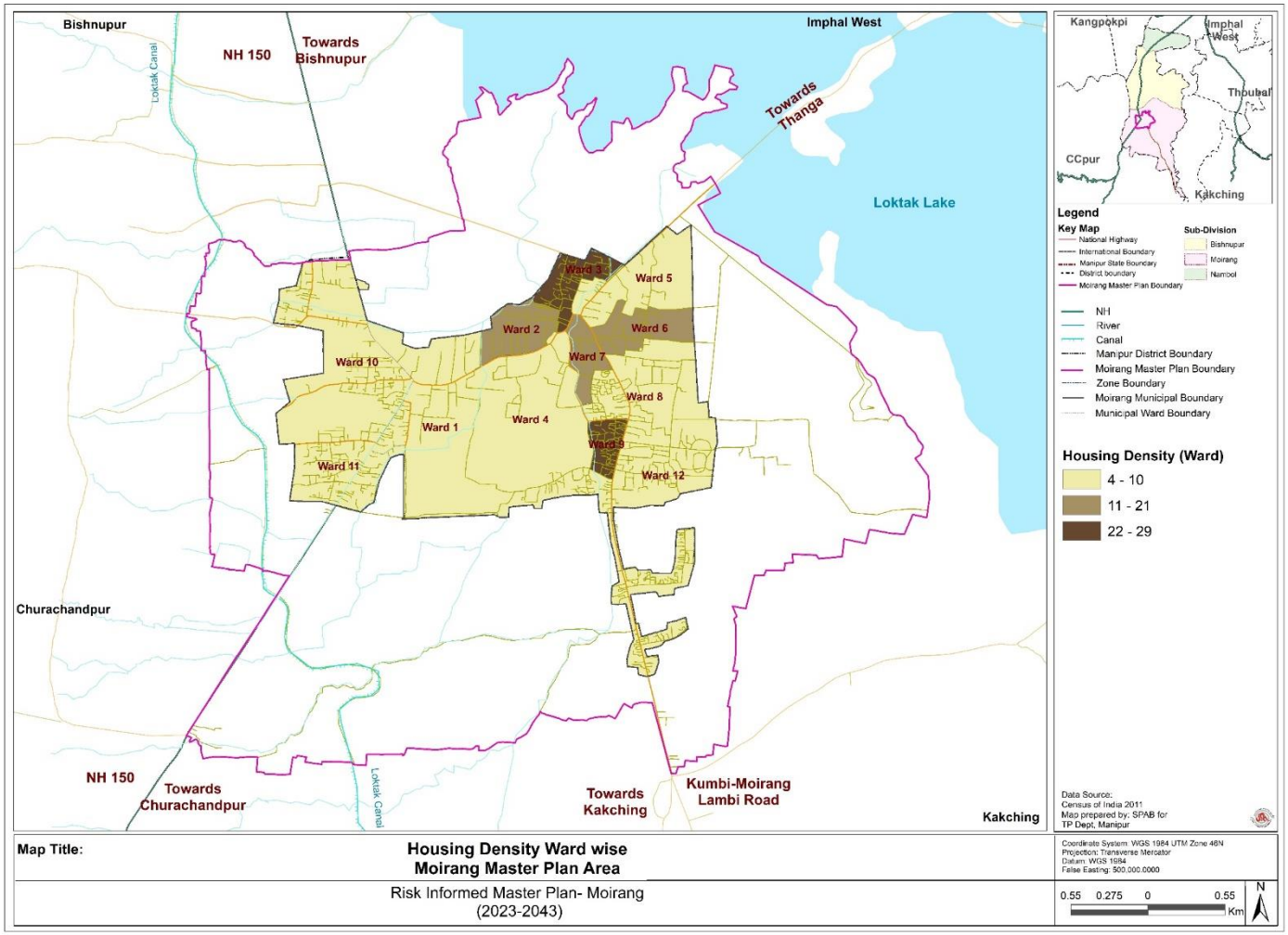
Housing density for the Moirang Municipal Council Area is 476 Ha as per ground truthing survey. The total houses in Moirang Planning area are 3914. Housing density for the planning area is 17. Ward wise housing density is given in Table 9.2-1 *(Source: Census of India, 2011).* Ward no. 3 and 9 has highest 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. These wards are large in area which is mostly agricultural dominated. Settlement are situated along the major road only. (Refer Map3.1-1 and 7.1-1)

Table 9.2-1: Housing density in Municipal Council Area ward wise

Ward. No.	Housing Density (hph)
Ward 1	4.78
Ward 2	18.64
Ward 3	27.01
Ward 4	4.60
Ward 5	9.05
Ward 6	16.49
Ward 7	20.78
Ward 8	5.66
Ward 9	28.79
Ward 10	3.78
Ward 11	9.89
Ward 12	5.50

Source: Census of India 2011

Map 9.2-1: Ward wise housing density



Source: Census of India 2011

Chapter 10: Transportation

Due to the proximity to the state capital, Imphal, Moirang has seen rapid urban growth. The growth has started clustering at centre of the town, densely populated area, along the NH 2 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 GTS and secondary survey from the concerned department includes origin and destination of PT and Intermediate Public Transport (IPT) services in the Moirang planning area.

10.1 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.

B. 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.

C. 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.

D. 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.

10.2 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. (Refer Map 10.2-1)

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.

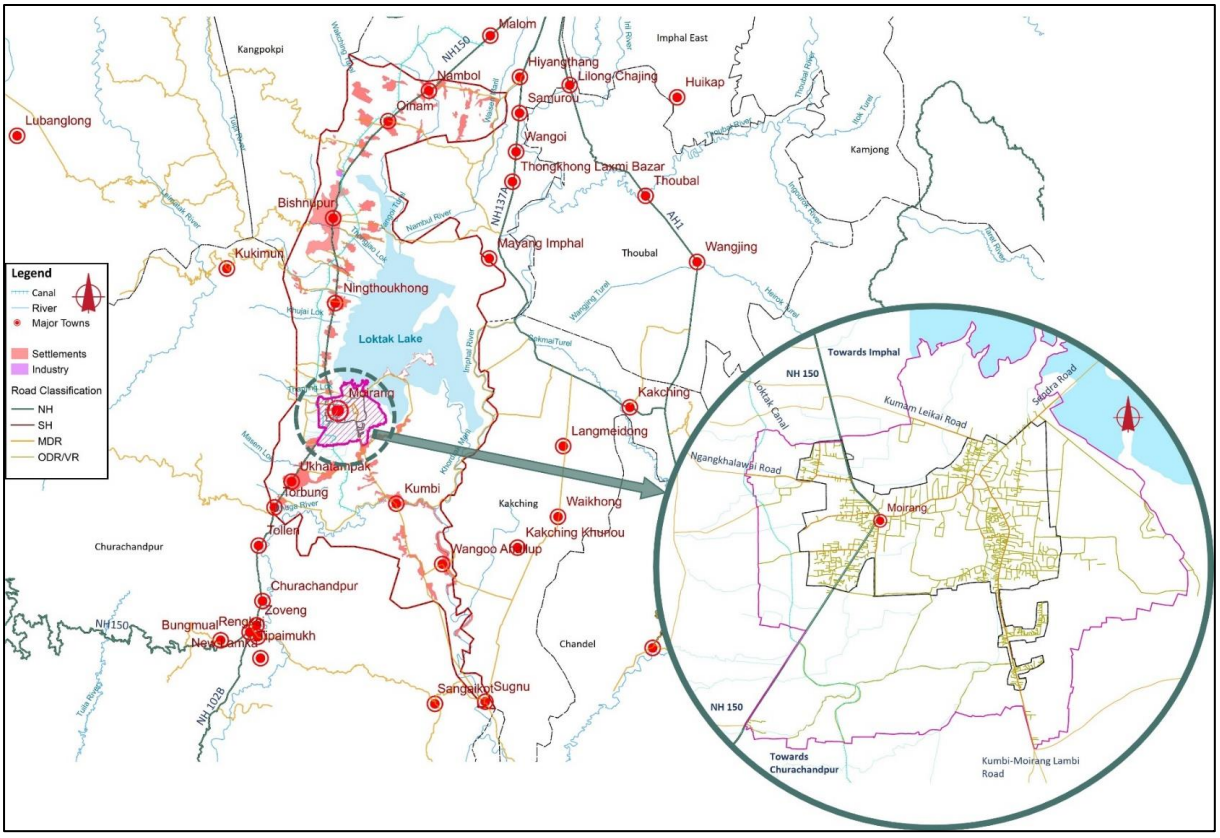


Figure 10.2-1: Road Hierarchy at regional level

Source: Google Earth Imagery

10.3 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 10.5-1).

10.4 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 10.4-1: Total length of types of roads

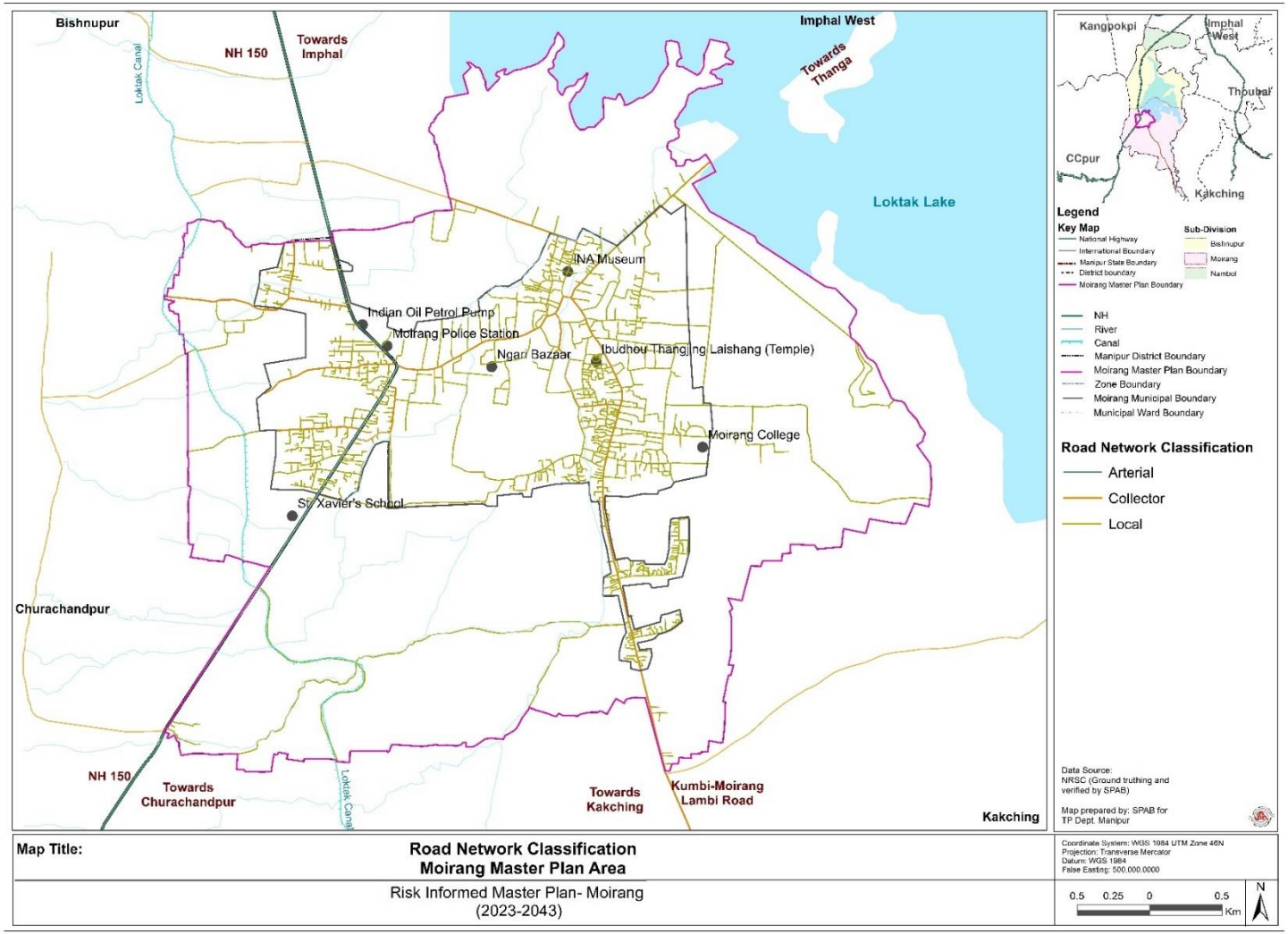
Type of Road	Length (Km)	%
Arterial (NH+SH)	3.18	2.8
Collector (MDR)	12.76	11.25
Local (ODR+VR)	97.45	85.94
Sub Total	113.39	

Source: Author

10.5 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 10.5-1. 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.

Map 10.5-1: Hierarchy of roads as per IRC classification in Moirang planning area



Source: Author

10.6 Major Trip Attractions

10.6.1. Daily basis

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 10.6-1: IMA Market, Moirang
Source: Ground Truthing Survey

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.

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.

Educational 1 (Little Master's Higher Secondary School): This is a major educational node.

Educational 2 (Moirang college): Moirang college is the major educational facility of the town located in front of CHC.

Figure 10.6-2: Moirang College, Moirang
Source: Ground Truthing Survey

Health 1 (CHC Moirang): Community Health Centre is in the Southwest part of Moirang.

Health 2: This health node is present near the main commercial area of the town. It has several clinics, hospitals, and pharmacy/ medical stores.

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.

PSP 2 (Municipal Council Office): Major PSPs like Municipal Council office, Sub Divisional Office, Sub Registrar Office, and Treasury Office are in this node.

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.

Recreational 2 (Multipurpose Ground): This ground is in front of INA HQ Memorial,

Religious:

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.

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.

10.6.2. Tourism basis (peak season)

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. Now, at this very spot, there is a memorial in stone.

Figure 10.6-3: INA HQ Memorial, Moirang
Source: Ground Truthing Survey

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 10.6-4: INA Museum, Moirang
Source: Ground Truthing Survey

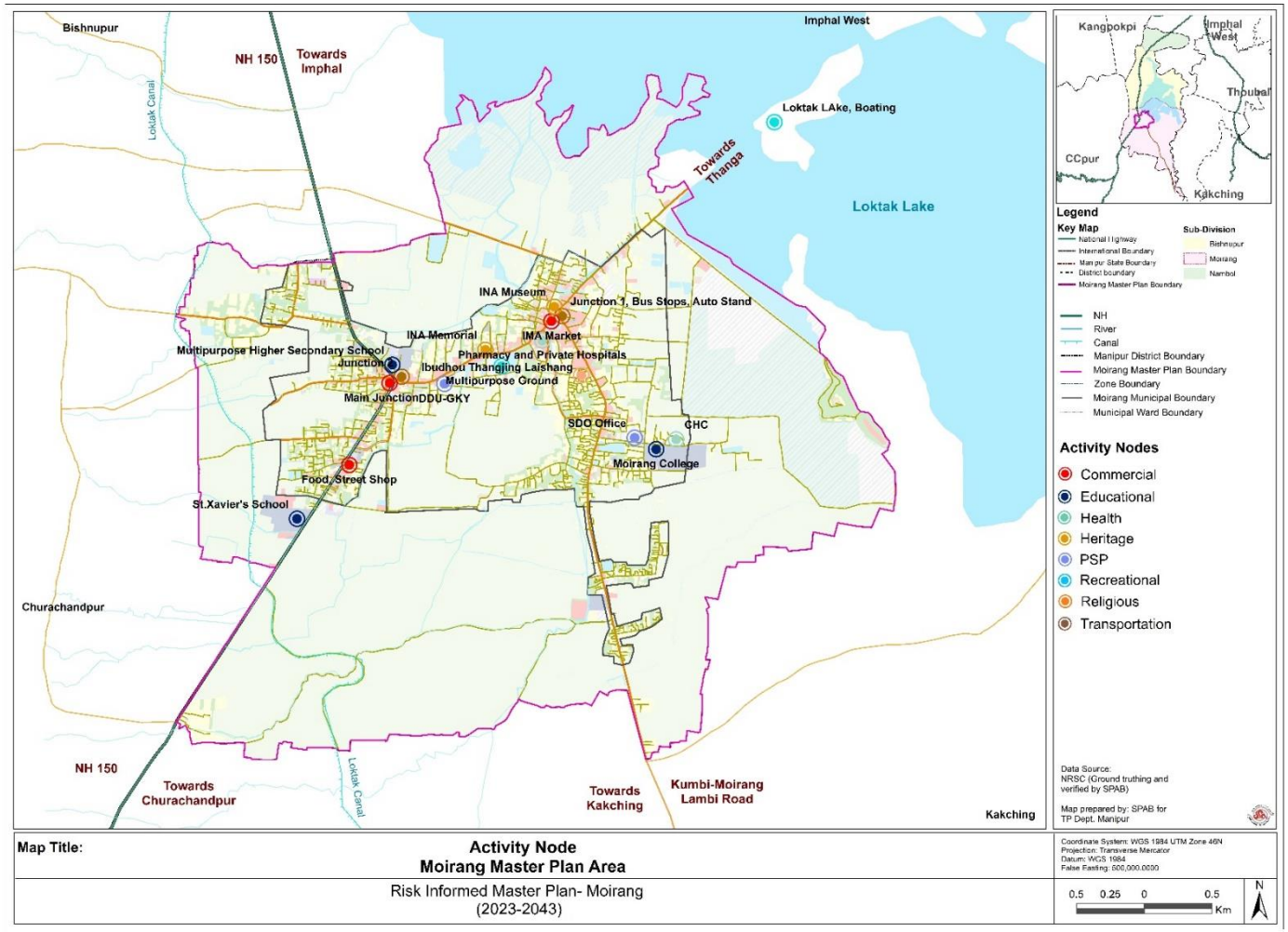
Sendra Park and Island: Sendra park and island is full of scenic beauty. It has several major resorts and hotels on this hilly island.

Sangai Ethnic Park (Moirang Khunou): Sangai Ethnic Park is located 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.

Figure 10.6-5: Sendra park and Island
Source: Ground Truthing Survey

Figure 10.6-6: Sangai Ethnic park
Source: epao.net

Map 10.6-1: Activity nodes in Moirang Planning Area



Source: Author

10.7 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. Other is near the IMA Market dedicated to auto, winger, cars and E-rickshaws.

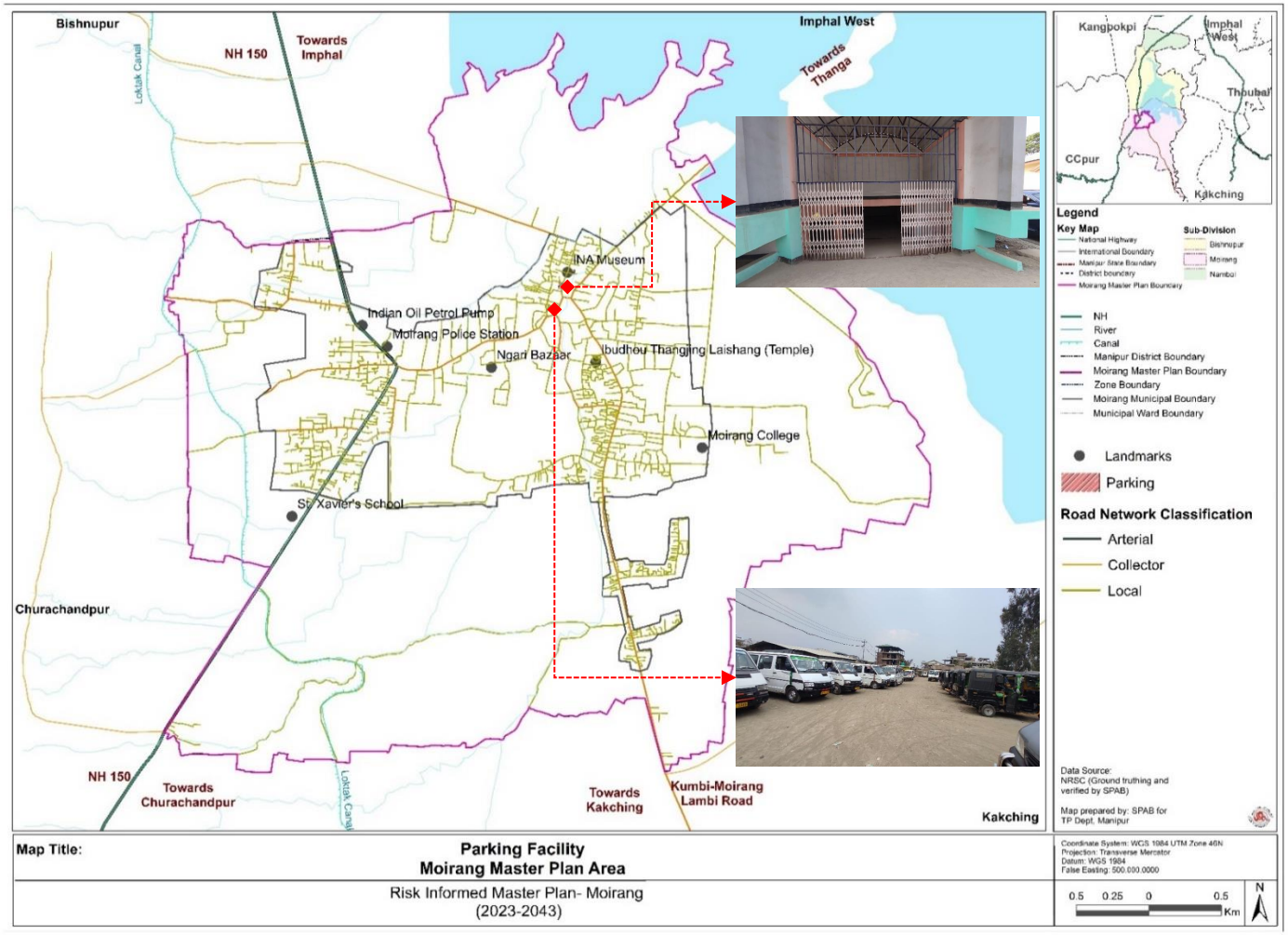
Figure 10.7-4: Multilevel parking in front of INA Museum, Moirang
Source: Ground Truthing Survey

Figure 10.7-3: On-street parking of E-rickshaw in marketplace
Source: Ground Truthing Survey

Figure 10.7-2: Dedicated Auto Parking near Main Market area in Moirang
Source: Ground Truthing Survey

Figure 10.7-1: Dedicated Auto and Winger Parking near Main Market area in Moirang
Source: Ground Truthing Survey

Map 10.7-1: Parking Facility in Moirang Planning Area



Source: Author

10.8 Shared Mobility

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

Figure 10.8-2: Shared Mobility Transport
Source: Ground Truthing Survey

10.9 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. This pressure is intensified by the presence of commercial and tourist nodes along these roads, leading to heightened parking demands.

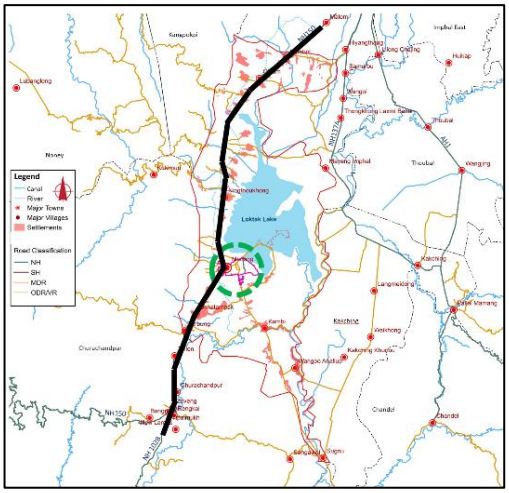


Figure 10.8-1: Single route for through movement
Source: Author

Figure 10.9-1: On-Street Parking
Source: Ground Truthing Survey

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 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 10.9-2: Commercial activities near INA
Source: Ground Truthing Survey

Figure 10.9-3: Condition of Local Roads
Source: Ground Truthing Survey

10.10 Observation and Way forward

The traffic congestion along the road stretch from INA HQ Memorial to Ibudhou Thangjing Laishang is notably high. 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.

Figure 10.10-1: Heavy traffic road stretch
Source: Google Earth Imagery

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.

Chapter 11: Social Infrastructure

11.1 Educational

11.1.1. 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, Loktak Christian High School, The Okshongbung Upper Primary School, St.Xavier's School, Moirang and New Model Public School are some of the major educational institutes present in the town.

Moirang College was established on 5th May 1963 at Moirang, a small town of scenic beauty on the bank of Loktak Lake and amidst 5 assembly constituencies.

Figure 11.1-1: Multipurpose Higher Secondary School and Moirang College

Source: Ground Truthing Survey

Figure 11.1-2: St. Xavier School, Moirang and Advance Intermediate College, Moirang
Source: Ground Truthing Survey

11.1.2. Gap Identification as per URDPFI Guidelines 2014

As per the URDPFI Guidelines 2014, 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 11.1-1: Gap identification as per URDPFI Guidelines 2014

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

Source: URDPFI Guidelines 2014

11.2 Health

11.2.1. 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 11.2-1:Community Health Centre (Left), Moirang and Pharmacy at Moirang Bazar (right)
Source: Ground Truthing Survey

11.2.2. Issues and gap Identification as per URDPFI Guidelines 2014

Moirang is largely dependent on Imphal, Bishnupur and Churachandpur for health facilities. CHC and National Charitable Hospital is serving the town. A town with high number of tourist population visiting annually, Moirang lack in higher health services such as multi-speciality hospital.

Table 11.2-1: Gap identification as per URDPFI Guidelines 2014

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

Source: URDPFI Guidelines 2014

11.3 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.

11.4 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 11.4-1: Social Infrastructure in Moirang planning area.

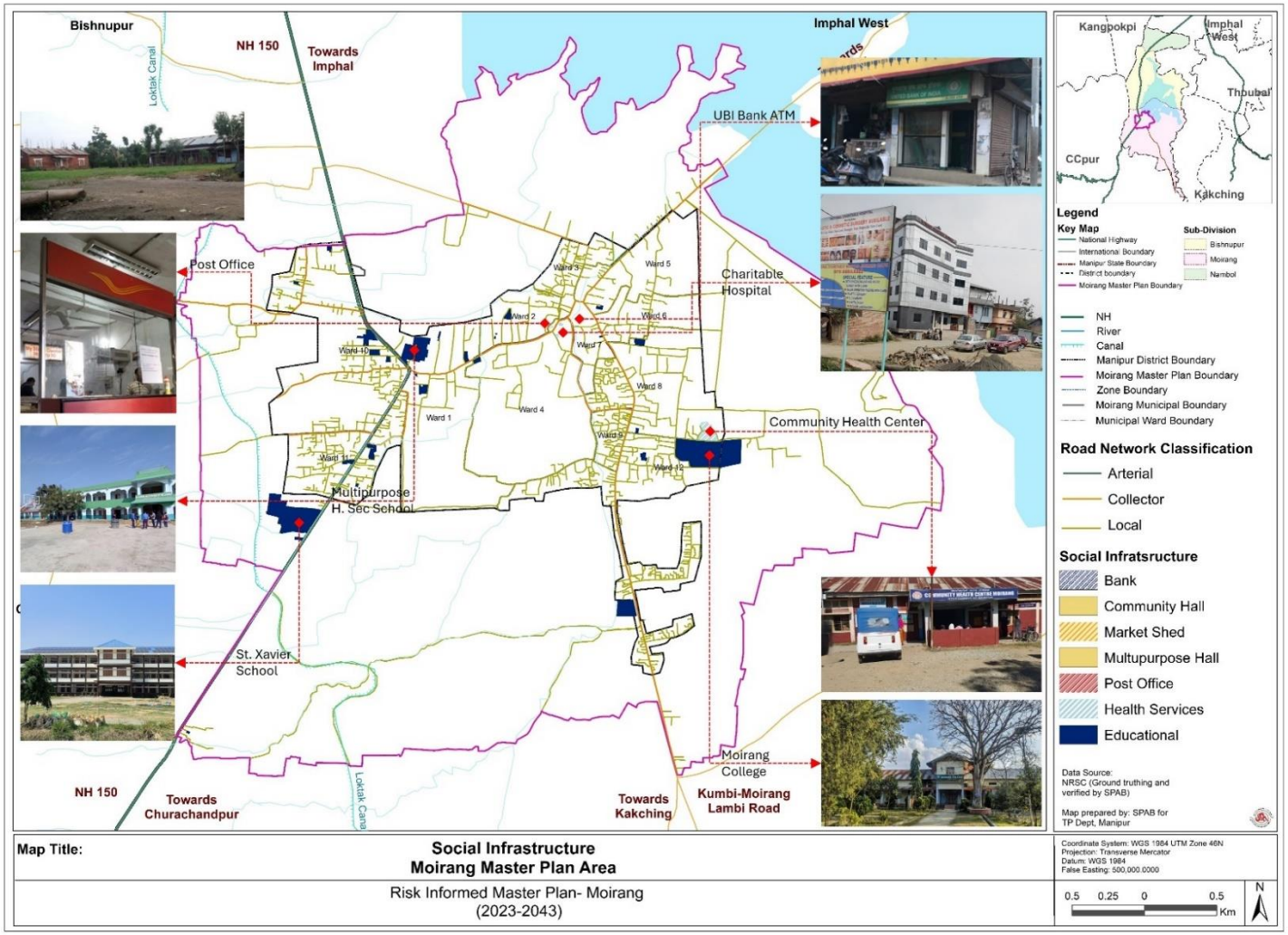
S. No.	Social Infrastructure	Area (Ha)
1	Banks	0.21
2	Community Hall	1.72
3	Educational	19.11
4	Health Services	1.19
5	Market Shed	0.75
6	Police Station	0.58
7	Post Office	0.03
8	Public Library	0.02
9	Recreational	2.24
	Total	**25.81**

Source: Author

11.5 Observation and Way forward

- Most of the banking facilities are concentrated in major commercial areas near IMA Market.
- Moirang as town is showing sufficiency in educational and healthcare services as per URDPFI Guidelines 2014.
- Tourist capacity of the town needs more diversification in health care, in terms of multi-specialty hospitals and clinics.

Map 11.5-1: Social Infrastructure in Moirang planning area



Source: Author

Chapter 12: Physical Infrastructure

12.1 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.

12.1.1. 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. 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.

There three overhead tanks in which treated water stored and then distribute by the piped network to the households. There are some areas which are still lacking in piped water supply.

Figure 12.1-1: Source of drinking water- Loktak Lake
Source: Google Images

Figure 12.1-2: Overhead tanks
Source: Ground truthing Survey

12.1.2. Issues

- No 100% pipes network connections in the planning area.
- Decrease in quality of water source due to disposal of grey water transporting through storm water drains.

12.2 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.

12.2.1. 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.

12.2.2. 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.

12.2.3. Issues

- Inadequate sewerage infrastructure
- Lack comprehensive sewerage systems, leading to improper disposal of sewage and increasing the risk of waterborne diseases.
- Lack of grey water management
- There is a need of combined of separate sewerage system which will systematically carry and treat storm water, grey water and black water to prevent the nuisance in the locality.

12.3 Solid Waste management

12.4 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 12.3-1:

12.5 Solid Waste Management Facility

A Solid waste management (SWM) site located in zone 7 of town, near to proposed ecological park (Refer Map 7.1-1 and 7.2-1). 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 12.5-1: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	**23407**	10533.15	421.33	10.53	**0.126**	-
2021	**26405**	11882.40	475.30	11.88	**0.143**	0.195
2031	**29632**	13334.54	533.38	13.33	**0.160**	0.195

2041	**33120**	14904.21	596.17	14.31	**0.179**	0.195

Source: URDPFI Guidelines 2014 and Author

Figure 12.5-1: i) Moirang Waste Management Project, ii) Collected Waste and iii) SWM collection vehicle.

Source: Ground Truthing Survey

12.6 Issues

- In residential localities, the absence of community bins is contributing to inadequate waste disposal options for residents.
- Raising awareness among local communities about responsible solid waste disposal is crucial to discourage open dumping in unauthorized areas.
- Tourist activities, such as those at Aquamarine Homestay and similar establishments, are contributing to solid waste disposal challenges in environmentally sensitive areas.
- Lack of Segregation at Source: The absence of proper waste segregation at the source hinders efficient recycling efforts. Mixed waste streams make it challenging to recover valuable materials and increase the burden on disposal sites.

- Landfill Management: Over-reliance on landfills as a disposal method leads to land degradation and groundwater contamination. Finding alternative and sustainable waste disposal solutions is a pressing challenge.

12.7 Storm Water Drainage System

12.7.1. 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.

Figure 12.7-1: Solid waste dump in drainage line

Source: Ground Truthing Survey

12.8 Issues

- Lack of storm water drains causing ponding in the low-lying areas.
- Katcha drains are susceptible to breakage and causes siltation which decreases the flow of water.
- Open pucca drains are susceptible to disposal of solid waste in market areas.
- Drains which are carrying waste from locality are connecting to nallahs and polluting it.

Table 12.8-1: 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

12.9 Electricity

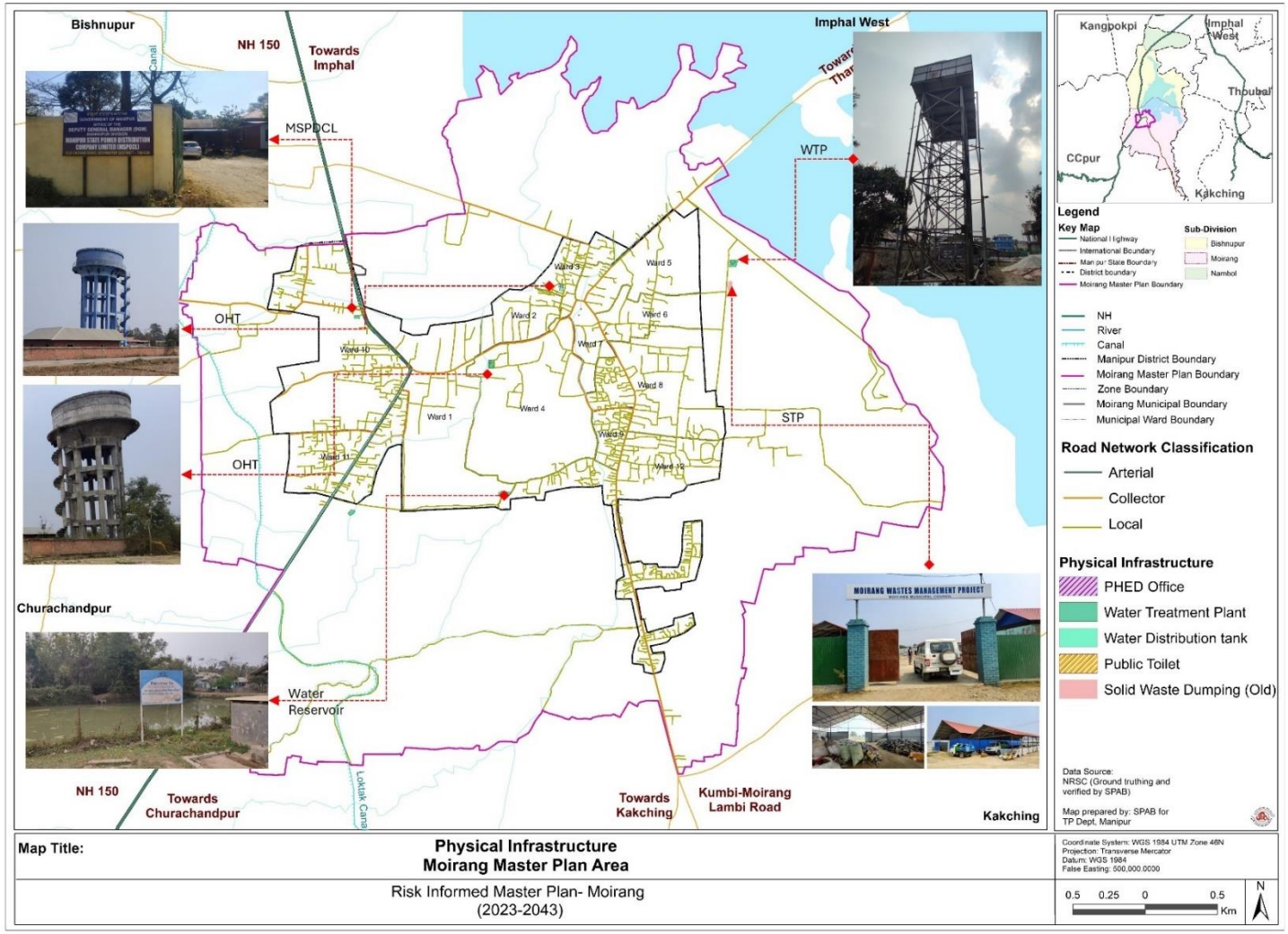
Moirang is dependent on Bishnupur for its electricity supply.

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 12.9-1:Electricity Facility in the Bishnupur town
Source: Ground Truthing Survey

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.

Map 12.9-1: Physical Infrastructure in Moirang planning area



Source: Author

12.10 Observation and way forward

- Supply piped water connection to 100% households.
- There is a need of decentralized combined or separate sewerage system.
- Inadequate solid waste disposal leads to create nuisance in the locality.
- The planning area needs a system of waste management where stakeholders work together in harmony.
- There is a need of storm water drainage system in the planning area.
- There is a need to prevent ponding in low lying areas.

Chapter 13: Environment/Eco-Sensitive

13.1 Green Spaces/ Eco-Sensitive Area

Keibul Lamjao National Park: The Keibul Lamjao National Park, located in the southeastern part of the Loktak Lake, is the only floating National Park in the world. The park spans over 40 square kilometers and is situated on the Loktak Lake. 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.

13.2 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 center 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 located in the campus of Moirang College.

13.3 Water bodies

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. Loktak Lake was accorded the status of a Ramsar Site of International Importance in 1990 and included on the Montreux Record in 1993 because of ecological problems such as deforestation in the catchment area, infestation of water hyacinth, and pollution *(Source: Ramsar sites information services and Loktak Atlas 2002).*

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. Loktak lake and its surrounding area is a major ecological zone. It has rich biodiversity consisting of 116 different species of birds, 54 fishes, 22 mammals, 68 reptiles and amphibians and 200+ plants. Loktak lake and its surrounding area is home of some of the major endangered species like Brow Antlered deer, Crane, Red Jasper Barb, Hog deer, Keeled Box Turtle and Dhole. Lesser Adjutant, Sarus crane, common pochard, hooded crane, Common carp, Amboina, Box Turtle, King Cobra and Burmese Python are some of the vulnerable species of this area.

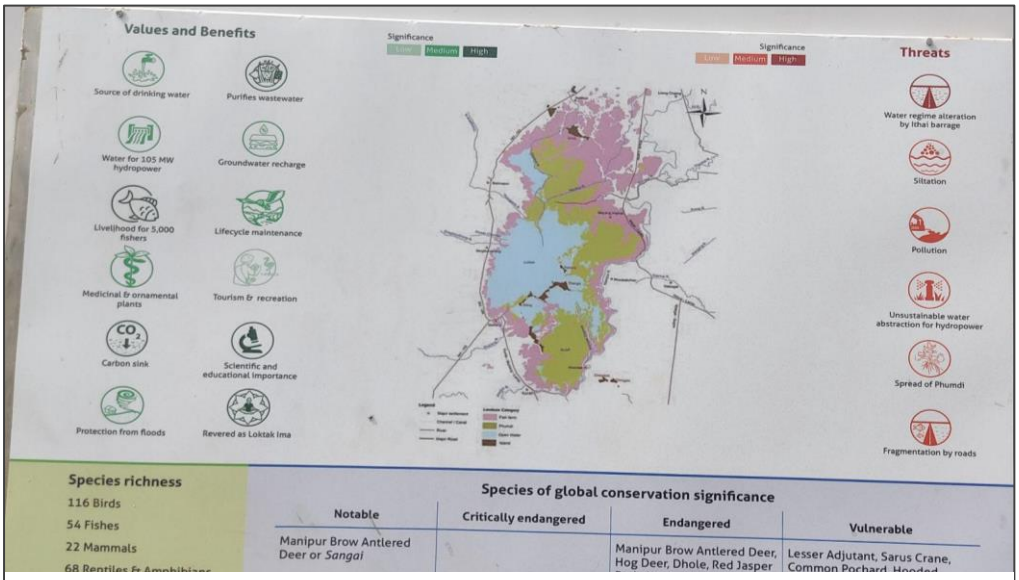
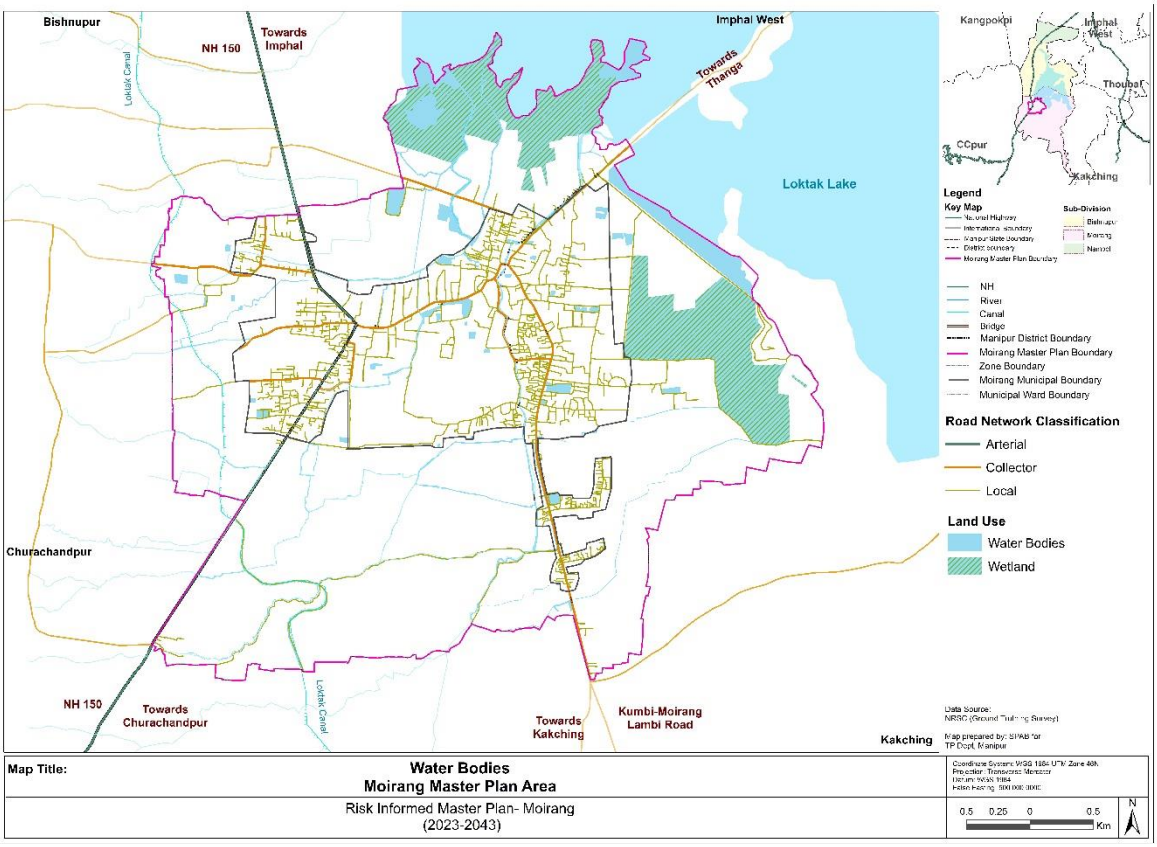


Figure 13.3-1: Benefits and Threat on Loktak Lake
Source: Loktak Development Authority

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 13.3-1: Water Bodies in Moirang Planning Area

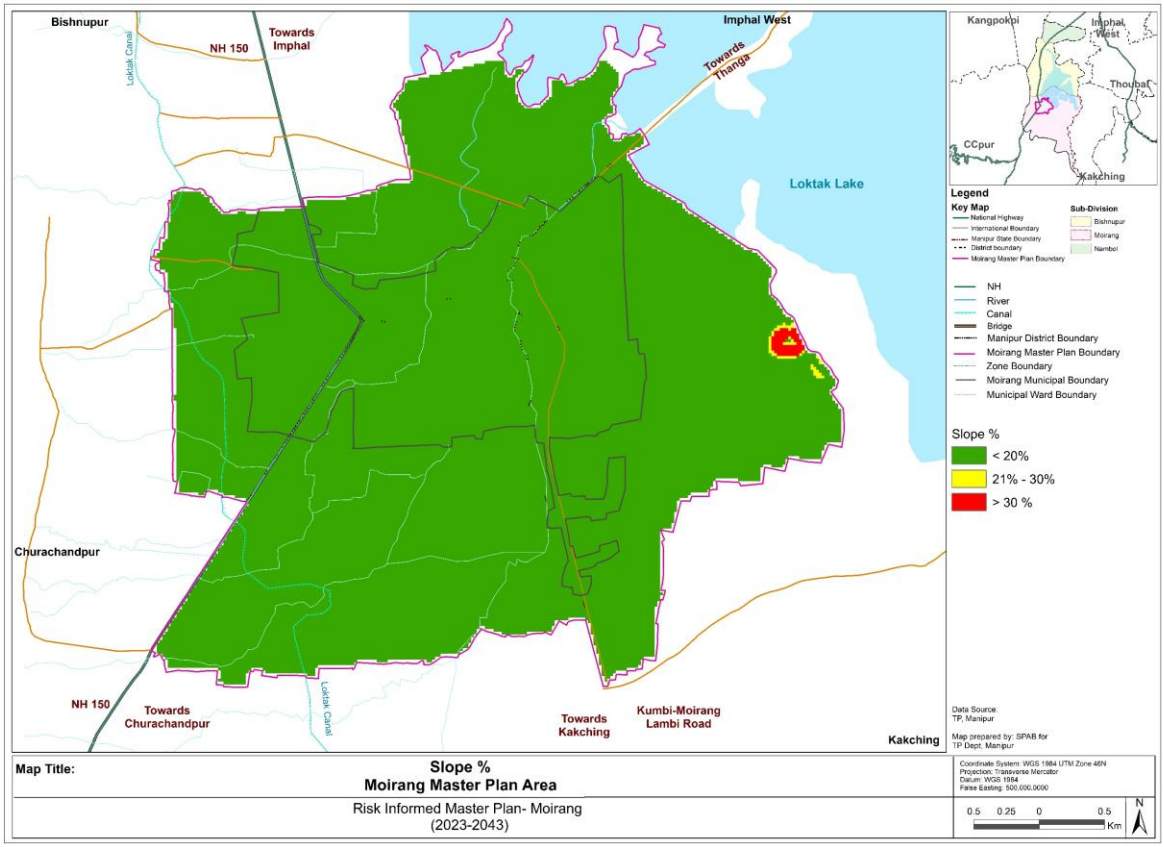


Source: Author

13.4 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 13.4-1, 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.

Map 13.4-1: Slope of Moirang Planning Area



Source: NRSC

Chapter 14: Heritage and Tourism

14.1 Heritage

14.1.1. INA HQ Memoria

Moirang town has two major historic heritage sites located at the center 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 14.1-1: Historic Site of INA Headquarter
Source: Ground Truthing Survey

14.1.2. 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.

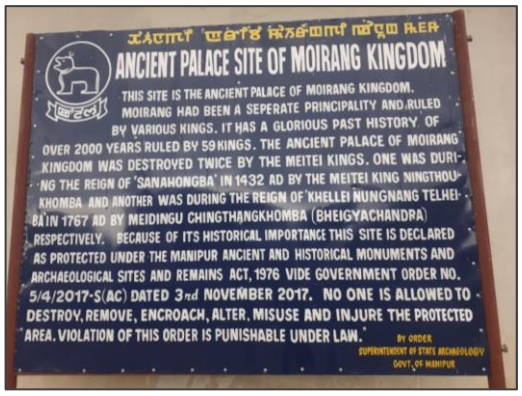


Figure 14.1-2: The Ancient Palace site of the Moirang Kingdom

Source: Ground Truthing Survey

14.2 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, making it an indispensable destination for discerning travellers seeking to immerse themselves in the unique charm of Manipur.

14.2.1. Tourist Attraction Places

INA HQ Memorial:

The Indian National Army Memorial and Museum in Moirang is a place that remembers important events from the past. It's a copy of a similar memorial in Singapore and 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.

Figure 14.2-1: Historic Site of INA Headquarter
Source: Ground Truthing Survey

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.

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 14.2-2: INA Museum, Moirang
Source: Ground Truthing Survey

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.

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

Figure 14.2-3: Loktak Inland Waterways Development Authority
Source: Ground Truthing Survey

during November to March. The Forest Department of Manipur maintains watch towers and two rest houses within the park.

Sendra Park and Island: Sendra park and island is full of scenic beauty. It has several major resorts and hotels on this hilly island.

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)

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 14.2-4: Ebuthou Thangjing Temple
Source: Ground Truthing Survey

14.2.2. 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.

14.3 Corresponding Issues

- Lack of diverse supporting infrastructure for tourism service (from shelter to hospitality)
- Accommodation facilities- Highly dependent on Imphal
- Travel and Transport service
- Maintenance and management

- Lack of one stop tourist information center
- No integration between one tourist attraction site with others.
- No proper demarcation/ buffer area for tourists to interact with the respective sites. Resulting,
- degradation of tourist spots.
- Lack of integration between Moirang with other tourism opportunities of Manipur state

14.4 Observations and Way Forward

- To develop a town as a tourism Centre for Manipur State due to its given location and connectivity.
- Provision of Supporting Infrastructure for Tourism Service.
- Provide a single window information system for tourists to make their travel safe and easy.
- Buffering around eco-sensitive area to protect
- Integration of Tourist attractions by Route Mapping such as Heritage walk & Nature walk.

Map 14.4-1:Tourism map of Moirang planning area

Source: Author

Chapter 15: Agriculture and Allied

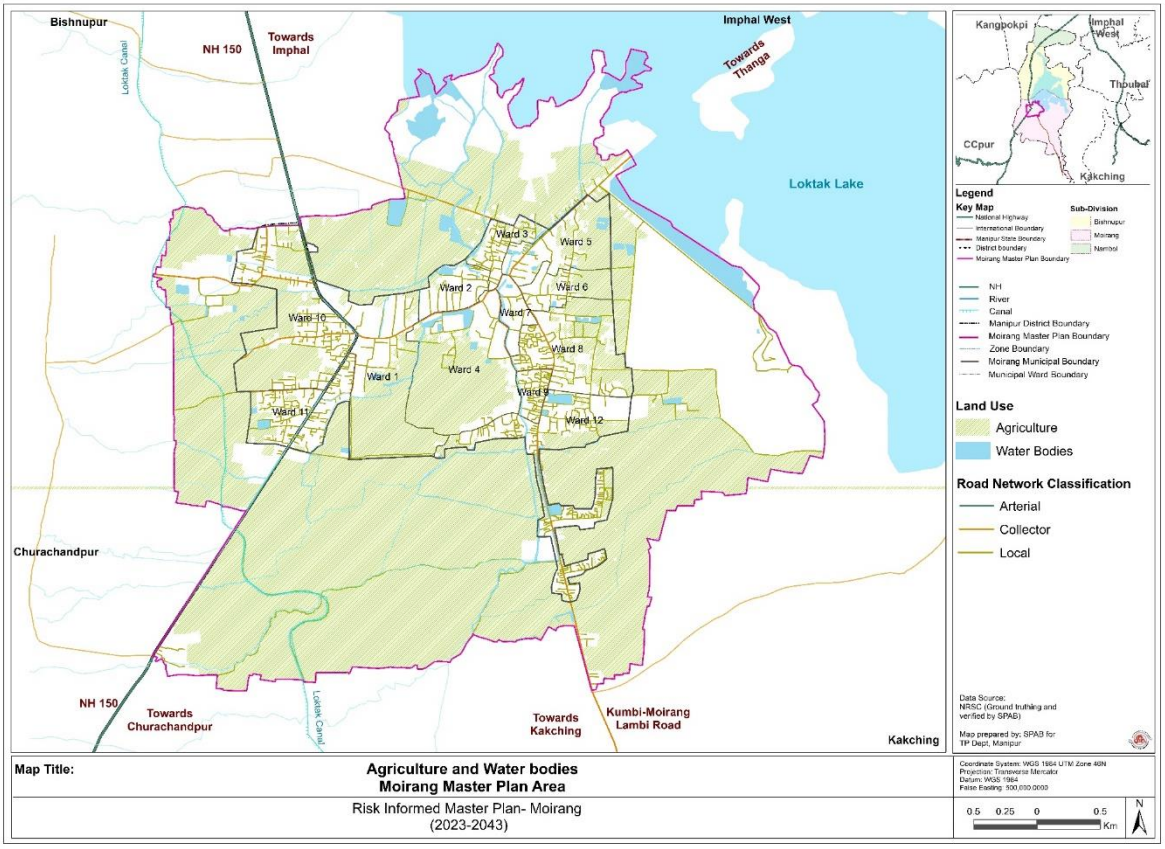
15.1 Activities

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.

15.2 Existing Issues

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

Map 15.2-1: Agriculture Field in Moirang Planning Area



Source: Author

Chapter 16: Risk Management Plan

16.1 Methodology for RIMP

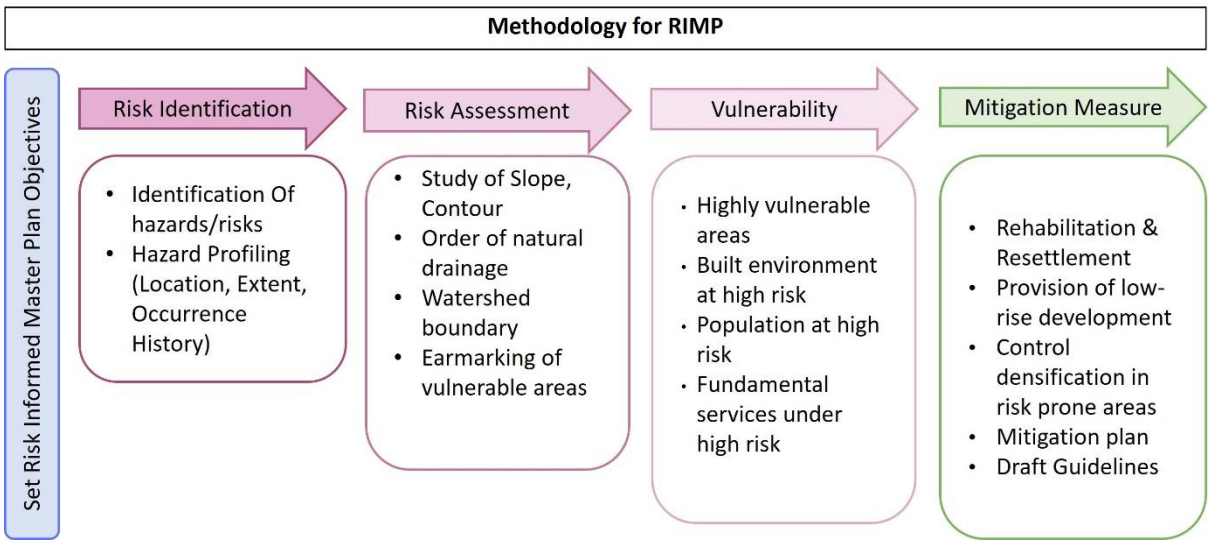


Figure 16.1-1: Methodology of RIMP

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.

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 analyzing 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.

16.2 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 in close proximity to the planning area.

16.3 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:

16.3.1. 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:

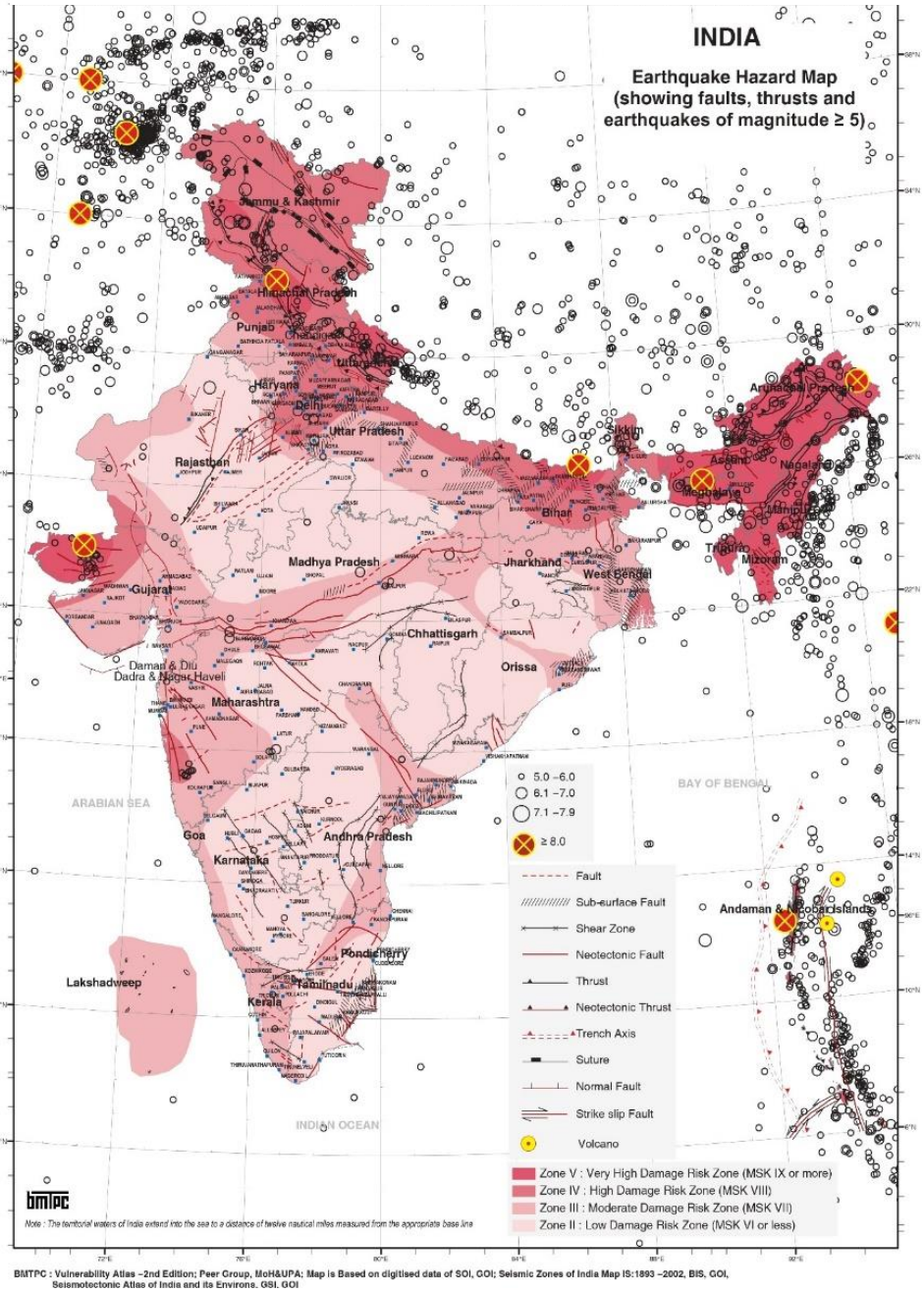
16.3.1.1. Earthquake

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 16.3-1. 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. 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.

Map 16.3-1: Earthquake hazard map of India



Source: BMTPC: Vulnerability Atlas

Table 16.3-1: 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, 21:30 IST	75 Km ESE of Moirang. The depth of earthquake was 10 km below the ground.	4.4 Magnitude
23.	March 20, 2023	60 Km ESE of Moirang Lat. 24.34 degree and long 94.35 degrees.	3.8 Magnitude

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 were 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-16.2-1.

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 earthquake (Refer Map 16.2-2) 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.

16.3.1.2. Flood

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.

Some major flood occurred in Bishnupur district are listed in Table 16.2-2

Table 16.3-2: 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.	The intensity of the flood was severe.
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

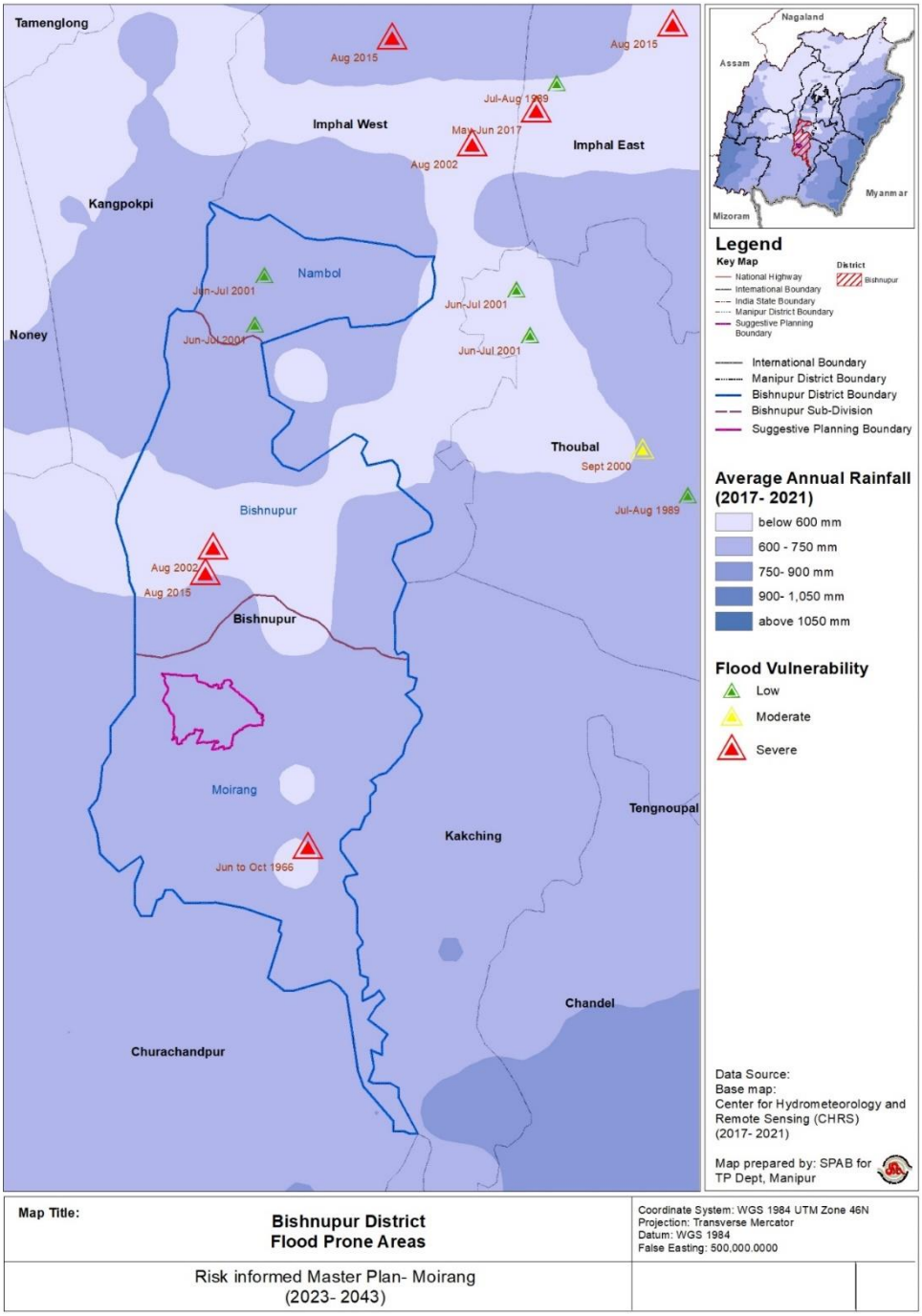
Source: CHRS and State Disaster Management Report 2017-2018 (Manipur)

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 low-lying terrain. This geographical arrangement further increases the town's susceptibility to floods.

Map 16.3-2: Flood Vulnerability



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

16.4 Risk Assessment

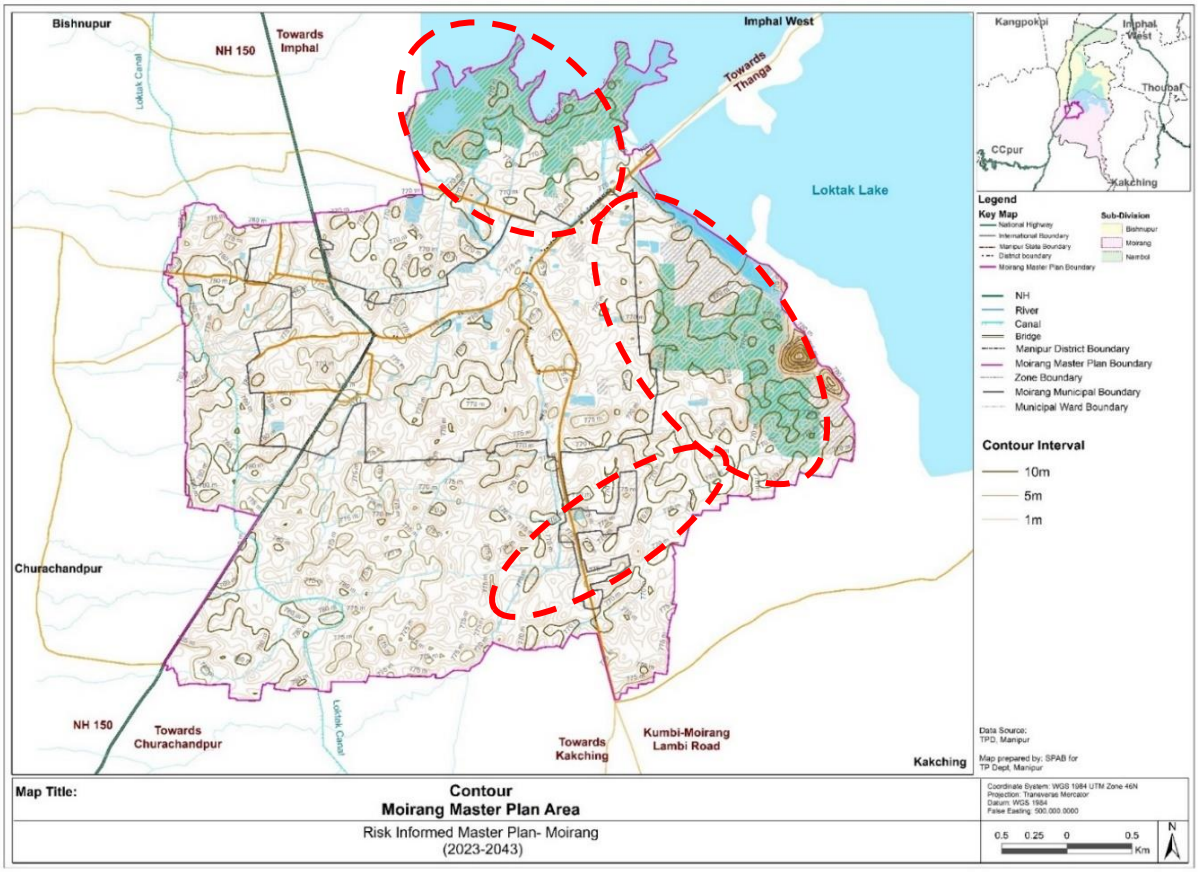
Risk assessment is a fundamental process to understand the impact of risk on people and environment in a broad perspective. While closely related, they serve distinct purposes in evaluating and addressing potential threats. The outputs of hazard and risk assessments inform decision-making processes, 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:

16.4.1. 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. (Refer Map 16.4-1)

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 16.4-1. 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.

Map 16.4-1: Contours at 1m, 5m and 10m of the Moirang Planning Area



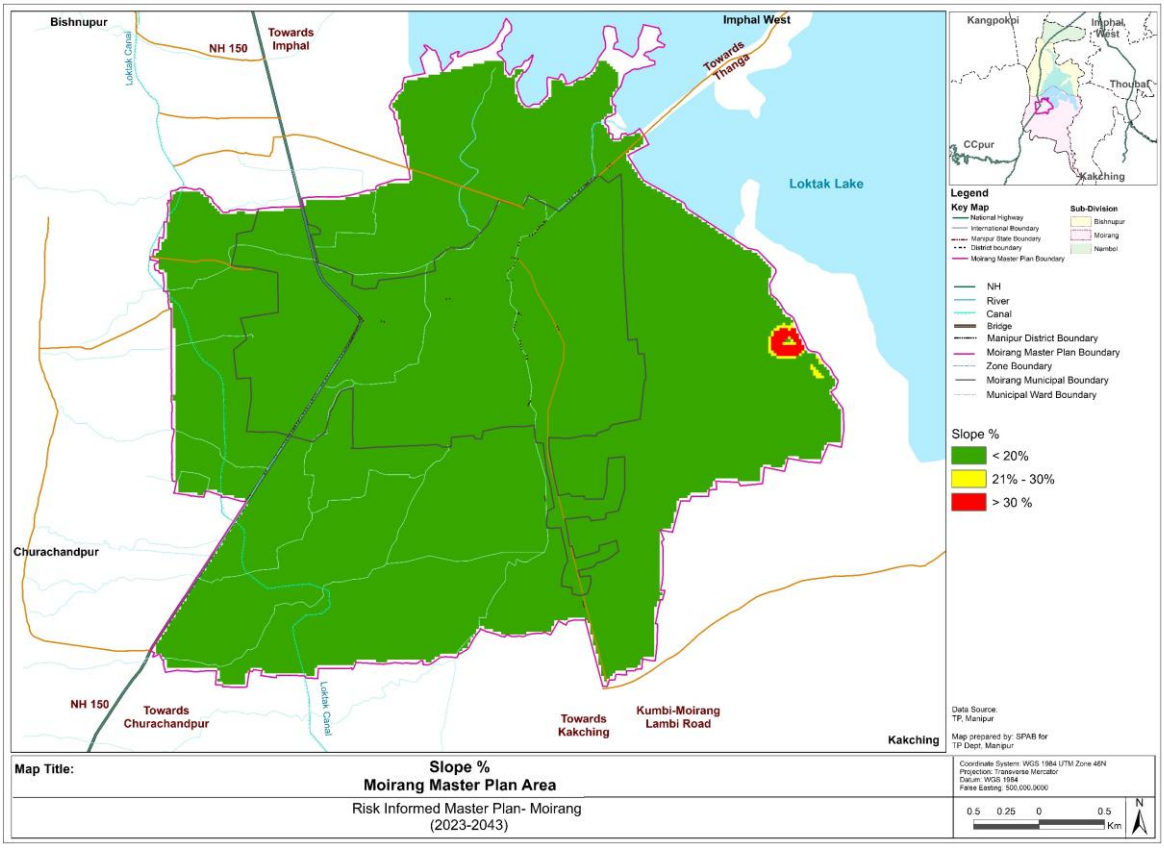
Source: Town Planning Department, Manipur

16.4.2. 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. 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. (Refer Map 16.4-2)

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. (Refer Map 16.4-2)

Map 16.4-2: Slope of the Moirang Planning Area



Source: NRSC

16.4.2.1. 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.

16.4.2.2. Moderate Slope (21-30%)

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

16.4.2.3. Steep Slope (>30%)

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

16.4.3. Natural Drainage and Watershed Boundary

16.4.3.1. Natural Drainage

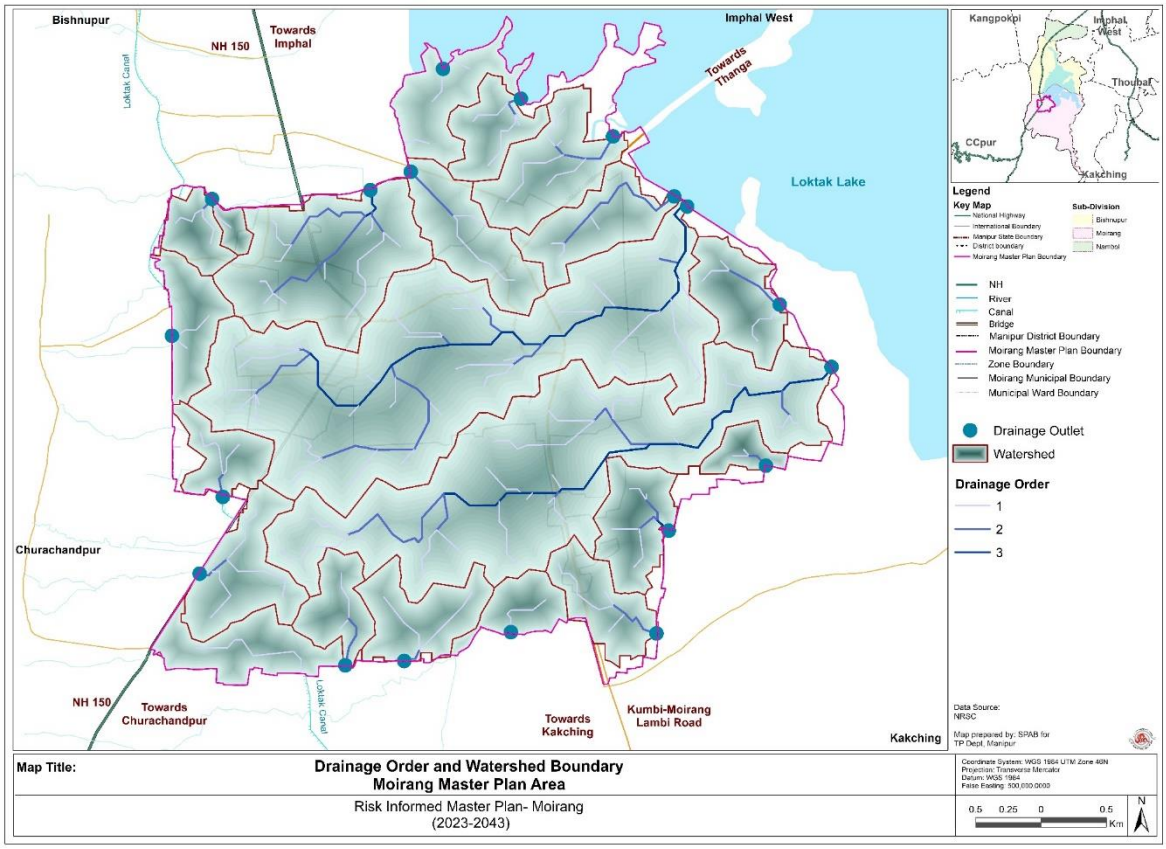
A connected set of lines which represent the surface-water drainage, oriented in the direction of flow. This drainage network prepared using digital elevation model (DEM) in GIS tool. In the Map 16.4-3, the drains are arranged in an order with reference to the sequence of network. This order of drainage 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.

16.4.3.2. 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.

Map 16.4-3: Drainage order and Watershed Boundary



Source: NRSC and Author

16.4.3.3. 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.

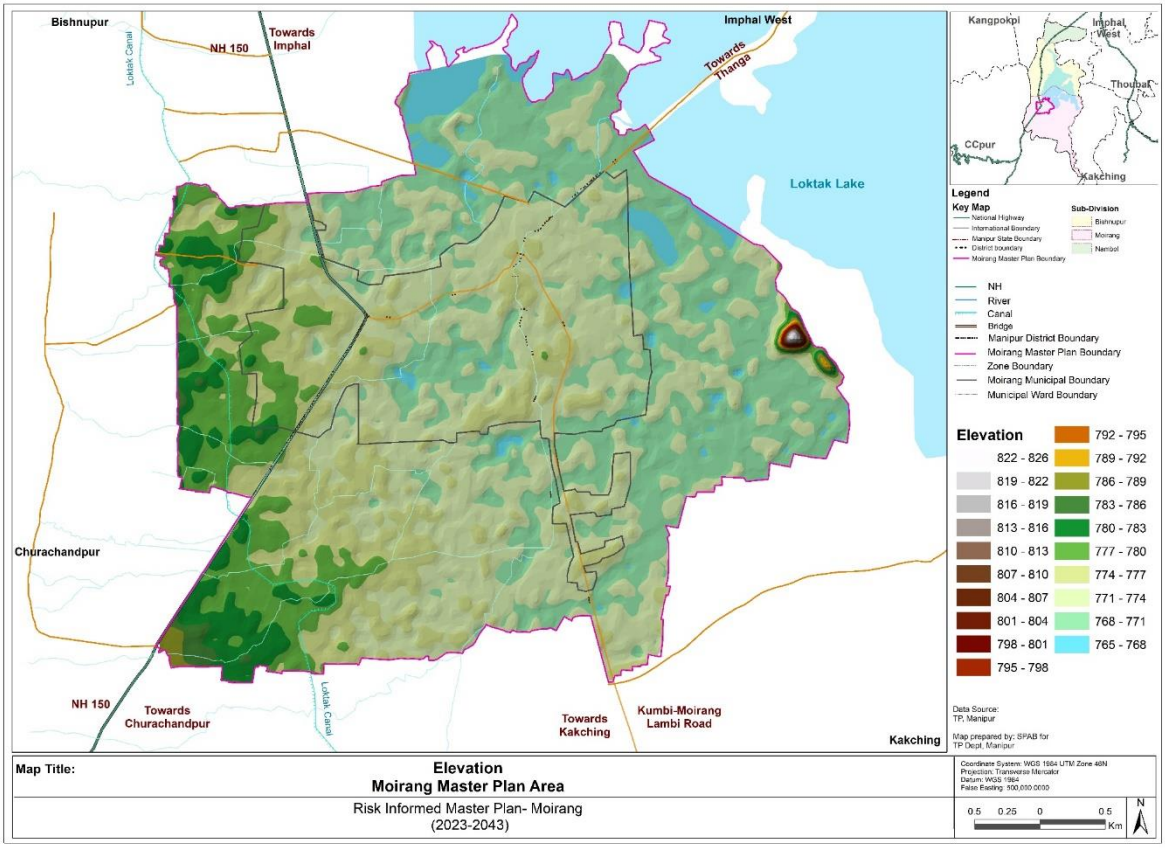
Elevation maps provide information about the slope of the land. Elevation maps are used in hydrological modelling to simulate water flows across the landscape. By incorporating rainfall

patterns and terrain elevation, hydrological models can predict potential flood scenarios and identify vulnerable areas.

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 16.4-4: Elevation

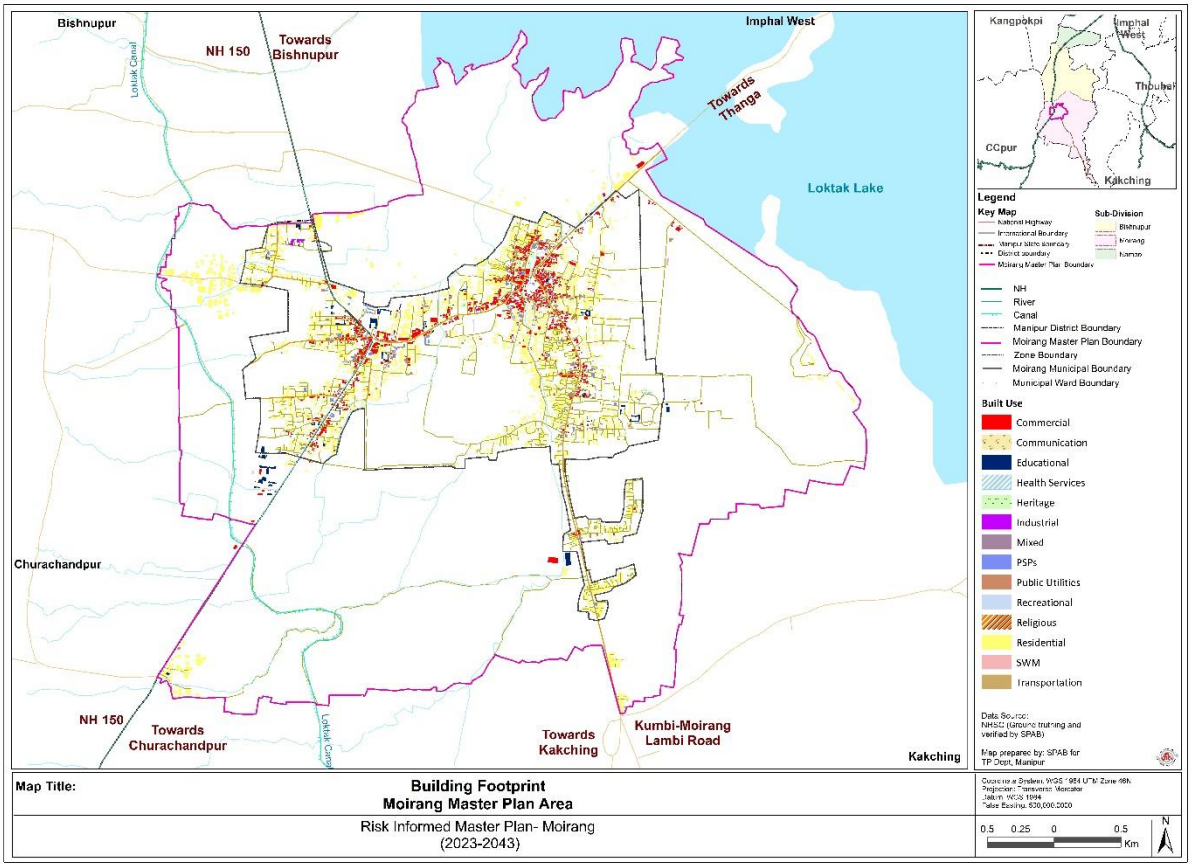


Source: NRSC & TPD, Manipur

16.4.3.4. 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 16.3-1 shows the various classes in which these built ups have been divided, for example residential, commercial, educational, etc. Commercial built ups are concentrated at junctions and along the major roads. Housing is also spreading linearly along the major routes.

Map 16.4-5: Building footprint in Moirang Planning Area



Source: Ground Truthing Survey

16.5 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:

16.5.1. 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:

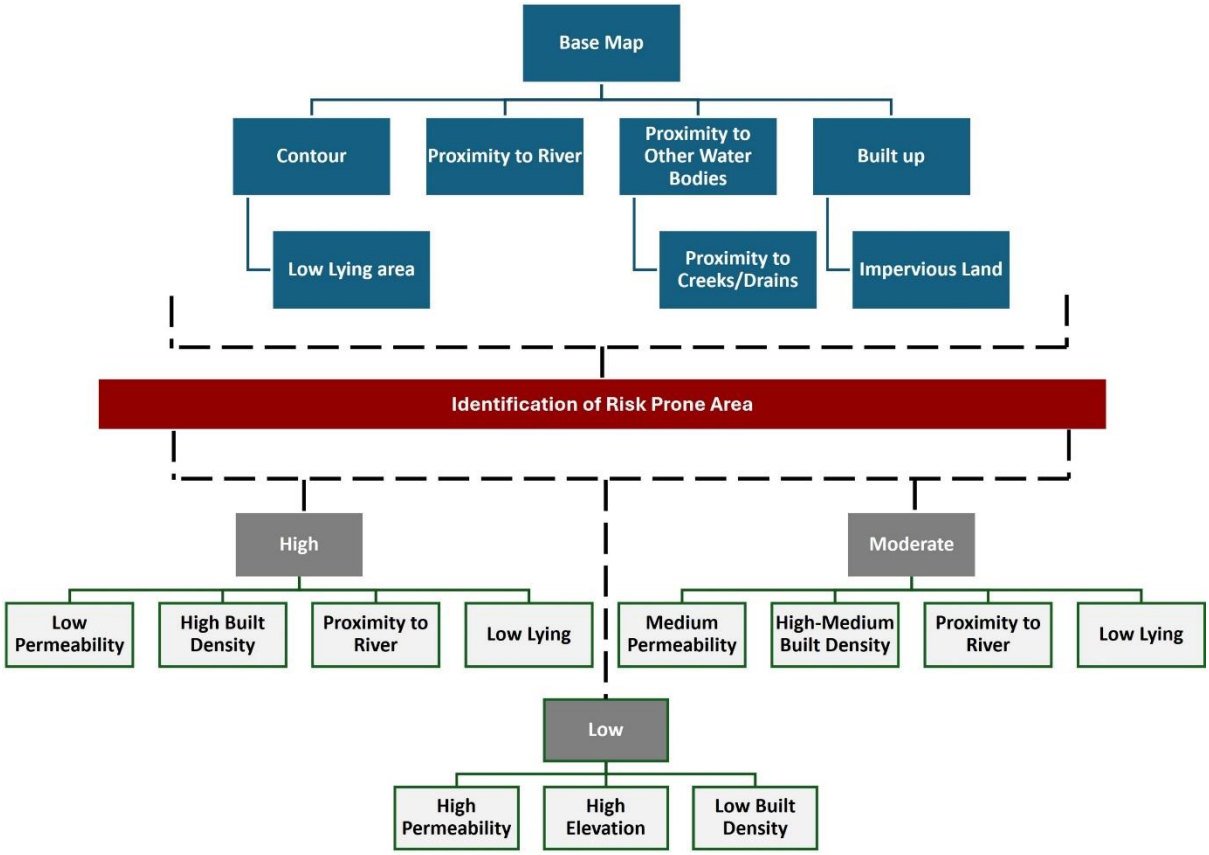


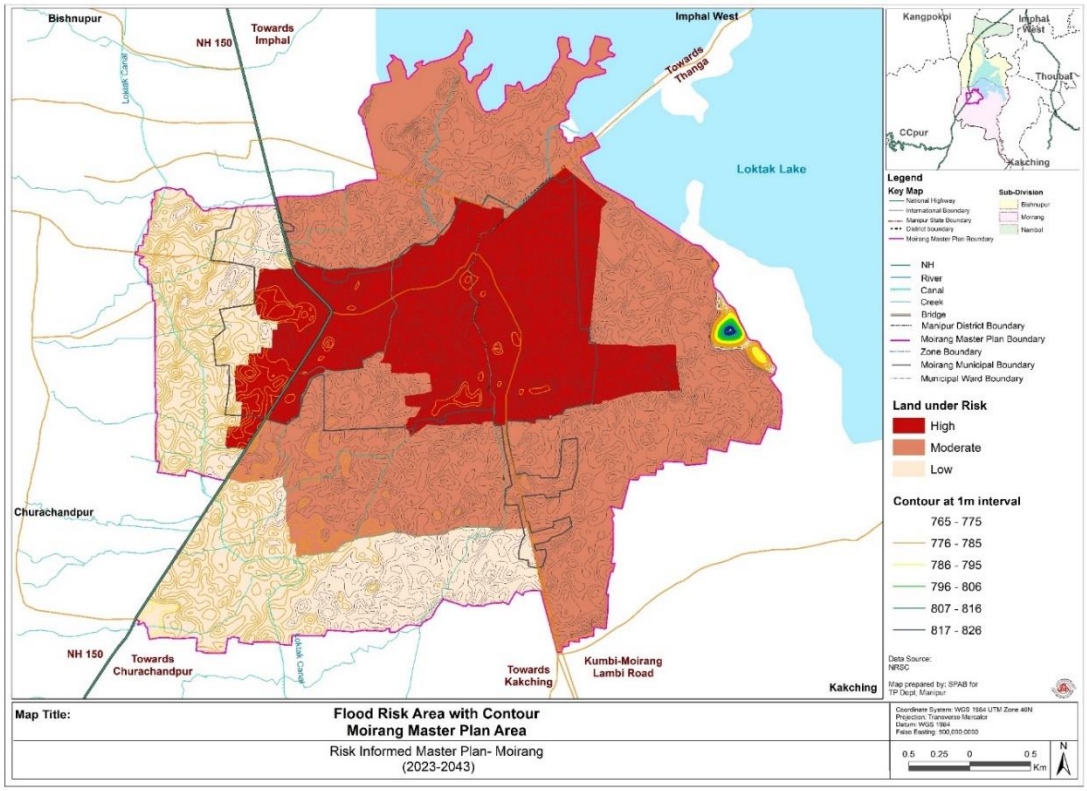
Figure 16.5-1: Methodology of Flood risk prone areas

16.5.2. Earmarking of Flood Prone Areas

16.5.2.1. 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.

Map 16.5-1: Low lying areas



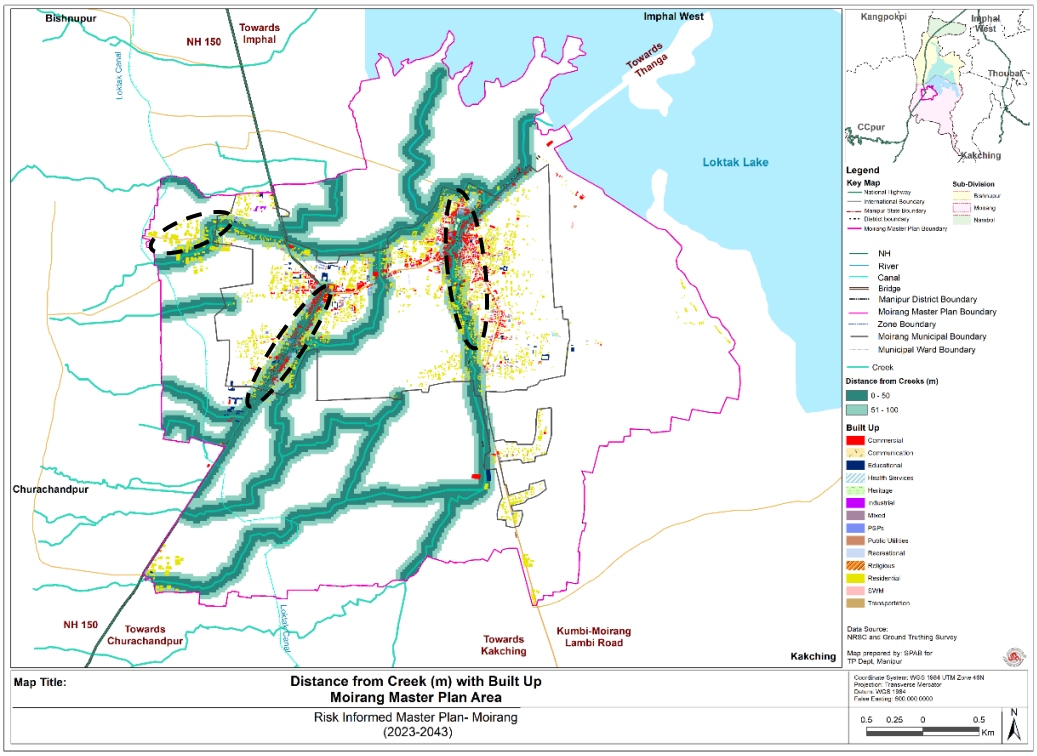
Source: TPD, Manipur

16.5.2.2. 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.

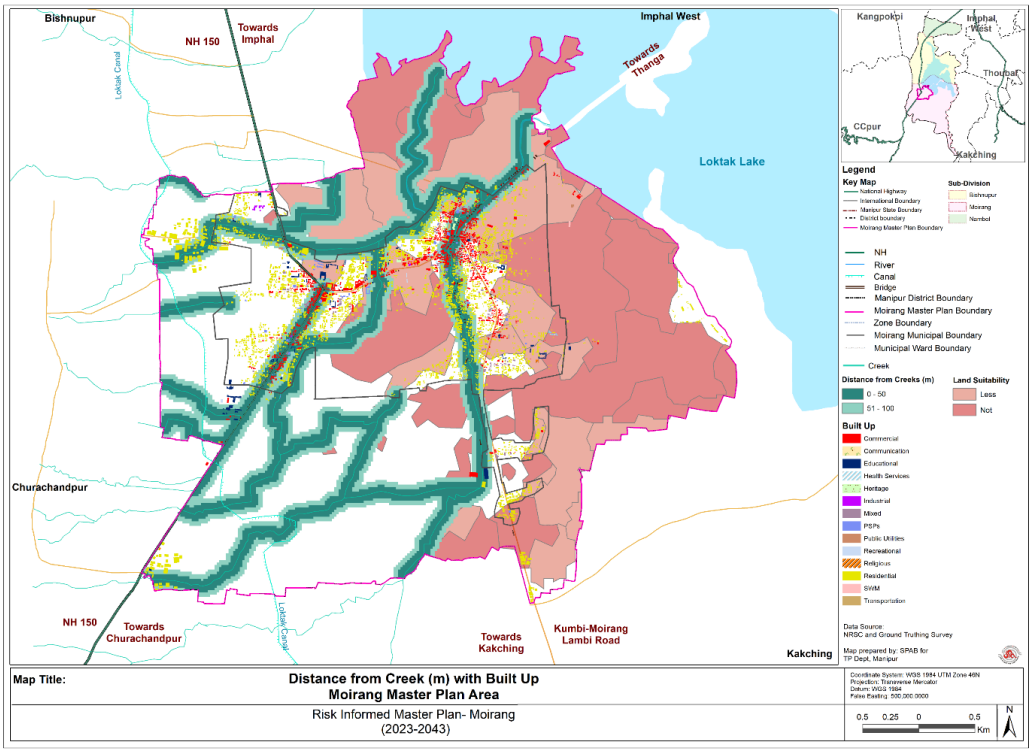
In Map 16.5-2 shows the location of creeks and water bodies other than rivers and areas susceptible to flooding because of impervious land around it. The more built density, the more impervious ground become. This reduces the infiltration of rainwater and increases the runoff over surface which further 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.

Map 16.5-3: Creeks buffer



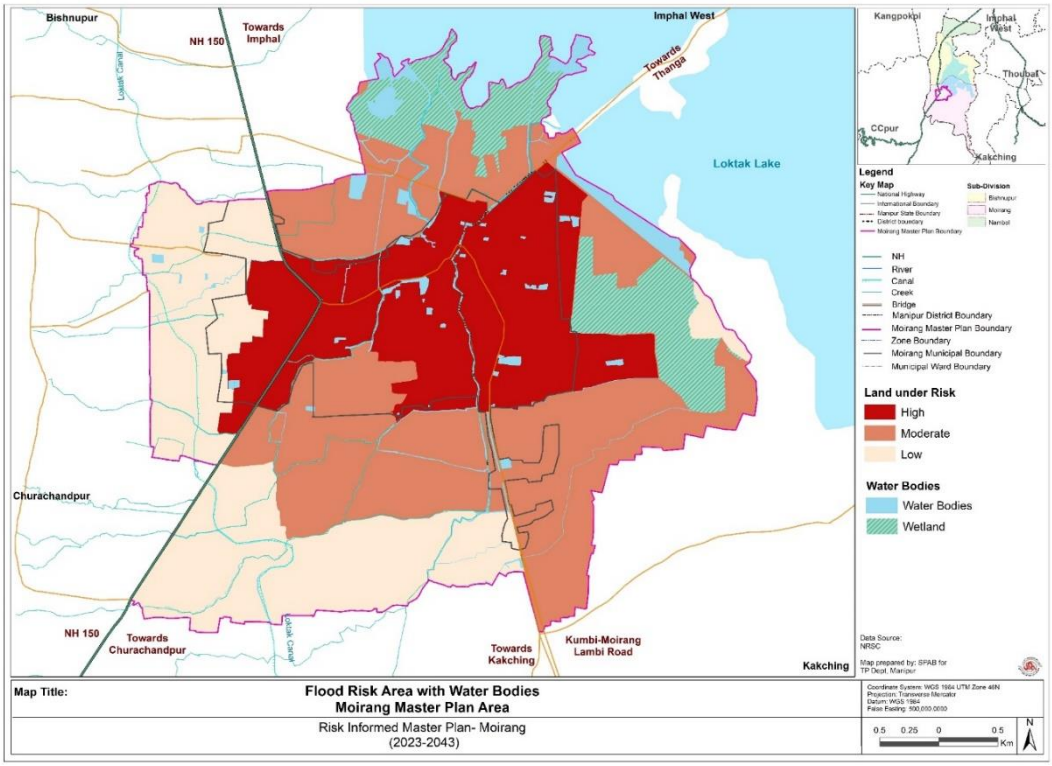
Source: Google Earth Imagery & Loktak Atlas

Map 16.5-2: Built in creek's buffer



Source: Ground Truthing Survey

Map 16.5-4: Other water bodies



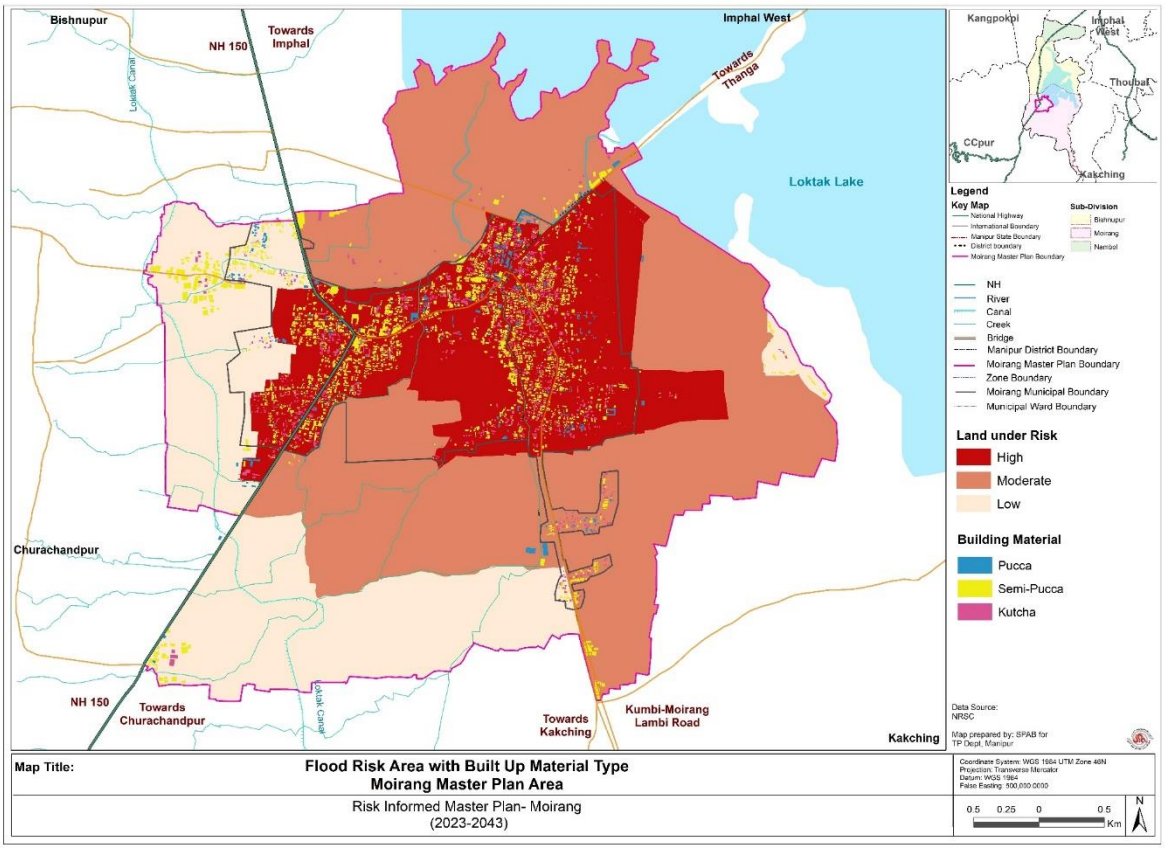
Source: Google Earth Imagery & Loktak Atlas

16.5.2.3. 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 16.5-5 shows areas in high risk which has dense built ups. The concrete surfaces has 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 16.5-5: Built environment



Source: Author

16.5.2.4. 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 some key factors which assess the flow direction of water:

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.

River: The direction of flow is determined by the river's course and the gradient of the land.

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.

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.

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.

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.

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.

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.

16.5.2.5. Historical Flood Data:

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.

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.

16.5.2.6. 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 built activities and water quality of the outflow channels.

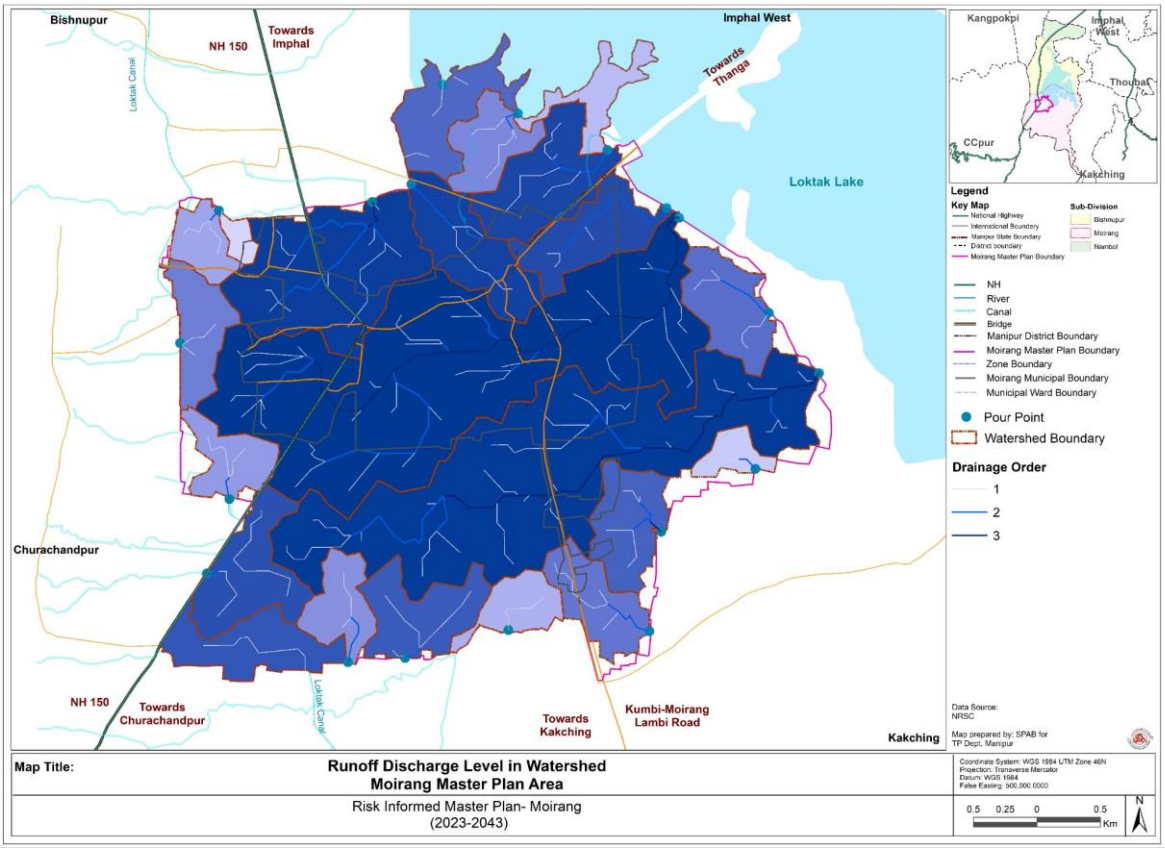
Watershed runoff is an important factor to know at what level the area is dealing with the heavy rainfall. It is pivotal to understand the relation between built environment and open spaces. In the Map 2.4-6, all order drains are flowing the slope and contour of the area and merging at one point. the 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 bye laws 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 2.4-6 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 bye laws. 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 16.5-6: Runoff capacity of watershed



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

Report of Manipur Vision 2030

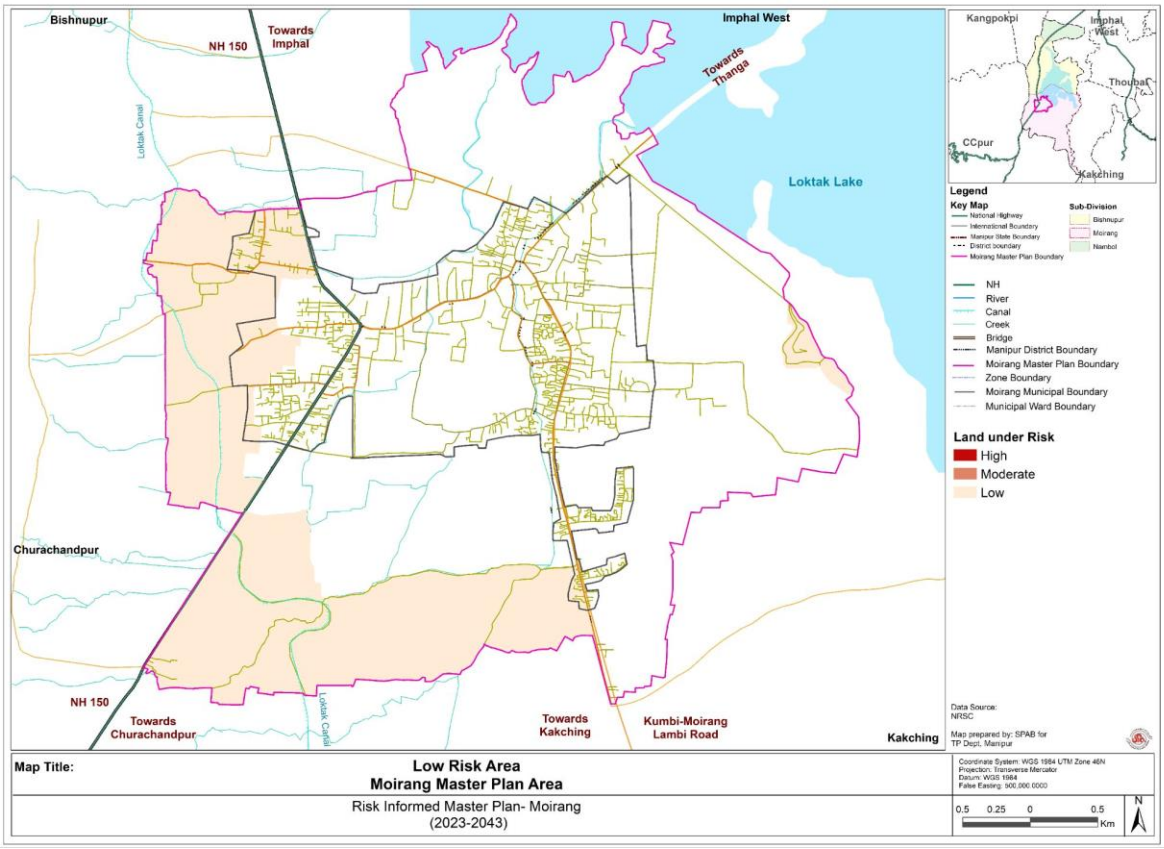
16.5.3. Flood Prone Areas

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.

16.5.3.1. 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 2.4-7 shows areas boast 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. Additionally, the infrastructure in these zones primarily consists of sturdy 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 northern to eastern sectors within the Imphal planning area exhibit these characteristics, signifying them as low-risk areas with regards to flooding.

Map 16.5-7: Low flood risk area

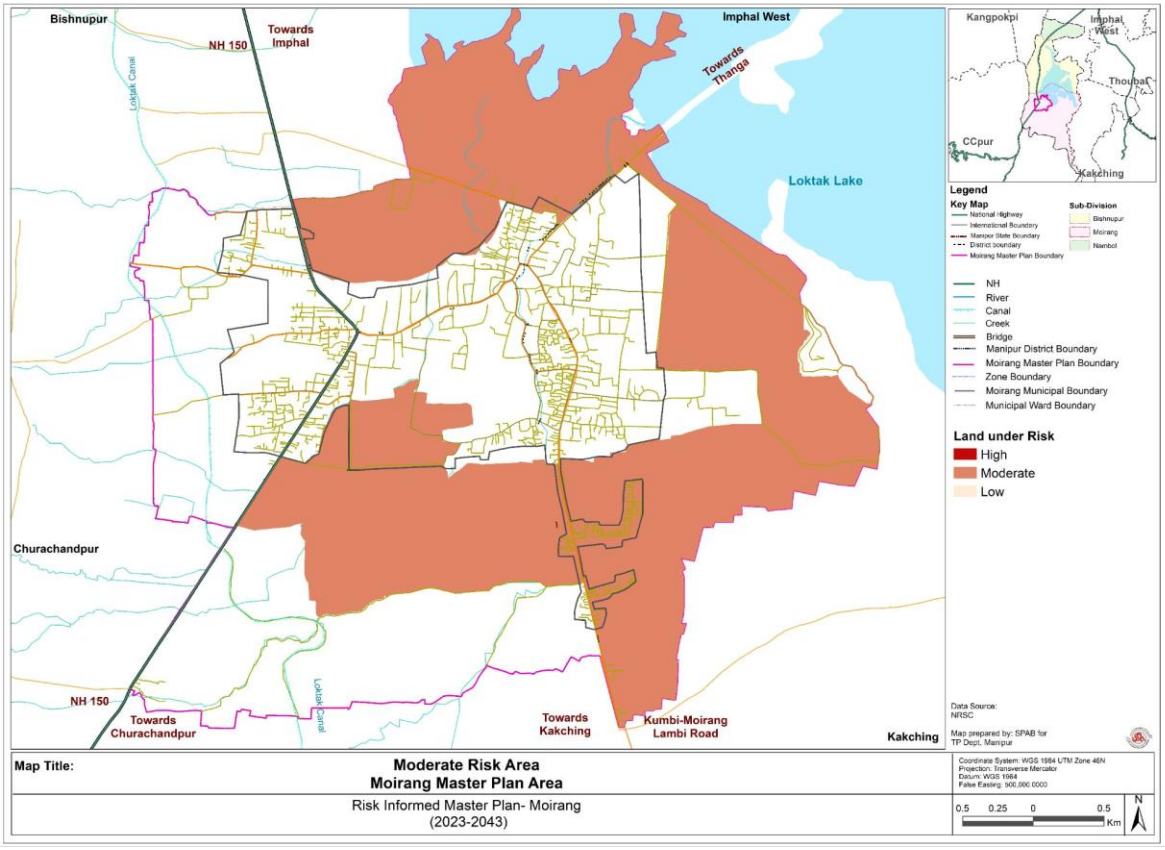


Source: Author

16.5.3.2. Moderate Flood Risk

Moderate flood risk areas in the Imphal 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 2.4-8 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 southwest and southeast sectors, these areas exemplify the complex factors influencing flood risk.

Map 16.5-8: Moderate flood risk area



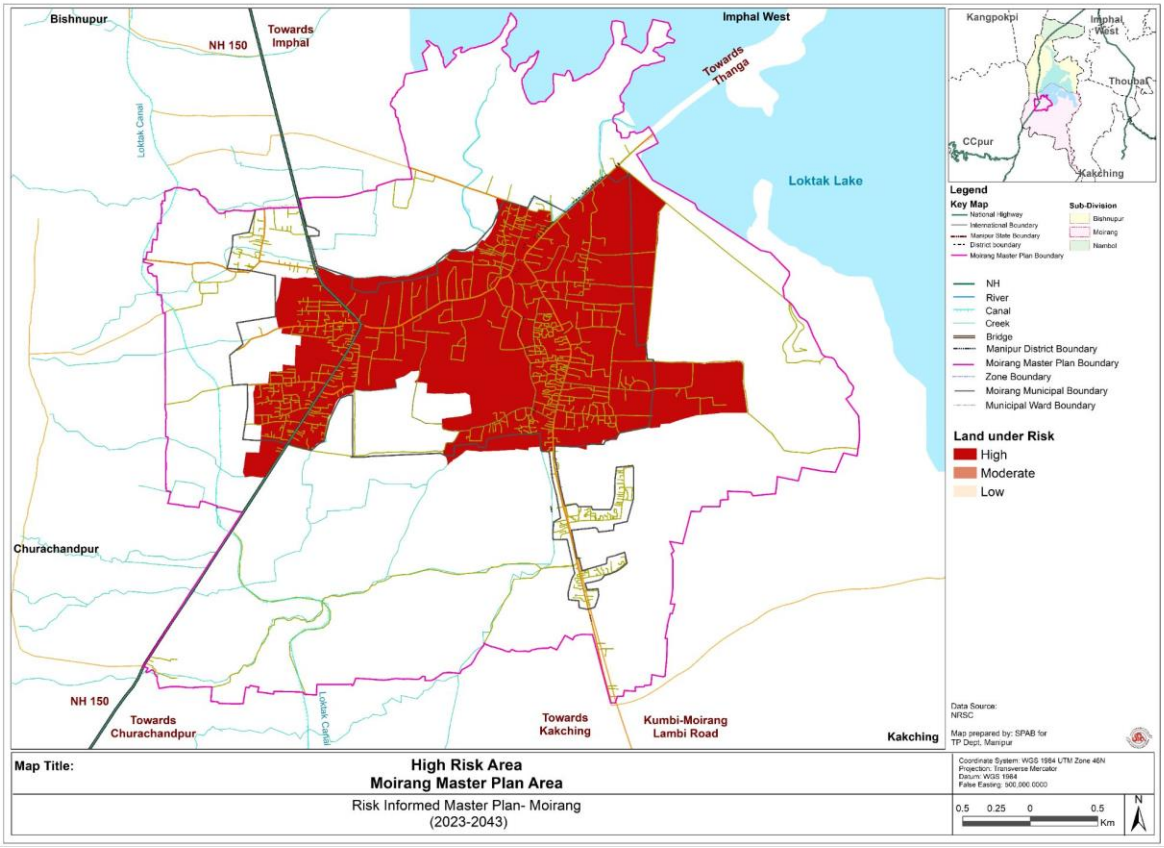
Source: Author

16.5.3.3. High Flood Risk

High flood risk areas in the Imphal 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 16.5-9, it shows that the high flood risk areas primarily lie in the western, southern, and central sectors of the Imphal 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.

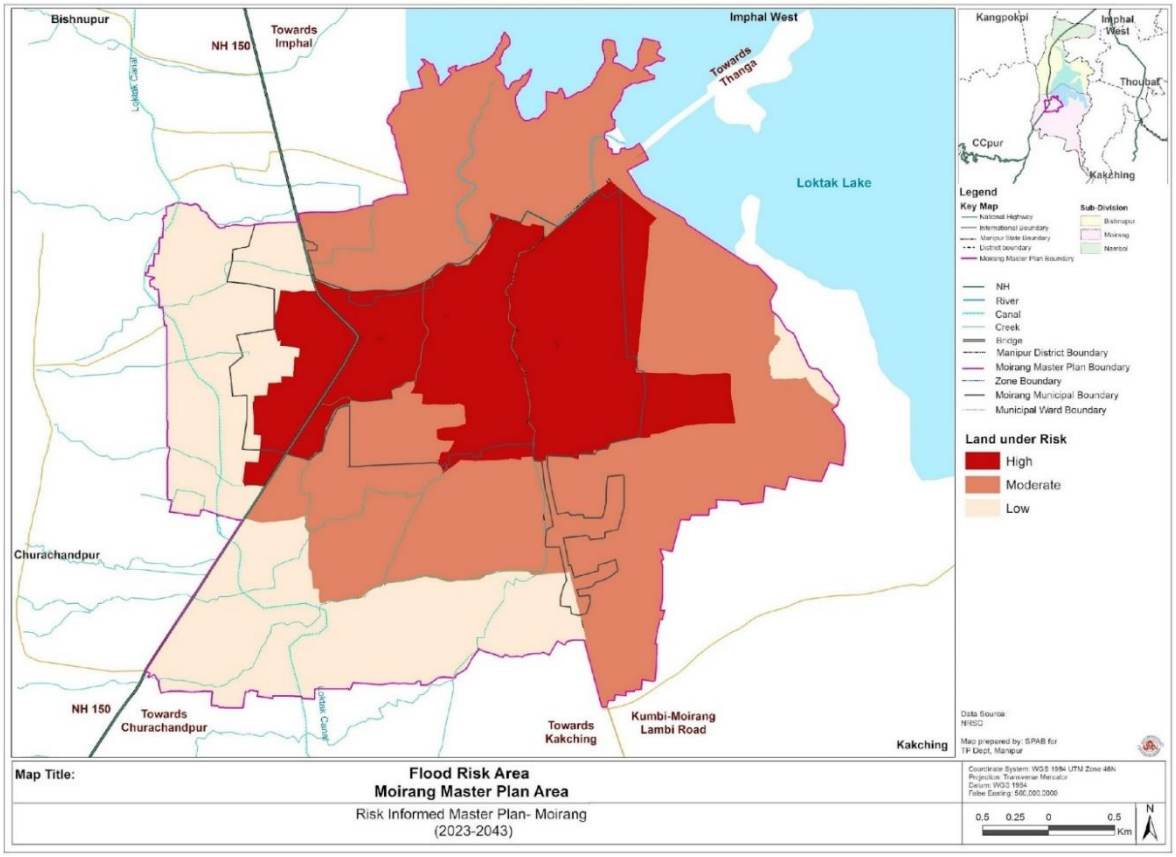
Map 16.5-9: High flood risk areas



Source: Author

Combining these factors in a holistic analysis it will provide a comprehensive understanding of flood-prone areas as shown in Map 16.5-10, enabling better flood risk assessment and mitigation planning. It's essential to involve experts in hydrology, geology, and urban planning to ensure a thorough evaluation of the potential risks.

Map 16.5-10: Flood prone areas



Source: Author

16.5.4. 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:

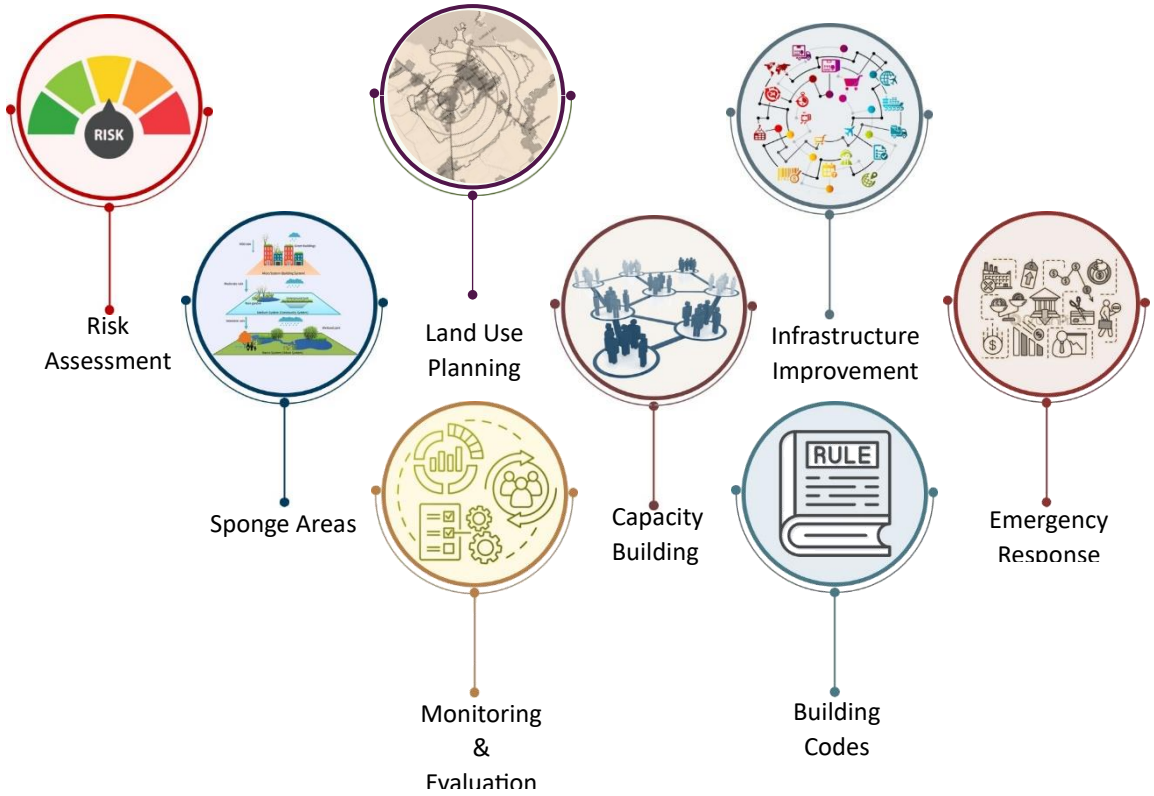


Figure 16.5-2: Mitigation Measure for Risk Reduction

16.5.4.1. 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.

16.5.4.2. 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.

16.5.4.3. 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.

16.5.4.4. 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.

16.5.4.5. 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.

16.5.4.6. 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.

16.5.4.7. 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

16.5.4.8. Flood Emergency Access

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

16.5.4.9. 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.

16.5.4.10. 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 bye laws 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 in order to get proper drainage. Built activities should happens in such a way that rain water 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 rain-water 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 rain water should move away from the site as early as possible without stagnation.

16.5.5. Earmarking of Earthquake Prone Areas

16.5.5.1. 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.

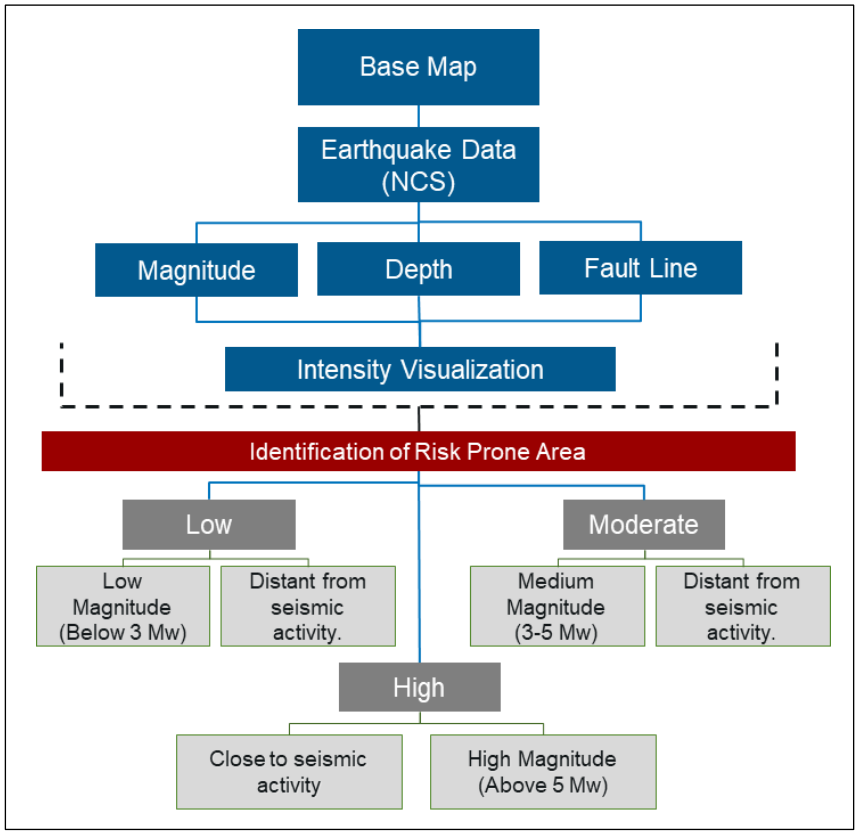
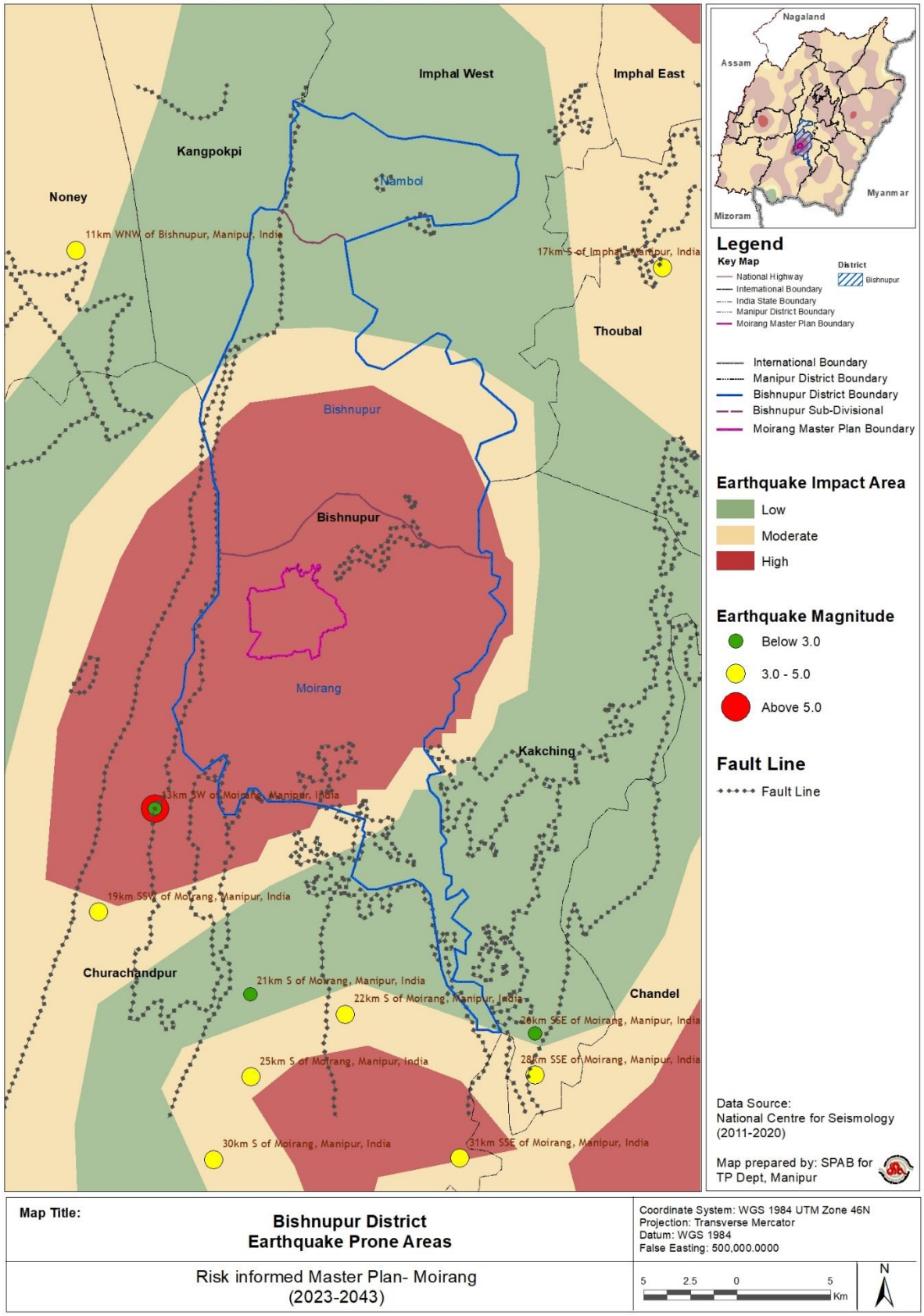


Figure 16.5-3: Methodology for earmarking earthquake prone areas

16.5.5.2. Earthquake Prone Area

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.
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.
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.

Map 16.5-11: Earthquake prone area



Source: National Centre for Seismology

16.5.6. Mitigation plan for Earthquake

16.5.6.1. 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.

16.5.6.2. 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.

16.5.6.3. 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.

16.5.6.4. 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.

16.5.6.5. 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.

16.5.6.6. 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.

16.5.6.7. 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.

16.5.6.8. 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.

16.5.6.9. 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.

16.5.6.10. Building Bylaws 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 bylaws based on the seismic risk and soil conditions of the area.

16.6 Suitability of areas as per slope gradient

The permission for building construction based upon slope gradient is typically governed by local building bye laws and regulations. Different regions and municipalities may have specific guidelines regarding the acceptable slope gradients for construction.

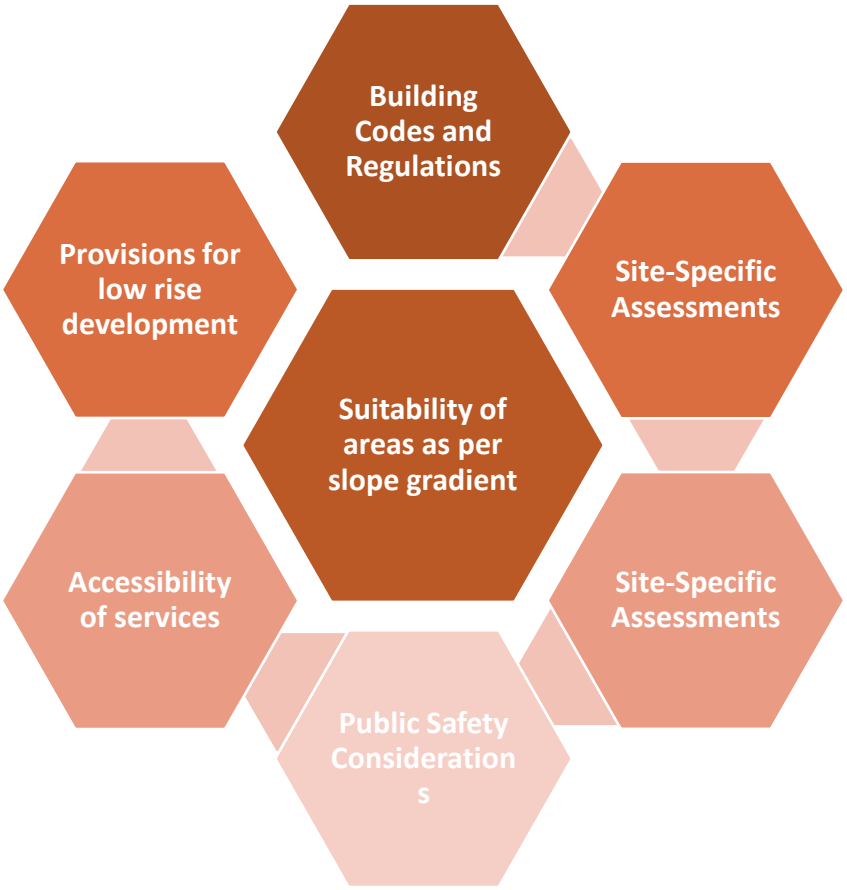


Figure 16.6-1:Suitability Factors

16.6.1. Building Codes and Regulations

Building bye laws 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.

16.6.2. 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.

16.6.3. 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.

16.6.4. 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

16.6.5. 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:

16.6.5.1. Elevation

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

16.6.5.2. 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 mold, decay, and corrosion.

16.6.5.3. 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.

16.6.5.4. 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.

16.6.5.5. 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.

16.6.5.6. Floodplain Regulations

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

16.6.5.7. 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.

16.6.5.8. 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 17: 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:

17.1 Considerations

17.1.1. 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.

17.1.2. 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.

17.1.3. 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.

17.1.4. 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.

17.1.5. 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.

17.1.6. 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.

17.1.7. 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.

17.1.8. 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 17.1-1: Total area of activities proposed

Proposal	Total Area (Ha)
PSP	4
Recreational	45.15
Educational	3.57
Health Services	0.43
Mixed	12.16
Public Utilities	1.69
Residential	41.62
Road	1.03
Transportation	4.18
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.

17.2 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.

17.3 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 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 17.3-1: Proposed Land Use distribution

Landuse	Existing		Proposals (Sector Based)	Total Proposed	
	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: Author

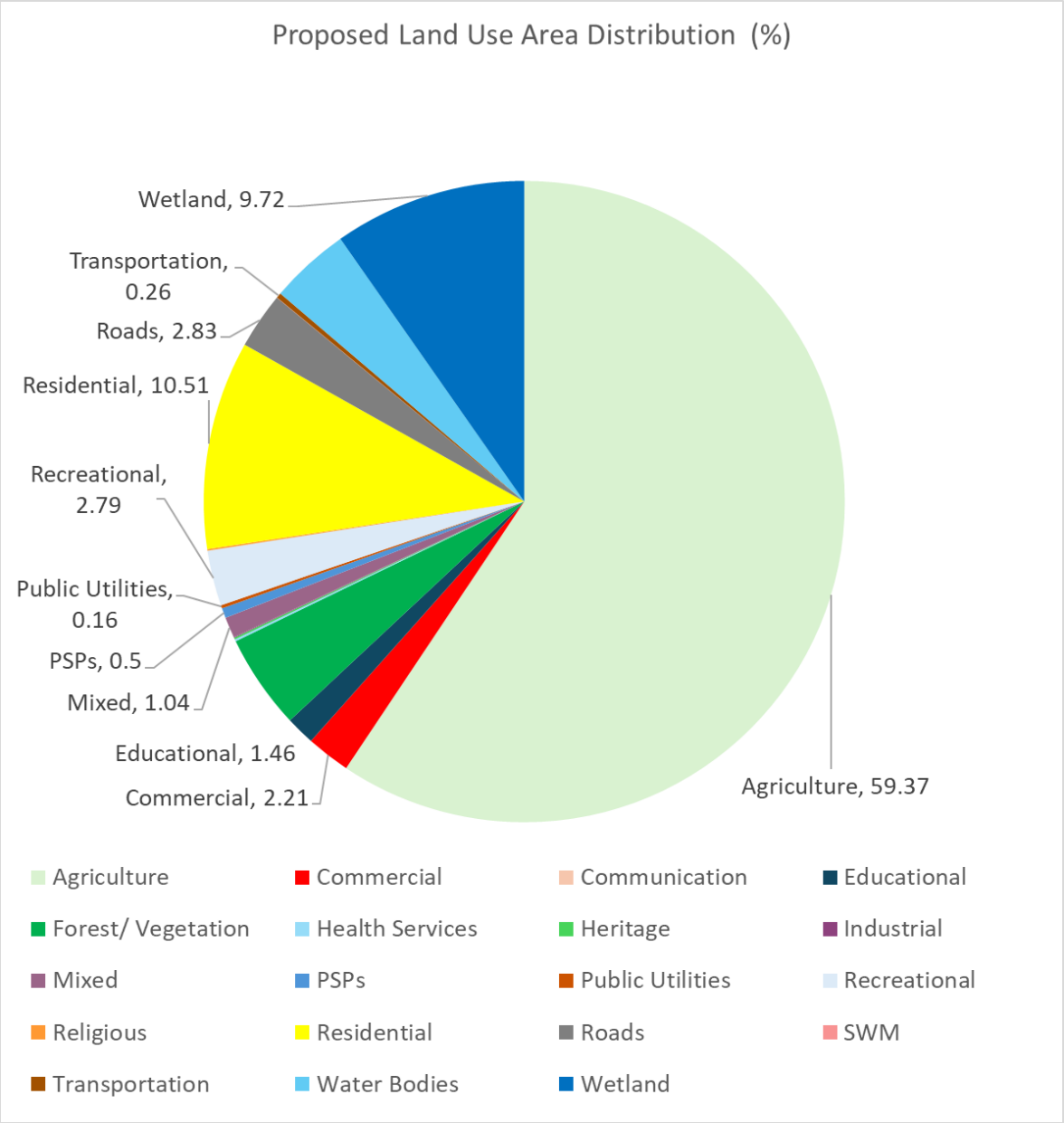
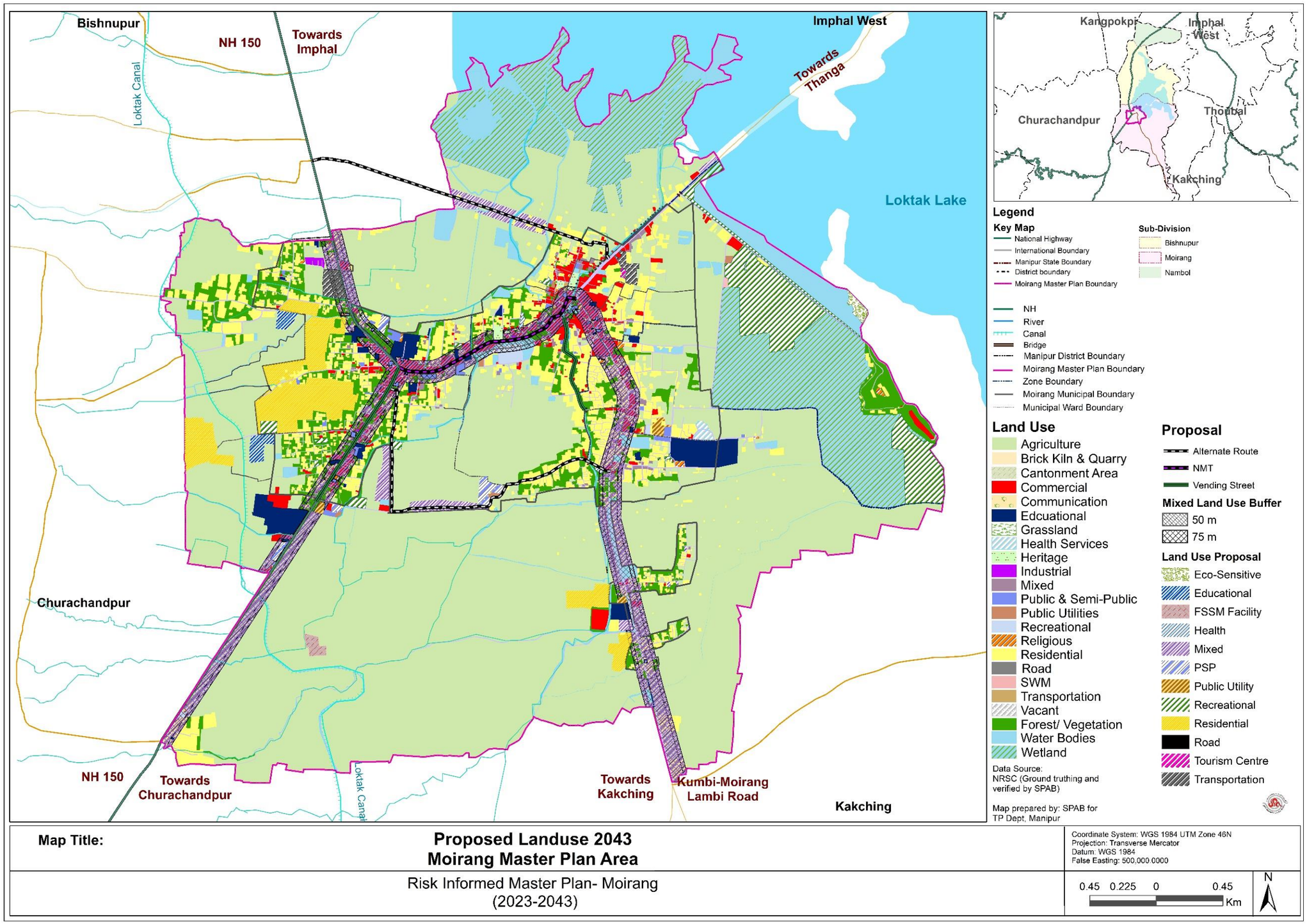


Figure 17.3-1: Proposed Land Use Area Distribution

Source: Author

Map 17.3-1: Proposed Land Use Map



17.4 Transportation

17.4.1. 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. 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 17.4-1. 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

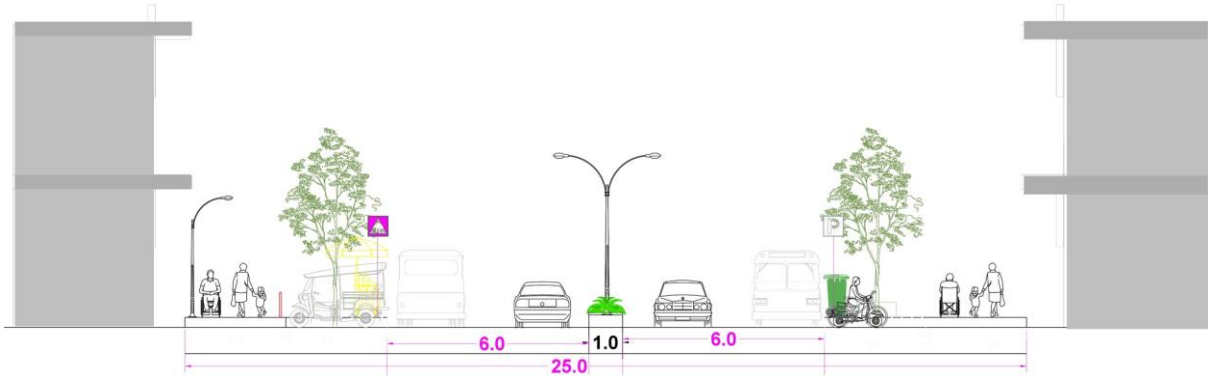


Figure 17.4-1: Alternate routes cross-section

expand both radially and in a more circular manner.

Source: Author

17.4.2. Proposed New Roads

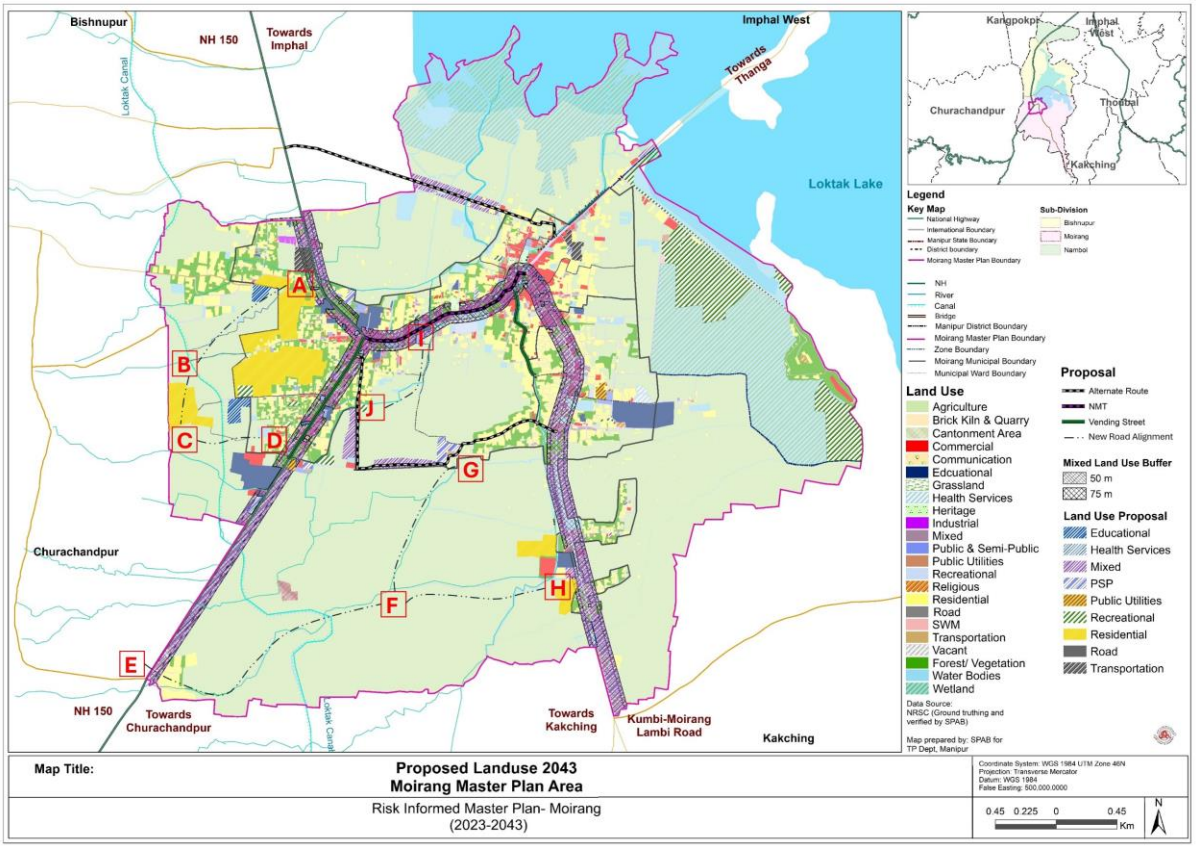
Improving existing roads is important in terms of easy movement of people, goods and services. Kutcha roads connected to roads along the creek and Loktak canals need to be strengthened as most residential/ housing is proposed towards it. Table 17.4-1 illustrate the roads that are identified as new road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

Table 17.4-1: Proposed new roads specifications

S. No.	Road	Width	Purpose
1.	Interconnecting roads Point, A, B, C to D	15- 20 m	Access to Residential/ Housing
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

Source: Author

Map 17.4-1: New Road Alignment



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 17.4-2:

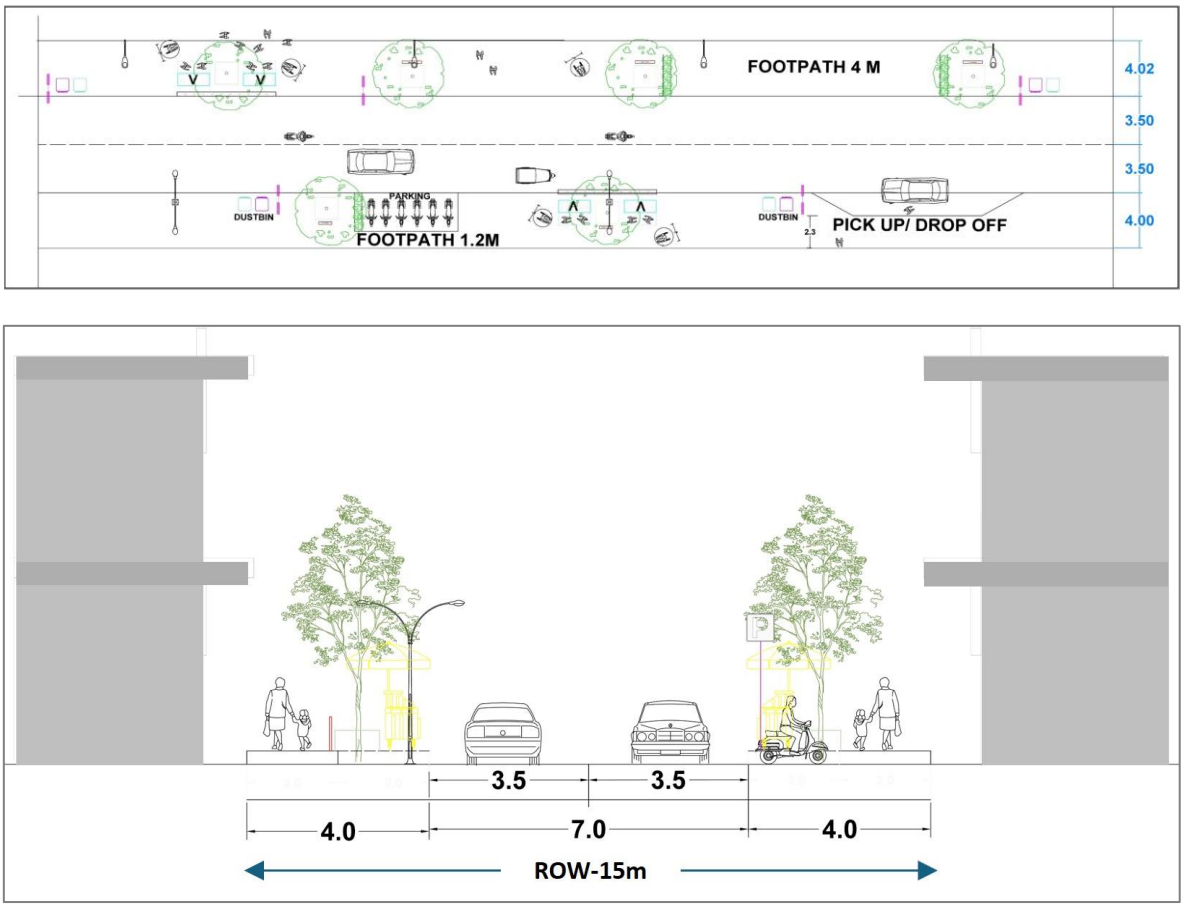


Figure 17.4-2: Proposed new roads plan and cross section

Source: Author

17.4.3. Zero Emission Zone (NMT)

Zero emission zones are defined as areas which prohibit the motorized vehicles and only zero emission vehicles such as electric cart/vehicle in the identified zones are allowed as shown in Figure 17.4-3. The purpose is to decarbonize the route by reducing carbon intensity transport. This proposal 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, improve environment and improve quality of life.

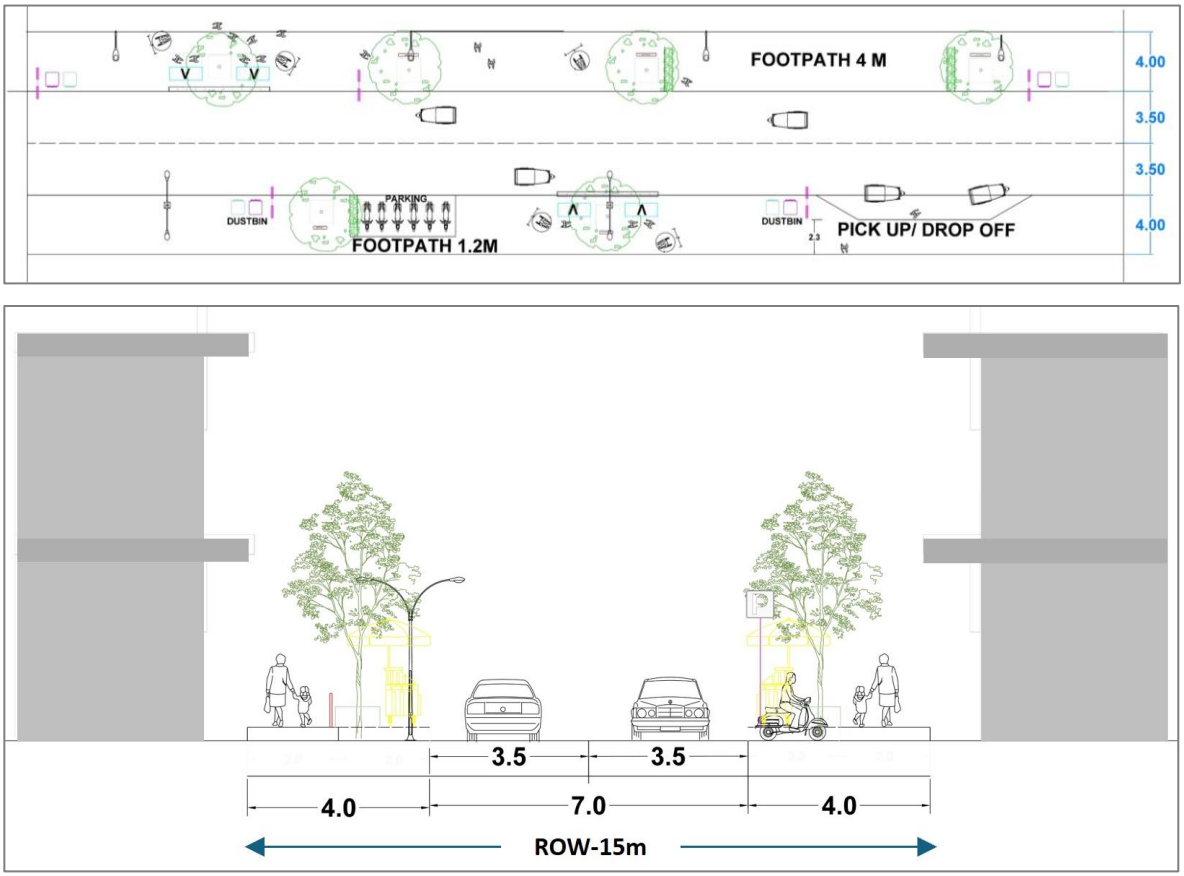


Figure 17.4-3: Proposed Zero emission zone (NMT Stretch) plan & cross-section

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 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. 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.

3. 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.

4. 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.

17.4.4. Proposed Parking

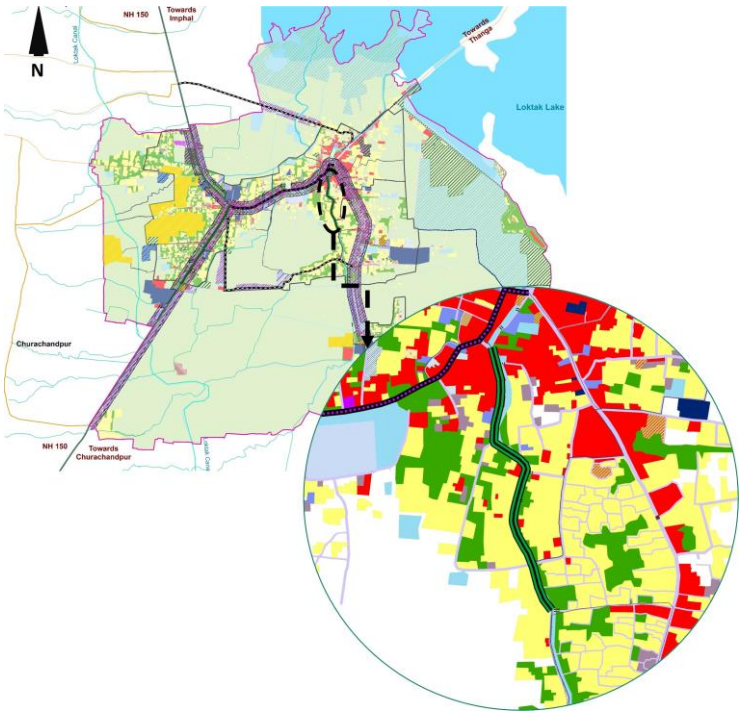
The proposed alternate routes and NMT zone are expected to redirect traffic to other areas of the town, facilitating a more uniform distribution of traffic across all roads. By restricting and regulating motorized vehicles within the NMT zone, there will be an increased demand for parking along these 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. Parking space 01 with an area around 0.48 Ha, is located along NH 150 to facilitate the NMT zone. Another parking space is near alternate route 2, having an area of 1.5 Ha. 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.

17.4.5. Vending Street

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)



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 17.4-4.

Figure 17.4-4: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)

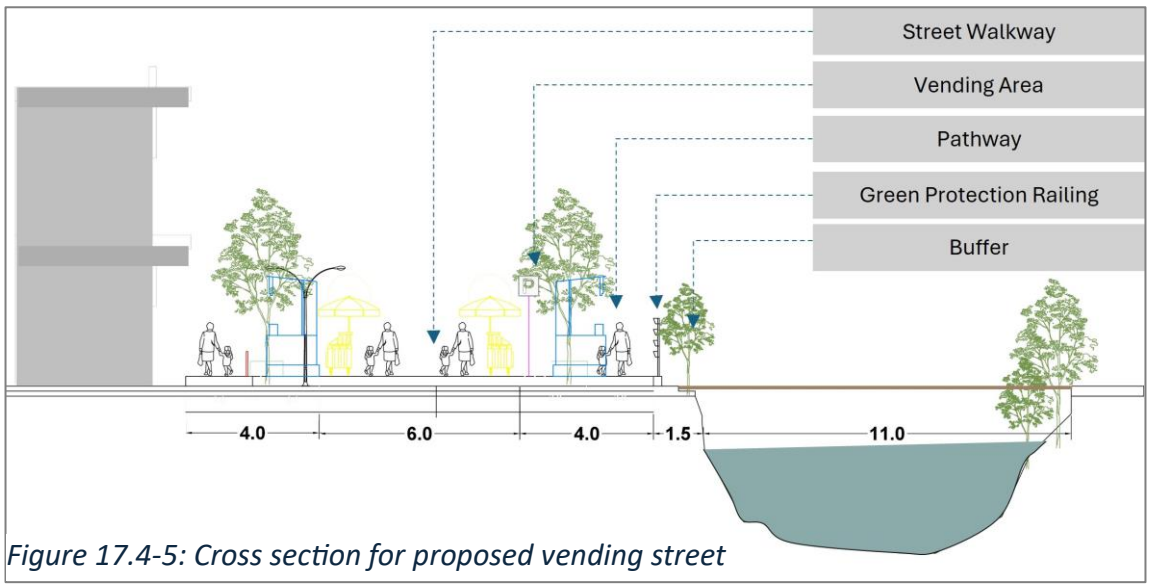


Figure 17.4-5: Cross section for proposed vending street

Source: Author

The recommended cross section for vending street is given in Figure 17.4-5. 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 to restrict the motorized vehicles. As per identified potential of the area, one parking is available near INA Museum and for surplus demand during festivals, spot is marked on Moirang-Kumbi road as shown in Figure 17.4-6.

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 17.4-6: 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.

Source: NIUA

Figure 17.4-7: Basic amenities for vendors and visitors

17.5 Social Infrastructure

17.5.1. 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 below:

Table 17.5-1: Demand for educational facilities as per URDPFI Guidelines 2014

Educational Facilities	Units Required for 2043 (as per URDPFI)	Units Required for 2043 after deducting existing	Total area required in 2023	Total area required in 2043
Pre primary	11	13	0.80	0.96
Primary School	7	8	2.40	2.80
Senior Secondary	2	2	1.80	1.80
College	1(Present)	0	0.00	0.00
Professional College	1	1	1.50	1.50
	Total		**6.50**	**7.06**

Source: URDPFI Guidelines 2014

17.5.2. 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. Below is the specified classification of health services required:

Table 17.5-2: 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**

Source: URDPFI Guidelines 2014

17.5.3. 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.

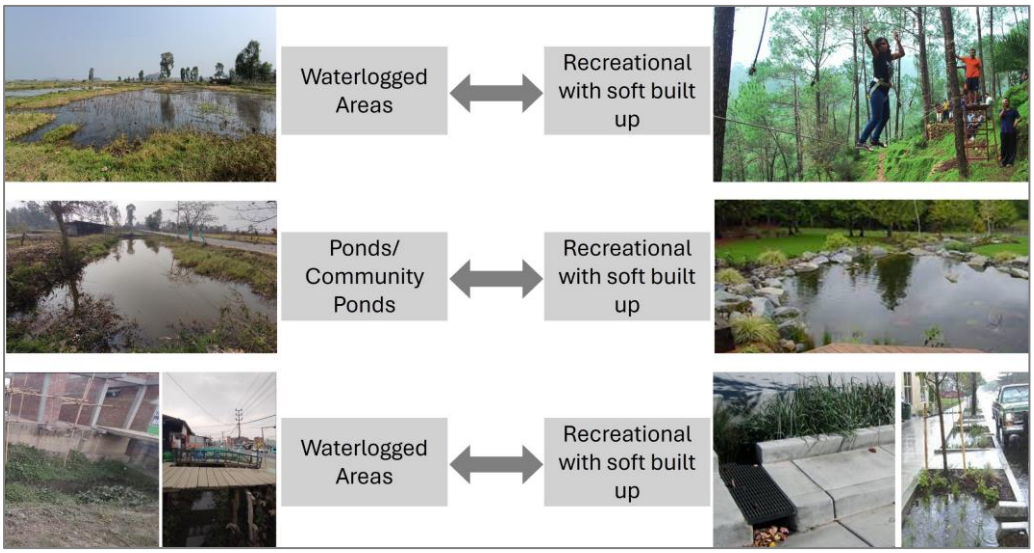


Figure 17.5-1: Approaches for Recreational spaces

Source: www.erinrockery.com

Furthermore, Moirang Town boasts numerous ponds utilized as community water bodies. Adjacent vacant land parcels are earmarked for housing and neighbourhood parks, with the intention of maintaining soil porosity. Additionally, a city-level park is proposed to enhance tourism.

Lastly, natural drains are identified for beautification, with two locations along NH 150 and behind the INA Museum toward the commercial area designated for development as blue-green infrastructure, ensuring their preservation for the future.

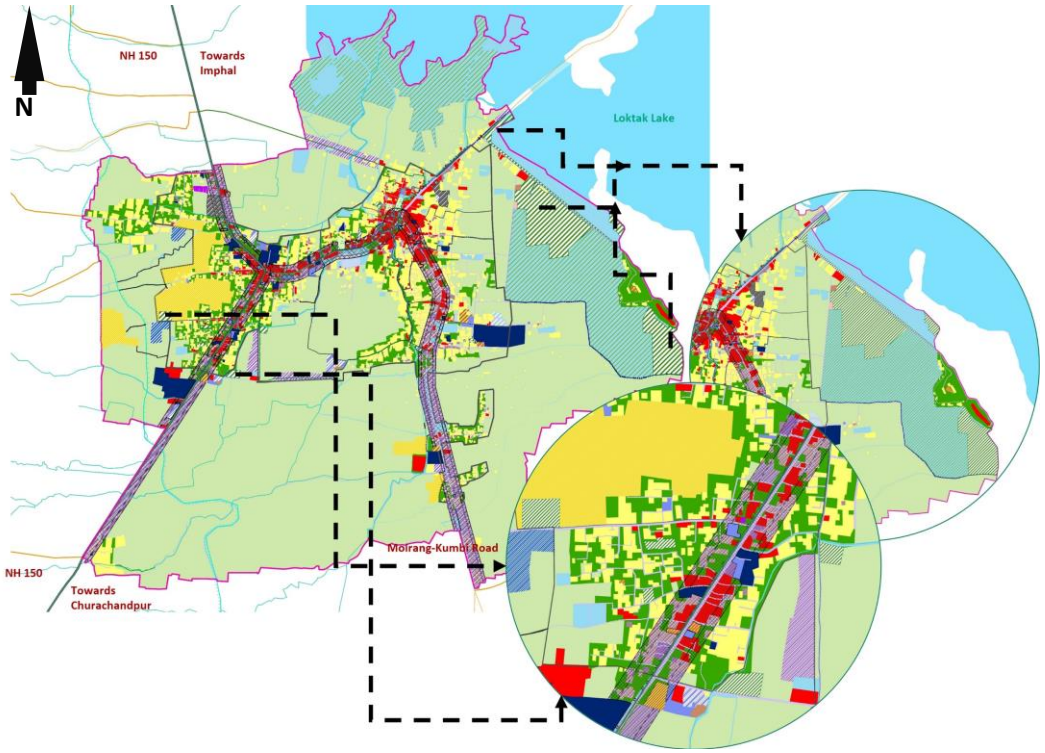


Figure 17.5-2: Proposed Recreational areas

Source: Author

17.6 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.

17.6.1. Water Supply

Availability of sustainable source of water with related infrastructure facilities is prime necessity for any development process. But prior to exploring for a sustainable source, it is utmost necessary that water demand is worked out based on alternate standards, benchmarks and acceptable norms. The piped water supply has to be designed to provide adequately for domestic needs, Institutional needs, Industrial use, unaccounted for water including distribution losses, treatment losses and transmission losses, other demands also.

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 17.6-1.

17.6.2. Sewerage

Reckless 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 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 17.6-1

Table 17.6-1: Water Supply Demand and Wastewater Generation till 2043

Year	WATER SUPPLY					WASTEWATER	
	Population	Water Demand (MLD)	UFW @15%	Total Water Demand (MLD)	Land Required for WTP(URDPFI)	Wastewater generation @80% (MLD)	Land Required for WTP(URDPFI)
2011	**23407**	1.64	0.25	**1.39**		**1.11**	
2021	**26405**	1.85	0.28	**1.57**	**0.03**	**1.26**	0.88
2031	**29632**	2.07	0.31	**1.76**	**0.04**	**1.41**	0.99
2041	**33120**	2.32	0.35	**1.97**	**0.04**	**1.58**	1.10

Source: URDPFI Guidelines 2014

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.

17.6.2.1. FSSM Sanitation Facility Value Chain

FSSM value chain divided in various stages which possibly manage human excreta safer and more efficient way. The stages are:

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.

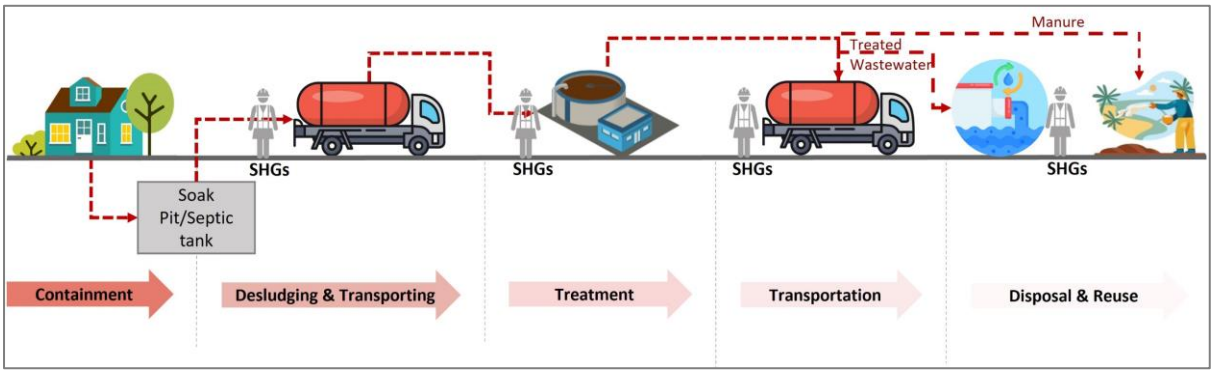


Figure 17.6-1: FSSM Model for sewerage management

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 Managemnt (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.

17.6.2.2. Sewage Treatment Plant

It is proposed to provide conventional Activated Sludge Process. The plant shall comprise of Coarse screen chamber, Sewage pumping station, Fine screen chamber, Grit chamber, Activated sludge type Aeration Chamber. The treatment plant (TTP) shall comprise pre-chlorination chamber, rapid gravity sand filters and post chlorination mechanism as per CPHEEO Manual. The reuse of treated wastewater, can be in any form such as direct disposal into water body, used for irrigation purposes, firefighting, etc.

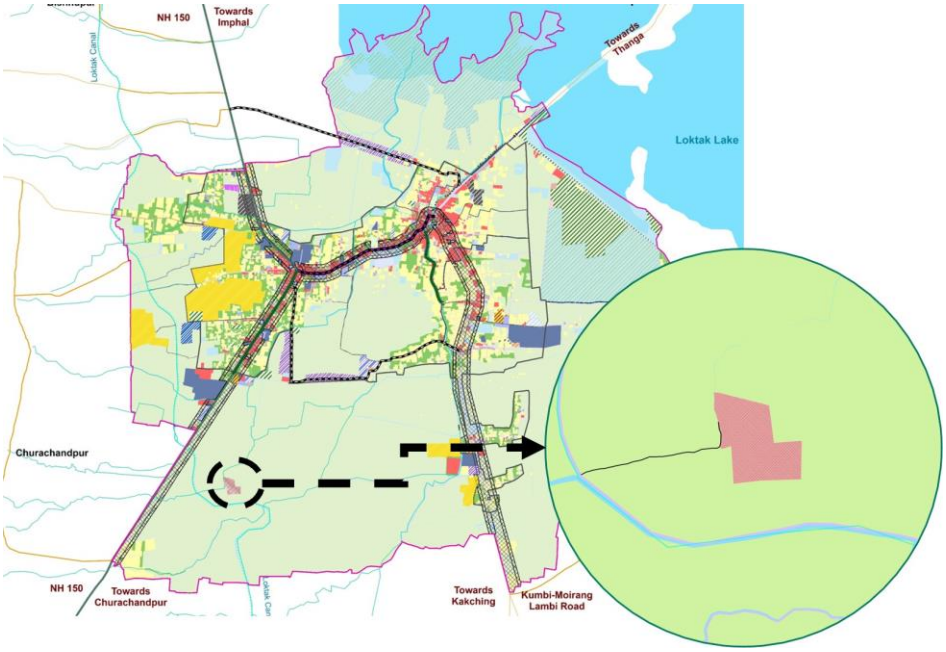


Figure 17.6-2: Location of FSMM Treatment Unit

Source: Author

17.6.3. 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.

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 17.6-3, 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 17.6-4. 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.

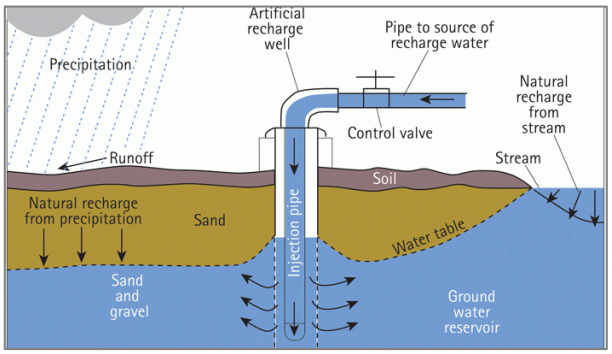


Figure 17.6-4: Recharge well

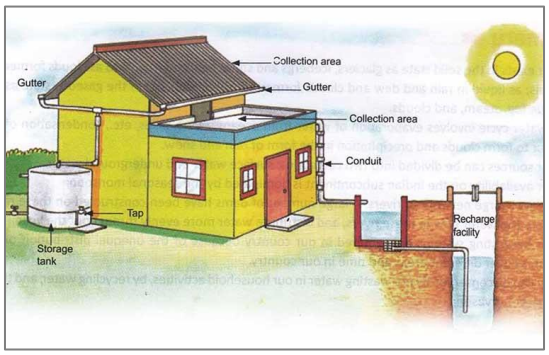


Figure 17.6-3: Rainwater harvesting

Source: www.ntotank.com

17.6.4. Solid Waste Management

17.6.4.1. 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 17.6-5: Segregation of solid waste

Source: Open Source

17.6.4.2. 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 17.6-2 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 17.6-2: 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	**23407**	10533.15	421.33	10.53	**0.126**	-
2021	**26405**	11882.40	475.30	11.88	**0.143**	0.195
2031	**29632**	13334.54	533.38	13.33	**0.160**	0.195
2041	**33120**	14904.21	596.17	14.31	**0.179**	0.195

Source: URDPFI Guidelines 2014

17.6.4.3. 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.

E. 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.

F. 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 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.

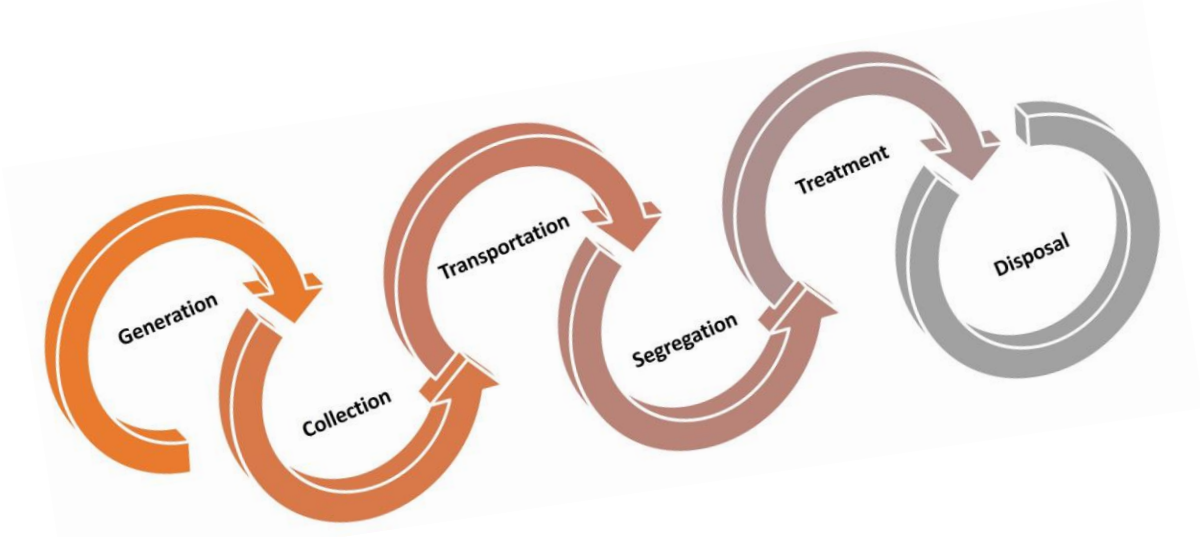


Figure 17.6-6: Solid Waste Management Process

Source: Author

Local body shall frame Bye-laws 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.

17.6.5. 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.

17.7 Tourism

Moirang, known for its tourism appeal, experiences a fluctuating floating population ranging from 2000 to 2500 individuals per day. To accommodate this influx of tourists and ensure smooth movement of people, several infrastructure services are necessary:

17.7.1. 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 17.7-1: Tourist Information Centre

Source: Author

17.7.2. 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 17.7-2: Upgradation of multipurpose ground

Source: Deshgujarat, hindustantimes.com and alphahousing.vn

17.7.3. 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.

17.7.4. 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.

17.8 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. 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. By juxtaposing the proposed residential land use with the current allocation, it is anticipated that approximately 180 hectares will be allocated to residential purposes, ensuring a uniform and planned development.

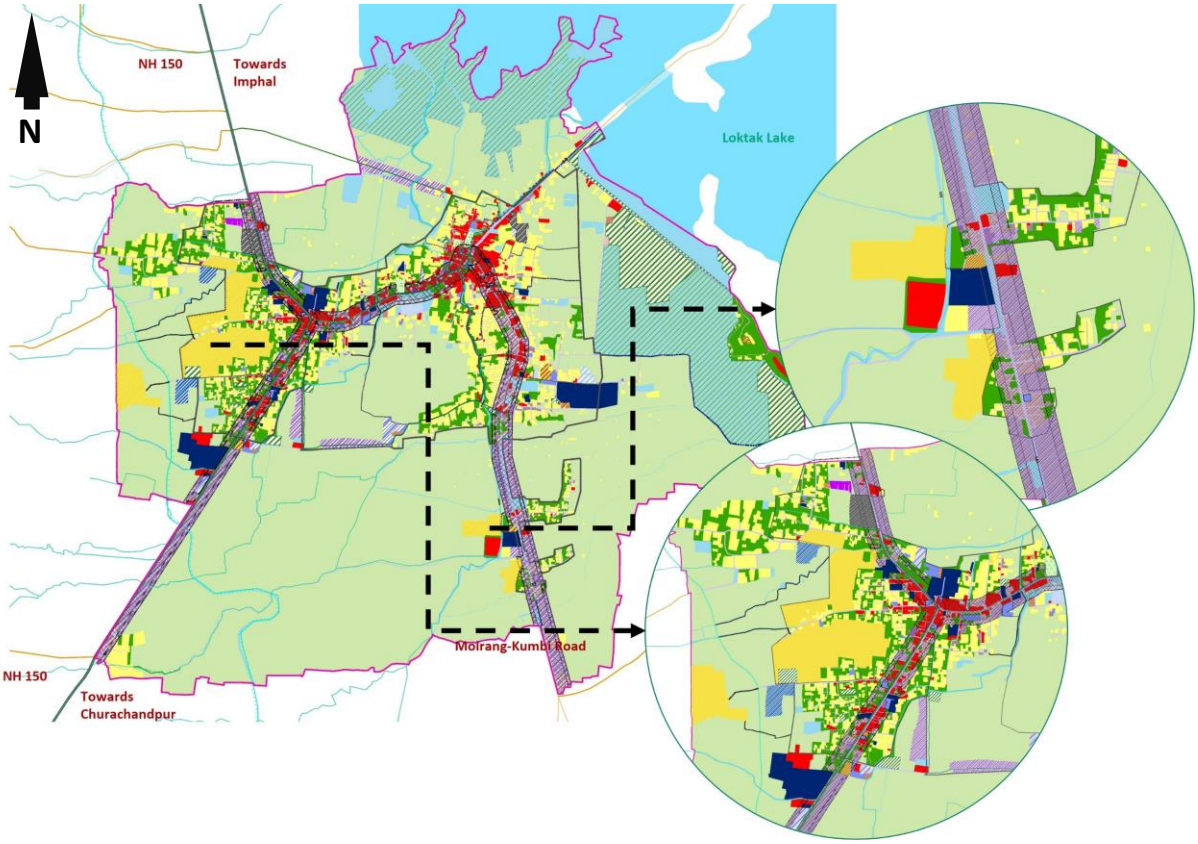


Figure 17.8-1: Location of proposed residential units

Source: Author

17.9 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 (Refer Table 17.3-1).

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 neighborhood 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 co-working 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 Map 17.9-1.

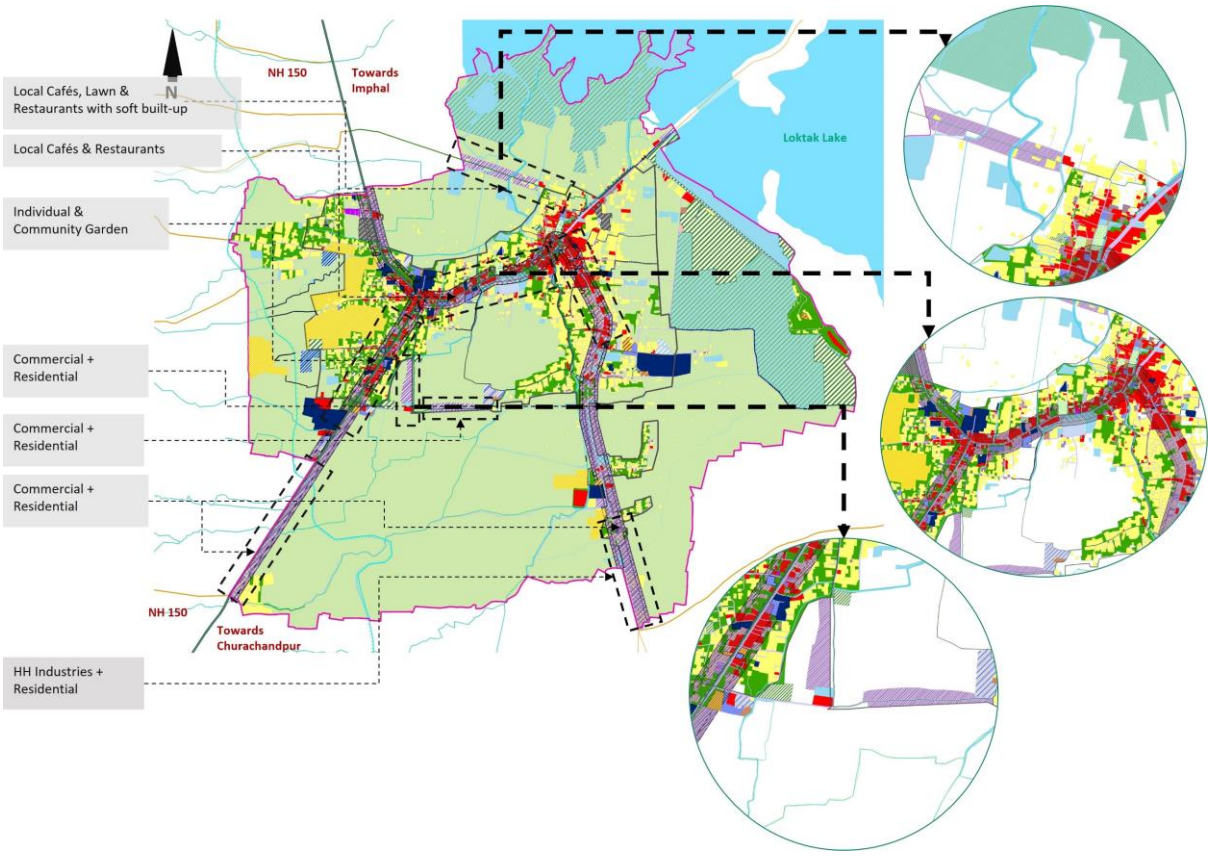
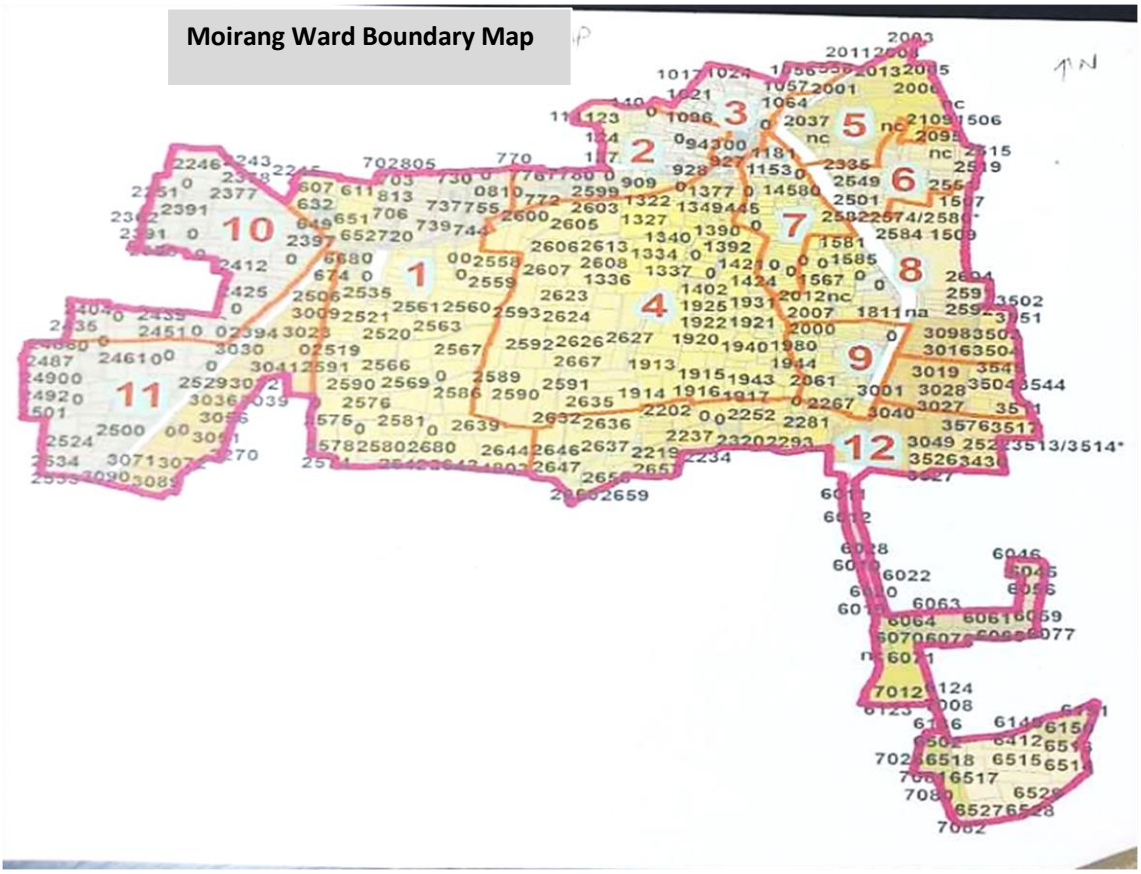


Figure 17.9-1: Locations of proposed mixed land use land area

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).
- 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.
- 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 walking. (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 √ on building Id polygon on the grid map 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 numbers)

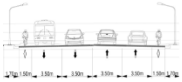
1. **Element Id:**
   Please identify the lowest value of element ID in the grid and enter it in the first column first row. Different row are to be entered with details of different element but sequentially (for example, 401 should be followed by 402, 403, and 404 in succession). The building/element 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.
2. **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

3. **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:**
   Please identify if 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 5a). 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 5a) and residential will come under Minor (Column 5b).
   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 blank.
5. **Road stretch Id:**
   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.
6. **Number of lane:**
   Please identify the number of lane present in the road you are presently observing. The standard one lane road is 3.5 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**).

A- 2 lane Road without divider



B - 4 lane Road without divider

C- 4 Lane road with divider

D- 6 Lane road with divider

7. **Right of Way (ROW):**
   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 Id. It is the land taken for the road from one end of the margin to the other end. It consists of Road/Carriageway and extra margin given for the future expansion of road. (Refer Figure-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.

A typical Right of way (ROW)

Figure-1

8. **Drain:**
   Please observe if there is any drain present in the given road stretch. It is constructed along the road length on the side of road. It let out the rain water from the road and also the household wastewater to

the nearby disposal 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**)

E- Drain with rain water+ household wastewater

F-One side drain along the road

G-Solid waste disposal around drain

H-Closed Drain

9. **Surface of Road:**
   Please identify the roads by looking at the materials used in road construction. Road surface are of two types:
   a) Hard Surface:
   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 **L**)

I- Bitumen/Asphalt/Black tar Road

J-Cement-Concrete road

K- Pavored+Cement Concrete Road

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**)

M-Loose grave/Moorum Road

N-Katcha Road

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**).

O- On street Parking

P- Off Street Parking

Annexure 3: Press release by Manipur state related to earthquake on 10th October 2020

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

1. An earthquake of magnitude **M:5.3** occurred on 10th 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 **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-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

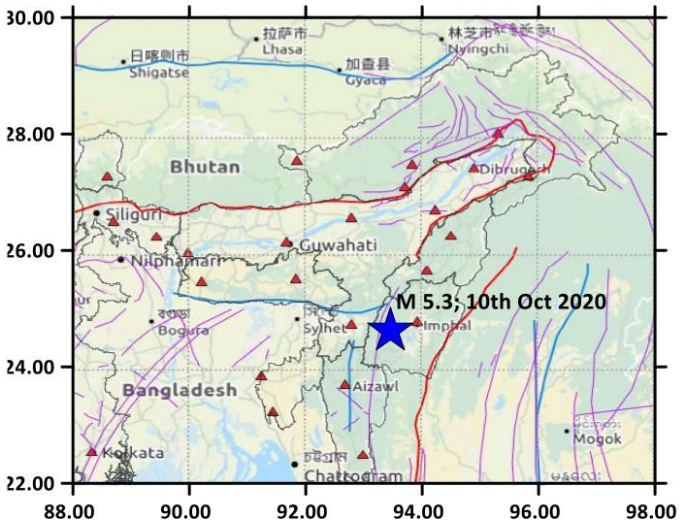


Figure 1: Map showing the location of the earthquake of M:5.3 (Blue Star) occurred on 10th October 2020 near Tamenglong district, Manipur State. Seismological stations of NCS in NE region of the country are also shown as Red colour triangle. The continuous thin blue and red thick lines are the major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

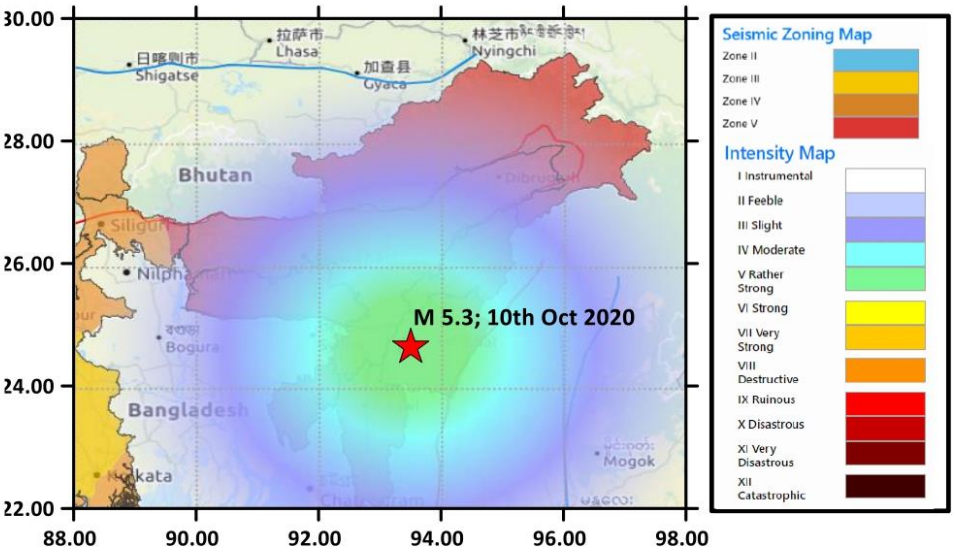


Figure 2: Map showing the intensity map of M:5.3 earthquake occurred on 10th October 2020 near Tamenglong District of Manipur State.

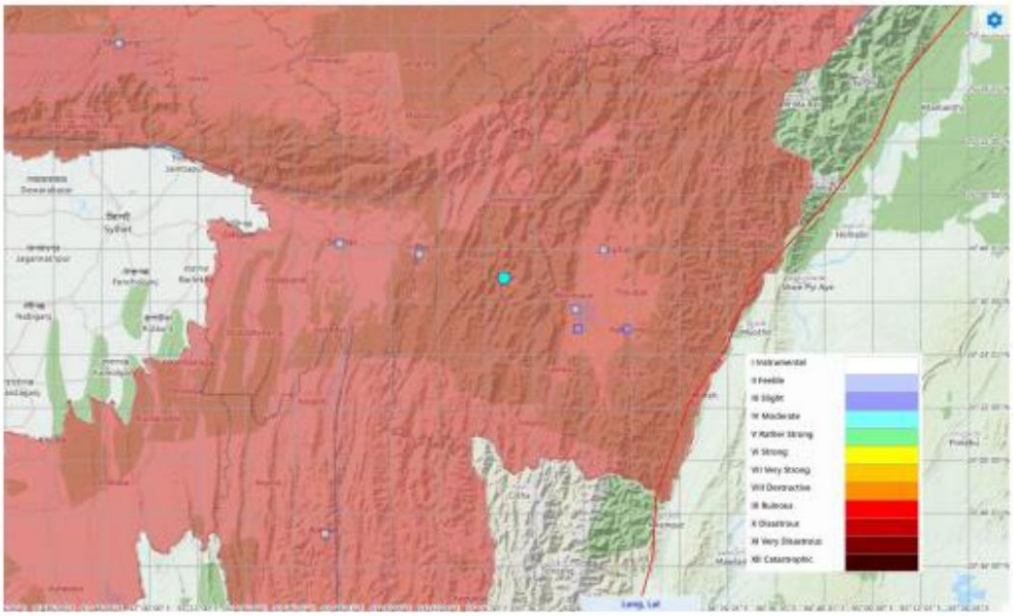


Figure 3: Map showing the epicentre of the earthquake (blue colour circle) and felt responses (squares) received within 18 hours from the occurrence of the earthquake.

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 (^{O}N)	Longitude (^{o}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

3

Date Day-mm-yr	Time (UTC) Hr:mn:sec	Latitude (^{O}N)	Longitude (^{o}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