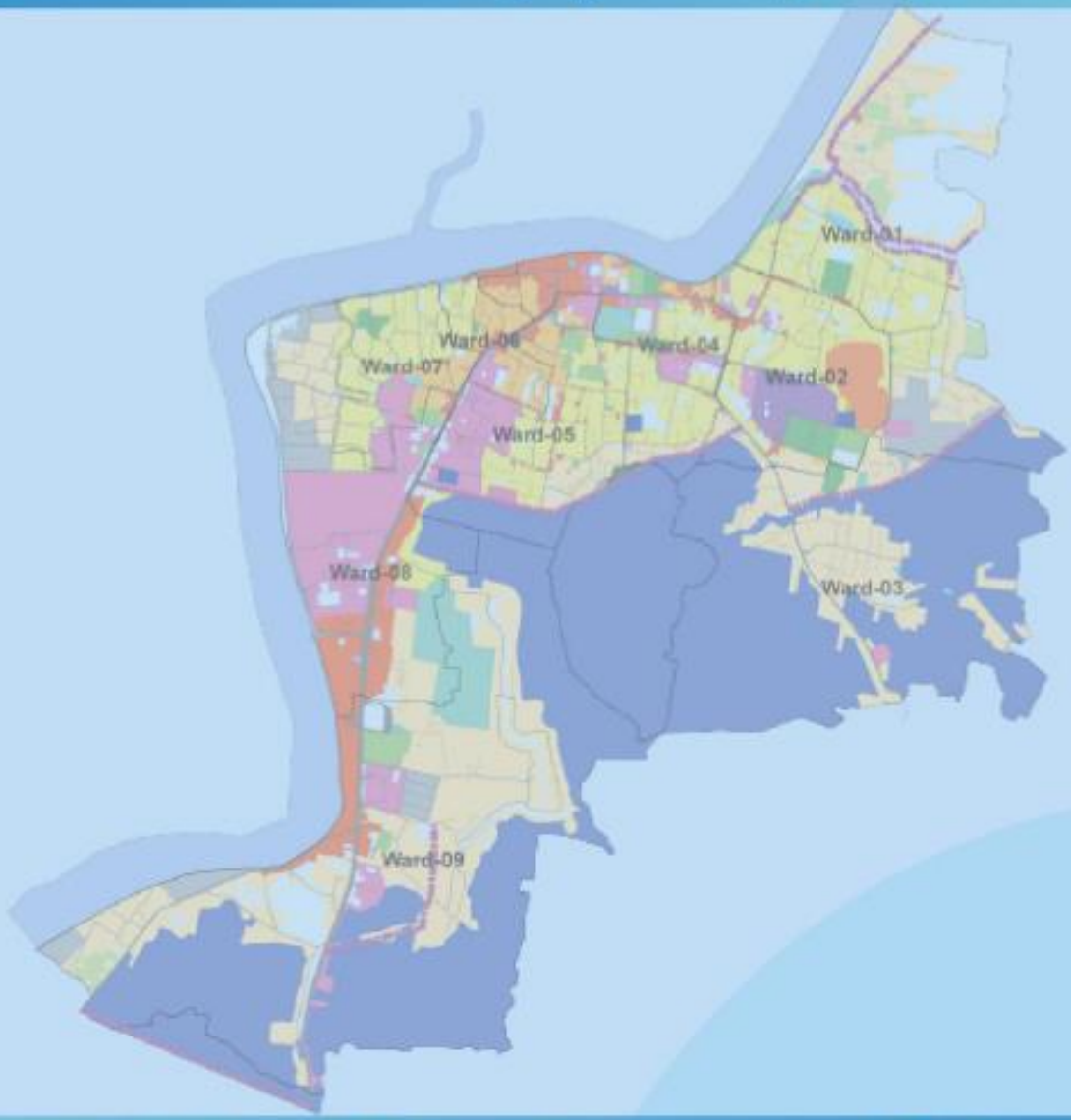
National Resilience Programme

Earthquake Sensitive Land Use Plan (ESLUP) for Sunamganj Municipality



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The project, **"Preparation of Earthquake Sensitive Land Use Plan (ESLUP) under National Resilience Programme (NRP): DDM Part"**, is a part of preparedness and mitigation activities of Sunamganj Pourashava in partnership with National Resilience Programme - DDM part - of the Ministry of Disaster Management and Relief. The cooperation extended by the MoDMR, DDM and UNDP for this project is highly appreciated and acknowledged by the research team.

The research team would like to express deepest appreciation to all those who have provided the possibility to complete this report. The team members express a special gratitude to Sunamganj Pourashava and ward offices and NRP team for offering the necessary support to arrange meetings and to communicate with various stakeholders.

Furthermore, a special thanks goes to ***Mr. Nader Bakth,*** honorable mayor of Sunamganj Pourashava for providing valuable suggestions and guidelines to perform the project works and complete the works more conveniently.

Last but not least, the project team is cordially thankful to the local people and volunteers of the study area for their kind cooperation and help during the training sessions, exploration of inventories, and field works of the research.

Executive Summary

Being located in one of the active seismic regions of the world, Bangladesh is susceptible to earthquake. An earthquake can cause both life loss and damage to physical infrastructure and facilities. To reduce the damages and frequency of these urban hazards a risk-sensitive land use plan is required with guidelines for earthquake sensitive development.

Sunamganj is one of the fast-growing urban centers in the northeastern part of the country located in the close proximity of dauki fault. The municipality is experiencing fast development which is taking place haphazardly. Due to the geographic location and development trend, the municipality is vulnerable to earthquake. Through the project named ***Preparation of Earthquake Sensitive Land Use Plan (ESLUP) under National Resilience Programme (NRP): DDM Part,*** an overall Earthquake Sensitive Land Use Plan including earthquake, flash flood, fire hazard, waterlogging risk zoning for Sunamganj Pourashava has been prepared.

An in-depth situation analysis has been done as it is an essential part of preparing Risk Sensitive Land Use Plan for Sunamganj Pourashava. To conduct the situation analysis - UAV image collection, processing, updating physical feature information (questionnaire survey through KOBO Toolbox), updating land use information, processing of survey data, field verification & updating of features, base map preparation, formatting of map and digital information, accuracy level of the spatial database, finalization of the spatial database and GIS map layout, field verification of maps, collection of secondary data, updating and finalization of GIS map layout, data analysis has been done.

Existing landuse categories has been analyzed in detail and the disaster issues of the pourashva are also incorporated with it. Again, landuse and disaster related national rules, regulations, acts, plans and policies has been reviewed during preparation period of this *Earthquake Sensitive Land Use Plan (ESLUP).* Then critical issues for landuse planning based on the existing conditions in respect of Demographic issues, Transport and Communication, Urban Utilities, Drainage and Environment, related other issues namely disaster, land use control, law and regulation etc. has been incorporated with the plan.

Population and the land uses has been projected before the proposed plan for 2041 has been prepared. Major concern for land use policy guideline has been given considering high risk of earthquake as well as fire hazard and floods. Guideline on different landuse categories has been provided to mitigate the earthquake as well as flood and fire hazard risk. At the last part of the plan some proposed recommendations have been included and an overall proposed earthquake sensitive land use plan map has been added to this report.

Acronyms

ASA	Association for Social Advancement
ASD	Action for Social Development
ATM	Automated Teller Machine
BC	Building Construction
BDP	Bangladesh Delta Plan
BGB	Border Guard of Bangladesh
BIWTA	Bangladesh Inland Water Transport Authority
BRAC	The Bangladesh Rural Advancement Committee
BNBC	Bangladesh National Building Code
CCA	Climate Change Adaptation
CNRS	Center for Natural Resource Studies
DDM	Department of Disaster Management
DRR	Disaster Risk Reduction
ERH	Education & Research, Health Facilities
ESLUP	Earthquake Sensitive Land Use Plan
ESLUPFG	Earthquake Sensitive Land Use Plan Focus Group
FSDS	Faecal Sludge Dumping Site
FGD	Focus Group Discussion
FSM	Faecal Sludge Management
GC	Govt./Institution, Community Facilities
GIS	Geographic Information System
GoB	Government of Bangladesh
ICT	Information and Communications Technology
IDI	In-depth Interview
KII	Key Informant Interview
LDC	Least Developed Countries
LGED	Local Government Engineering Department
Mb	Body-Wave Magnitude
ML	Local magnitude
MoDMR	Ministry of Disaster Management and Relief
MS	Master of Science
Ms	Surface-Wave Magnitude
MSL	Mean Sea Level
Mw	Moment Magnitude
NDMP	National Disaster Management Plan

NGOs	Non-Governmental Organizations
NRP	National Resilience Project
PPA	Person Per Acre
RCA	Rolling Compacted Concrete
(RCIM	Residential, Commercial, Industrial and Mixed Use
RSLUP	Risk-sensitive Land Use Planning
SOD	Standing Orders on Disasters
SWDS	Solid Waste Dumping Site
TDMS	Technical Data Management System
TDRS	Temporary Debris Staging and Reduction Site
UAV	Unmanned Aerial Vehicle
UNDP	United Nations Development Programme
UTIDP	Upazila Towns Infrastructure Development Project
VARD	Voluntary Association for Rural Development
WDMC	Ward Disaster Management Committee

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Glossary of Terms

Disaster	A serious disruption of the functioning of a community or society involving widespread human, material, economic or environmental losses exceeding the ability of the affected community or society to cope using its own resources.
Disaster risk	The potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period.
Disaster risk reduction	The systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster.
Exposure	People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses.
Geographical Information Systems (GIS)	Computer software designed to capture, manage, analyze, and display multiple forms of geographically referenced information.
Geomorphology	The science of surface landforms and interpretation on the basis of geology and climate.
Hazard map	A map that highlights areas that are affected by or vulnerable to a particular hazard.
Land use	The spatial location of functions and activities
Land use plan	A document or set of documents which provide clear policy and strategic instruction for achieving sustainable, effective spatial development for a given area.
Land use planning	Systematic and iterative procedure carried out in order to create an enabling environment for sustainable development of land resources which meets people's needs and demands. It assesses the physical, socio-economic, institutional and legal potentials and constraints with respect to and optimal and sustainable use of land resources, and empowers people to make decisions about how to allocate those resources.
Magnitude	The magnitude is a number that characterizes the intensity of an earthquake. Magnitude is based on measurement of the maximum motion recorded by a seismograph. Several scales have been defined, but the most commonly used are (1) local magnitude (ML), commonly referred to as "Richter magnitude", (2) surface-wave magnitude (Ms), (3) body-wave magnitude (Mb), and (4) moment magnitude (Mw).
Natural hazard	A dangerous natural phenomenon (such as a flood, storm or earthquake) that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.
Pourashava	A municipality at the local level.
Resilience	The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.
Risk assessment	A methodology to determine the nature and extent of risk by analyzing potential hazards and evaluating existing conditions of vulnerability/capacity that could pose a potential threat or harm to people, property, livelihoods and the environment on which they depend.
Risk sensitive land use planning	The process of mainstreaming disaster risk management parameters in

	land use planning
Vulnerability	The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.
Ward	Smallest local administrative (local government) unit of urban areas. For operational convenience, a municipality's area is divided into three or more wards. The ward boundaries are specified by gazette. A ward has a ward parishad (council).

Chapter-1 Introduction

Bangladesh is highly disaster-prone country due to its geographical location. Again, rapid urbanization has created growing demand for urban infrastructure and in many cases, cities are growing on the areas prone to natural hazards. Being located in one of the active seismic regions of the world, Bangladesh is susceptible to earthquake. An earthquake can cause both life loss and damage to physical infrastructure and facilities. To reduce the damages and frequency of these urban hazards a risk-sensitive land use plan is required with guidelines for earthquake sensitive development. Along with earthquake fire hazards, waterlogging should be included in the plan which can equally hamper urban living.

1.1 Background of the Project

Bangladesh is one of the countries in the world most at risk from the negative impacts of climate change including increases in frequency and intensity of extreme weather events and hazards. Although Bangladesh has made a tremendous stride in disaster management by utilizing its indigenous knowledge, coping strategy and effective management system and is considered as a role model in disaster management, population growth, migration, and unplanned development of economic activities are also inducing an impetuous increase of vulnerability. As Bangladesh hopes to upgrade from Least Developed Country (LDC) category by 2024, disaster risk reduction still remains a key priority of the GoB.

Moreover, Bangladesh is experiencing rapid urbanization during last decades with about 37% of the total population, living in urban areas in 2018. Though the level of urbanization is still relatively low compared to developed countries, but a concern for the fast-growing urban centers especially small towns and municipalities. Being located in one of the active seismic regions of the world, Bangladesh is susceptible to earthquake. Although there was no major earthquake in the recent past, but a moderate to large earthquake may create havoc in urban settings.

Sunamganj is one of the fast-growing urban centers in the northeastern part of the country located in the close proximity of dauki fault. Sunamganj Pourashava is situated in very severe earthquake prone areas of Bangladesh. The municipality is experiencing fast development which is taking place haphazardly. Due to the geographic location and development trend, the municipality is vulnerable to earthquake.

The risk sensitive land use plan presumably offers an opportunity to incorporate risk reduction into development and spatial plans by engaging the government at various levels, private sector, civil society, international development organizations, and other key stakeholders. Moreover, the land use planning process will help the municipality to address its need to reduce disaster risks as part of its pursuit for sustainable development.

Through the project named ***Preparation of Earthquake Sensitive Land Use Plan (ESLUP) under National Resilience Programme (NRP): DDM Part,*** an overall Risk Sensitive Land Use Plan including earthquake, flash flood, fire hazard, waterlogging risk zoning for Sunamganj Pourashava has been prepared through this assignment. This final landuse plan report includes gap analysis, strategies to be adopted, risk sensitive land use maps, building construction guidelines for the municipality, planning policy documentation and institutional arrangement for implementation of the proposed plan.

1.2 Philosophy of the Preparation of Risk Sensitive Land Use Plan

The philosophy behind preparation of Risk Sensitive Land Use Plan of the Pourashava lies in the very motive of incorporating risk reduction into development and spatial plans through a process of engaging the government at various levels, private sector, civil society, international development organizations, and other key stakeholders. The Risk Sensitive Land Use Plan aims for the resilience of urban development for concentrated development at an urban scale following the principles of disaster resilient development.

1.3 Objectives of the Project

The overall objective of the project is to enhance resilience of urban development in Sunamganj Municipality through inclusive, gender responsive disaster management and risk informed development. The specific objectives are as follows.

I. To identify existing land use patterns and potential hazard prone areas in Sunamganj Municipality with regard to especially earthquake and other disasters as well;
II. To identify the risk is related to land profile and explore the areas of interventions to address the soil/land types for promoting risk sensitive planning
III. To guide earthquake friendly construction practice for infrastructure development;
IV. To provide guidelines for earthquake sensitive development of the municipality.

1.4 Scope of Work of the Project

The scope work of this project is to provide participatory, evidence-based and implementable earthquake sensitive land use planning that enables the authority to enhance the disaster preparedness. The focus and methods of the project would be as below;

1. **Development of Baseline Data Set:** Development of baseline data set includes the activities of an earthquake sensitive land use planning focus group (ESLUPFG) formulation and relevant plans, policies and institutional arrangements revision, detail survey to identify major features like road network, water bodies and major land use of the municipality, detail survey (plot to plot) for the ward number 2, 4 and 5 of the municipality. All maps and database preparation.

2. **Situation Analysis:** It includes earthquake hazard prone locations incorporation, risk assessment for ward number 2,4 and 5 for land zoning similar to the assessment conducted in Bangladesh.

3. **Strategy Formulation and Land Use Planning:** Includes vision, goal and objectives of land use planning and strategies to be adopted formulation. Based on the vision, goal, objectives and strategies, Land Use Plan and building construction guidelines are preparation for the Municipality.

4. **Policy and Institutional Arrangement:** Planning policy documentation formulation and institutional arrangement for implementation of the proposed plan.

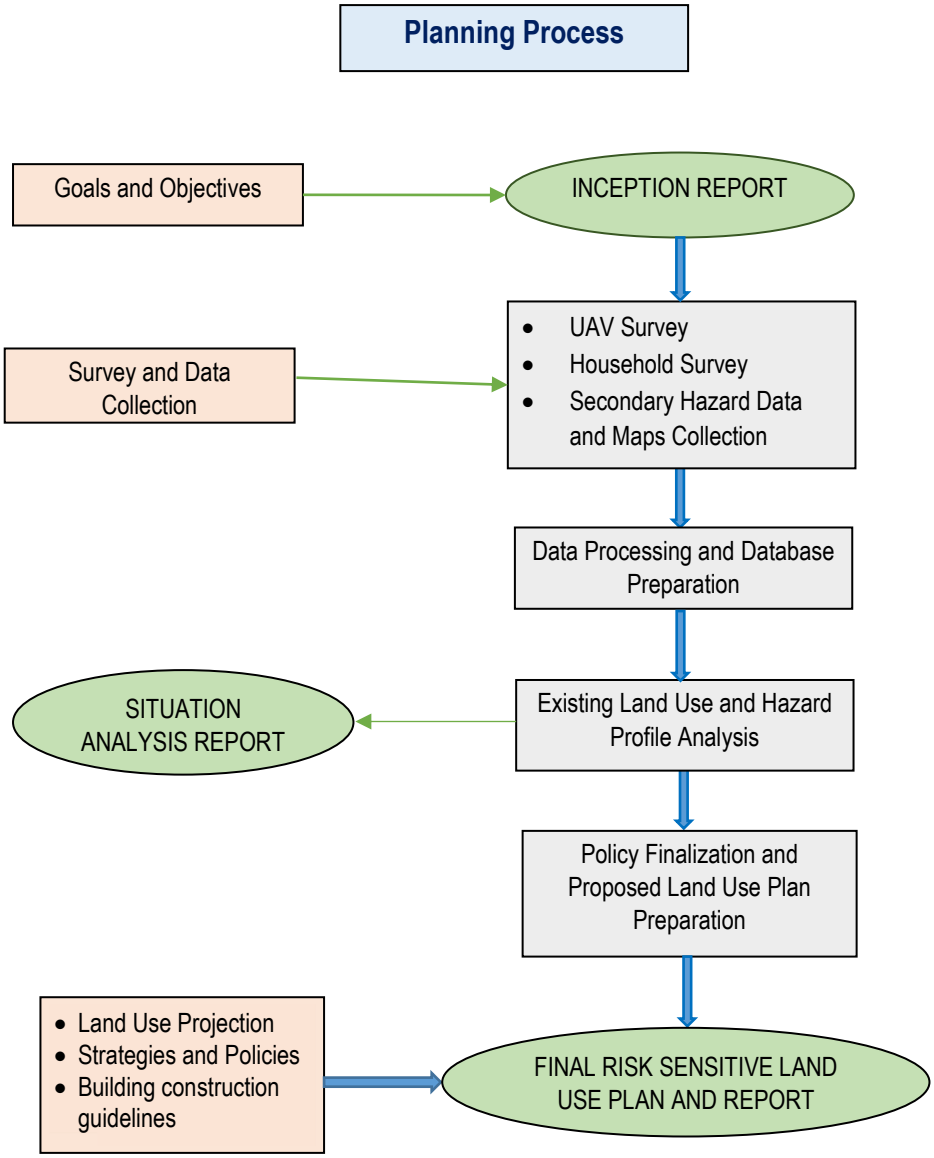
1.5 Approach and Methodology

The project is aimed at enhancing the resilience of urban development in Sunamganj Municipality through inclusive, gender responsive disaster management and risk informed development.

The current project is preparing a Risk Sensitive Land Use Plan of the Pourashava, where the existing condition and different landuses are identified, studied and analyzed and the probable solutions are to be sought to ameliorate the same. The study moves through a process of data collection-analysis and fixation of objectives for planning. The approach is based on UAV survey and field survey for data collection and collection of information from secondary sources.

The data is presented through maps, text, graphs and tabular form. Analysis of collected data is carried out to identify the nature and extent of landuses and structural uses prevailing in the Pourashava and the situation analysis report and maps prepared and submitted. Through the process, involvement of the stakeholders has been ensured to make the plan as much user friendly as possible. For this purpose, continuous formal and informal discussions and meetings have been carried out throughout the project period using a participatory approach.

After doing all these jobs thoroughly the Risk Sensitive Land Use Plan had been done based on a prepared planning standard for Pourashava level and formulating future strategies for the corresponding area. Again, after final consultation with the stakeholders on the prepared plan the Final Risk Sensitive Land Use Plan has to be completed.



1.6 Challenges

During conducting the assignment challenges those had to be faced are-

- ✓ In this assignment only three selected wards are presented with detail structural use due to time limitation
- ✓ Lacking of adequate multi-hazard situation relevant information for risk zone identification of Sunamganj Pourashava
- ✓ Hazard scenario development have been done based on only available secondary data
- ✓ Primary data from physical feature survey does not have the required accuracy due to non-available paticipants.
- ✓ All proposed participants of FGD were not available etc.

1.7 Organization of the Earthquake Sensitive Land Use Plan Report

The Land Use Plan Report is organized in three major parts with an introduction at the beginning. The three major parts contain various components of work under the project of Sunamganj Pourashava. The major parts of the plan of Sunamganj Pourashava are as follows:

Chapter 1: It describes the background of the project, philosophy and objectives of the Earthquake Sensitive Landuse Plan, methodology and scope of the work and organization of the plan report.

Chapter 2: Existing development status sets the conceptual framework and strategies for proposed landuse plan of the Pourashava based on its potentials for the next 20 years up to 2041.

Chapter 3: Earthquake vulnerability of the study has been presented in this chapter. Detail hazard assessment has also been included in this part for three selected wards (ward no 2, 4 and 5) of Sunamganj Pourashava.

Chapter 4: Critical issues like demographic, drainage, transportation, disaster, land use etc. of the land use plan have been described in this part.

Chapter 5: Relevant previous laws, policies and regulations have been reviewed and summarized here.

Chapter 6: Projections of different variables for land use for the next 20 years up to 2041.

Chapter 7: Policy guidelines for use of land and urban services like residential, commercial, recreational, health & education facilities, solid waste management, water body conservation etc. have been described in this chapter.

Chapter 8: Recommendations for overall risk sensitive land use plan implementation and conclusions are given in this chapter.

Chapter-2 Existing Development Status of Pourashava

2.1 Study Area Location

Sunamganj Pourashava is situated in the northeastern part of Bangladesh, at Sunamganj district in Sylhet Division. The Pourashava is located in the Sunamganj Sadar Upazila and is situated on the bank of the Surma river. The location of the Pourashava is between 25°4'N 91°24'E. This pourashava is made up of 9 wards, with the main and largest town in Sunamganj. Administrated with an area of 22.17 sq. km. and the municipality is the hub of economic center, technology invention, education, tourism, center of quality life etc. of the surrounding upazillas. The study area is represented in figure 2.1.

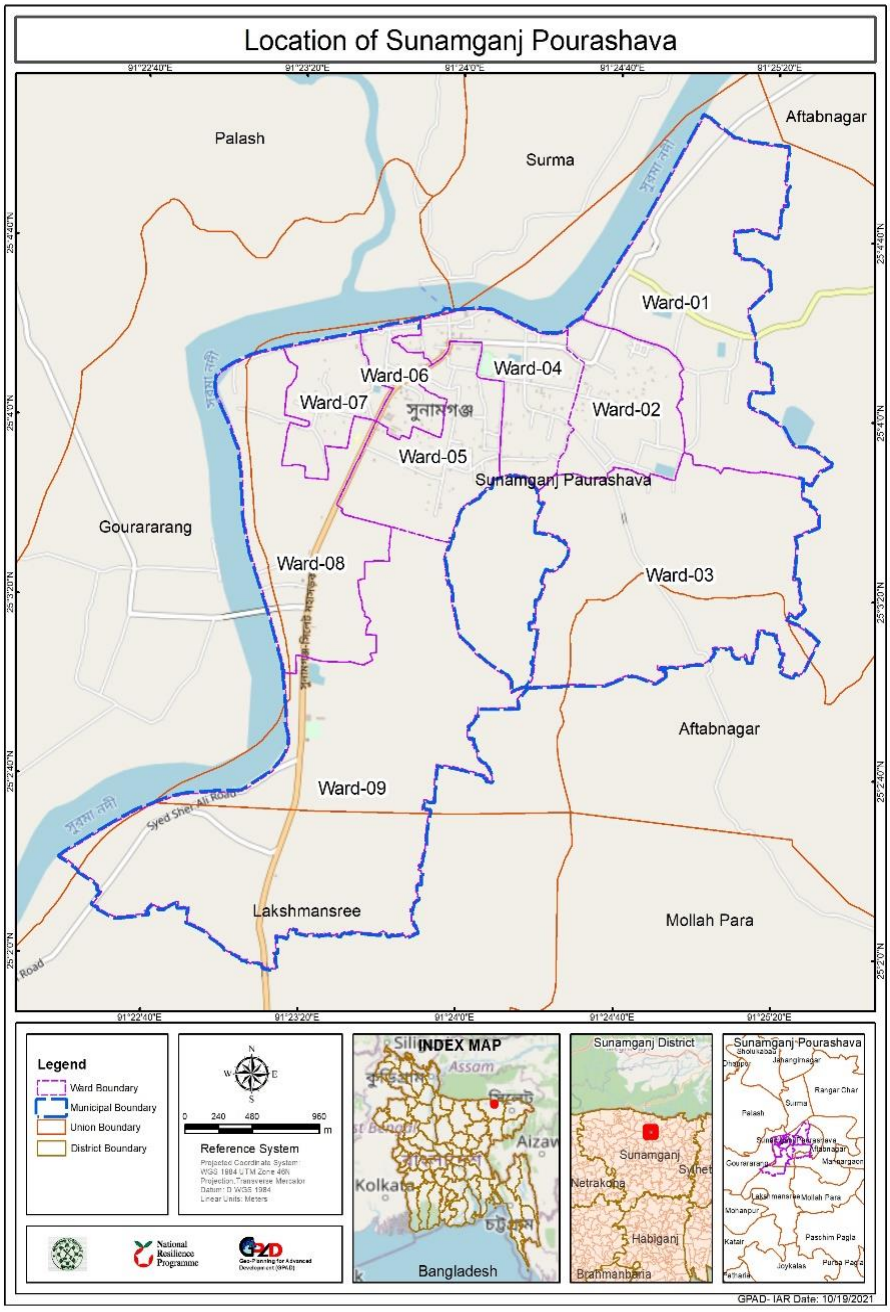


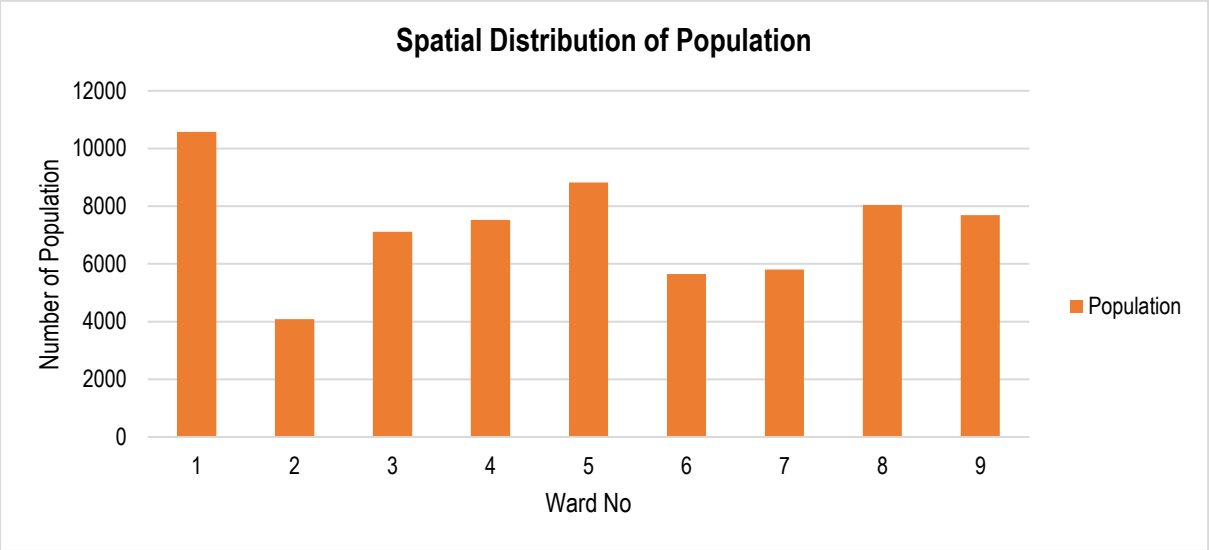
Figure 2.1: Sunamganj Pourashava Location Map

2.2 Population

Total population of the Pourashava is 87,570 with population density of 3950 per sq. km or 16 per acre and population growth rate is 2.13% (Sunamganj Pourashava, 2021). The literacy rate of the study area is above 70% and the major land use of the area is residential.

2.2.1 Spatial Distribution

According to BBS 2011, the highest population of the pourashava is found in ward no 1 and the lowest in ward no 2. figure 2.2 shows the spatial distribution of the population in the wards.



Source: BBS, 2011

Figure 2.2: Spatial Distribution of Population

2.2.2 Density

Population density of 2,4 and 5 no ward is on average around 22 people per acre. Sunamganj Pourashava has added at least 30 percent to its population in the last decade. The table shows the density (Person Per Acre) of the wards. Among them ward no 7 has the highest density (PPA). In comparison to this, the Ward no 9 has the lowest density.

Table 2.1: Population Density of the Wards

Ward no	Population Density (PPA)
Ward-1	15
Ward-2	20
Ward-3	31
Ward-4	28
Ward-5	16
Ward-6	30
Ward-7	73
Ward-8	12
Ward-9	7

Source: BBS, 2011

2.2.3 Age Distribution

According to the NRP-BUET JIDPUS Sunamganj Field Survey 2020, age distribution of the population of ward no 2,4 and 5 is categorized into five clusters (Table 2.2 shows cluster wise population with percentage of wards no 2, 4 and 5). The clusters are:

a) Children (below 10 years)
b) Young (11 to 20 years)
c) Adult (21 to 30 years)
d) Middle Age (31 to 60 years)
e) Aged Persons (more than 60 years)

Table 2.2: Population of Different Age Groups

Age Groups	Ward no 2		Ward no 4		Ward no 5	
	Popⁿ	%	Popⁿ	%	Popⁿ	%
Children (below 10 years)	327	8	903	12	1147	13
Young (11 to 20 years)	776	19	1655	22	1235	14
Adult (21 to 30 years)	1675	41	1504	20	2294	26
Middle Age (31 to 60 years)	1226	30	2633	35	3529	40
Aged Person (more than 60 years)	82	2	827	11	618	7
Total	**4086**	**100**	**7522**	**100**	**8822**	**100**

Source: (NRP-BUET-JIDPUS-Sunamganj, 2021)

From the table 2.3, it can be stated that majority of the population belongs to the middle age group (31 to 60 years) and the lowest amount of population belongs to the more than 60 years' age group. Generally, children and aged persons are considered more vulnerable to any type of disasters. According to this point, ward no 4 is more vulnerable to earthquakes as the percentage of children and the aged person is more than other two wards.

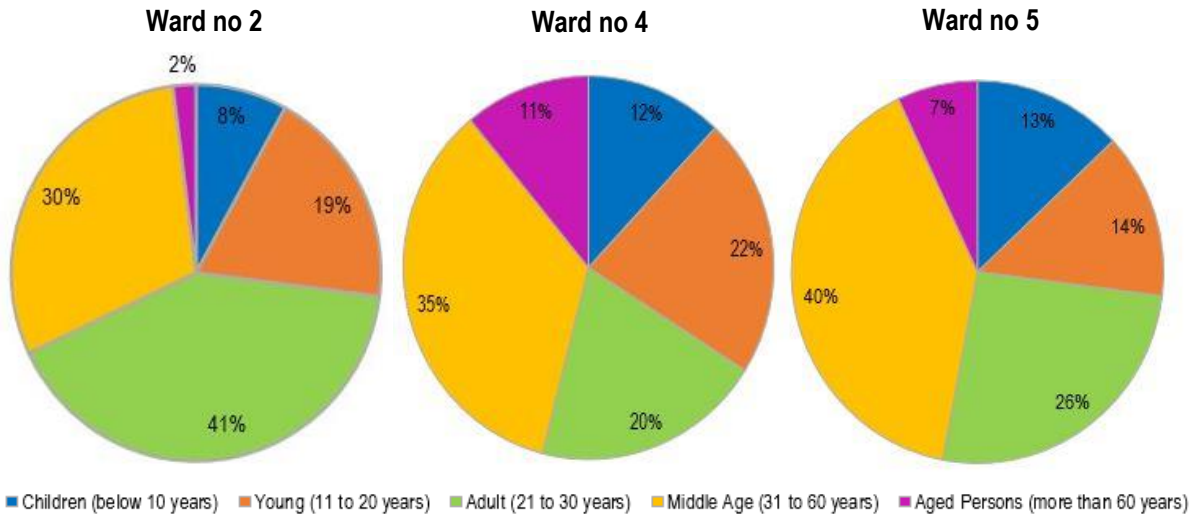


Figure 2.3: Population Ratio of Different Age Groups

The chart in figure 2.3 shows that, in ward no 2, most of the people (41%) are of the adult age group (21 to 30 years). The percentage of aged people (more than 60 years) is the lowest (2%) portion of the total population of the ward. On the other hand, in ward no 4, the percentage of middle-aged people (35%) is higher than other age groups and the lowest ratio is 11% (Aged person group). Similarly, in ward no 5, the percentage of middle-aged people (40%) is higher than other age groups and the aged person group (more than 60 years) has the lowest ratio (7%).

2.3 Physical Infrastructure

Physical Infrastructure of Sunamganj Pourashava includes existing structure details, road network, drainage network etc. Here structure type, structure height, detail building use, road length, road type, drainage type is described which provides a clear vision of existing physical infrastructure status of the study area. This existing status helps to prepare the policies and guidelines for the Earthquake Sensitive Land Use Planning of the study area.

2.3.1 Structure Type

According to the field survey 2021, three types of buildings have been found in Sunamganj Pourashava. Most of the buildings in the study area are semi pucca (6,616). Katcha buildings (6,207) are almost same in amount of semi pucca building. Pucca buildings (4,489) are in the lowest amount of the three types of structure. Table 2.3 shows the detailed amount of the buildings of each type in wards 2, 4 and 5.

Table 2.3: Structure Types in Sunamganj Pourashava

Ward No	Katcha	Pucca	Semi Pucca	Total
1	698	670	1270	2638
2	**227**	**440**	**530**	**1197**
3	609	212	836	1657
4	**244**	**648**	**1041**	**1933**
5	**391**	**1017**	**955**	**2363**
6	345	306	555	1206
7	655	287	415	1357
8	1068	495	450	2013
9	1970	414	564	2948
Total	**6207**	**4489**	**6616**	**17312**

Source: (Field Survey, 2021)

From the table, the total amount of the structure in three wards is 5493 and the highest number of structures have been found in ward number 5. The ratio of semi pucca structure in ward no 2 (44.28%) and 4 (53.86%) is higher than other types of building. On the other hand, in ward no 5 the amount of pucca building (43.04%) is larger than katcha and semi pucca building. Grossly, number of katcha structure (391) and pucca structure (1,017) is higher in ward number 5 and number of semi pucca structure is higher in ward number 4 (1,041) than other two wards. After analyzing the structure amount and type we can realize that ward no 5 is more vulnerable than other two wards as the ward has highest number of structure as well as pucca structure. Figure 2.4 shows the visual comparison of structure type among the wards of Sunamganj Pourashava.

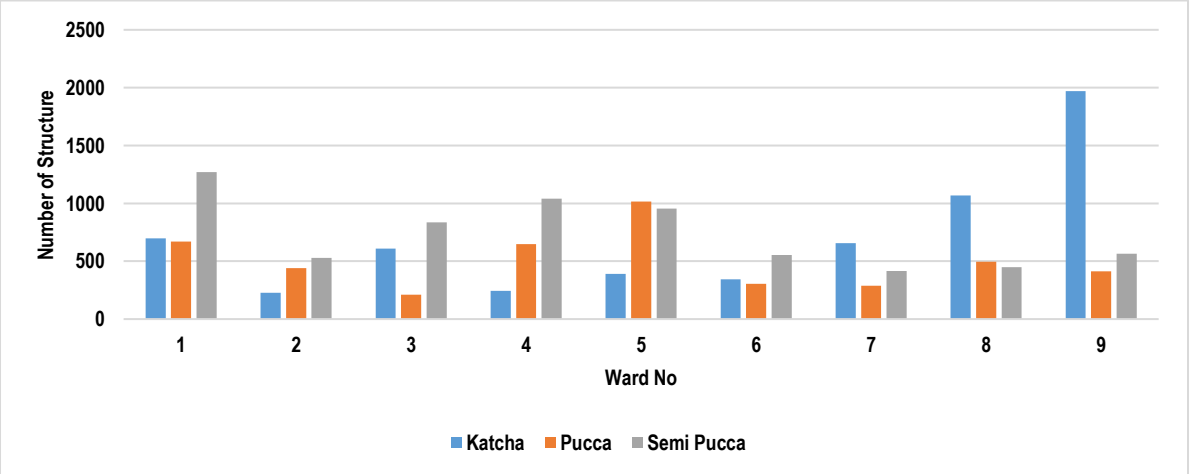


Figure 2.4: Structure Type in Sunamganj Pourashava

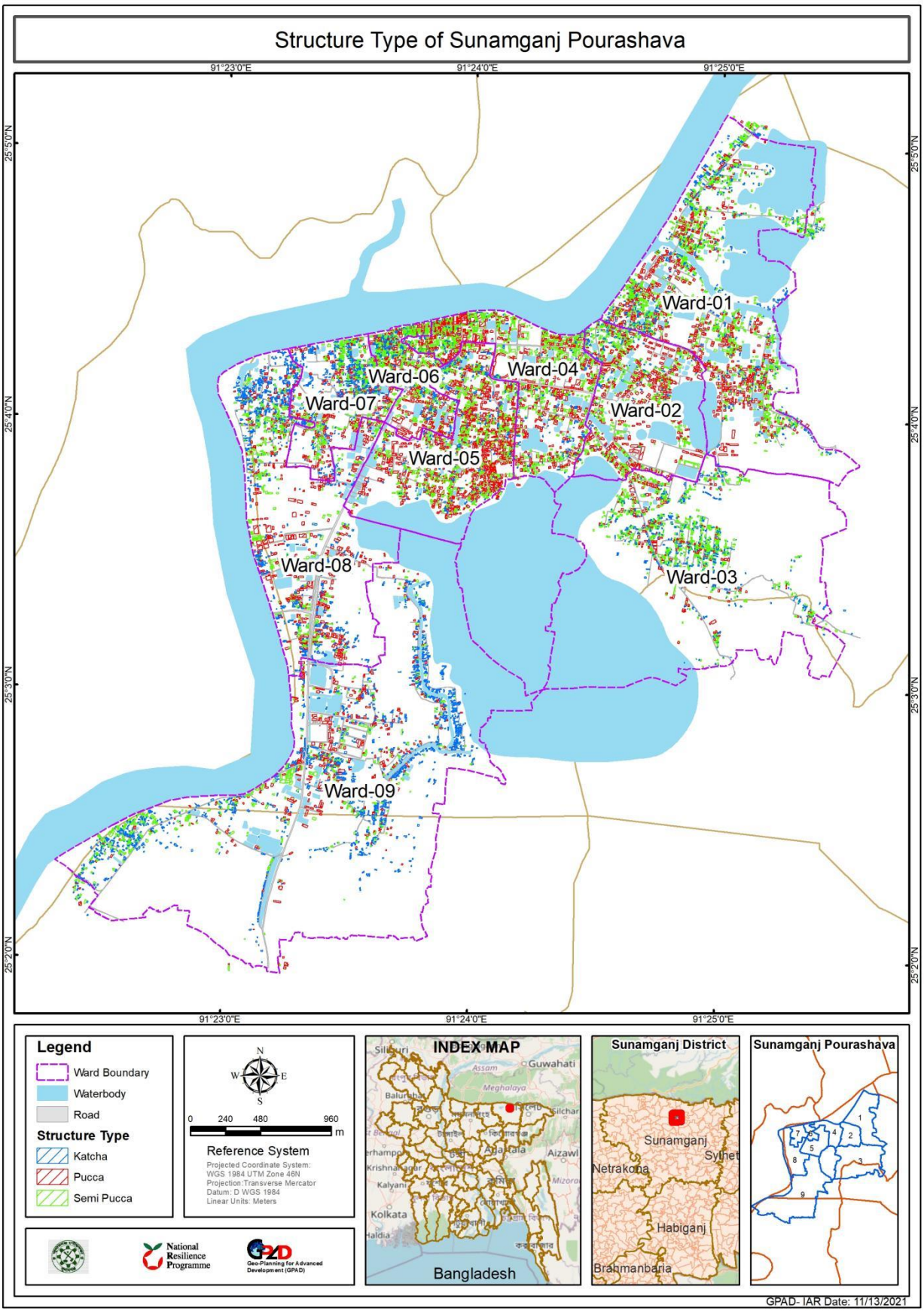


Figure 2.5: Structure Type Map of Sunamganj Pourashava

2.3.2 Structure Height

According to the Field survey 2021, building floor heights have been found between 1 to 7 storied in ward no 2, 4 and 5. Most of the buildings in the study area are single storied. Structure heights are categorized into four categories like single storied, two & three storied, four & five storied and above five storied. Table 2.4 shows the detailed structure height in ward 2, 4 and 5.

Table 2.4: Structure Height of Ward no 2, 4 and 5

SL no	Structure Height	Structure Number			
		Ward no 2	Ward no 4	Ward no 5	Total
1.	Single Storied	936	1497	1860	4293
2.	Two & Three Storied	237	395	465	1097
3.	Four & Five Storied	23	40	37	100
4.	Above Five Storied	1	6	2	9
Total		1197	1933	2363	5499

Source: (Field Survey, 2021)

From the table, the total amount of the structure in three wards is 5493 and the highest number of structures are single storied building. The amount of two & three storied structure in ward no 5 (465) is higher than other wards. On the other hand, in ward no 4 the amount of four & five storied building (40) is larger than other two wards. There is only one building in ward no 2 having above 5 storied and in ward no 4 the highest number of high-rise building is higher than other two wards. According to this information ward number 4 and 5 are more vulnerable than ward no 2 as ward no 4 has 6 buildings above 5 storied and ward no 5 has the highest number of structures. Figure 2.6 shows the chart and figure 2.7 shows the map of structure height variation of these three wards.

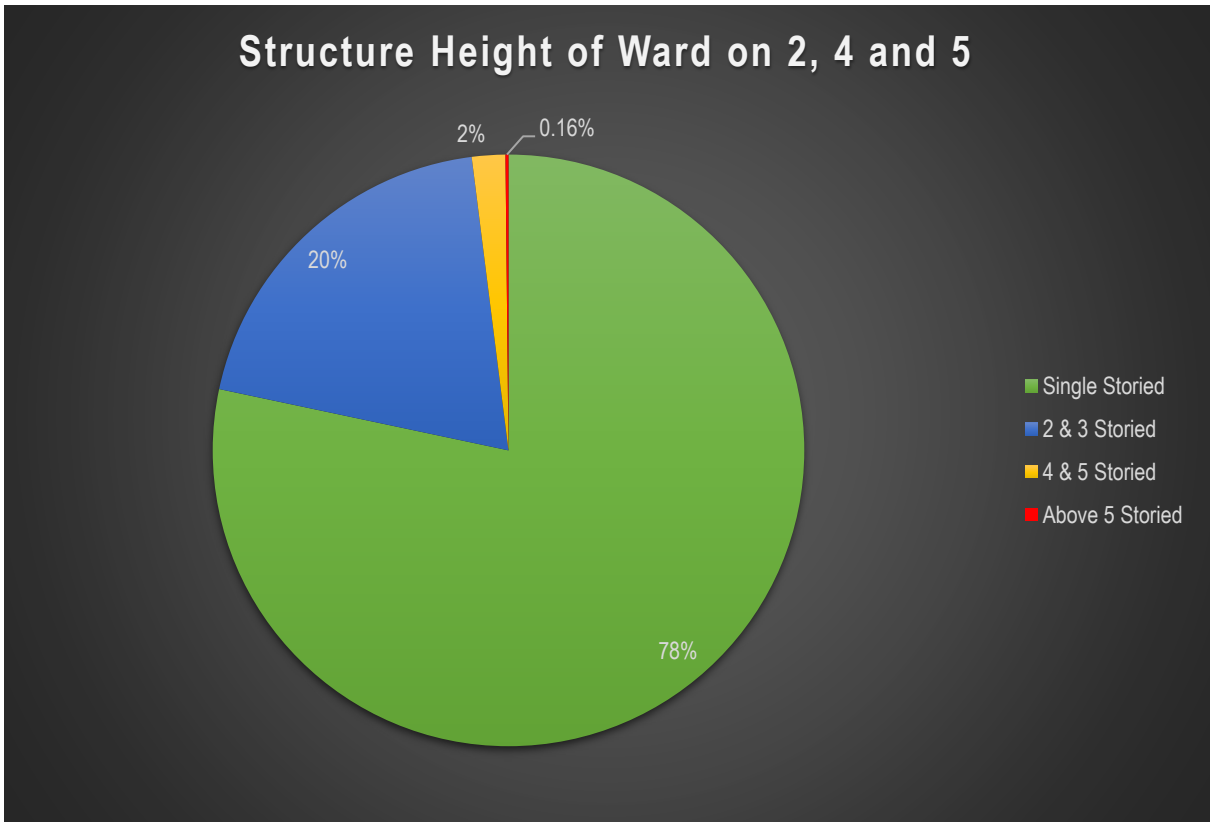


Figure 2.6: Structure Height of Overall Ward 2, 4 and 5

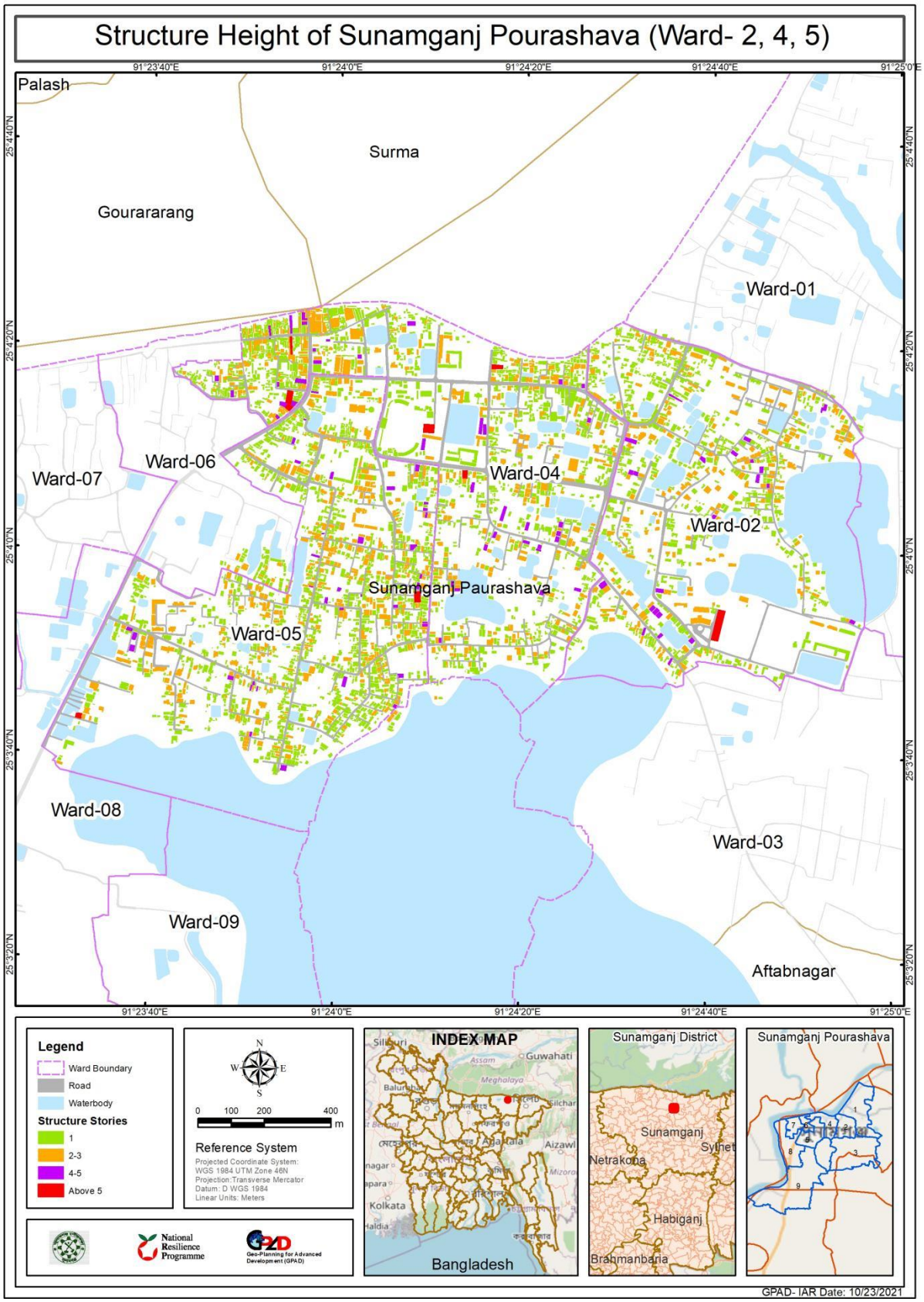


Figure 2.7: Structure Height of Overall Ward 2, 4 and 5

2.3.3 Detail Building Use

From field survey 2021, eleven types of structural use have been found in ward no 2,4 and 5. Major structural use of surveyed area is residential. Table 2.5 shows the detail building use of the selected three wards.

Table 2.5: Detail Building Use of Ward No 2, 4 and 5

SL no	Structure Use	Structure Number					
		Ward no 2	%	Ward no 4	%	Ward no 5	%
1.	Residential	927	77.44	1316	68.08	1897	80.28
2.	Commercial	90	7.52	378	19.56	245	10.37
3.	Mixed Use	35	2.92	62	3.21	50	2.12
4.	Restricted & Special Use	11	0.92	11	0.57	39	1.65
5.	Govt./Institution	8	0.67	15	0.78	20	0.85
6.	Community Facilities	9	0.75	22	1.14	25	1.06
7.	Education & Research	10	0.84	26	1.35	27	1.14
8.	Health Facilities	11	0.92	7	0.36	3	0.13
9.	Industrial	0	0.00	1	0.05	0	0.00
10.	Miscellaneous	67	5.60	65	3.36	28	1.18
11.	Under Construction	29	2.42	30	1.55	29	1.23
Total		1197	100	1933	100	2363	100

Source: (Field Survey, 2021)

From Table 2.5 in ward no 4 commercial structure ratio is higher (19.56%) than other two wards and an industry is also located in this ward. Therefore, this ward will be more economically affected by earthquake or fire hazard or other disaster. Besides the population density of the ward also makes it more vulnerable towards earthquake. On the other hand, the ratio of residential building (80.28%) in ward no 5 is more than other wards. So, this ward is also vulnerable to a massive earthquake. Figure no 2.8 represents the details use of building in the selected wards.

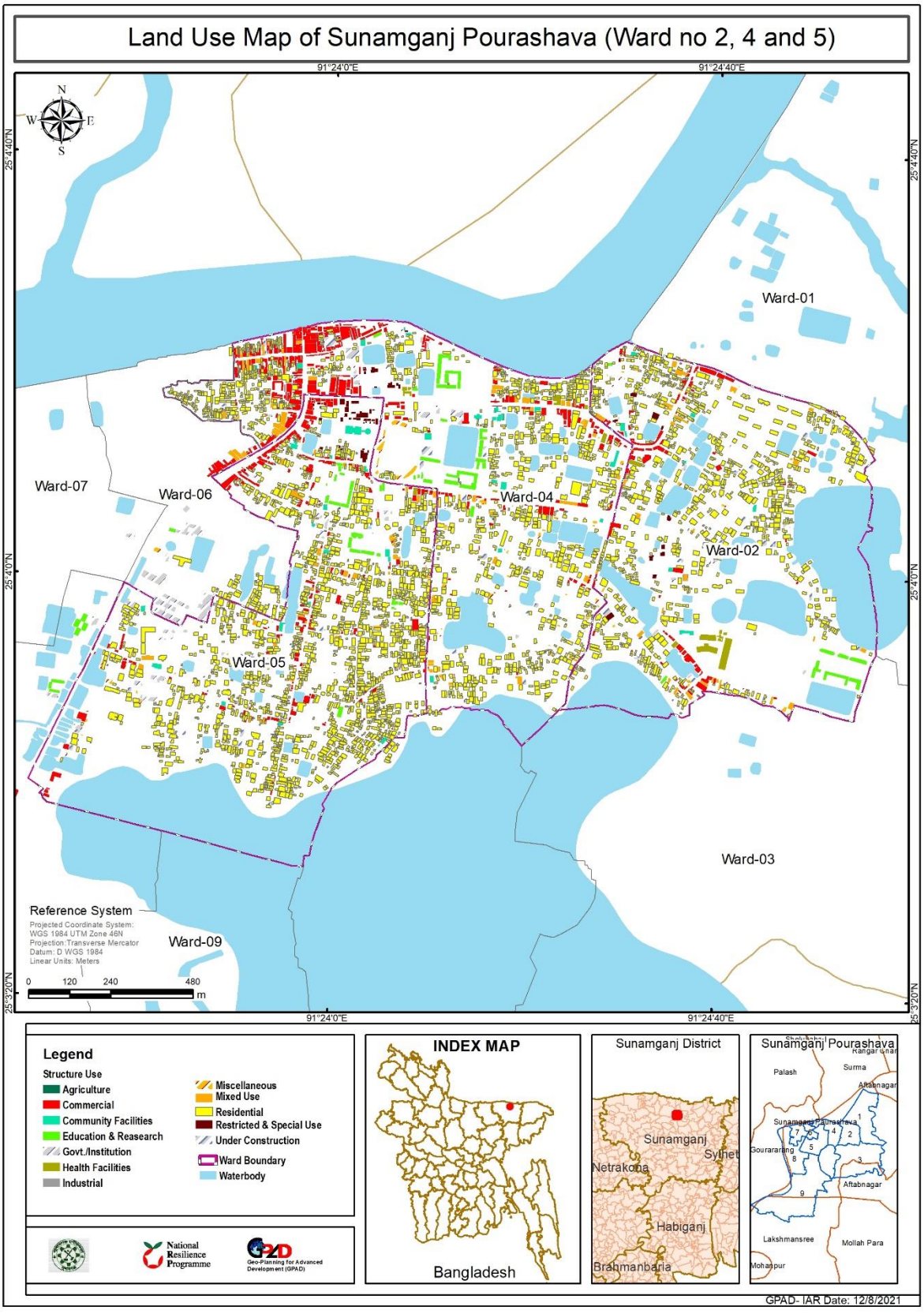


Figure 2.8: Detail Building Use Ward 2, 4 and 5

2.3.4 Road Network System

In Sunamganj Pourashava, highway, secondary and tertiary roads exist. Total 101.33 km of road infrastructure is existing in the pourashava. Among these wards, ward no1 has the highest length of narrow road (width <3m). Ward no 1, 2, 3 and 7 has no roads with a width of more than 7 meters (Table 2.6).

Table 2.6: Length of Road in Ward 2, 4 and 5 on width basis

Ward No.	Road Length in Kilometer				
	Width <3m	Width 3-5m	Width 5-7m	Width >7m	Total
1	8.73	7.12	0.00	0.00	15.85
2	2.29	4.75	2.25	0.00	9.29
3	4.01	4.63	0.00	0.00	8.63
4	4.78	3.18	1.02	2.54	11.52
5	5.43	5.88	0.14	1.66	13.11
6	1.84	2.03	0.72	0.31	4.90
7	2.68	4.23	0.06	0.00	6.97
8	4.34	4.45	2.16	1.73	12.68
9	5.07	8.65	2.06	2.61	18.39
Total	**39.16**	**44.92**	**8.40**	**8.85**	**101.33**

Source: Field Survey, 2021

The following table 2.7 shows the total length based on the road type. Most of the road is pucca, but 5.7 km road is found katcha or semi-pucca.

Table 2.7: Type of Road in Ward 2, 4 and 5

Ward_no	Road Length in Kilometer			
	Katcha	Pucca	Semi-Pucca	Grand Total
1	1.61	12.20	2.03	15.85
2	0.56	7.72	1.02	9.29
3	0.39	7.24	1.00	8.63
4	0.87	8.70	1.95	11.52
5	0.77	9.37	2.97	13.11
6	0.09	4.14	0.66	4.90
7	0.70	5.85	0.42	6.97
8	1.20	10.64	0.85	12.68
9	1.90	13.13	3.36	18.39
Total	**8.10**	**78.99**	**14.25**	**101.33**

Source: Field Survey, 2021

Based on this fact, it can be said that these wards of Sunamganj Pourashava require further widening and development of roads. In case of any disaster narrow roads can become the main concern. In the figure 2.9 the distribution of different widths of roads is shown. Mostly tertiary and access roads are found to be narrow roads. Along with road width road surface type should also be considered as more katcha road makes the area more vulnerable to disaster.

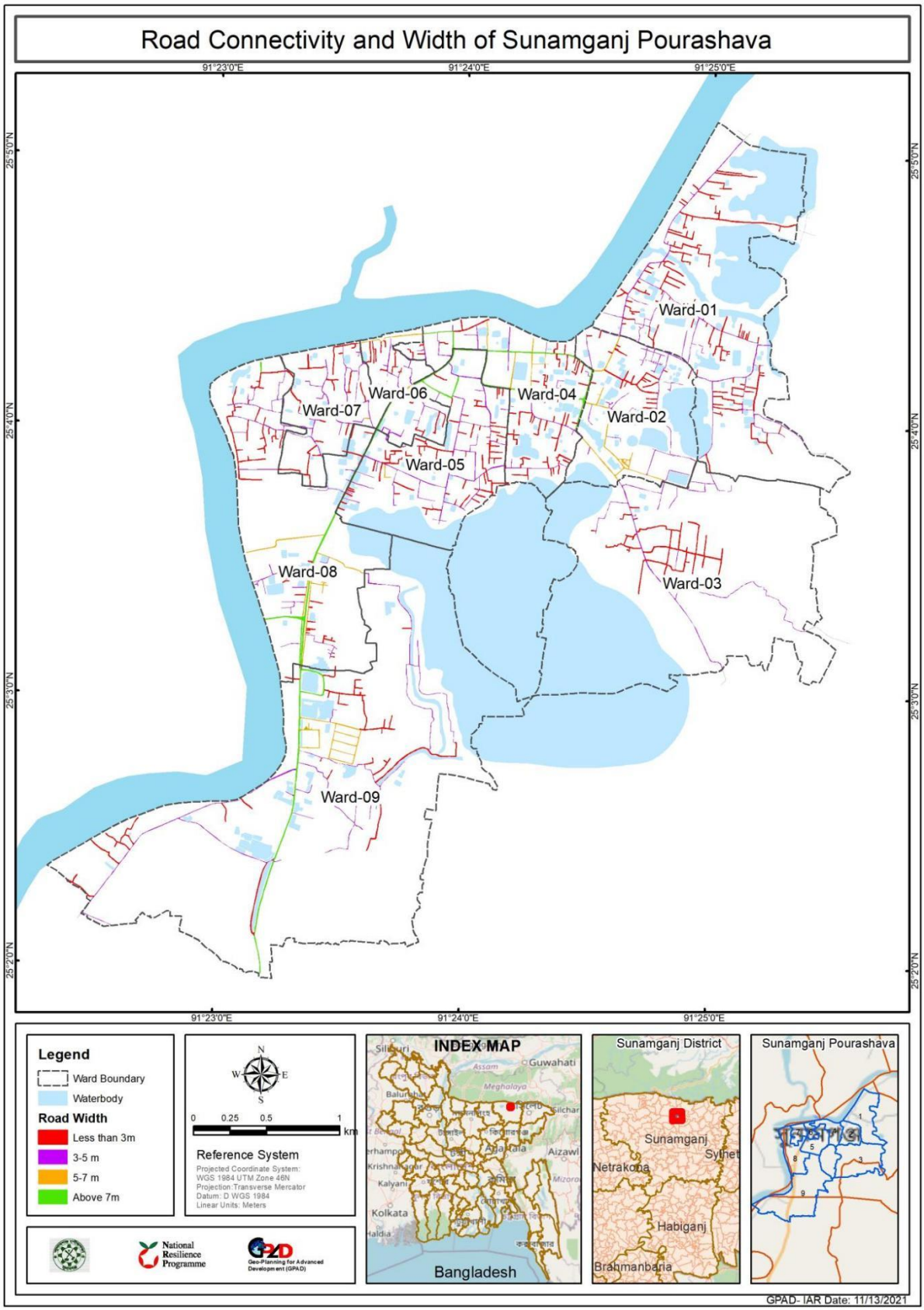


Figure 2.9: Road Width Variation in Sunamganj Pourashava

2.3.5 Existing Drainage System

From the Drainage Master Plan of Sunamganj Pourashava, there are only 1.46 km secondary drains and 2.17 km existing tertiary drains. Sunamganj Pourashava needs a good number of additional drains for having an efficient drainage network. At places, the drainage paths (tertiary drains) are obstructed with garbage bags, encroachments etc. resulting in decreasing the discharge capacity of drainage system. Besides, water-logging is created at several points of the town after a moderate rainfall, due to absence of an efficient drainage network. The list of existing drains is presented in Table 2.8 and 2.9 (only for selected wards).

Table 2.8: Existing Drainage Condition of Sunamganj Pourashava.

Sl No.	Drain Type	Length (km)
1	Primary Drains/Khal	-
2	Secondary Drains	1.461
3	Tertiary Drains	2.174
	Total	3.635

Source: Drainage Master Plan of Sunamganj Pourashava

Table 2.9: List of Existing Drainage Network of Sunamganj Pourashava (Ward 2, Four & Five)

Sl No.	Drain ID	Location (Ward No.)	Drain Type	Length (meter)	Condition	Outfall
1	ES1	2.4	Secondary	1003	Good	Low Land
2	ES2	5	Secondary	458	Fair	Low Land
3	ET1	5,6	Tertiary	447	Fair	Highway Borrow pit
4	ET2	4,5,6	Tertiary	401	Fair	Highway Borrow pit
5	ET3	5	Tertiary	131	Fair	Low Land
6	ET4	4,6	Tertiary	303	Fair	Highway Borrow pit
7	ET6	5,7,8	Tertiary	241	Fair	Low Land
8	ET8	5	Tertiary	209	Fair	ES2
Note:	***ES: Existing Secondary Drain;***		***ET: Existing Tertiary Drain***			

Source: Drainage Master Plan of Sunamganj Pourashava

2.3.5.1 Major Outfall for Storm Water Discharge

Sunamganj is a crescent-shaped town, bordered by the Surma river along with its outer extent and the vast Dekar Haor area forming the inner extent. Besides these two major outfalls, Owegkhali Khal, Sonakhali Khal and the borrow pit adjoining the main highway serve as intermediate outfalls for the existing drains. Figure 2.10 (next page) shows the major outfall for storm water discharge of Sunamganj Pourashava.

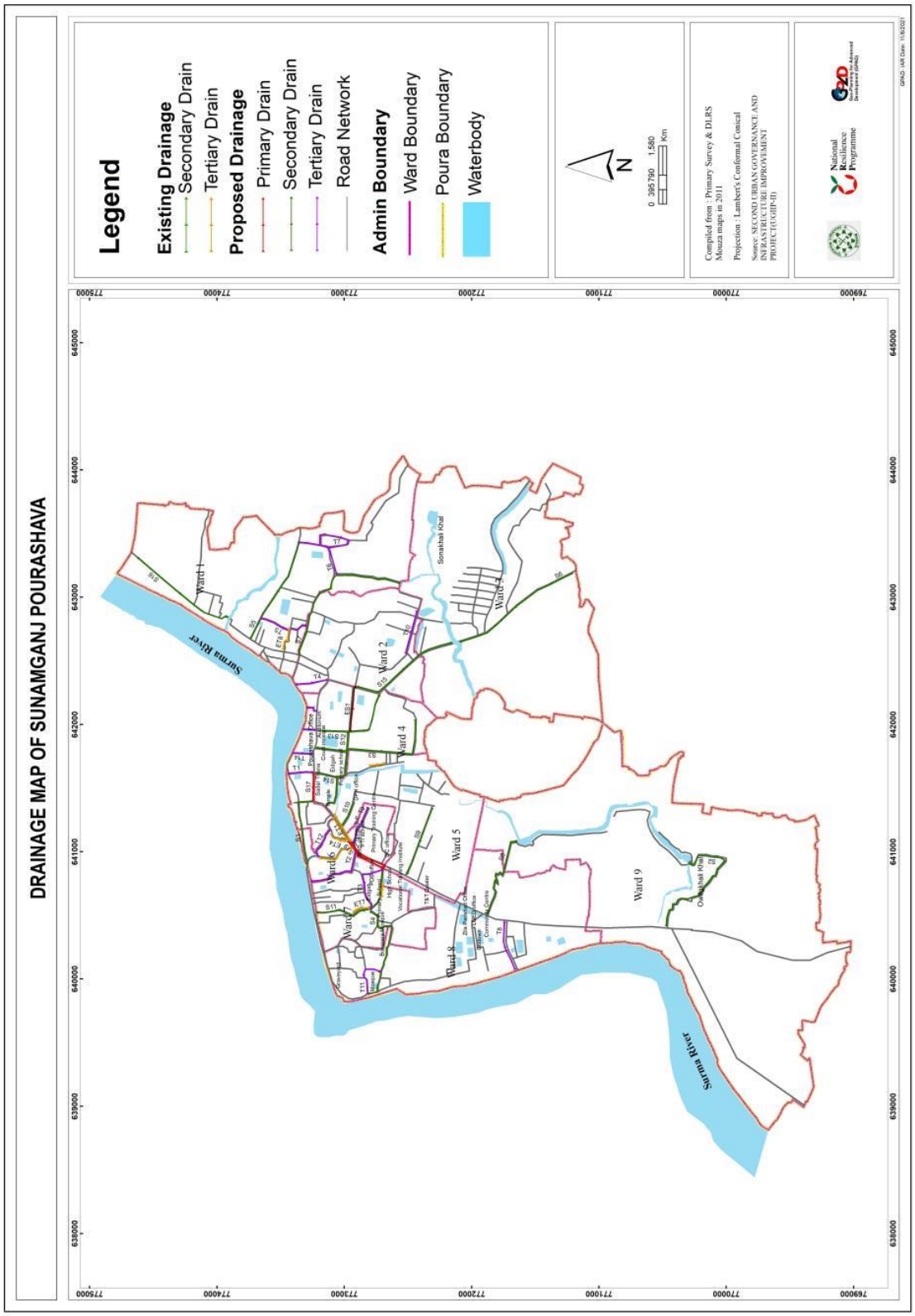


Figure 2.10: Drainage System of Sunamganj Pourashava

2.4 Community Facilities

Community facilities of Sunamganj Pourashava includes education facilities, health facilities, recreational and open space facilities, religious facilities etc. In ward no 2, 4 and 5 of Sunamganj Pourashava, total 18 educational structures, 25 religious facilities structures, 5 health facility structures and 16 other community facilities are identified from the field survey, 2021. These structures should be considered as highly sensitive land-use in land use planning as risk upon gathering of people in any disaster occurrence. The distribution of these structures within the wards is given in following tables (Table 2.10, 2.11, 2.12, 2.13)

Table 2.10: Educational Institutes in Ward 2, 4 and 5

Educational Structures	Ward no			
	Ward 2	Ward 4	Ward 5	Total
College	1	0	0	1
Primary School	1	2	0	3
High School	1	6	3	10
Other Educational	1	1	1	3
Training Institute	0	0	1	1
Total	**4**	**9**	**5**	**18**

Source: Field Survey, 2021

Table 2.11: Health Facilities in Ward 2, 4 and 5

Health Facility Structures	Ward no			
	Ward 2	Ward 4	Ward 5	Total
Community Clinic	0	0	0	0
Hospital	2	1	1	4
Other Health Services	1	0	0	1
Total	**3**	**1**	**1**	**5**

Source: Field Survey, 2021

Table 2.12: Religious Facilities in Ward 2, 4 and 5

Community Facilities Structures	Ward no			
	Ward 2	Ward 4	Ward 5	Total
Mosque	5	4	4	13
Temple	3	1	4	8
Church	0	1	0	1
Graveyard/Eidgah/Samshan/Religious club etc.	0	1	2	3
Total	**8**	**7**	**10**	**25**

Source: Field Survey, 2021

Table 2.13: Other Community Facilities in Ward 2, 4 and 5

Community Facilities Structures	Ward no			
	Ward 2	Ward 4	Ward 5	Total
Police Station	0	1	0	1
Public Toilet	0	0	1	1
Social Organization	1	5	4	10
Sports & Recreation	0	3	0	3
Utility Services	0	0	1	1
Total	**1**	**9**	**6**	**16**

Source: Field Survey, 2021

From the tables it is clear that ward no 2 has the lowest number of education and community facilities but has the highest number of health facilities which does not make it disaster vulnerable. On the other hand, ward number 4 has almost same education, health, religious and other community facilities as ward no 5 has but ward no 5 has the lowest number of health facility which makes the ward more vulnerable. Figure 2.11 represents the education, health facilities, religious facilities and other community facilities of ward no 2, 4 and 5.

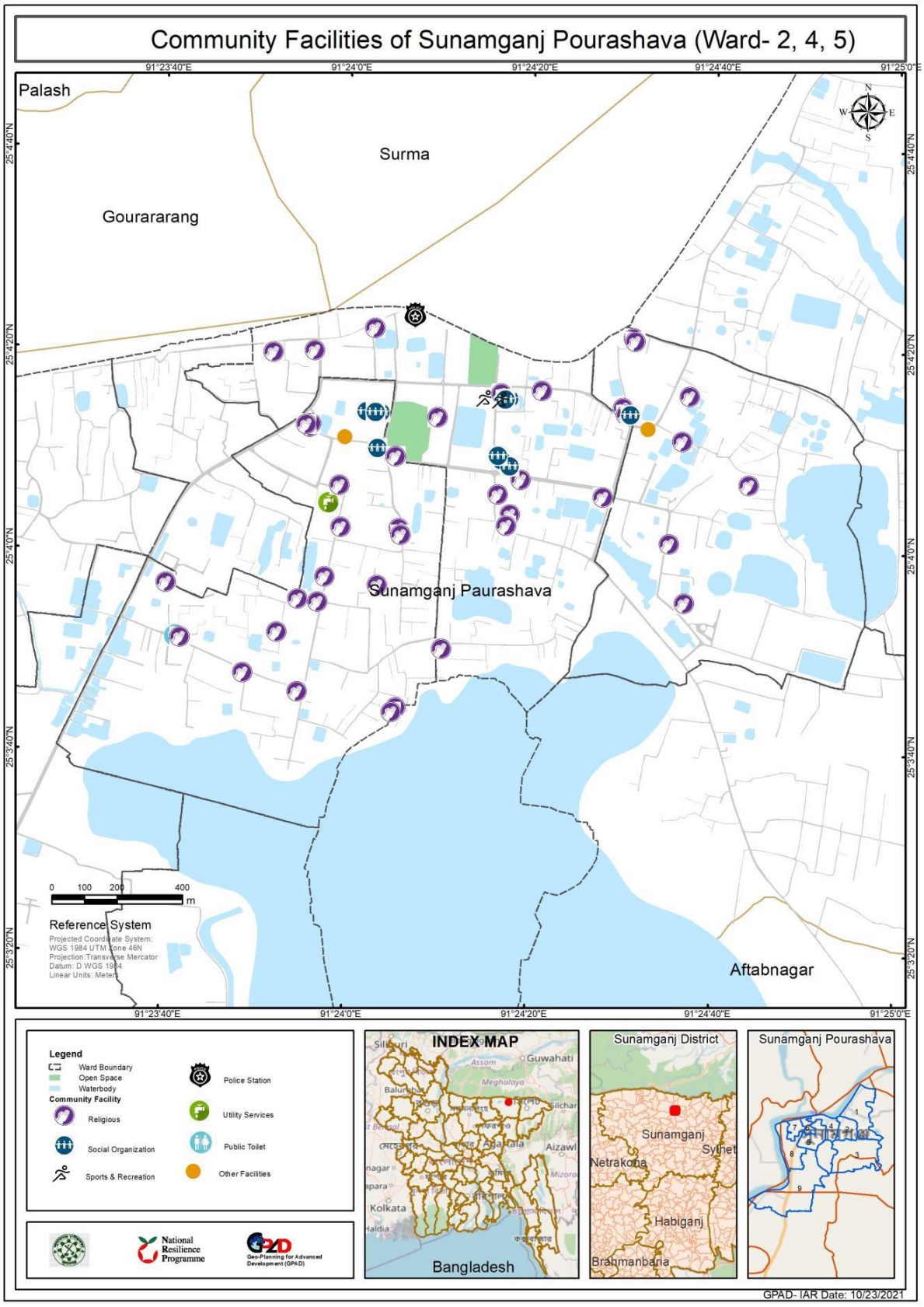


Figure 2.11: Existing Community Facilities in Sunamganj Pourashava (Ward- 2, 4, & 5)

2.5 Existing Landuse

Sunamganj Pourashava has different types of land use. Based on the field survey 2021, the land use of selected area has been categorized into 12 types of land use (See Annex 3). Table 2.14 represents the details land use of the nine wards.

Table 2.14: Land Use Details of Sunamganj Pourashava

Land Use (Area in acre)	Ward No.								
	1	2	3	4	5	6	7	8	9
Administrative	3.3	1.3	0.0	4.7	3.9	5.6	0.2	21.3	44.7
Agriculture	22.6	0.0	0.0	0.0	0.0	0.0	3.9	0.0	20.4
Commercial	0.0	2.2	0.0	10.6	9.6	4.2	0.0	21.9	17.6
Education	0.0	11.1	0.0	9.3	6.8	0.0	0.0	0.6	4.8
Health	0.0	24.4	0.0	1.8	0.1	0.0	0.0	0.0	0.0
Industry	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mixed Use	0.0	2.2	0.0	7.5	2.2	0.0	0.0	2.8	0.0
Open Space	6.4	0.0	0.0	2.9	0.0	0.3	0.0	0.0	0.0
Places of Worship	0.3	0.2	0.4	2.2	1.0	0.8	1.2	0.7	0.6
Recreational	0.0	0.0	0.0	5.2	0.0	0.0	0.0	0.0	0.0
Residential	182.1	20.8	124.2	42.4	85.6	4.4	16.0	40.6	210.0
Restricted Area	0.0	4.4	0.0	0.0	0.0	0.0	0.0	19.3	0.0
Transportation	7.6	0.0	6.0	0.0	0.0	1.8	3.0	8.0	14.9
Waterbody	120.1	0.0	2.2	0.0	0.0	3.4	3.1	11.8	43.4
Total	**344.5**	**66.6**	**280.0**	**86.5**	**109.2**	**19.7**	**26.2**	**126.3**	**748.2**

Source: (Field Survey, 2021)

From the above table, we can understand major land use in selected three wards is residential. Among the wards ward no 1 has the highest extent of areas of residential use. On the other hand, ward no 1, 4 and 6 have open Space and recreational area whereas other wards have no open space. In figure 2.12 presents the detail land use of Sunamganj Pourashava.

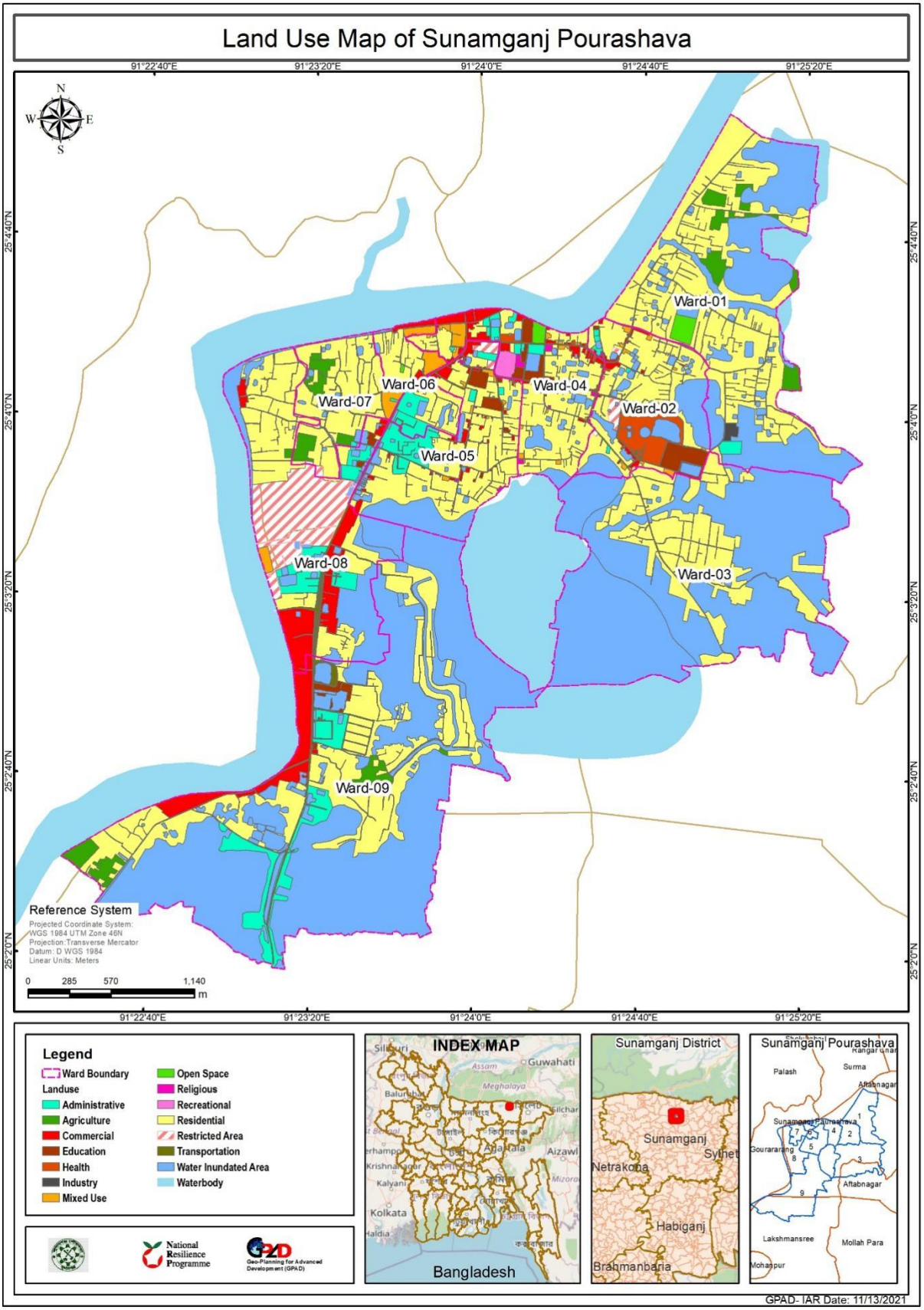


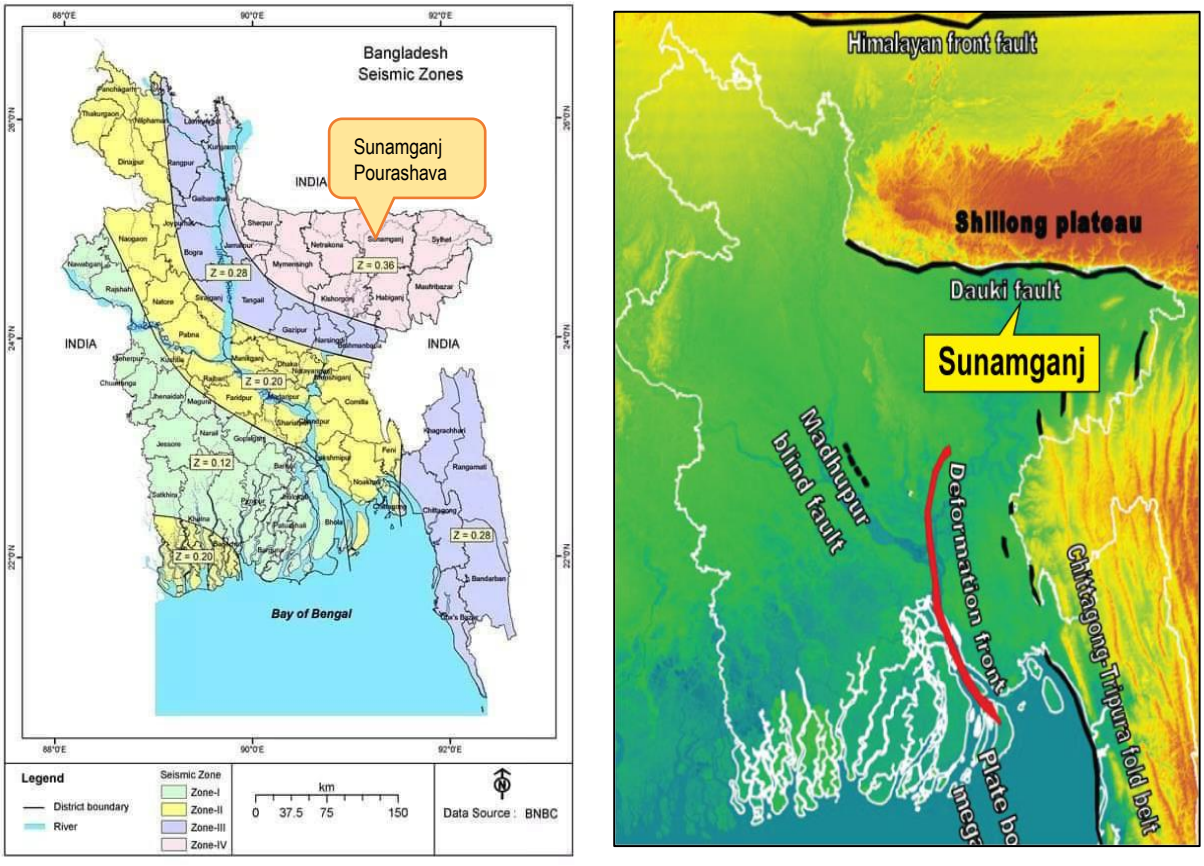
Figure 2.12: Existing Land Use Map of Ward 2, 4 and 5

Chapter-3 Earthquake Study of Sunamganj Pourashava

3.1 Earthquake Vulnerability of the Area

Bangladesh is located at the borders of Indian, Burmese and Eurasian plates which makes the country susceptible to frequent earthquakes. The country is also located close to the very active Himalayan front and ongoing deformation in nearby parts of south-east Asia exposes it to strong shaking from a variety of earthquake sources that can produce tremors of magnitude 8 or greater (CDMP, 2009). Chittagong, Sylhet, Dhaka, Rangpur, Bogura, Mymensingh, Cumilla, Rajshahi are very vulnerable to a major earthquake disaster (CDMP, 2009). During the last 150 years, Bangladesh faced seven earthquakes of large magnitude (Richter magnitude M≥7.0) with epicenters in India and Bangladesh (Al Hussaini, 2016). Other than that, Bangladesh has regularly faced many small earthquakes.

Sunamganj is located at a vulnerable seismic zone near the Dauki fault. According to the Revised Seismic Zoning Map of BNBC, Sunamganj belongs to seismic zone 4 (z = 0.36). Sunamganj faced a severe earthquake of magnitude ***7.6 in 1918*** originated at Sreemangal upazila of the Moulvibazar district. Also, the district was severely damaged by the earthquake incidents ***occurred in 1923 and 1997***. Figure 3.1 represents the earthquake hazard map incorporated with study area base map. In Sunamganj, earthquake hazard is classified as a medium according to the information that is currently available. This means that there is a 10% chance of potentially-damaging earthquake shaking in project area in the next 50 years.



Source: (Paul, Hasan, Akhter, & Rahman, 2019)

Figure 3.1: Earthquake Vulnerability of Sunamganj

3.2 Detail Earthquake Hazard Assessment of Ward No 2, 4 and 5

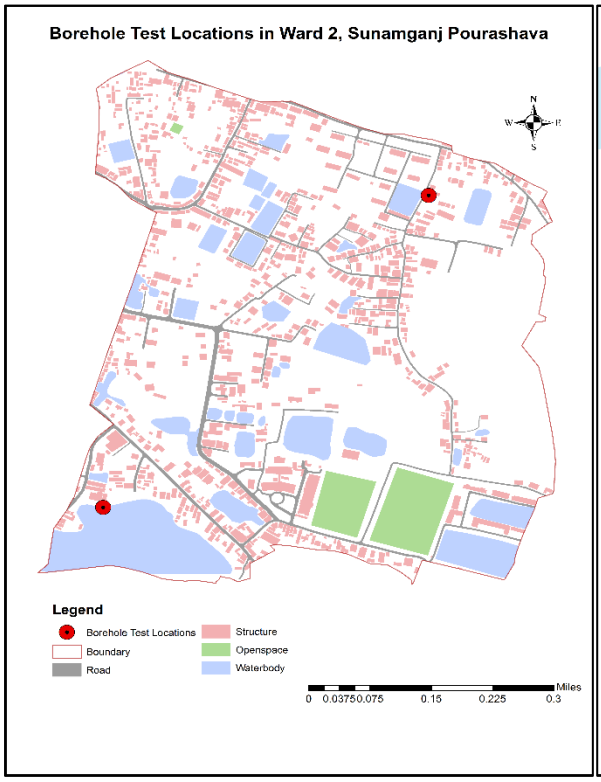
Detailed earthquake hazard assessment results have been collected from the "***Earthquake Risk Assessment for Developing Contingency Plans, Training Modules and Awareness Materials for Rangpur City Corporation and Tangail, Rangamati and Sunamganj Pourashavas" report, 2021***. In this report, the borehole location and soil profile for Ward no. 2, Ward no. 4, and Ward no. 5 of Sunamganj Pourashava have been analyzed in detail. It also presents information regarding the microtremor test for the determination of natural frequency. It will help to know the local soil condition and local seismic effect.

3.2.1 Borehole Data (SPT value and Description of Soil)

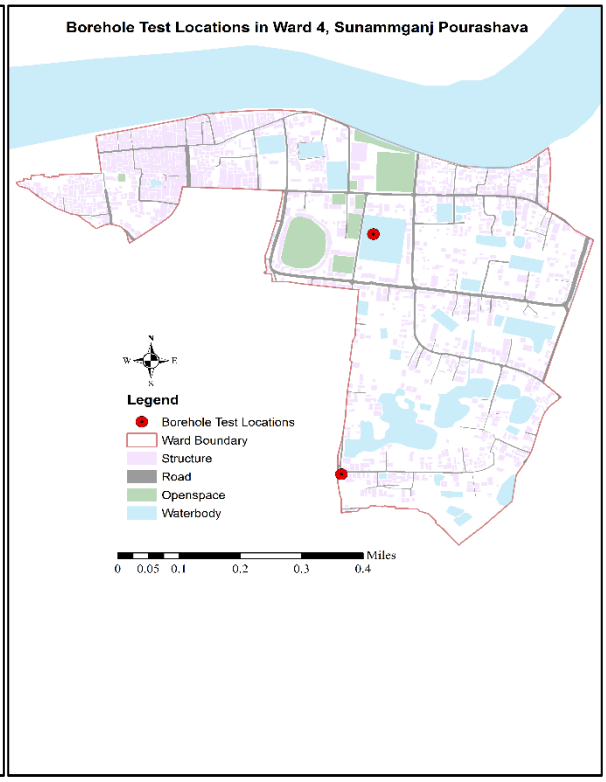
Two boreholes were done in each ward of the three selected wards of Sunamganj Pourashava. Table 3.1 lists the locations of the boreholes in each ward. The borehole diameter, used in these tests was 100 mm. Both disturbed and undisturbed samples were collected from the borings. 20 readings of SPT-N value at 1.5m intervals up to 30 m were taken. Figure 3.2 shows the location of the borings in different wards.

Table 3.1: Location of bore holes in Sunamganj Pourashava

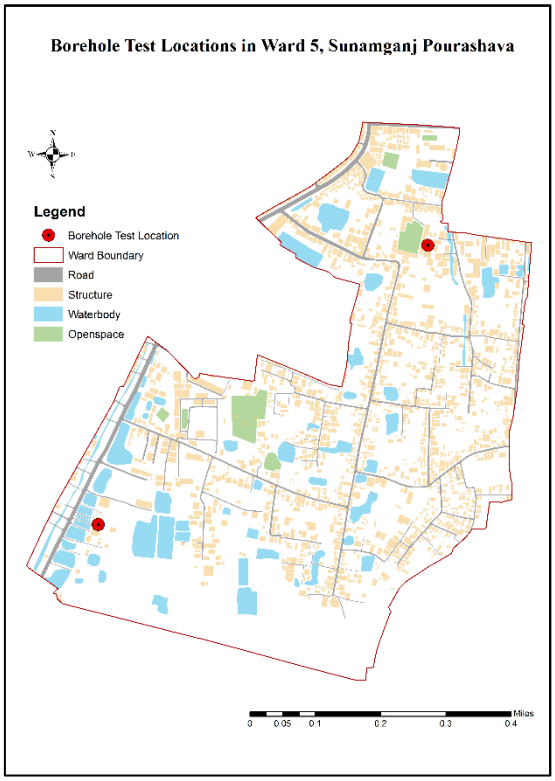
Ward No.	Bore Hole No.	Location	Latitude and Longitude
Ward 2	Bore Hole 1	Moynar Point	25°04'04.6"N 91°24'29.9"E
	Bore Hole 2	Beel Para	25°04'04.7"N 91°24'30.1"E
Ward 4	Bore Hole 1	Ukil Para	25°04'16.5"N 91°24'16.4"E
	Bore Hole 2	Shantibag Jame Masjid	25°04'16.6"N 91°24'16.5"E
Ward 5	Bore Hole 1	Badhon Para	25°04'02.3"N 91°24'18.3"E
	Bore Hole 2	Gulshan School	25°04'02.4"N 91°24'18.4"E



(a)



(b)



(c)

Figure 3.2: Location of bore holes (a) Ward no. 2; (b) Ward no. 4; (c) Ward no. 5 of Sunamganj Pourashava

3.2.2 Soil Profile of Bore holes of Ward no. 2

The soil profile of borehole 1 in Figure 3.3 shows four different layers of soil. The N value up to 10.5m is less than 10. So, the top 10.5m have less shear strength as both cohesion and angle of internal friction are positively correlated to SPT-N value (Kumar et al., 2016). Beyond this, the N value increases up to 20 (at 12m) and drops by 3 in the next 1.5m. After 13.5m, the value increases with minor fluctuations reaching the maximum value of N is 32 at 30m. A detailed description of the soil types is shown in Figure 3.3.

On the other hand, the soil profile of borehole 2 in Figure 3.4 also shows four different layers of soil. At the top 4.5m, the N value is below 5 and thus represents soil of low shear strength. The N value remains below 10 up to 9m and steadily increases to 36 at 18m. It is the maximum N value that was obtained between both the boreholes. As the depth increases, the N value keeps decreasing till 27 m where a value of 20 is obtained. In the next 3m, the value increases slightly and reaches 25. up to 24m. Then again Hence, from the comparison of both the boreholes, it can be observed that the soil strength of both the boreholes is quite similar.

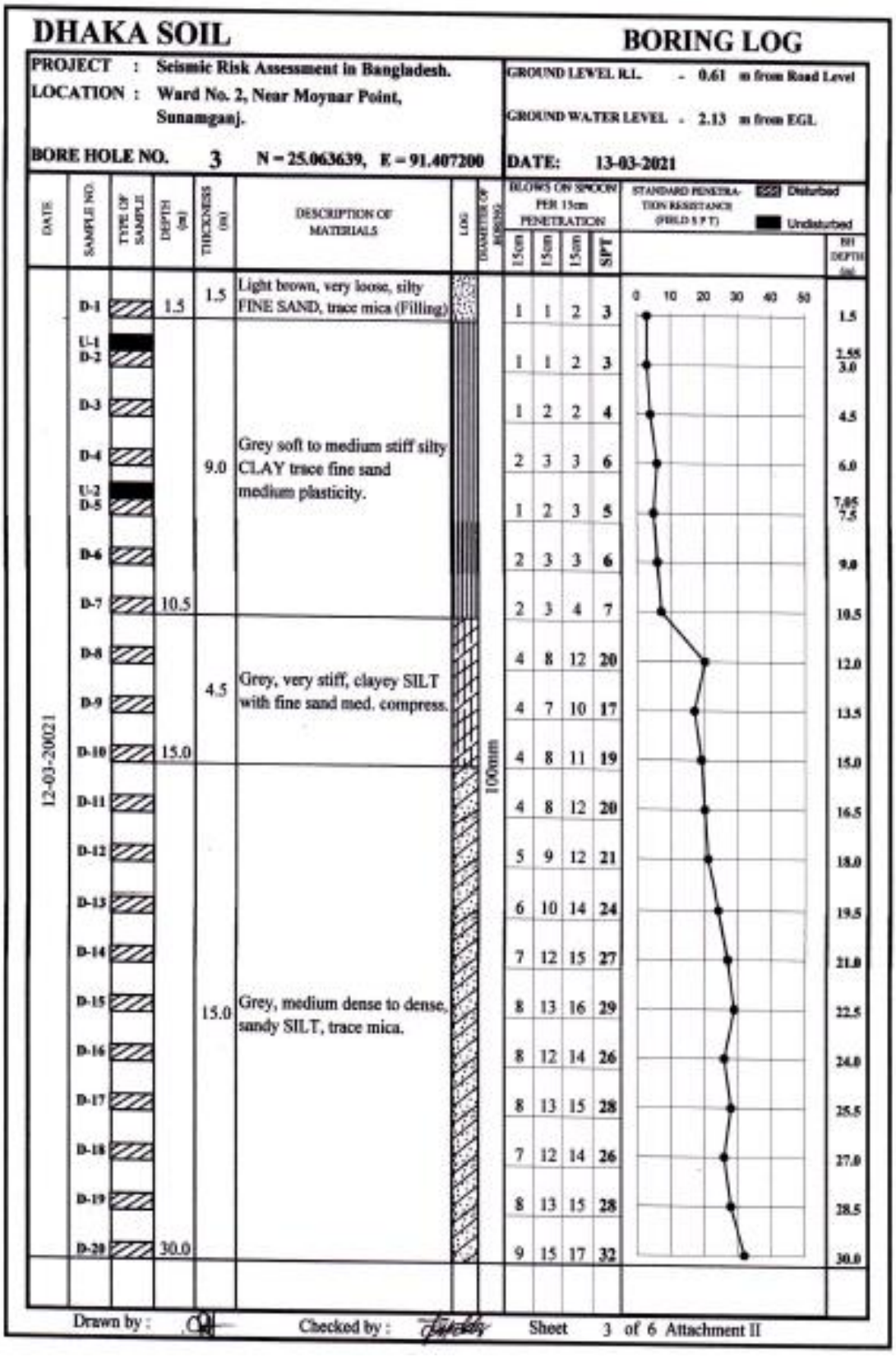


Figure 3.3: SPT data of Bore Hole 1 of Ward 2

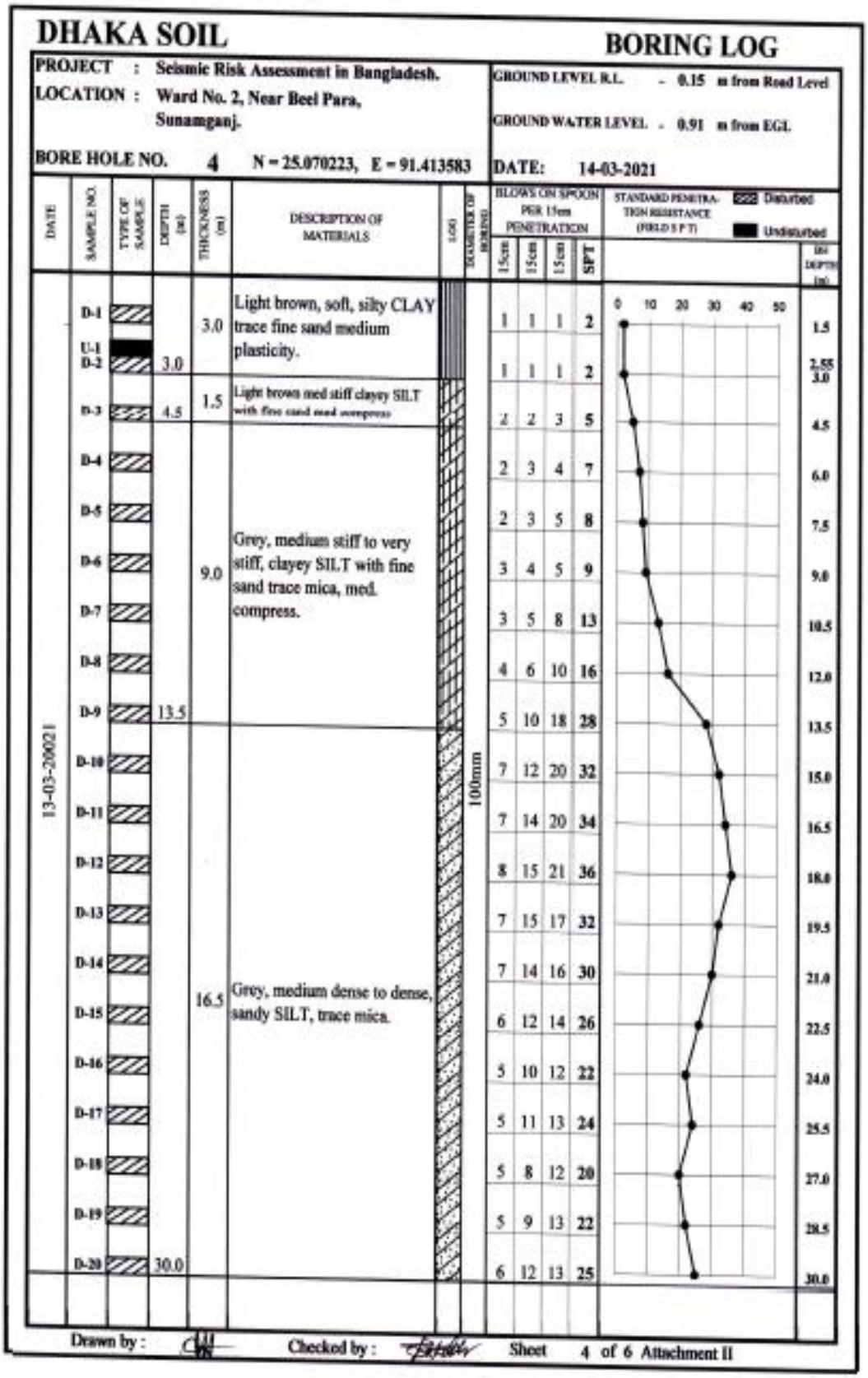


Figure 3.4: SPT data of Bore Hole 2 of Ward 2

3.2.3 Soil Profile of Bore holes of Ward no. 4

The soil profile of bore hole 1 in Figure 3.5 shows five different layers of soil. The N value up to 10.5m is less than 5. Thus, the top 10.5m have poor strength characteristics as both cohesion and angle of internal friction are positively correlated to SPT-N value (Kumar et al., 2016). Moreover, a layer of organic clay with peat was located from 7.5m to 9m. The SPT-N value increases beyond 10.5 and reaches a maximum of 28 at 16.5m. As the depth increases further, the N value remains within 20 to 24, with an exception at 24m where the value becomes 27. The detailed description of the soil types is shown in Figure 3.5.

The soil profile of bore hole 2 in Figure 3.6 also shows five different layers of soil. However, no organic soil was detected in this borehole. Up to 7.5m, the SPT-N value remains below 5 resulting in low soil strength. The SPT-N

value increases beyond this depth with occasional fluctuation and reaches at a value higher than 20 (N=24) at 18m. At the last layer of medium dense sandy silt, the N values stay mostly steady between 18-24. However, the maximum value of 26 is obtained at 27 m. Though from the comparison of both the bore holes it can be observed that their strength characteristics are quite similar, the presence of organic soil in borehole 1 shall be carefully considered during construction.

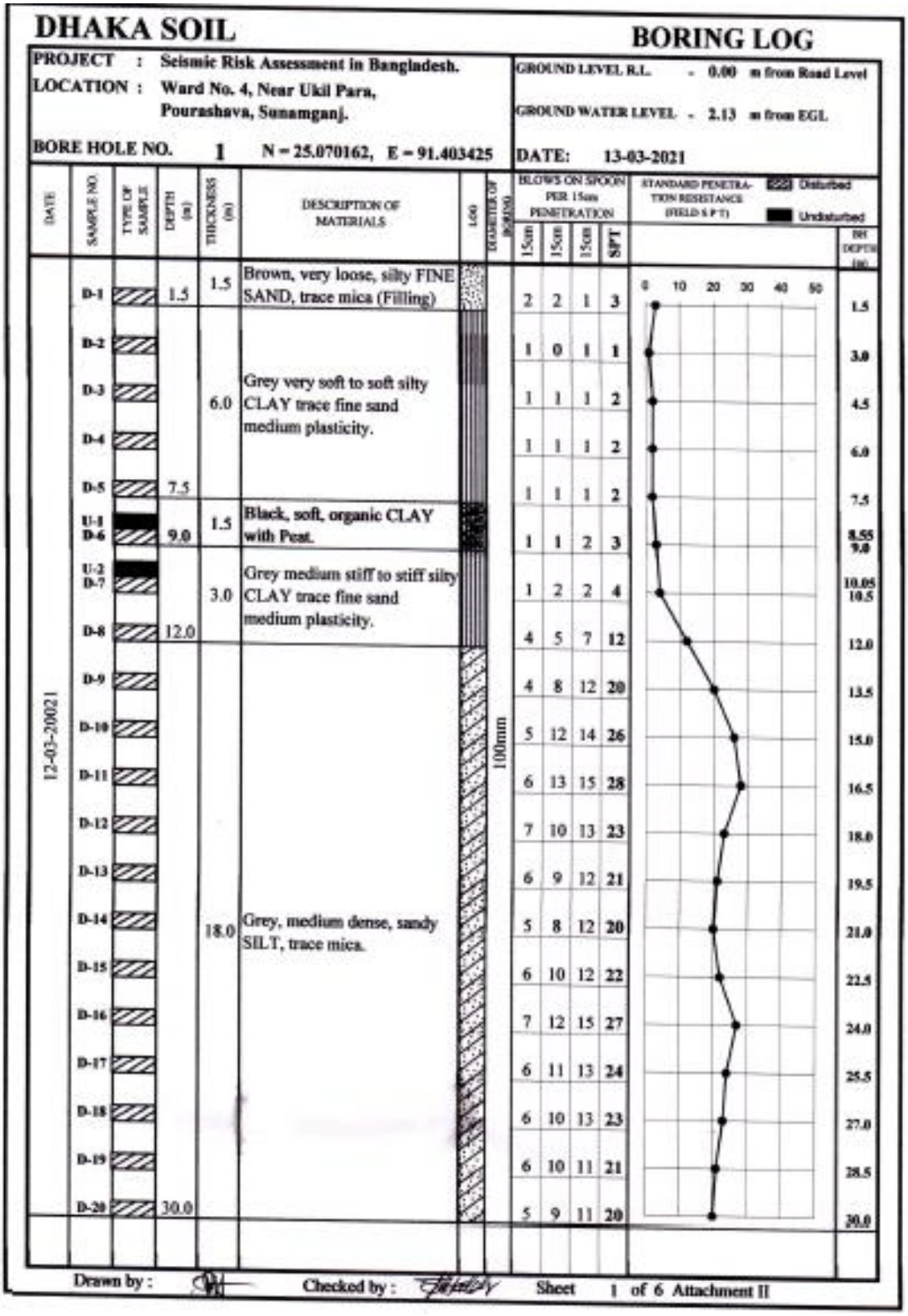


Figure 3.5: SPT data of Bore Hole 1 of Ward 4

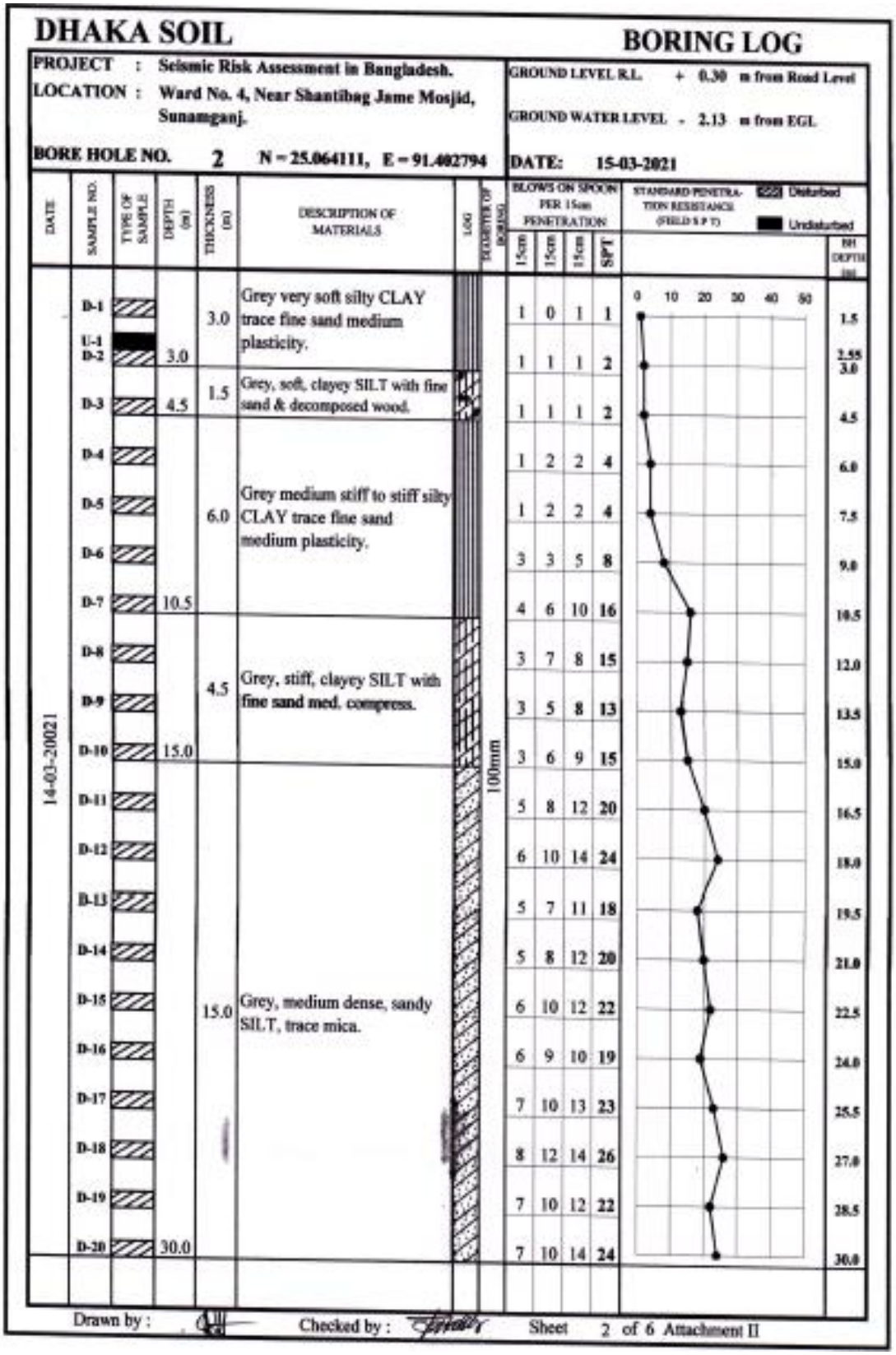


Figure 3.6: SPT data of Bore Hole 2 of Ward 4

3.2.4 Soil Profile of Bore holes of Ward no. 5

The soil profile of bore hole 1 in Figure 3.7 shows four different layers of soil. The N value up to 10.5m is less than 10. So, the top 10.5m possess poor shear strength characteristics as both cohesion and angle of internal friction are positively correlated to SPT-N value (Kumar et al., 2016). Beyond this, the N value steadily increases up to 21m and reaches a value of 26. In the next 9m, the value remains within 25-27, 27 beings the maximum SPT-N value obtained for this boring. The detailed description of the soil types is shown in Figure 3.7.

On the other hand, the soil profile of bore hole 2 in Figure 3.8 shows three different layers of soil. The soil of top 10.5m has an SPT-N value less than 5. Thus, the strength characteristics of this soil layer is very poor and worse as compared to the top 10.5m of borehole 1. The N value slowly increases up to 19 at 16.5m. There is a sudden jump in N value in the next 1.5m where it reaches 27 and which may be attributed to the change in soil layer. In this final soil layer, the N value fluctuates between 20-26. However, N=17 has been obtained at the depth of 21m

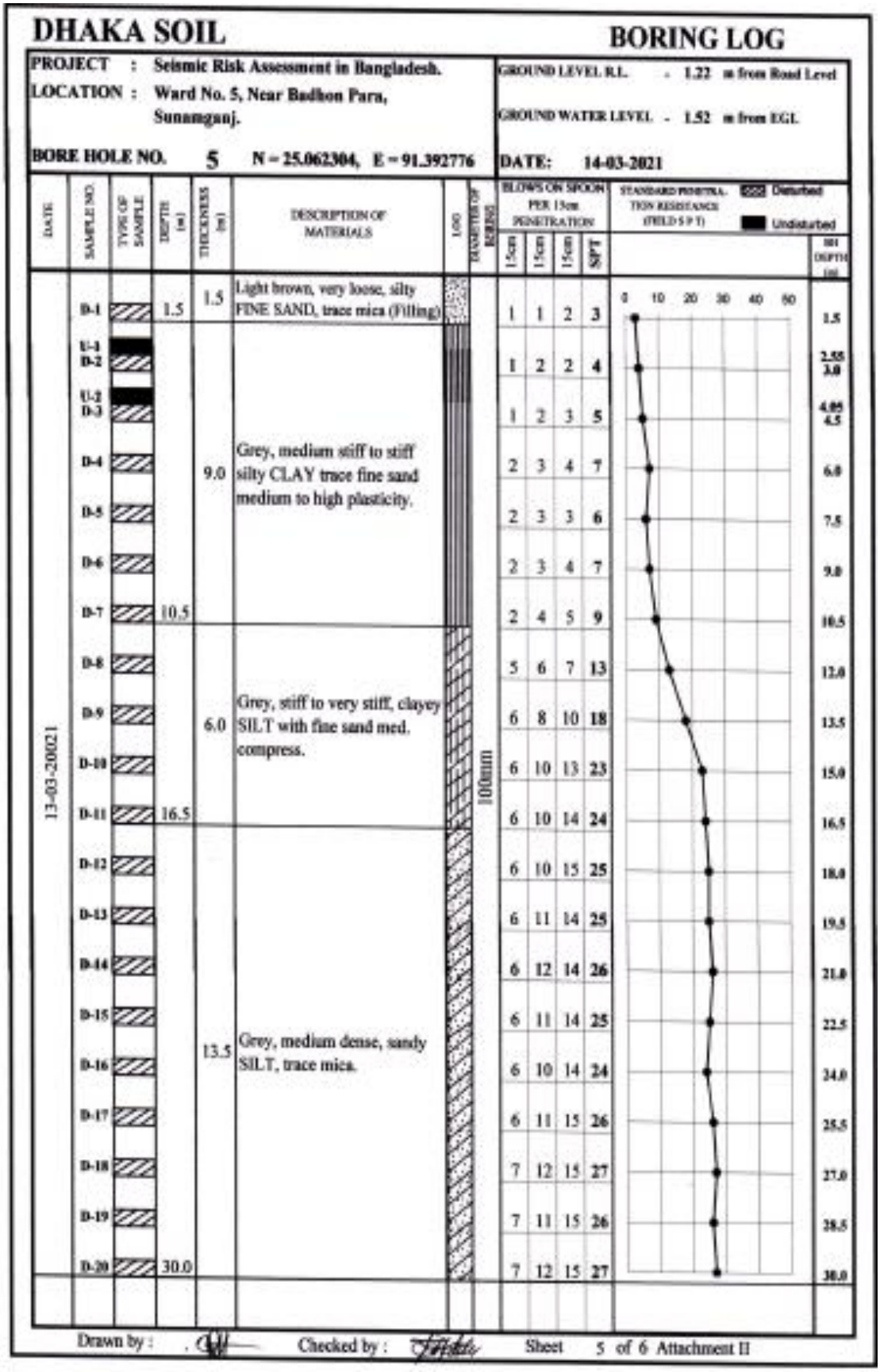


Figure 3.7: SPT data of Bore Hole 1 of Ward 5

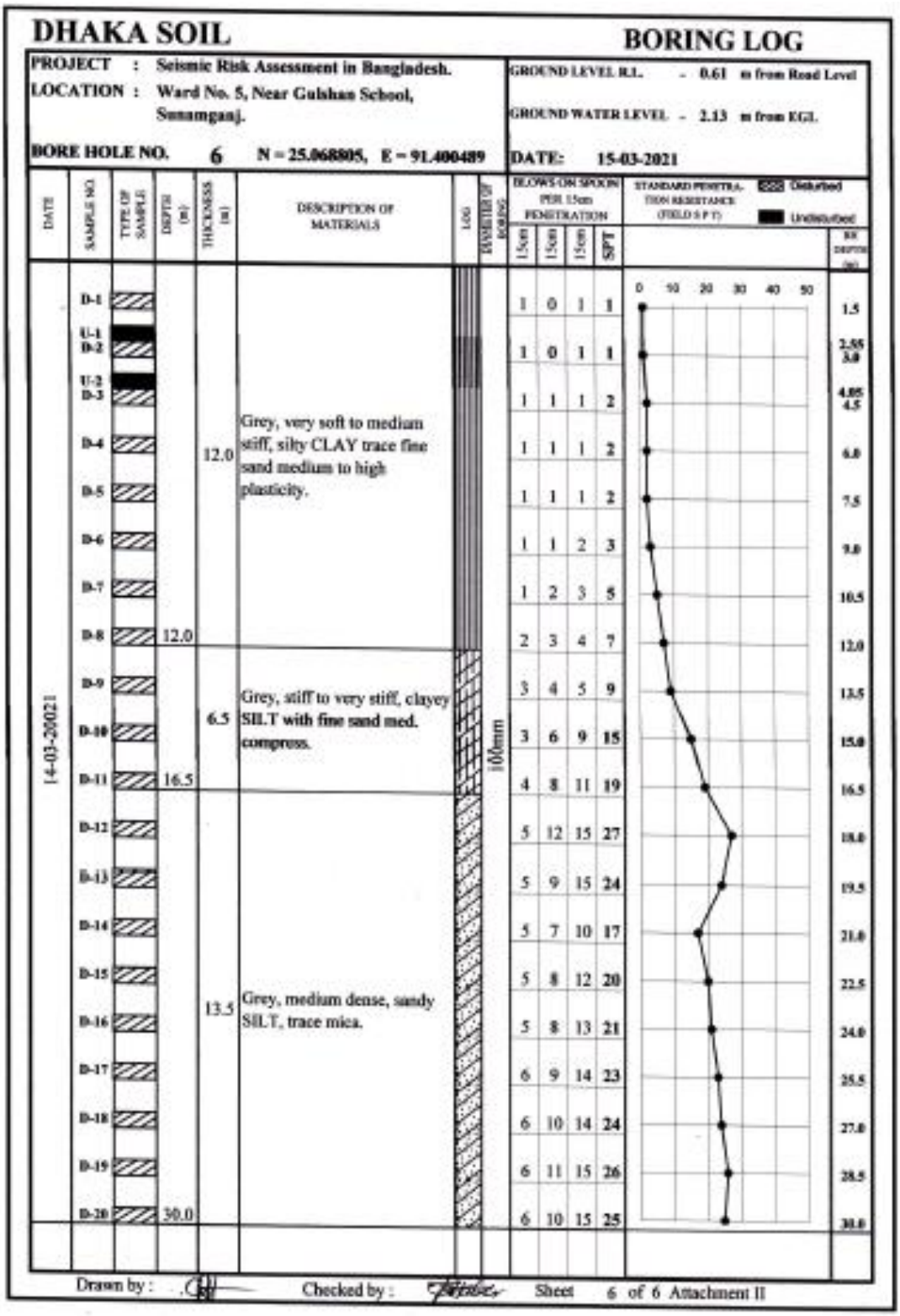
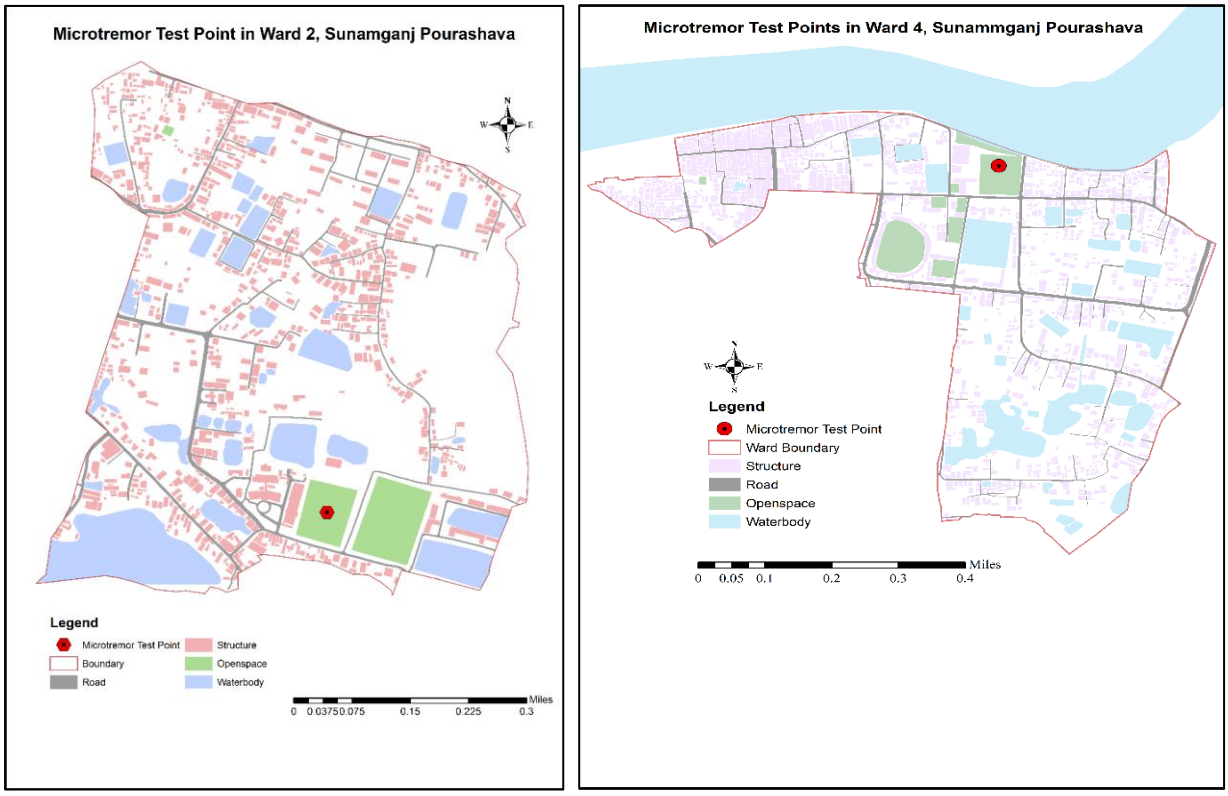


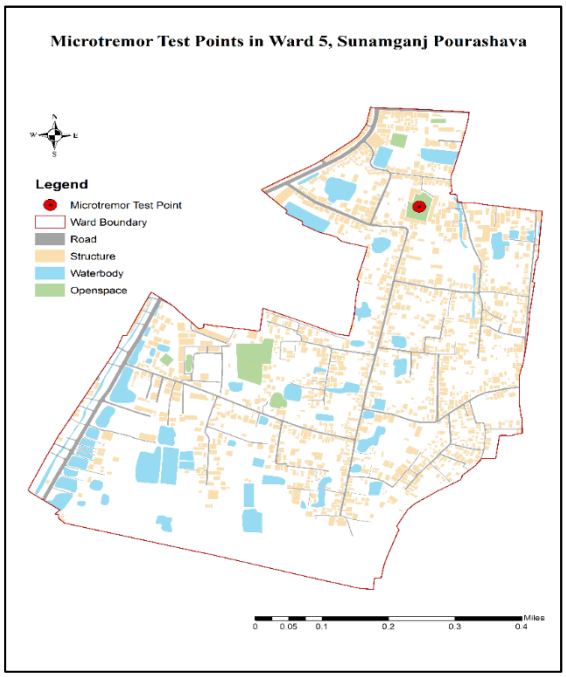
Figure 3.8: SPT data of Bore Hole 2 of Ward 5

3.3 Microtremor Test

Microtremor test was conducted at one location of each ward of Sunamganj Pourashava. Figure 3.9 shows the location of Microtremor tests in the three wards of Sunamganj Pourashava.



(a) (b)



(c)

Figure 3.9: Microtremor test locations at (a) Ward no. 2; (b) Ward no. 4; (c) Ward no. 5

3.3.1 Result of Microtremor test for Ward 2

Figure 3.10 shows the Amplitude ratio vs Frequency graph for ward 2 of Sunamganj Pourashava.

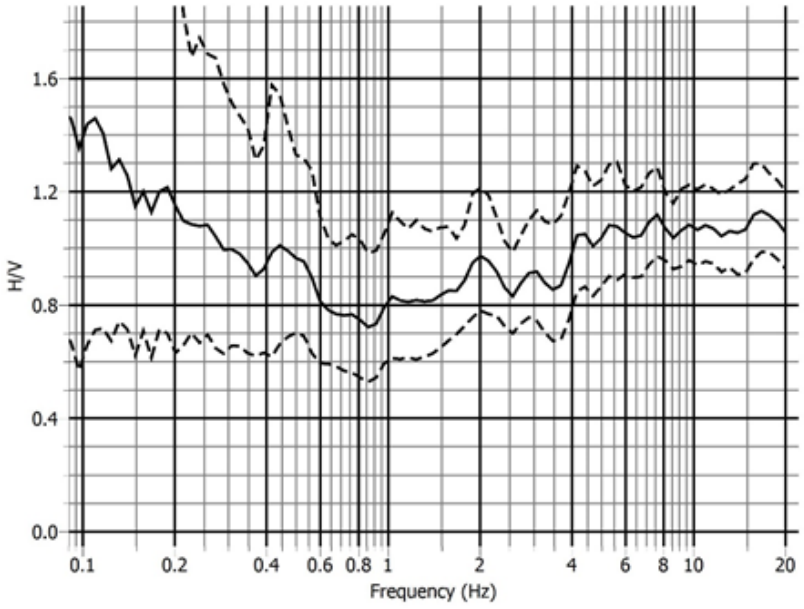


Figure 3.10: Amplitude Ratio vs Frequency graph of Ward no. 2 of Sunamganj Pourashava

From the graph, no peak was observed in the amplitude ratio. Thus, the natural frequency could not be estimated from the microtremor analysis. However, using empirical equations along with the soil profile obtained from the boreholes, the shear wave velocity of the 30 meter 1-D soil column was found to be around 127.68 m/s (Bore hole-1) and 137.78 m/s (Bore hole-2). Calculations with shear wave velocity showed that the predominant period for the soil was 0.904 seconds. Hence, for the location of the microtremor test, the predominant/natural frequency of the soil, at which the amplitude of the ground motion, is the maximum is 1.11 Hz.

3.3.2 Results of Microtremor test for Ward 4

Figure 3.11 shows the Amplitude ratio vs Frequency graph for Ward 4 of Sunamganj Pourashava.

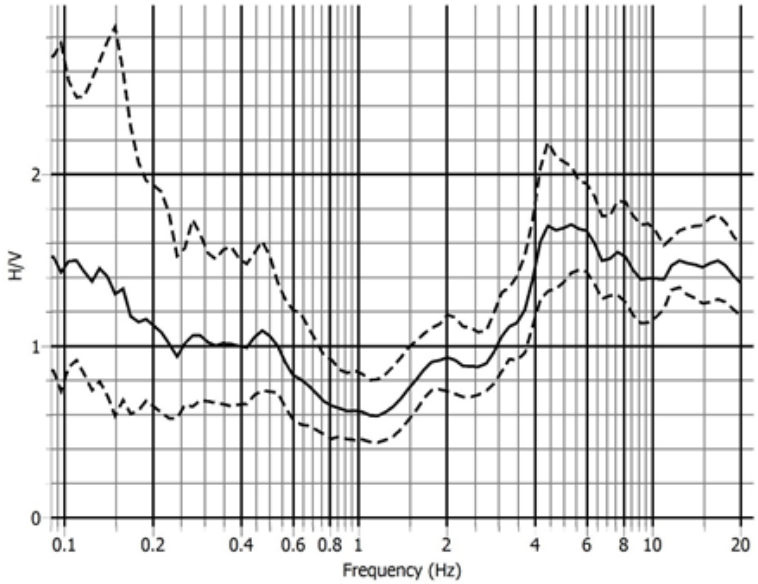


Figure 3.11: Amplitude Ratio vs Frequency graph of Ward no. 4 of Sunamganj Pourashava

From the graph, we can observe that the amplitude ratio is maximum at around 4.5 Hz. The frequency at which the amplitude ratio shows a prominent peak is considered to be the predominant/natural frequency of the soil at that location. So, the predominant frequency is around 4.5 Hz. The predominant period is 0.22s. Using empirical equations along with the soil profile obtained from the bore holes, the shear wave velocity of the 30 meter 1-D soil column was found to be around 129.05 m/s (Bore hole-1) and 130.78 m/s (Bore hole-2).

3.3.3 Results of Microtremor test for Ward 5

Figure 3.12 shows the Amplitude ratio vs Frequency graph for Ward 5 of Sunamganj Pourashava.

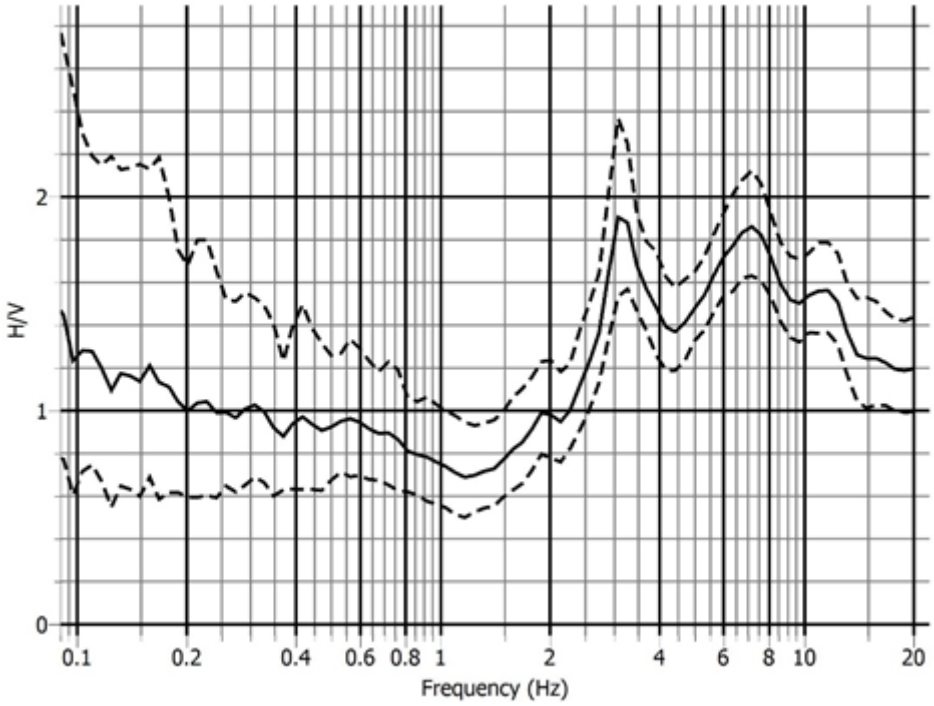


Figure 3.12: Amplitude Ratio vs Frequency graph of Ward no. 5 of Sunamganj Pourashava

From the graph we can observe that the amplitude ratio is maximum at around 3.2 Hz. The frequency at which the amplitude ratio shows a prominent peak is considered to be the predominant/natural frequency of the soil at that location. So, the predominant frequency is around 3.2 Hz. The predominant period is 0.31s. Using empirical equations along with the soil profile obtained from the bore holes, the shear wave velocity of the 30 meter 1-D soil column was found to be around 135.98 m/s (Bore hole-1) and 126.03 m/s (Bore hole-2).

3.4 Earthquake, Fire Hazard and Flood Risk Zone Identification in Ward No 2, 4 and 5

After analyzing all the data (collected from field survey 2021) through weightage method (for details see Annex 1) earthquake, fire hazard risk zone has been identified in ward no 2, 4 and 5 and flood risk zone for overall Sunamganj Pourashava. Figure no 3.13, 3.14, 3.15 shows the map of identified risk zone.

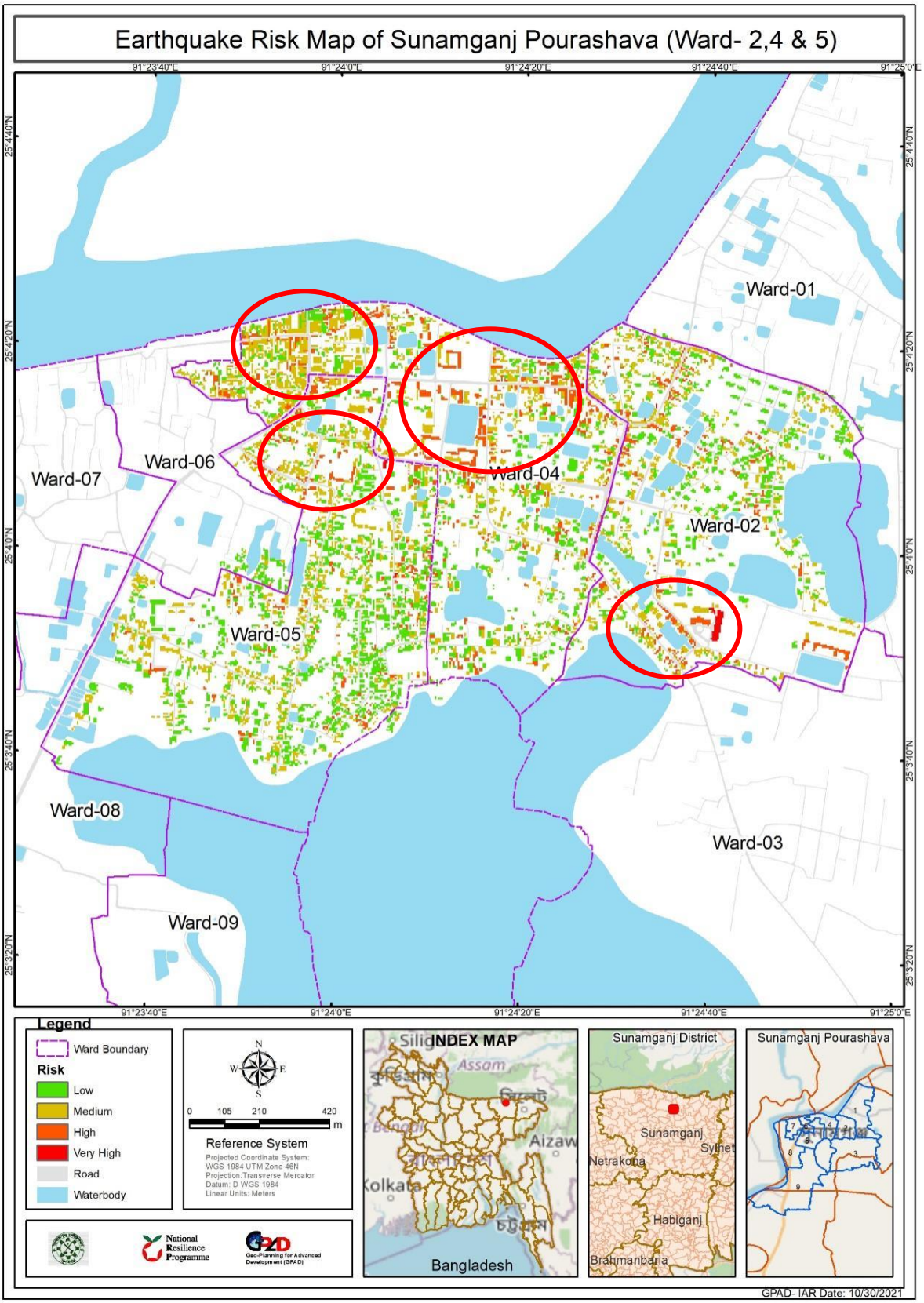


Figure 3.13: Map of Earthquake Risk Zone

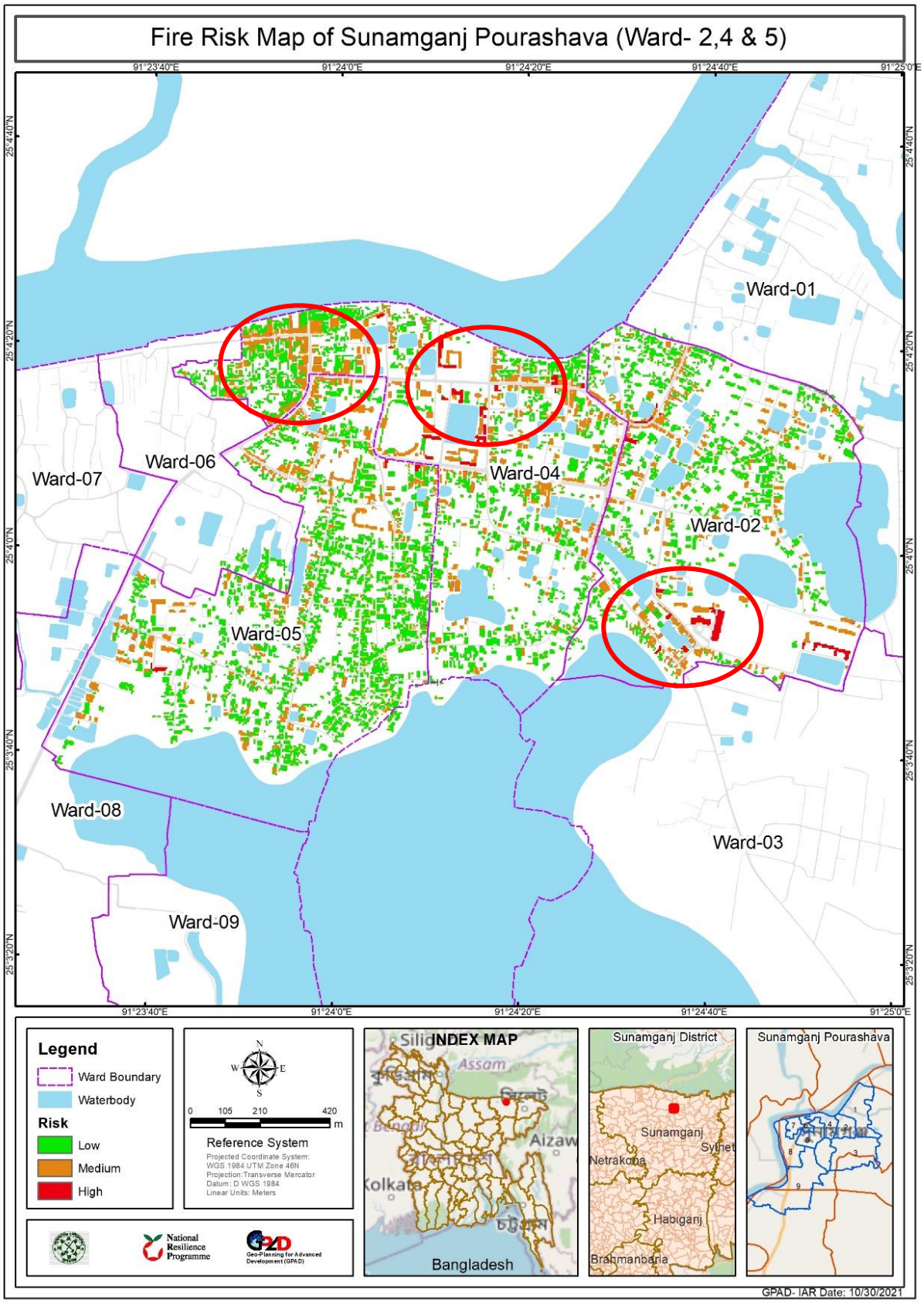


Figure 3.14: Fire Hazard Map of Ward no 2, 4 and 5

Flood Inundation Risk

Sunamganj is located on the bank of the Surma river. The recorded highest water level of Surma river is 9.29mMSL whereas Danger Water Level is 7.80mMSL for Sunamganj Pourashava. (BWDB, 2021).

According to the Drainage Master Plan of Sunamganj Pourashava the annual high-water level at Sunamganj ranges from elevation 8.24 m to 9.46 m PWD with an average value of elevation 8.82 m PWD. The danger level at the station was set at elevation 8.24 m PWD. A moderate flood (elevation 8.82 m PWD) with a 1-in-25-year return period may inundate considerable low-lying areas of the Pourashava. The floods can also overtop the banks of the river in the town area and flow through it to reach the hoar area at the southern side of the town. The town slopes away from the riverbank to the haors in a north to south direction. Flash floods can occur in the river several times a year. Daily variation in slope can be very large with the slope tending to be highest on the rising limb of flood waves and decreasing on the falling limb.

Sunamganj Pourashava is a flood-prone area. For geographical reasons most of the land is low. The main reasons for floods during the last five years (2015-2020) were excessive rainfall and overflow of river water. Most flood-affected areas were Alipara, Arefin Nagar, Baniapara, Bilpar, Baropara, Courtpoint, DS Road, East Sultanpur, Hasanbari, Jagannathbari Road, Jail Road, Jalilpur, Jamaipara, Kajirpoint, Mallikpur, Muhammadpur, Moinarpoint, Muktarpara, Notunpara, Pallabi, Alipara, Pallabi Muhammadpur, Pallabi, Roypara, RPNagor, Shantibagh, Sultanpur, TkBamonnogor, Ukilpara, Voyeskali, Waiskali, West Sultanpur.

Sunamganj Pourashava lacks an integrated drainage system. Most drains are connected to low lands. During the rainy seasons, water-logging is common which hampers normal life and also increases the risk of mosquito/fly-borne diseases. The drainage system is prone to damage due to a lack of canals and blocking of low lands.

From figure 8.4 it can be said that some extent of the area in wards 2, 4, and 5 is in a low flood zone, and some is not flood-prone zone (SPARSSO, 2021). The figure also shows among the three wards ward no 5 is more vulnerable to a flash flood.

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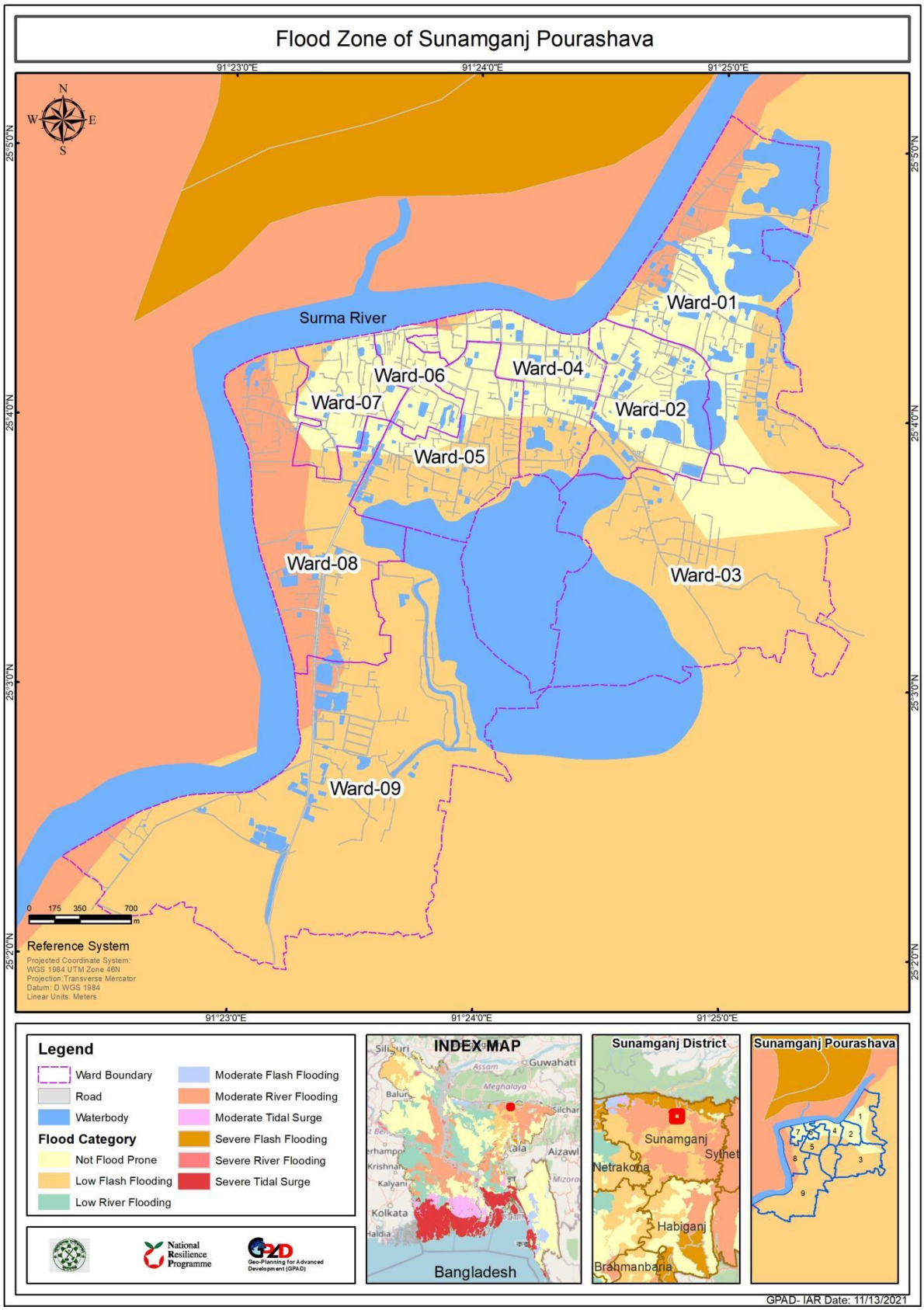


Figure 3.15: Flood Zone Map of Sunamganj Pourashava

Chapter-4 Critical Issues for Planning

Deficiency in proper land use zoning and services is one of the major critical problems of the Pourashavas in Bangladesh, and Sunamganj is no exception. The reasons for such deficiency may vary but are mostly linked with the disaster risk and resource potential of the Pourashavas. Chapter 4 describes the critical issues for land use planning based on the existing conditions in respect of Demographic issues, Transport and Communication, Urban Utilities, Drainage and Environment, related other issues namely disaster, land use control, law, and regulation, etc. The weaknesses in the present development processes are also taken into consideration to identify the critical issues for planning at Sunamganj Pourashava.

4.1 Socio-Economic and Demographic Issues

Most of the Pourashavas in Bangladesh are basically urban centers with direct links to rural areas. There are significant differences in the standard of socio-economic wellbeing and demographic characteristics of these small towns with metropolitan and major cities in the country. Most of these Pourashava has a small population, not enough to sustain economic growth to render services and facilities for quality of life needed in an urban environment. As a result, qualities in socio-cultural and demographic matters suffer from after-effects of the hazards like earthquakes, fire hazards and floods. In the preparation of various components of the land use plan of Sunamganj Pourashava, this critical aspect of reality in development has to be addressed for sustainable solutions.

4.2 Transportation and Communication

Communication network plays a very important role in land use planning. Houses and other establishments always prefer roadside lands to have easy access to different places. The Pourashava has a very low traffic volume. Traffic Conflict is not common and frequent in Sunamganj town. However, without planning a transport network for the Pourashava area as a whole, a standard transport network and an efficient traffic management system for the future cannot be ensured. The nature of problems and deficiencies are identified below.

a. Unplanned and Narrow Road

Roads in the pourashava are being developed without using any planning standard and network plan. As a result, narrow roads with tortuous patterns are common. Narrow roads and poor maintenance of those roads are major problems for traffic movement in the town. New houses and other structures are cropping up along these sub-standard narrow roads which cause difficulties for evacuation and fire service facilities. This is likely to poise traffic movement problems in the future when development becomes more intense and the density of population increases. The existing narrow roads require widening and improvements of pavement thus it will be helpful to make the pourashava disaster resilient. Some road segments within the Pourashava are built in an unplanned manner. These segments will require improvement as per future traffic volume and required space for turning lanes.

b. Unplanned and Inadequate Bus, Truck, and Tempo Terminal/Stand

At present, there is one bus stand used as a terminal in the pourashava area. It has a very small area. Three para transit stands have been found here in this pourashava; one at Bokpoint Chottor, second at Kali bari Point and third at Kazir Mor. This is not enough to support the whole pourashava area and population of around 87,570. It will not be able to support in a massive disaster situation. The distribution is not planned too, which creates problems during traveling from the distant part of the pourashava.

A key issue related to the sustainable development of planning area providing a minimum quality and standard of living pertains to the availability of and accessibility to basic infrastructure facilities, viz. water, power, sewerage, drainage and solid waste management. The present state of infrastructure problems in the Pourashava may become a cause of the crisis. At present, the state of telecommunications and power scenario in Sunamganj Pourashava is not so good. There is no water and gas supply facility in this Pourashava. Thus, a critical need for advance action and arrangement is required for adequate provision of physical infrastructure.

4.3 Drainage and Environment

The majority of the population at Sunamganj Pourashava is deprived of drainage facilities. Uncollected waste is washed out into the roadside drains and natural canals. Blockage of drains by solid waste reduces the carrying capacity of drains and natural canals and becomes a source of pollution. Pourashava has very limited resources to clean the drains. It has been observed that in some areas, domestic sewage conveys directly to these water channels. Waterlogging is a problem in some parts of Sunamganj Pourashava, causing waterlogging for 5-7 days each time during heavy rainfall between June and November every year.

The sources of surface water pollution are domestic waste, unhealthy sanitation and extensive use of fertilizer in agriculture. The condition of solid waste management at Sunamganj Pourashava is very poor.

4.4 Disaster Issues

As Sunamganj is located along the tectonic plate boundary, so it is more vulnerable to earthquake devastation. Dauki falt is found at the boundary line of Sunamganj district. Mitigation measures are to be suggested in the earthquake-sensitive land use plan of the pourashava.

In the planning and designing of the building guideline, road network, drainage system and other major physical features, the aspect of flooding has to be considered seriously. According to the water level data of *Flood Forecasting & Warning Centre, 2021*, the flood danger level of the Surma River at Sunamganj point is 7.80 mMSL. The highest level of flood has been recorded in this area is 9.29 mMSL. So, the safe level for construction and new development has been considered 10 mMSL. Waterlogging is another issue to be considered here. For its unplanned manner of development and inadequate drainage network, it is necessary to concentrate on this issue especially to mitigate it in the future.

Densely populated areas and the markets places are more vulnerable to fire hazards in Sunamganj pourashava. New development in future should be carried out in a planned way thus the sensitivity of fire hazards in the study area can be mitigated to a possible extent.

4.5 Laws and Regulations

The absence of adequate planning and development control is a problem in all urban areas of Bangladesh and Sunamganj is no exception. A number of legislative measures are there to help the administration of the urban areas, urban development, and management. But all these enacted planning laws could not be enforced and many of them are not efficient in regulating planning. Due to a lack of proper implementation and enforcement, these laws remain inactive. Some weaknesses in the implementation are also observed in some conditions. So, it has turned into a critical problem for the implementation of plans for towns and cities. A substantial portion of national resources is invested in building construction in both the public and private sectors. In order to ensure the optimum return of this investment and to achieve the satisfactory performance of the buildings in terms of safety, serviceability, health, sanitation and general welfare of the people, building construction needs to be controlled and regulated. Legislative measure for such control has been provided in the East Bengal Building Construction Act, 1952 and from time to time, regulations have been promulgated by the government under Section 18 of this Act. As per law, it is mandatory to get any structure approved by the appropriate authority before construction. Permission to build construction in Pourashava is administered by this authority within its jurisdiction. However, as elsewhere in the country, noncompliance to these rules is also observed here.

a. Weak Local Government

Though Pourashava is a democratically elected urban local government, its authority is limited to working as a local government. In most cases, prior government permission is required before taking any legal action. Section-66, Section-69 (1) and (2), Section- 72 (4), Section-32 (2) of Pourashava Act are a few examples. This is one of the reasons that there has been little progress in the decentralization of governance at the local level in Bangladesh.

b. Public Participation in Plan Making Process

The planning and development Acts of earlier times had contained a little scope for the authorities concerned to seek public opinion on their city/town plans prepared before they are sent to the government for final approval. Not

having any scope for public participation is against the democratic norms of a modern society. The authority must involve people in the planning and development process, and hear their views, needs and grievances to mitigate problems. This vital aspect should be incorporated in the Ordinance through revision.

c. Coordination of Activities of Public Sector Development Agencies

There are a large number of public sector development agencies working in the town and surrounding areas. There is hardly any coordination among activities of these development agencies. The absence of coordination results in wastage of resources and often brings misery to the people. This is commonly evident in our urban development works, for example, as one agency digs the streets for telecommunication network and repairs the streets, another agency starts digging for sewerage ducts. Effective coordination, in this case, would result in an integrated approach to development work reducing wastage of resources. There should be provisions in the Ordinance for such coordination by the Pourashava Authority to ensure accountability of the agencies working for their respective jobs in municipal development.

d. New Rules for Practicing Planning Standards

At present, there is no standard for infrastructure, services and facilities provided by the public sector. There is a need to formulate standard rules for services and facilities and get incorporated in the Pourashava Ordinance/Act to secure public interests. A standard has been set in the UTIDP for future land use proposals in the Master Plan of the Pourashava.

e. Betterment fee

Due to the failure of execution of the powers of charging betterment fee, all the benefits of land value enhancement due to Pourashava development of infrastructure go to the adjacent landowners or the persons having an interest therein. A proper execution of betterment fees will help increase in revenue earning of the Pourashava.

f. Penalty for Violation of Plan Provisions

The penalty for violation of plan provisions provided in the Ordinance (Section 49) is only Tk. 5000 and for delay Tk.50/day, if the violation continues further after notification. This is an extremely low rate of penalty, which should be revised for a substantial increase to prevent any violation effectively. The penalty provision should be more stringent to ensure the enforcement of plan provisions.

4.6 Existing Problems and Weaknesses in the Development

The major problems that currently exist in Sunamganj Pourashava include the following:

a. The Pourashava town has a weak economy and revenue base that does not support improvement in the socio-economic wellbeing of the people. The Pourashava authority for lack of resources fails to make required investments in the development of physical infrastructure to improve the quality of life of the people living in the town.

b. The Pourashava has also no definite plan for the development of various physical infrastructures in the near future in a planned manner. With a lack of resources, it also lacks professionally skilled manpower to carry out development in a planned way.

Thus, for making this Pourashava a viable urban centre, attention should be paid toward cost-effective development of all of its required infrastructure in phases, with the help of professionally skilled manpower and utilizing the newly prepared Earthquake Sensitive Landuse Plan as an important tool for disaster resilience.

Chapter-5 Review of National Plans and Policies

5.1 Review of Relevant National Plans, Acts, Laws and Policies

The various existing policies, regulations and laws of the country have direct and indirect effects on the preparation and implementation of the Earthquake Sensitive Land Use Plan of Sunamganj Pourashava. These are briefly reviewed in this chapter to examine their adherence to the landuse plan of the Pourashava.

5.1.1 Eighth Five Year Plan (July 2020-June 2025)

The implementation of the Delta Plan during the 8FYP will play a major role in implementing the government's strategic shift towards better management and reduction of natural disaster incidence, especially from flooding, sea-level rise, salinity and waterlogging. Specific activities for better disaster management under the 8FYP include: developing adaptive research on disaster and climatic issues, adopt proven technologies, developing a vulnerability index which will help channelize equitable resources to the targeted districts. Developing a focused and specific DRR-CCA indicator in the overall performance tracking for the plans, programs and projects.

5.1.2 Bangladesh Delta Plan (BDP), 2100

The Bangladesh Delta Plan (BDP) 2100 is a long-term integrated techno-economic mega plan that integrates all delta-related sector plans and policies, enveloping a delta vision and strategies that make it possible to integrate sector plans and policies for the long term and to present actionable interventions with a road map for realization. BDP 2100 specific goal 1 is to ensure safety from floods and climate change related disasters; strategies in this plan are developed at 3 Levels. At national level: flood risk and fresh water management; At hotspot level haor, flash flood areas and urban areas; in cross-cutting issues sustainable land use and spatial planning and earthquake are included.

5.1.3 The Perspective Plan, 2021-2041

In recognition of the substantial development challenges, the government has embarked on a perspective plan covering 2021 to 2041. The perspective includes great strides in human development including health and nutrition, effective population control, progress in all levels of education, primary, secondary and tertiary in addition to commendable improvement in science and technology, along with great achievement in ICT. Infrastructure development will improve integrated multi-modal transport encompassing, railways, roads and inland water transport having connectivity with our neighboring countries. The plan has goals in seven broad categories: (i) Income and Poverty; (ii) Human Resource Development (iii) Water and Sanitation; (iv) Energy and Infrastructure, (v) Gender Equality and Empowerment; (vi) Environment Sustainability; and (vii) Information and Communications Technology (ICT). Pursuing environmentally friendly development is an abroad development goal underlying the categories of environmental sustainability which indicates the planning for an ecofriendly and disaster resilient development.

5.1.4 Disaster Management Act 2012

Disaster Management Act, 2012 is the regulatory framework, providing relevant legislative policy and best practice framework under which the activities of disaster risk reduction and emergency management can be managed and implemented from national to the local level administration. This law was enacted with a view to making disaster-related activities coordinated, target-oriented and strong; and making rules for an effective disaster response framework/ mechanism for all types of disasters.

5.1.5 National Disaster Management Policy 2015

National Disaster Management Policy 2015 defines the national perspective on disaster risk reduction and emergency management, and describes the strategic framework, and national principles of Disaster Management in Bangladesh. This provides legal framework for hazard specific risk management, and preparation of risk reduction work plan for any national organization.

5.1.6 Standing Orders on Disaster (SOD), 2019

The Standing Orders on Disasters (SOD) have essentially been prepared to outline the various roles and responsibilities for the disaster committees from national level to local level involved in Disaster Management. SOD is the only legal document that clearly describes the management structure of different committees and their

functional roles & responsibilities from national to local levels across the following four disaster phases: a) Response Preparedness Stage, b) Alert/Warning Stage, c) Disaster Stage, d) Rehabilitation, Reconstruction and Recovery Stage.

The Standing Orders on Disasters (SOD) have essentially been prepared to outline the various roles and responsibilities for Pourashava / City Corporation and committees involved in Disaster Management at all levels within Bangladesh. The standing orders are not written to cover a specific hazard but rather take an all-hazards approach outlining a range of roles and tasks, which would need to be undertaken regardless of the hazard concerned.

5.1.7 Bangladesh National Building Code (BNBC), 2020

Bangladesh National Building Code (BNBC) has been prepared in 1993 and the latest enacted version is BNBC, 2020. The objective of the BNBC is to set a minimum standard for design and construction of building as well as to set standard for building materials to be used during construction and also put a direction on the use and maintenance of buildings to ensure safety and public welfare. By the proper and rigorous implementation of BNBC it is possible to achieve a safe living environment as it provides direction and restriction on the building design and heights in the risk sensitive area. It refers to what will be the civil engineering precaution and set back rule to build a house in an earthquake-prone area. That means if a RSLUP is designed properly with the exact classification of disaster risk sensitivity through land-use zoning the it is possible to bridge the gap between the plan and implementation accordingly.

5.1.8 National Disaster Management Plan (NDMP), 2021-2025

The National plans have been developed to address the Government of Bangladesh's Vision to reduce the vulnerability of the poor to the effect of natural, environmental and human induced hazards and this plan is currently under review. The plan has taken a comprehensive and holistic approach to Disaster Management within Bangladesh with particular emphasis on the capacity building across all levels to improve the response and recovery management at all levels. Specifically, the objectives of the National Plan are to:

- Align the strategic direction of Disaster Management programs with national priorities and international commitments.
- Articulate the vision and goals for Disaster Management
- Outline the strategic direction and priorities to guide the design and implementation of Disaster Management policies and programs.
- Create a cohesive and well-coordinated programming framework incorporating
- Government, non-government and private sector.
- Ensure that Disaster Management has a comprehensive and all-hazards focus comprising disaster risk reduction and emergency response.
- Illustrate to other Ministries, NGOs, Civil Society and the private sector how the work can contribute to the achievements of the strategic goals and government vision on Disaster Management.

The National Plan for Disaster Management essentially sets out a framework for other agencies and participating organizations and committees to consider when adopting plans for their particular level. Key issues such as risk reduction, capacity building, climate change adaptation, livelihood security, gender mainstreaming, community empowerment and response and recovery management are all factored in the National Plan.

The draft National Plan provides a detailed synopsis of the following hazards that Bangladesh is exposed to:

- Earthquake
- Fire
- Flood
- Cyclones and Storm Surges
- Tornado
- River Bank Erosion
- Drought
- Arsenic Contamination

- Salinity Intrusion
- Tsunami
- Infrastructure Collapse

While the draft National Plan outlines clearly those threats listed above it does not attempt to provide details on how each of those hazards would be managed in terms of pre disaster response and post disaster activities. These specific actions are derived firstly from the standing orders and then from Agency and sectoral plans and contingency planning documents.

5.1.9 The Local Government (Pourashava) Act, 2009

Clause 32 of the document identifies manmade for the preparation of the master plan for pourashava. Such plans should be prepared within five years of establishment of the municipality. That means all pourashava should have a master plan including proper land use zoning.

5.1.10 The Building Construction Act 1952

This Act was prepared in 1952 to prevent haphazard construction of buildings and excavation of tanks that are likely to interfere with the planning of certain areas in Bangladesh. The Act is usually exercised in areas under the urban local governments. The Act sets some conditions regarding construction of buildings in urban areas, where the Act will be in execution.

The landuse plan shall show the future land use of the area through land use zoning. The buildings will be approved according to the land use provisions of the zoning plan. Pourashava has the scope of exercising the following provisions/actions:

- ✓ **Building Construction Rules**
  The Act in its Section 18 keeps provision for preparation of Building Construction (BC) rules to ensure health and environment-friendly building development.
- ✓ **Power to Removal of Construction (Section 3B)**
  The Act gives special power to plan approval authority to remove any building that did not follow the specified rules of the Act or take action against any building owner who constructs building violating the rules after approval of the building plan.
- ✓ **Restriction on Cutting of Hills (Section 3C)**
  The Act forbids cutting of any hill without prior permission of the appropriate authority.
- ✓ **Removal of Unauthorized Building (Section 7)**
  The Act empowers the authority to remove any building that has been built violating the BC rules. On failure to do so, the authority itself shall dismantle it and the entire cost shall be recovered from the owner as public demand.
- ✓ **Appeal**
  The Act, however, keeps provision for appeal, if the owner finds himself aggrieved due to any action by the authority.

5.1.11 Other Sectoral Policies and Acts related to Land Use Planning

The major Sectoral Policies and Acts related to Land Use Planning are described below:

Sector Policies:

- National Urban Policy (Draft)
- National Housing Policy, 1993
- Population Policy, 2004
- Agriculture Policy, 2004
- Industrial Policy, 2005
- Bangladesh Urban Management Policy Statement, 1999

Major Acts and Rules

- Town Improvement Act, 1953
- Building Construction Rules, 1996
- Brick Burning (Control) Ordinance, 1989
- Conservation of Environment Act, 1995
- Land Development for Private Housing Project Act, 2004

5.2 Applicability of the Acts, Regulations and Policies in the Land Use Plan

The key aspects of the policies presented in this chapter have both direct and indirect relationships with the preparation of landuse plan of pourashava in general, and Sunamganj Pourashava in particular. The Pourashava Act 2009, the Building Construction Act 1952, the BNBC 2020 etc. have serious stakes in the execution of pourashava Earthquake Sensitive Land Use Plan. The other policies also have relevance in the preparation of landuse plan for an urban center. As a result, the relevant aspects of the Acts, rules, and policies are mentioned in this chapter and are taken into consideration in the preparation of the land use plan for the pourashava. The key aspects that are most relevant with the preparation of pourashava Earthquake Sensitive Land Use Plan are shown in Table 5.1.

Table 5.1: Important Provisions of Different Acts, Policies and Rules

Act/Ordinance, Policies, Rules	Relevance with Earthquake Sensitive Land Use Plan
Eighth Five Year Plan (July 2020-June 2025)	Provides focused and specific DRR-CCA indicator for the Earthquake Sensitive Land Use Plan of Sunamganj Pourashava.
Bangladesh Delta Plan (BDP), 2100	Formulation and effective execution of Earthquake Sensitive Land Use Plan including flood risk at the local level Delta Plan has provided effective guidelines.
The Perspective Plan, 2021-2041	Contains seven development goals for sustainable and environment friendly housing development through controlling unplanned and haphazard housing area development. Also provides disaster resilient development guidelines.
Disaster Management Act 2012	Indicates regulatory framework, relevant legislative policy and best practice framework under which the activities of disaster risk reduction and emergency management can be managed and implemented at local level administration.
National Disaster Management Policy 2015	Provides a legal framework for hazard specific risk management, and preparation of risk reduction work plan for any national organization.
National Plan for Disaster Management, 2021-2025	To align the strategic direction of disaster management programs with national priorities and international commitments, articulate the vision and goals for disaster management, outline the strategic directions and priorities to guide the design and implementation of disaster management policies and programs, create a cohesive and well-coordinated programming framework incorporating government, non-government and private sector, and ensure that disaster management has a comprehensive and all-hazards focus comprising disaster risk reduction and emergency response.
Standing Orders on Disaster (SOD), 2019	Provides an outline of various roles and responsibilities of pourashava or ward disaster management committees involved in Disaster Management.
Bangladesh National Building Code (BNBC) 2020	Provides a standard for design and construction of building as well as to set standard for building materials to be used during construction and also put a direction on the use and maintenance of buildings to ensure earthquake and fire hazard safety. The BNBC also suggests for conservation and restoration of historic buildings.
The Building Construction Act 1952	Land use plan shall show the future land use of the area through land use zoning. The buildings will be approved according to the land use provisions of the zoning plan. Act provides health and environment-friendly building development guidelines. Specify special power to remove any building that did not follow the specified rules of the Act. Provides guidelines to take action against any building owner who constructs building violating the rules after approval of the building plan.

Chapter-6 Projections for Land Use Plan

6.1 Population projection

Planning the size and composition of a region's population and the way it will change in the future is an important factor to be considered. On the basis of the trend in population growth shown in Census 2011, the estimation of population growth has been made. Total population of the pourashava is 87,570 with population density of 3950 per sq. km or 16 per acre and population growth rate is 2.13% (Sunamganj Pourashava, 2021). The plan has been prepared for the next twenty years (2021-2041). Therefore, population projection for 2041 has been done through the following equation:

$$P_n = P_0 (1+r)^t$$

Where, according to BBS 2011, annual growth rate of Sunamganj, r = 2.13%, P_0 = Population of 2011, t = Interval time

Table 6.1: Ward Wise Projected Population of Sunamganj Pourashava

Ward no	Population, 2011	Population, 2021 (projected)	Population, 2031 (projected)	Population, 2041 (projected)
Ward no 1	10581	13064	16128	19913
Ward no 2	4086	5045	6228	7690
Ward no 3	7115	8784	10845	13390
Ward no 4	7526	9292	11472	14163
Ward no 5	8822	10892	13447	16602
Ward no 6	5654	6981	8618	10640
Ward no 7	5808	7171	8853	10930
Ward no 8	8051	9940	12272	15151
Ward no 9	7689	9493	11720	14470
Total	**65332**	**80660**	**99585**	**122949**

Source: BBS 2011

6.2 Land Use Requirement Projection

***All the standard has been collected from Jagannathpur Pourashava Master Plan: 2011-2031*

a) Residential Area Estimation

Table 6.2: Residential Area Estimation

Ward No	Recommended Standard	Land in Acre		
		Estimated Area	Existing Land	Additional Requirement
Ward no 2	150 persons/acre	51.27	89.09	Existing land is more than enough
	100 persons/acre	76.9		
Ward no 4	150 persons/acre	94.42	126.44	Existing land is more than enough
	100 persons/acre	141.63		Extra 15.19-acre area will be needed
Ward no 5	150 persons/acre	110.68	122.28	Existing land is more than enough
	100 persons/acre	166.02		Extra 43.74-acre area will be needed

Source: Field Survey, 2021

b) Commercial Area Estimation

Table 6.3: Commercial Area Estimation

Ward no	Use/Facility	Recommended standard	Land in Acre		
			Estimation	Existing Land	Additional Requirement
Ward no 2	Wholesale market	1.00 acre/ 10000 population	0.77	4.38	4.08
	Retail sale Market	1.00 acre/ 1000 population	7.69		
Total			**8.46**	**4.38**	**4.08**
Ward no 4	Wholesale market	1.00 acre/ 10000 population	1.42	16.25	0.67
	Retail sale Market	1.00 acre/ 1000 population	14.16		
Total			**15.58**	**16.25**	**0.67**
Ward no 5	Wholesale market	1.00 acre/ 10000 population	1.66	10.28	7.98
	Retail sale Market	1.00 acre/ 1000 population	16.60		
Total			**18.26**	**10.28**	**7.98**

Source: Field Survey, 2021

c) Industrial Area Estimation

Table 6.4: Industrial Area Estimation

Ward no	Use/Facility	Recommended standard	Land in Acre		
			Estimation	Existing Land	Additional Requirement
Ward no 2	Small scale	1.50 acre/ 1000 population	11.54	0.00	19.23
	Cottage/agro-based	1.00 acre/ 1000 population	7.69		
Total			**19.23**	**0.00**	**19.23**
Ward no 4	Small scale	1.50 acre/ 1000 population	21.24	0.02	35.39
	Cottage/agro-based	1.00 acre/ 1000 population	14.16		
Total			**35.41**	**0.02**	**35.39**
Ward no 5	Small scale	1.50 acre/ 1000 population	24.90	0.00	41.50
	Cottage/agro-based	1.00 acre/ 1000 population	16.60		
Total			**41.50**	**0.00**	**41.50**

Source: Field Survey, 2021

d) Educational Land Use Estimation

Table 6.5: Educational Land Use Estimation

Ward no	Use/Facility	Recommended standard	Land in Acre		
			Estimation	Existing Land	Additional Requirement
Ward no 2	Nursery	0.5 acre/10,000 population	0.38	11.1	0.05
	Primary School/ kindergarten	2.00 acre/5000 population	3.08		
	Secondary/High School	5.00 acre/ 20,000 population	1.92		
	College	10.00 acre/20,000 population	3.85		
	Other	5.00 acre/ 20,000 population	1.92		
Total			**11.15**	**11.1**	**0.05**
Ward no 4	Nursery	0.5 acre/10,000 population	0.71	9.31	11.23
	Primary School/ kindergarten	2.00 acre/5000 population	5.67		
	Secondary/High School	5.00 acre/ 20,000 population	3.54		
	College	10.00 acre/20,000 population	7.08		
	Other	5.00 acre/ 20,000 population	3.54		
Total			**20.54**	**9.31**	**11.23**
Ward no 5	Nursery	0.5 acre/10,000 population	0.83	6.84	17.23
	Primary School/ kindergarten	2.00 acre/5000 population	6.64		
	Secondary/High School	5.00 acre/ 20,000 population	4.15		
	College	10.00 acre/20,000 population	8.30		
	Other	5.00 acre/ 20,000 population	4.15		
Total			**24.07**	**6.84**	**17.23**

Source: Field Survey, 2021

e) Health Facility Land Use Estimation

Table 6.6: Health Facility Land Use Estimation

Ward no	Use/Facility	Recommended standard	Land in acre		
			Estimation	Existing land	Additional requirement
Ward no 2	Health complex/ hospital	10 acre/10,000 population	7.69	24.58	Existing land is more than enough
	Health center/ Maternity clinic	1.00 acre/ 5,000 population	1.54		
Total			**9.23**	**24.58**	
Ward no 4	Health complex/ hospital	10 acre/10,000 population	14.16	1.76	15.24
	Health center/ Maternity clinic	1.00 acre/ 5,000 population	2.83		
Total			**17.00**	**1.76**	**15.24**
Ward no 5	Health complex/ hospital	10 acre/10,000 population	16.60	0.08	19.84
	Health center/ Maternity clinic	1.00 acre/ 5,000 population	3.32		
Total			**19.92**	**0.08**	**19.84**

Source: Field Survey, 2021

f) Religious Places Land Use Estimation

Table 6.7: Religious Places Land Use Estimation

Ward no	Use/Facility	Recommended standard	Land in acre		
			Estimation	Existing land	Additional requirement
Ward no 2	Mosque/Church/ Temple	0.5 acre/ 20,000 population	0.19	0.16	0.42
	Eidgah/ Graveyard	1.00 acre/ 20,000 population	0.38		
Total			**0.58**	**0.16**	**0.42**
Ward no 4	Mosque/Church/ Temple	0.5 acre/ 20,000 population	0.35	2.18	Existing land is more than enough
	Eidgah/ Graveyard	1.00 acre/ 20,000 population	0.71		
Total			**1.06**	**2.18**	
Ward no 5	Mosque/Church/ Temple	0.5 acre/ 20,000 population	0.42	0.98	0.27
	Eidgah/ Graveyard	1.00 acre/ 20,000 population	0.83		
Total			**1.25**	**0.98**	**0.27**

Source: Field Survey, 2021

g) Open Space, Waterbody and Recreational Facilities Land Use Estimation

Table 6.8: Open Space, Waterbody and Recreational Facilities Land Use Estimation

Ward no	Use/Facility	Recommended standard	Land in acre		
			Estimation	Existing land	Additional requirement
Ward no 2	Play field/ground	3 acre/ 20,000 population	1.15	0.00	16.53
	Park	1.00 acre/ 1,000 population	7.69		
	Neighborhood Park	1.00 acre/ 1,000 population	7.69		
	Waterbody	1.00 acre/ 20,000 population	0.39	58.39	Existing land is more than enough
Total			**16.92**	**58.39**	**16.53**
Ward no 4	Play field/ground	3 acre/ 20,000 population	2.12	2.89	27.56
	Park	1.00 acre/ 1,000 population	14.16		
	Neighborhood Park	1.00 acre/ 1,000 population	14.16		
	Waterbody	1.00 acre/ 20,000 population	0.71	20.14	Existing land is more than enough
Total			**31.16**	**23.03**	**27.56**
Ward no 5	Play field/ground	3 acre/ 20,000 population	2.49	0.0	35.69
	Park	1.00 acre/ 1,000 population	16.60		
	Neighborhood park	1.00 acre/ 1,000 population	16.60		
	Waterbody	1.00 acre/ 20,000 population	0.83	38.74	Existing land is more than enough
Total			**36.52**	**0.00**	**35.69**

Source: Field Survey, 2021

h) Transportation Facilities Land Use Estimation

Table 6.9: Transportation Facilities Estimation

Ward no	Use/Facility	Recommended standard	Land in acre		
			Estimation	Existing land	Additional requirement
Ward no 2	Bus terminal	1.00 acre/ 5000 population	1.54	9.66	1.09
	Truck terminal	1.00 acre/ 10000 population	7.69		
	Baby taxi/tempo stand	0.5 acre/ per ward	0.5		
	Rickshaw/van stand	0.25 acre/ per ward	0.25		
	Road network	1.00 acre/ 1000 population	7.69		
Total			**10.75**	**9.66**	**1.09**
Ward no 4	Bus terminal	1.00 acre/ 5000 population	2.83	35.38	Existing land is more than enough
	Truck terminal	1.00 acre/ 10000 population	1.42		
	Baby taxi/tempo stand	0.5 acre/ per ward	0.5		
	Rickshaw/van stand	0.25 acre/ per ward	0.25		
	Road network	1.00 acre/ 1000 population	14.16		
Total			**45.32**	**35.38**	**9.94**
Ward no 5	Bus terminal	1.00 acre/ 5000 population	3.32	14.01	8.32
	Truck terminal	1.00 acre/ 10000 population	1.66		
	Baby taxi/tempo stand	0.5 acre/ per ward	0.5		
	Rickshaw/van stand	0.25 acre/ per ward	0.25		
	Road network	1.00 acre/ 1000 population	16.60		
Total			**53.13**	**14.01**	**8.32**

Source: Field Survey, 2021

Chapter-7 Policy Guidelines for Use of Land and Urban Services

Sunamganj is a very important pourashava in Sunamganj District. It is situated in high risk zone of earthquake. It is not very far from Dauki fault. A Major concern for land use policy guideline has been given considering high risk of earthquakes as well as fire hazards and floods. The following sub points represent the policy guidelines for use of land, structural use and urban services.

7.1 Guideline for Residential and Administrative Structure

Most of the land of the pourashava is used for residential as well as administrative use. Depending on the growing population more residential area will be required in near future. To avoid the adverse effect of massive earthquake/ floods or fire hazard some mandatory guidelines should be followed during the building construction.

For earthquake

- ✓ Before constructing buildings, land use clearance certificate should be collected
- ✓ Occupancy certificate should be collected
- ✓ Seismic zone value, soil liquefaction, soil characteristics and occupancy rate should be considered in building design in an earthquake risk zone
- ✓ Earthquake load should be incorporated in load calculation of the structure of the earthquake risk zone
- ✓ Floor height should not be more than six floors.
- ✓ Foundation of the structure should be pile foundation.
- ✓ Reinforcement specifications provided in BNBC 2020 should be strictly followed.
- ✓ Compressive strength of concrete should not be less than 21N/mm^2
- ✓ The ratio of the actual tensile strength to the actual yield strength is not less than 1.25.

For fire hazards

- ✓ For residential buildings and occupancy rate below 50 people one separate fire exit and fire safety control room should be constructed at fire hazard risk zone. The area of the fire safety control room should be 10 sqm. Fire exit should be indicated with an arrow and sufficient light on every floor of the building
- ✓ Occupancy rate above 50 to 500 people two fire exits, above 500 to 1000 people three fire exits and above 1000 people 4 fire exits should be available
- ✓ Non-Combustible Construction can be adopted for the structure at fire hazard risk zone
- ✓ Water reservoir like a ground tank or roof-top tank or a natural water source should be available for adequate water flow for firefighting
- ✓ Residential buildings exceeding total floor area 500 m^2 shall have manual alarm system and portable extinguishers provided in the escape stairs route
- ✓ High rise boarding house, hotels and lodging houses, educational buildings, hospitals, industrial and commercial buildings manually operated electric fire alarm system shall be provided along with hydrant system

For flash floods

- ✓ Natural drainage flow should not be diverted through structure construction
- ✓ Flood control zone map according to mouza map should be prepared and available at the local level
- ✓ Building floors should be constructed above the height of the highest flood elevation level (at least 10m from mean sea level as the highest level of flood has been recorded 9m)
- ✓ The height of entry level of basements should be higher than the flood level of the area thus the basement remains dry and usable during the flood period
- ✓ Floors below the flood height should be constructed with impermeable materials thus it can resist the damage of flooding

7.2 Guideline for Drainage Network

Sunamganj Pourashava needs a good number of additional drains for having an efficient drainage network. Primary drains should be constructed as there is no primary drain in the pourashava area. The drains should be cleaned regularly like on a monthly basis. The drains should be wider and well-constructed for better drainage network. A detailed drainage plan can be prepared for the construction of a drainage treatment plant at every outfall.

7.3 Guideline for Road Network

Roads having width below 3m causes difficulties during the evacuation of an earthquake or fire hazard. The width of the roads should be at least 4 to 5m (12 ft to 15 ft). Again, katcha roads are more vulnerable to earthquakes and floods. So, the katcha roads of the pourashva should be converted into RCC constructed roads. The minimum height of the roads should be at least 10m from mean sea level to reduce the flood damage.

7.4 Guideline for Waterbody Conservation

In Sunamganj pourashava total water body area is 184 acres. The existing water body should be reserved and strict rules should be applied to prohibit filling up the waterbody of the pourashava. Waterbodies are used as the water reservoir during a massive fire hazard. Waterbodies can be conserved enforcing environmental policies, laws and acts or enacting new regulations, which call for protection natural water bodies. Regulation of Wetland Conservation Act should be followed strictly. The waterbody of the pourashava should be free from water pollution.

7.5 Guideline for Sanitation Facilities

Sanitation facility should be ensured for every household of the pourashava. As the pourashava is affected by floods there should not be any open pit latrine or hanging latrine. The plinth level of the latrine structure should be higher than the highest flood level of the area. Basic hygiene should be ensured in every sanitation facility.

7.6 Guideline for Open Space Conservation

Open space like playgrounds, parks or fields should be conserved as they can be used as evacuation points during earthquake or fire hazard. Every ward should have at least one open space with conveniently accessible roads.

7.7 Guideline for Educational Institutions

The height of the structure should not be more than 4 to 5 storied. Educational institutes should be constructed as multipurpose building. The building construction should be followed all the rules and guideline for earthquake resilience and fire protection. Each building needs at least three emergency exits for fire hazard or earthquake. When the building is used as a disaster shelter, he ground floor should not be used for education purpose as the floor can be flooded during the flood period.

7.8 Guideline for Health Facilities

Health care centers should be available at local level. The center should have adequate fire protection and the height of the structure should not be more than 5 storied. There must be separate facilities for the disabled person or patient during emergencies. Each building needs at least two emergency exits for fire or earthquake. Health centers should have adequate facilities like sufficient WASH facilities, medical team, medicines etc. to serve as disaster shelters during flood or earthquake. Sufficient first aid kits must be preserved in each health center to serve a massive earthquake or fire hazard affected people. Awareness building up program on disaster risk reduction should be arranged by the health center authority.

7.9 Guideline for Solid Waste Management and TDMS

There should be specific place for dumping spot as well as TDMS and in every colony. There should be at least two waste collection points. There should also be a specified waste collection and dumping system from the pourashava authority. A monitoring body should be available to monitor the overall waste collection system. A properly monitored waste and debris collection and dumping system can reduce the mismanagement of recovery phase of a disaster like floods or earthquakes. The area of dumping spot or TDMS should be at least 1.5 acres.

7.10 Guideline for Commercial, Industrial and Mixed Used

Commercial and industrial land use should be separated from residential areas. Earthquake and fire hazard risk and the amount of damage at the industrial and commercial area is higher than other areas as the occupancy rate is high. In industrial and commercial structures automated sprinkler systems should be adopted. Toxic chemicals must be treated with extra safety thus it can't cause any fire incident. Again, at least three emergency exits in every single structure. Buildings of this area must be less than six floors. For mixed used zone of the pourashava should be maintained the specific rules for different land use accordingly. All the buildings should have constructed maintaining the flood level (plinth level at least 10m).

Chapter-8 Recommendations and Conclusion

This chapter of the plan report highlights the various measures needed to be taken in order to execute the plan. Effective implementation of a plan is the most important part of the total planning process. A proposed Earthquake Sensitive Land Use Plan has been prepared to mitigate the hazard risk at Sunamganj pourashava. Recommendations are provided in this part of the plan report for executing the plan accordingly.

8.1 Recommendations

Several recommendations have been provided to prepare the proposed Earthquake Sensitive Landuse Plan. This recommendation will guide the pourashava authority in plan implementation phase. Recommendations are for both overall pourashava and the selected wards to create an earthquake, fire and floods risk free pourashava.

8.1.1 Ward Multipurpose Center

A ward multipurpose center is needed at every ward of Sunamganj pourashava. Therefore, overall 9 ward multipurpose centers will be established in the pourashava. The area of the center should not less than 1.5 acres. The center will be constructed to provide multipurpose services like community center, disaster shelter/ evacuation center, ward administrative service center (ward office). This center will provide health services as well. Health services include first aid treatment, maternity health care, awareness program on disaster preparedness and risk reduction etc.

Three possible locations have been identified in selected three wards (ward no 2, 4 and 5) for establishing ward multipurpose center. The area has been proposed around 2 acres for each center. In ward no 2 the selected place for ward multipurpose center is a free land beside Sunamganj Govt. College. The place is surrounded in by 20 feet wide roads in two different directions. The roads will be convenient for emergency evacuation for earthquake or flood and the nearby waterbody will be used as water reservoir for fire hazard.

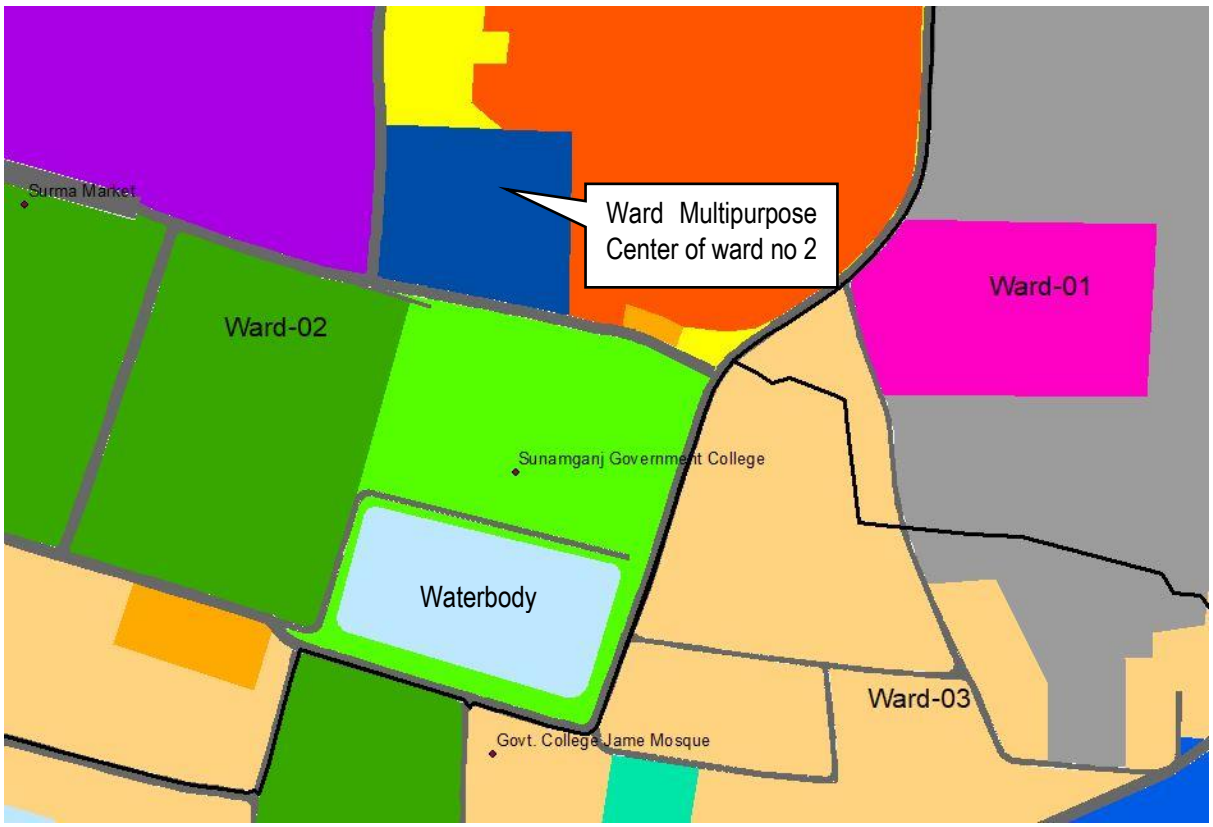


Figure 8.1: Ward Multipurpose Center Location of Ward No 2

In ward no 4, the proposed ward multipurpose center can be located at Shantibag area near Shantibag Fatema Jame Masjid. The place is also surrounded by 20 feet wide roads and a large waterbody. Again, in ward no 5 the proposed ward multipurpose center can be located near the circuit house. It has also roads and waterbody within a convenient distance. So, the proposed ward multipurpose center will be effective in disaster risk reduction of Sunamganj Pourashava.

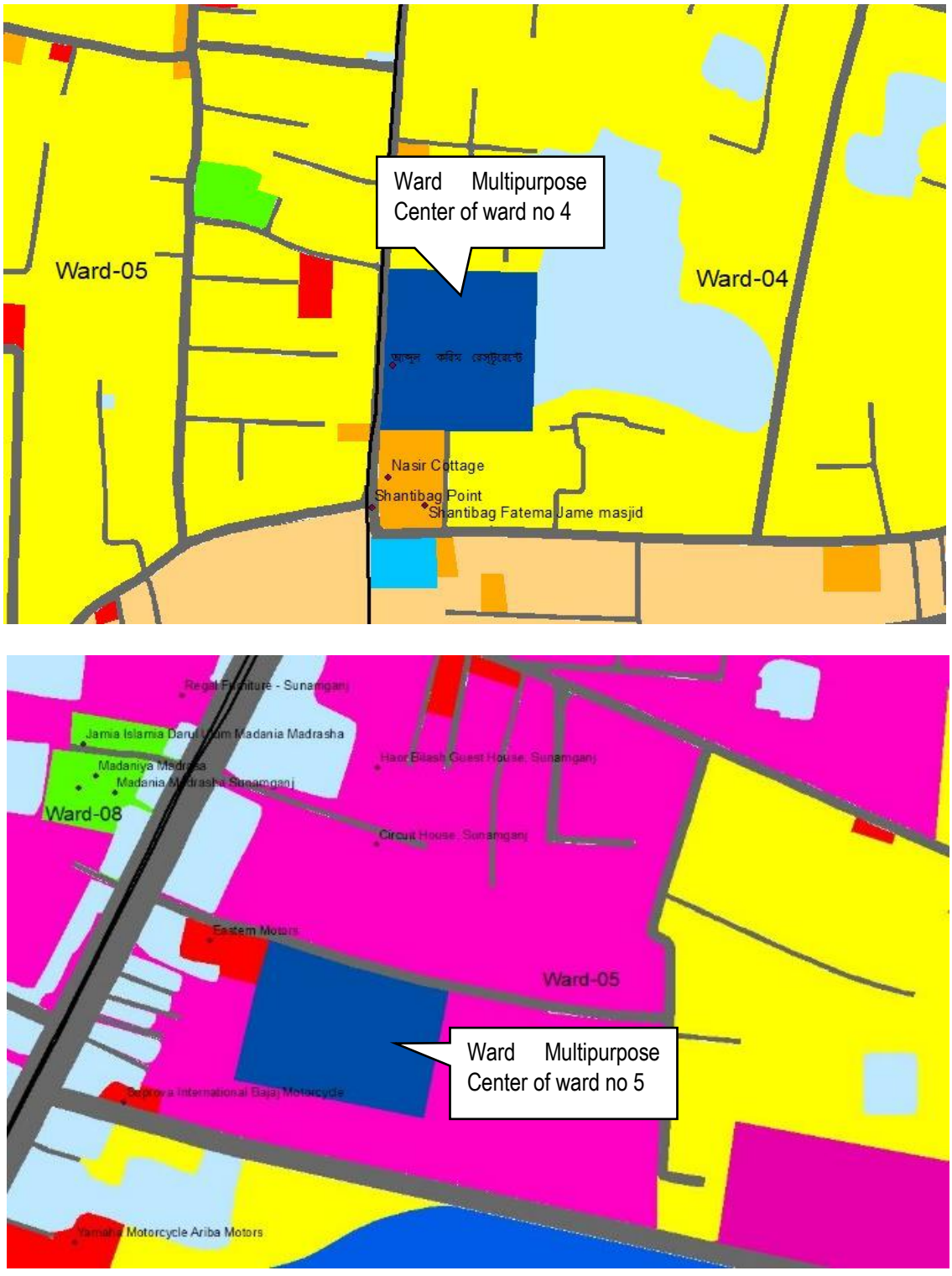


Figure 8.2: Location of Ward Multipurpose Center of Ward no 4 and 5

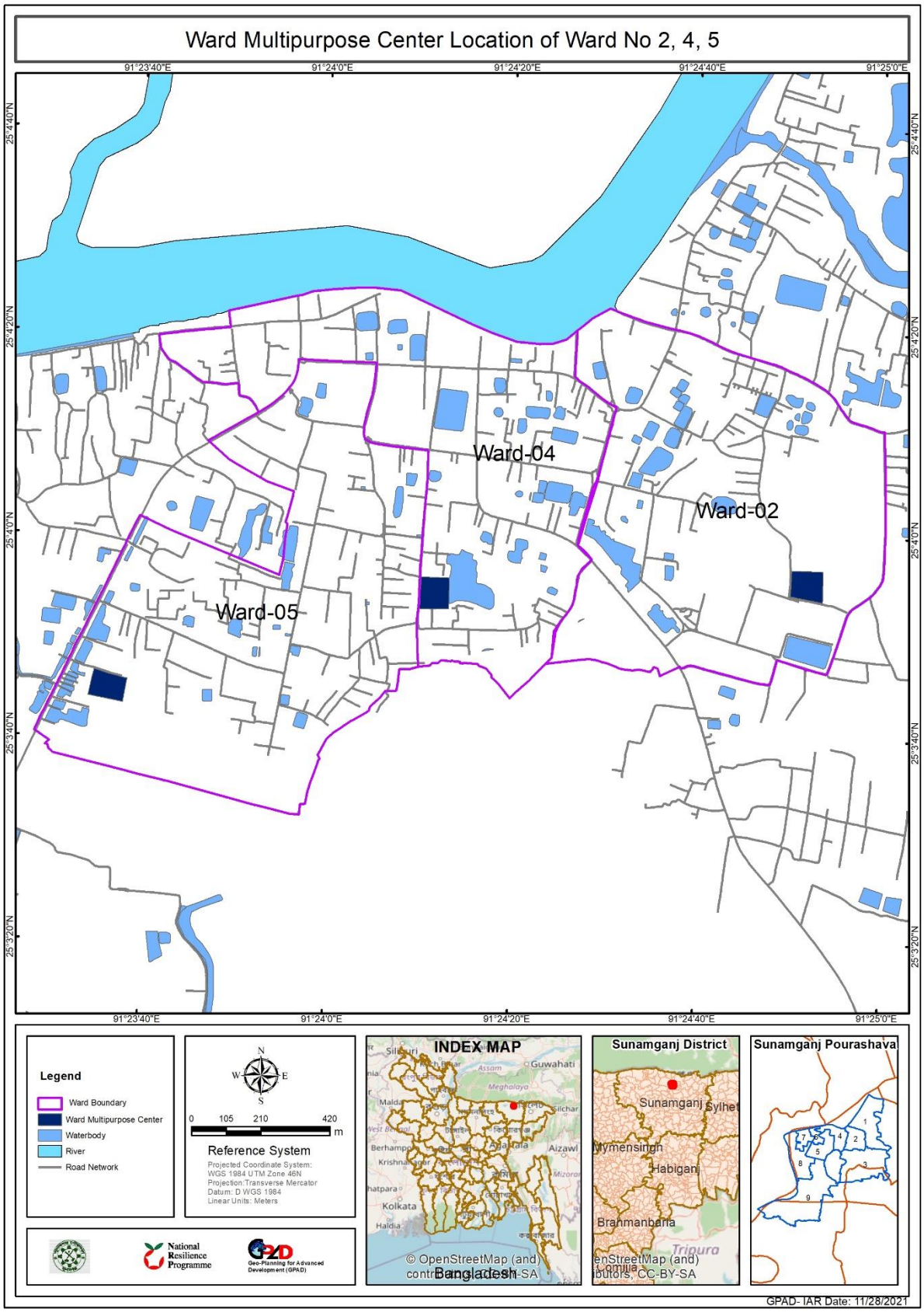


Figure 8.3: Location of Ward Multipurpose Center of Ward no 2, 4 and 5

8.1.2 Proposed Waterbody Conservation

Waterbody should be protected from filling up as they are essential to mitigate the fire hazard risk as well as work as a water reservoir to reduce the flood risk. Waterbody also must be pollution-free as the water can be used emergency periods when more water supply is needed like in an earthquake shelter. Total eight waterbodies have been identified to be protected in wards no 2, 4 and 5.

In ward no 2:

1. Waterbody beside Sunamganj Government College should be conserved as this will serve the proposed ward multi-purpose center in ward no 2.
2. Waterbody near Wapda Jame Masjid will be conserved.

In ward no 4:

1. Waterbody beside Shantibag Fatema Jame Masjid should be conserved as this will serve the proposed ward multi-purpose center in ward no 4.
2. Waterbody owned by Sunamganj Municipality will be conserved as water reservoir.
3. Waterbody near Farmer Bazar must be conserved as it can be used as water source in any fire hazard caused in bazar area which has been identified as an earthquake and fire risk zone.

In ward no 5:

1. Waterbody beside Sunamganj Circuit House should be conserved as this will serve the proposed ward multi-purpose center in ward no 5.
2. Waterbody near Shree Shree Kali Mandir will be conserved.
3. Waterbody near Kali Bari Temple must be conserved as it can be used as water source in any fire hazard caused in bazar area which has been identified as earthquake and fire risk zone.

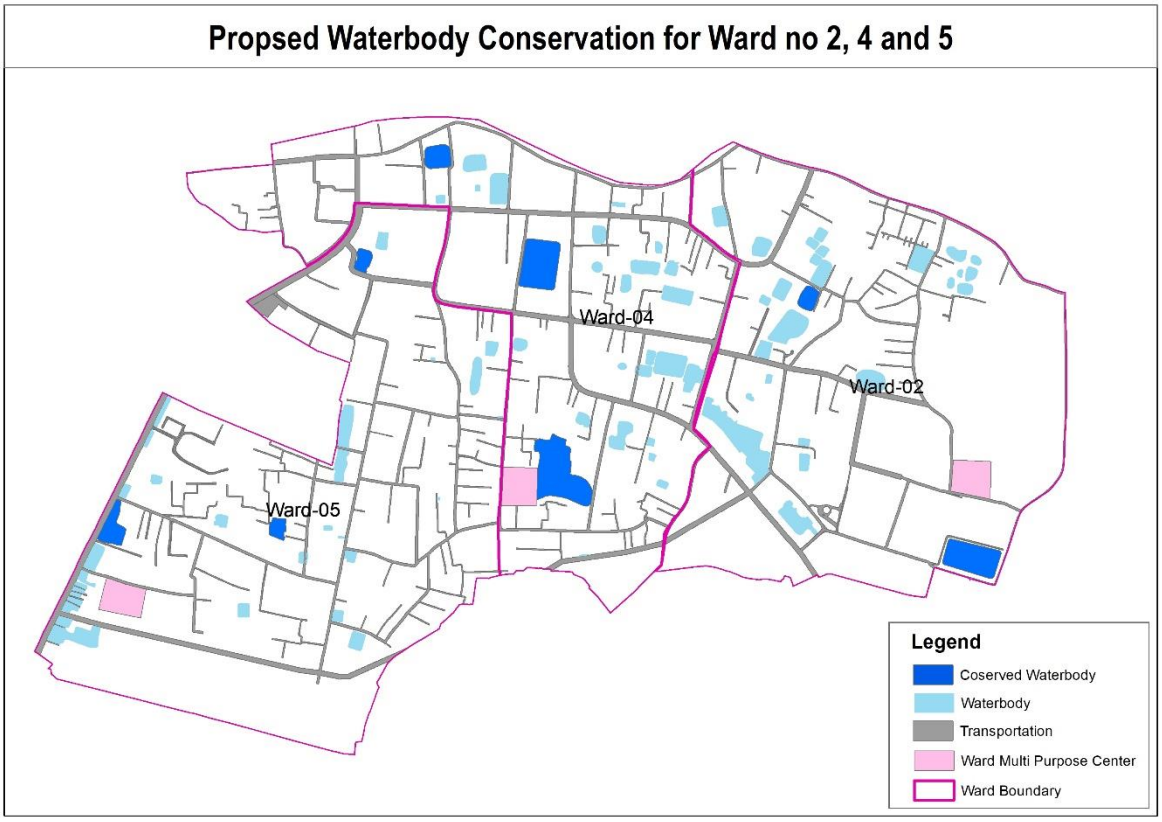


Figure 8.4: Proposed Waterbody Conservation for Ward no 2, 4 and 5

8.1.3 Waste Dumping Zone

Waste dumping zone has been proposed in three different categories. They are-

i. Solid Waste Dumping Site (SWDS)
ii. Faecal Sludge Dumping Site (FSDS)
iii. Temporary Debris Staging and Reduction Site (TDRS)

Three suitable locations have been proposed for waste dumping zone in Sunamganj pourashava for waste management. Solid waste dumping site has been identified at the boundary place of ward no 4 and ward no 5 near Ukil para. Total area of the SWDS is around 2 acres. The area is easily accessible and far from residential area. Proposed river embankment can also be used as an accessible road to this site.

Faecal sludge dumping site (FSDS) for the pourashava has been proposed at Natun para in ward no 5. The area of the site is approximately 2.85 acres. On the other hand, a large Temporary Debris Staging and Reduction Site (TDRS) can be located at ward no 2 near Sunamganj Government College having an area of 3.73 acres. This site can be used as the debris deposit site produced due to any hazard. These two sites both are far from the residential areas and equally well accessible. Figure 8.5 (next page) represents the location of the waste dumping sites named SWDS, FSDS and TDRS in Sunamganj pourashava.

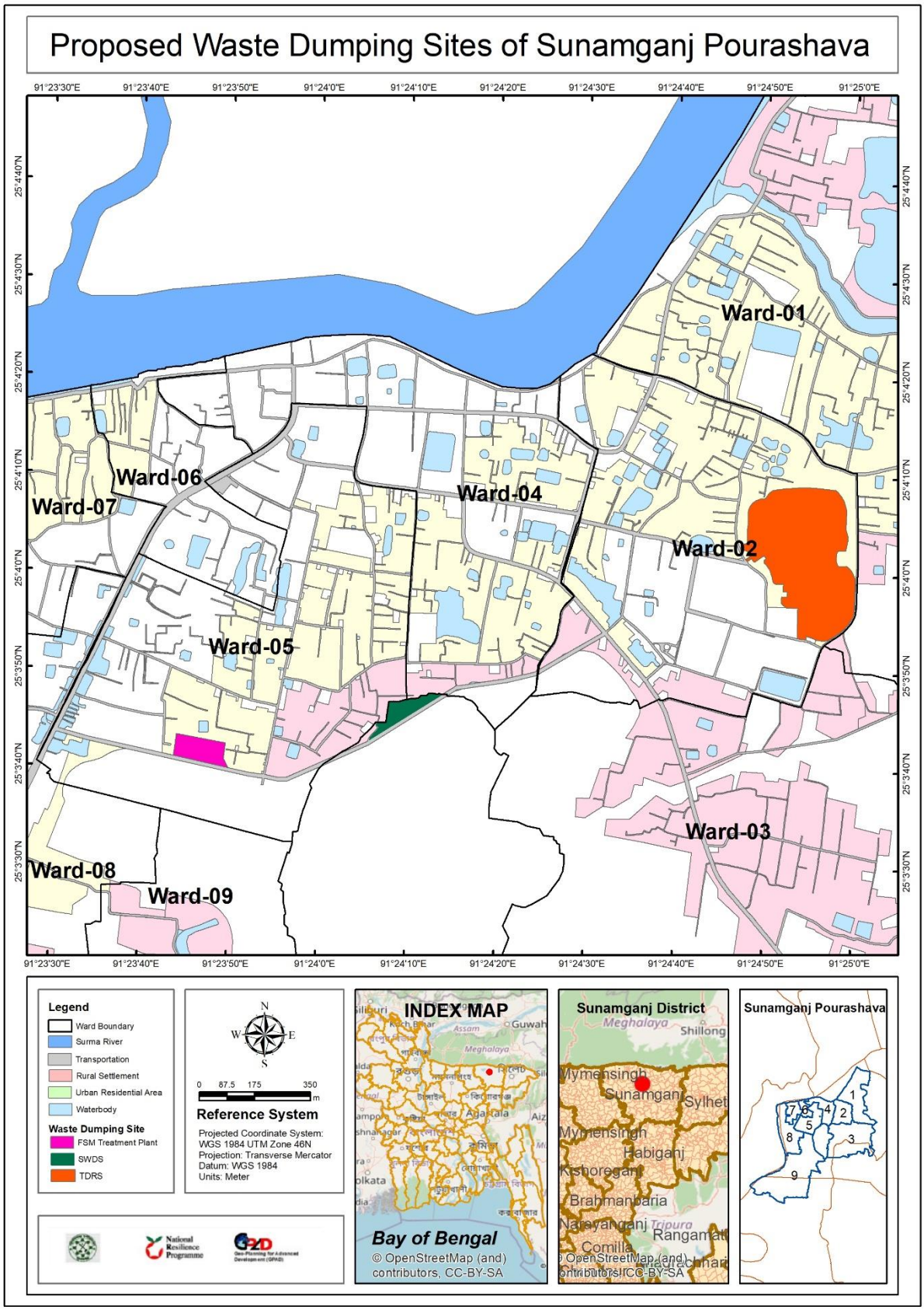


Figure 8.5: Location of Proposed Waste Dumping Sites

8.1.4 Proposed Road Network

In Sunamganj pourashava the condition of existing road network is not satisfactory. The amount of katcha and narrow road is not negligible at all. To reduce the risk sensitivity of the existing land use of the area improvement of road network of the pourashava is must. To make the roads of the study area disaster resilient some specific initiatives should be taken by pourashava authority-

- ✓ Katcha roads should be reconstructed to make them paved roads
- ✓ Minimum width of primary roads should be 80 feet, secondary roads should be 40 feet and the tertiary roads should be 20 feet.
- ✓ No road should exist below 12 feet.
- ✓ Embankment should be constructed along with the river bank to protect the area from flood hazard.

Around 17.27 km of additional roads have to be constructed to meet up the future demand and reduce the risk sensitivity of the study area. Among this proposed road length 1.53 km road has to be constructed outside of the ward boundary to maintain the road connectivity. Total 97 roads (49.46 km) have to be widened to the selected width according to road type. Around 16.85 km long embankment will be constructed in which 15.47 km long embankment will be constructed inside the ward boundaries. All the proposed road network and embankment is shown in Table 8.1, Figure 8.6 (next page) and Figure 8.7.

Table 8.1: Proposed Roads and Embankments Length

Ward No	Length in Kilometer		
	Existing Road	New Road	Proposed Embankment
1	15.85	2.85	4.01
2	9.29	0.98	0.39
3	8.63	0.86	1.30
4	11.52	1.46	1.41
5	13.11	1.77	0.90
6	4.90	0.34	0.45
7	6.97	1.77	0.55
8	12.68	2.71	3.30
9	18.39	3.00	3.16
Grand Total	**101.33**	**15.74**	**15.47**

Source: Proposed by Study Team

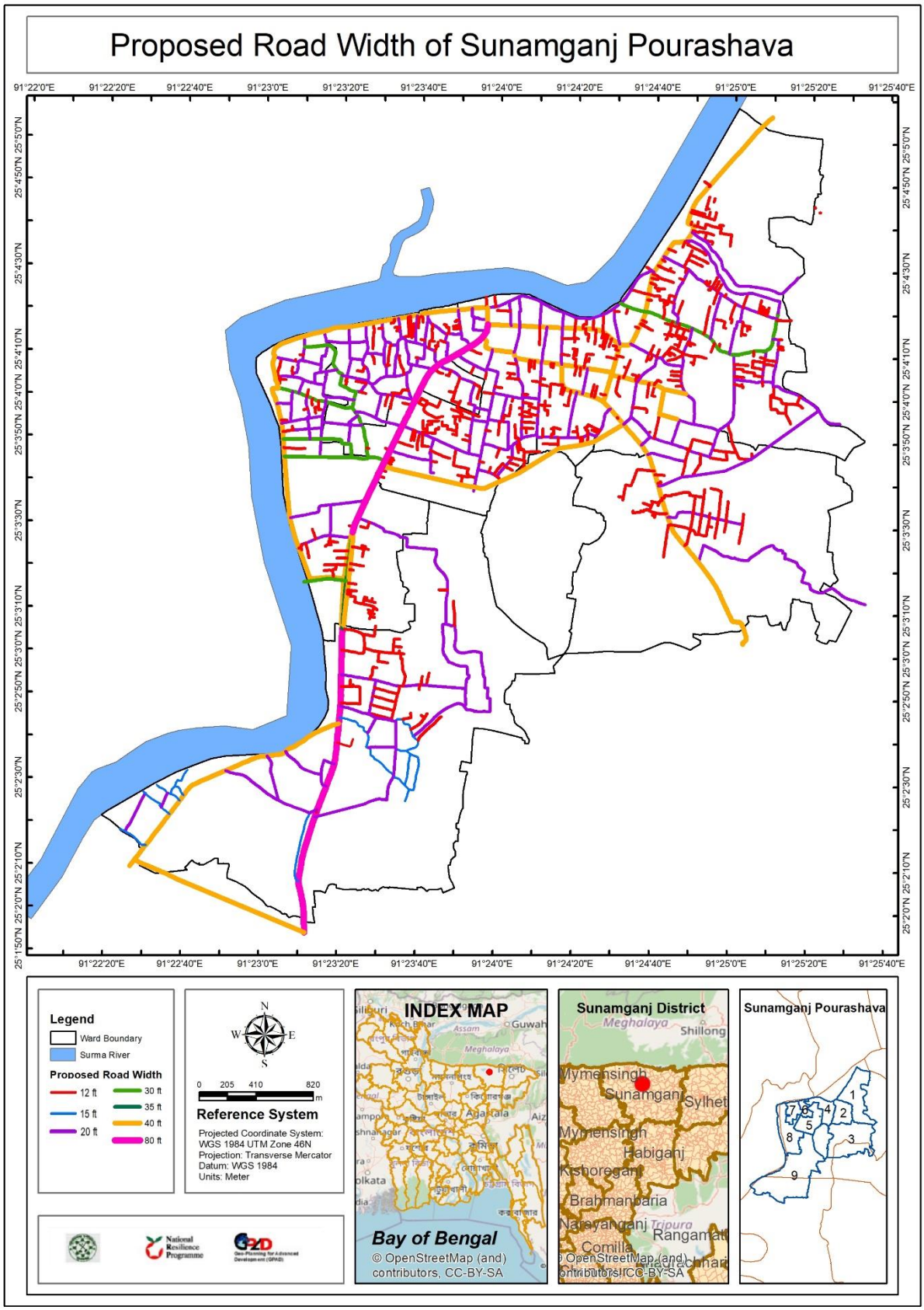


Figure 8.6: Proposed Road Network with Specified Width

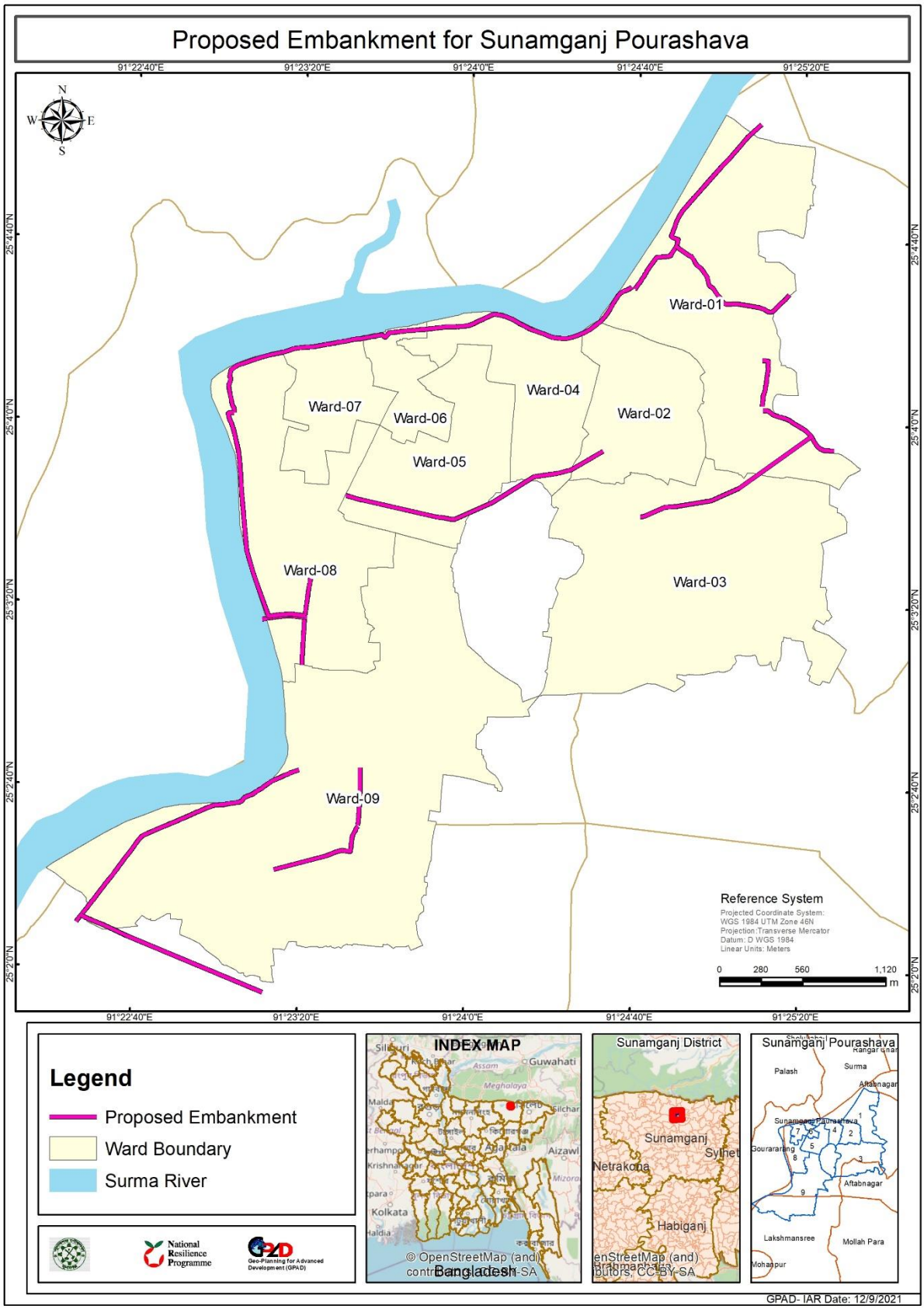


Figure 8.7: Proposed Embankment for Sunamganj Pourashava

8.1.5 Proposed Open Space Conservation

Open spaces should be protected from filling up as they are essential to mitigate the earthquake and fire hazard damage as they can be used as evacuation space. Total six open spaces have been identified to be protected for ward no 2, 4 and 5.

For ward no 2:

1. Open space beside Sunamganj Government College should be conserved and this is near the proposed ward multi-purpose center in ward no 2.
2. Open space near Sunamganj Sadar Hospital will be conserved.
3. Open space beside Sunamganj Government College Jame Mosjid in ward no 3 will be conserved.
4. Open space near Hakim Market in ward no 1 will be conserved.

For ward no 4 and 5:

1. Jubilee School Playground should be conserved as an evacuation space.
2. Sunamganj Stadium can be used as an evacuation space for earthquakes or fire hazards.

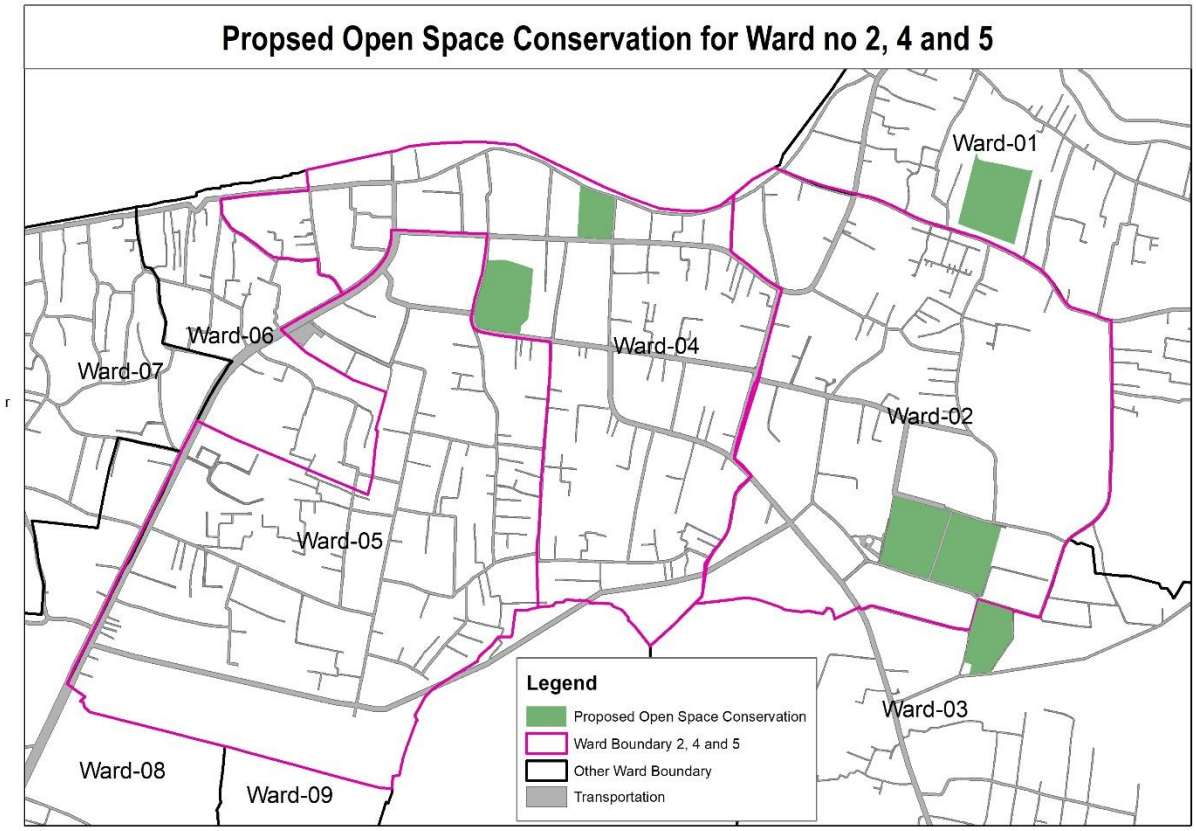


Figure 8.8: Proposed Open Space Conservation for Ward no 2, 4 and 5

8.1.6 Recreational and Restricted Area

To mitigate the limitation of recreational facility a resort is proposed to establish in the boundary area of ward number 8 and 9. The area of the resort will be approximately 55 acres with different recreational facilities. The embankment will be aligned with a linier park as a buffer area and recreational facility. The overall length of the linear park should be same as the embankment. Around 1000 acres' area of the pourashava has been suggested as restricted area to reduce the flood hazard vulnerability. Again, some rural settlement has also been identified as restricted area to reduce the land use risk sensitivity. Figure 8.9 (next page) shows the proposed recreational and restricted area.

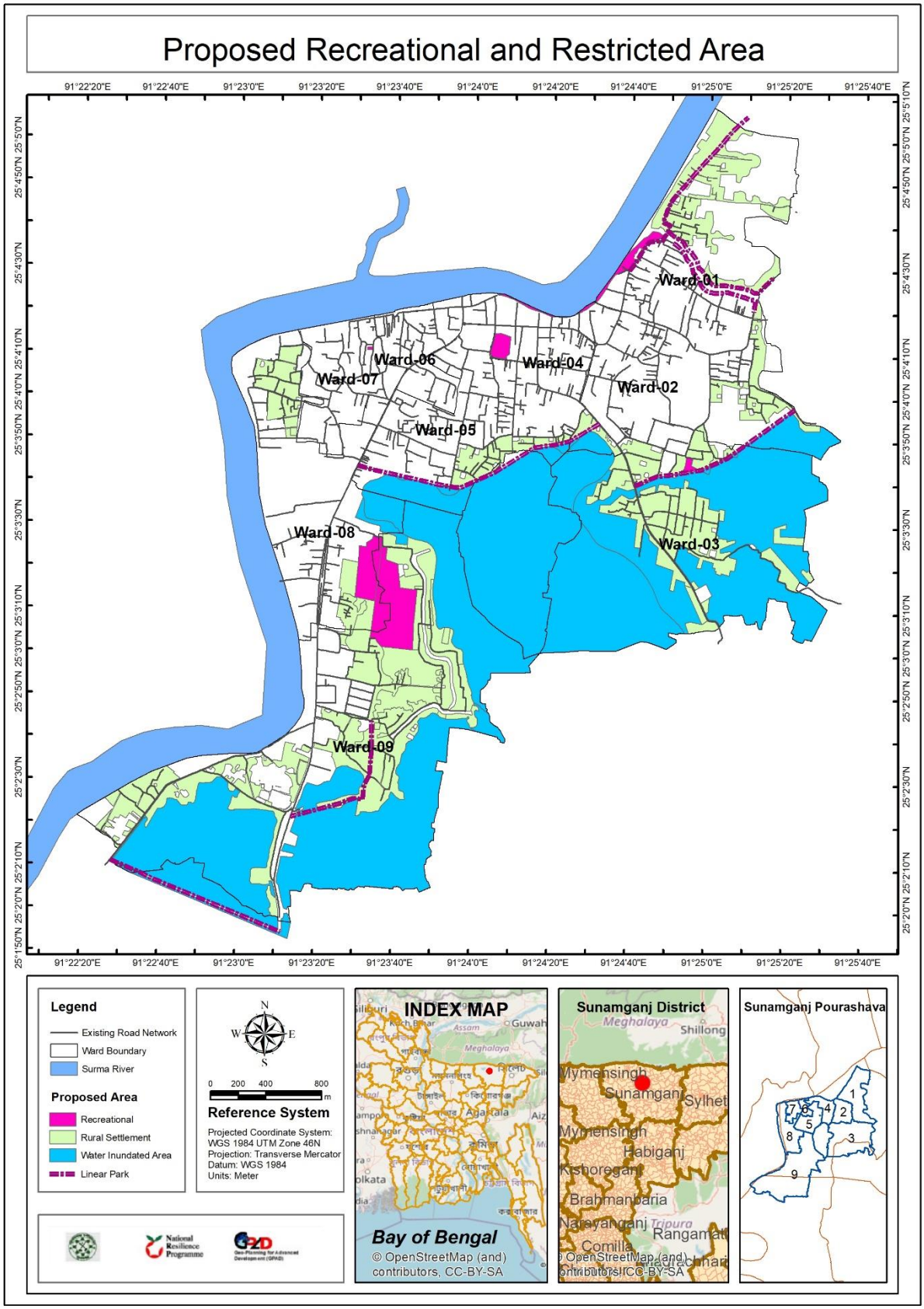


Figure 8.9: Proposed Recreational and Restricted Area of Sunamganj Pourashava

8.1.7 Overall Proposed Earthquake Sensitive Land Use Plan

An overall Earthquake Sensitive Land Use Plan has been prepared with proposed area and location of different land uses. All the land use categories have been divided into specific zone. To mitigate the intensive earthquake damage of the area ward multipurpose center has been proposed. Commercial and industrial areas are identified as the most vulnerable area (red zone in map) for fire hazard. In this proposed plan water inundation area has been identified where the flood risk is higher than other area. Similarly, rural settlements of the study area which is the most vulnerable land use has an area of 611.73 acre. In the proposed plan rural settlement has been identified as the development restricted area as this area is vulnerable to flood. Table 7.2 shows the area of different land zone of Sunamganj Pourashava. Figure 8.10 (next page) represents the overall proposed earthquake sensitive land use plan of Sunamganj Pourashava.

Table 8.2: Proposed Area of Earthquake Sensitive Land Use Plan

Land Use Categories	Area (acre)
Administrative	211.14
Agriculture	27.37
Commercial	114.35
Education	37.71
FSM Treatment Plant	2.85
Growth Center	6.09
Health	25.97
Industrial Zone	79.95
Mixed Use	78.36
Open Space	27.72
Places of Worship	11.54
Recreational	69.89
Rural Settlement	611.73
SWDS	2.12
TDRS	28.84
Transportation	186.51
Urban Residential Area	378.31
Water Inundated Area	1244.24
Waterbody	259.51
Total Area	**3404.19**

Source: Proposed Earthquake Sensitive Land Use Plan, 2021

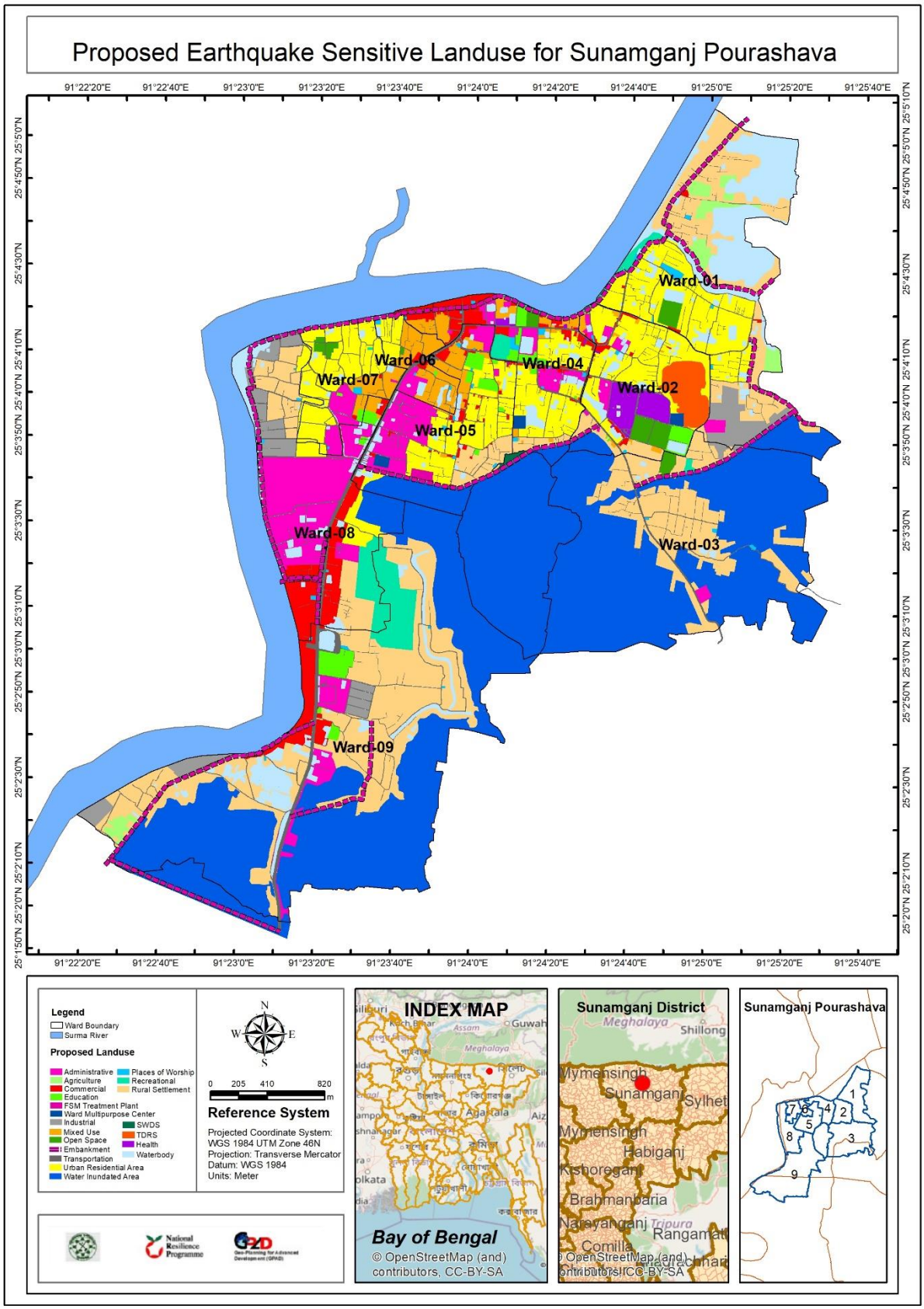


Figure 8.10: Proposed Earthquake Sensitive Land Use of Sunamganj Pourashava

8.2 Conclusion

This *Earthquake Sensitive Land Use Plan (ESLUP)* has been prepared under *National Resilience Programme (NRP): DDM Part* to identify existing land use and potential hazard prone areas, guide earthquake friendly construction practice for infrastructure development, and provide comprehensive guidelines for earthquake sensitive development. An overall Risk Sensitive Land Use Plan including earthquake, flash flood, fire hazard, water-logging risk zoning for Sunamganj Pourashava has been prepared to achieve the goal. But it should be bear in mind that this land use plan is neither a stand-alone document nor a static document. It should be an ongoing process integrated and coordinated with activities suggested by other documents.

This earthquake sensitive land use plan report has been generated with risk reduction tools into development and spatial plans by engaging the government at various levels, private sector, civil society, international development organizations, and other key stakeholders. Existing land use categories have been analyzed in detail and the disaster issues of the pourashva are also incorporated with it. Again, landuse and disaster related national rules, regulations, acts, plans and policies has been reviewed during preparation period of this *Earthquake Sensitive Land Use Plan (ESLUP).* Some major guidelines on the use of specific land of the pourashava have been provided in the plan. Involvement of the local level authority was ensured in every level of this plan preparation period.

Process and factors of risk sensitive land use planning are clarified and analyzed in this study of Sunamganj Porashava to assess the implementability and applicability of land use for earthquake, fire & flood disaster risk reduction. Success of this plan depends on the highly legitimate ability and skills of the pourashava officials of Sunamganj. Moreover, in this study, not all the process was completed yet. The important factor, such as development of plan implementation projects, budget plan, etc. still remains to complete the comprehensive plan. In the next stage, financial resources issues should be studied to develop the realistic budget program for the realization of land use management policies and programs

References

(BWDB), B. W. (2021). *Flood Forecasting & Warning Centre*. Retrieved October 21, 2021, from http://www.ffwc.gov.bd

(2020). *Bangladesh National Building Code (BNBC) .* Dhaka: Ministry of Housing and Public Works.

(2009). *Comprehensive Disaster Management Programme (CDMP).* Dhaka.

Federal Emergency Management Agency, USA, 2015 edition

(2013). *Guidelines for Mainstreaming Disaster Risk Reductioninto Land Use Planning for Upazilas and Municipalities in Bangladesh.* ADPC and UDD.

(2016). *Handbook of Risk Sensitive Land Use Planning for Upazilas and Municipalities in Bangladesh.* Dhaka: Urban Development Directorate (UDD).

Khalid Al-Hussaini, B. M. (2016). Stubblocks interleveling PTS Technique. *The Journal of Engineering*, 134-140.

Kumar, R., Bhargava, K., & Choudhury, D. (2016). Estimation of Engineering Properties of Soils from Field SPT Using Random Number Generation. *INAE Letters*, *1*(3), 77-84.

NRP-BUET-JIDPUS-Sunamganj. (2021). *Draft Earthquake Contingency Plan for Ward 2, Ward 4, and Ward 5 of Sunamganj Municipality*.

Paul, S., Hasan, K., Akhter, S., & Rahman, M. (2019). Geospatial analysis of the depletion of surface water body and floodplains in Dhaka City (1967 to 2008) and its implications for earthquake vulnerability. *Springer*, 565.

(2014). *Risk-Sensitive Land Use Planning (RLUP) Guidebook.* World Bank and EMI.

(2006). *Risk-Sensitive Land Use Planning, a module of the Natural Disaster Risk Management Program.* World Bank Institute.

Roy, S. (2014). Probabilistic Prediction for Earthquake in Bangladesh: Just How Big Does the Earthquake Have to Be Next Years? *Open Journal of Earthquake Research, 3*, 108-114.

(2019). *Standing Orders on Disaster.* Dhaka: Ministry of Disaster Management and Relief.

Sunamganj Pourashava. (2021, September 9). Retrieved from http://www.sunamganjpourashava.org/

Bangladesh Space Research and Remote Sensing Organization (SPARSSO, 2021), http://www.sparrso.gov.bd/

Zaman, M. A., & Monira, N. J. (2017). A Study of Earthquakes in Bangladesh and the Data Analysis of the Earthquakes that were generated In Bangladesh and Its' Very Close Regions for the Last Forty Years (1976-2016). *Journal of Geology & Geophysics, 6*(4), 300-304.

Annex 1: Earthquake and Fire Hazard Assessment Criteria

Earthquake Assessment Criteria:

A. Structure Type

Structure type and floor	**Score**
Pucca above 3 stories	0.4
Pucca below 3 stories	0.3
Semi-pucca	0.2
Katcha	0.1

B. Structure Use

Structure use	**Score**
Residential, Commercial, Industrial and Mixed Use (RCIM)	0.4
Education & Research, Health Facilities (ERH)	0.3
Govt./Institution, Community Facilities (GC)	0.2
Other Uses	0.1

C. Road Width

Structures with road width	**Score**
Structures with road width less than 3m	0.4
Structures with road from 3m to 5m	0.3
Structures with road from 5m to 7m	0.2
Structure with more than 7m	0.1

D. Population

Population Density	**Score**
Above 400	0.4
100-400	0.3
30-100	0.2
0-30	0.1

Weight: This table provides the weight for each criterion.

Criteria	**Weights**
Structure type and floor	0.4
Structure use	0.3
Structures with road width	0.2
Population Density	0.1

Fire Hazard Assessment Criteria:

A. Waterbody

Distance from waterbody	**Score**
More than 20m	0.4
Within 20m	0.1

B. Structure Use

Structure use	**Score**
Residential, Commercial, Industrial and Mixed Use (RCIM)	0.4
Education & Research, Health Facilities(ERH)	0.3
Govt./Institution, Community Facilities(GC)	0.2
Other Uses	0.1

C. Road Width

Structures with road width	**Score**
Structures with road width less than 3m	0.4
Structures with road from 3m to 5m	0.3
Structures with road from 5m to 7m	0.2
Structure with more than 7m	0.1

D. Population

Population Density	**Score**
Above 400	0.4
100-400	0.3
30-100	0.2
0-30	0.1

Weight: This table provides the weight for each criterion.

Criteria	**Weights**
Distance from waterbody	0.4
Structure type and floor	0.3
Structure use	0.2
Population Density	0.1

Annex 2: Data Collection Questionnaire

1. Questionnaire for Household Survey

General Information	
Surveyor Name	
Ward No.	
Structure Basic Information	
Name of Significant Buildings	
Year Constructed (Pucca)	
Structure Type	Pucca
	Semi-Pucca
	Katcha
Structure Floor	
Structure Use Information	
Residential	Bungalow/Villa
	Govt. Guest/Rest/Circuit House
	Single household unit
	Multi household unit
	Apartments
	Govt./Institution Staff Quarters
	Workers Quarters
	Student's hostel
	Bachelor Quarters/Mess
	Old Home
	Orphanage
	Day/Child Care
	Slum
	Squatter
	Bathroom
	Kitchen
	Other Residential
Commercial	Market/Bazaar
	Grocery Shop
	General Retail
	Heavy Retail
	Services
	Heavy Services
	Food & Drink
	Building Materials
	Hotels
	Wholesale & Storage
	Financial Services (Bank/ Insurance)
	Private Office/NGO

	Training Centre
	Filling/Refueling Station
	Other Commercial
Industrial	Agro based Industry
	Chemical
	Cottage Industry
	Food Manufacturing
	Readymade Garments
	Leather
	Metal
	Paper
	Pharmaceuticals
	Brick
	Cement
	Glass & Ceramic
	Plastic and Rubber
	Textile
	Automobiles
	Printing & Packaging
	Other Industry
Educational	College
	University
	Madrasa
	Medical College
	Research Institute
	Primary School
	High School
	Training Institute
	Other Educational
Health Facilities	Hospital
	Clinic
	Rehabilitation Centre
	Community Health
	Veterinary
	Other Health
Govt./Institution	Government Office
	Local Government Office
	Court
	Pourashava Office
	Councilors Office
	Land Register Office
	Embassy/High Commission
	Others Institutions
Community Facilities	Religious

	Utility Services
	Waste Management
	Social Organization
	Public Toilet
	Graveyard
	Fire Station
	Police Station
	Police Box
	Fire Station
	Sports & Recreation
	Civic Amenities
	Other Facilities
Mixed Use 1 Mixed Use 2 Mixed Use 3	Residential
	Commercial
	Industrial
	Education & Research
	Health Facilities
	Government/Institution
	Community Facilities
	Restricted & Special Use
	Transport & Communication
	Agriculture
	Under Construction
	Miscellaneous
Restricted & Special Use	Air Force
	Ansar Camp
	BGB
	Army
	Navy
	Jail
	Juvenile Correction Center
	Other Detention Centre
Transport & Communication	Airport
	Bus Depot
	Bus Terminal
	Ferry Ghat
	Landing Station
	Launch Terminal
	Multistoried Car Park
	Rail Station
	Truck Terminal
	Passenger Shed
	Ticket Counter
	Toll Plaza

	Other Transport
Agriculture	Poultry Farm
	Dairy Farm
	Others
	Hatchery
	Nursery
	Other
Under Construction	
Miscellaneous	Car Parking
	Generator Room
	Abandoned/Vacant
	Guard Room
	Miscellaneous
Population Information (Residents/ Employees/ Students/ Other use wise)	
Number of Males	
Number of females	
Number of Child (Less than 6 years)	
Number of Old (More than 60 Years)	
Number of Special Need/Disabled persons	
Other Information	
Picture: Take image if its more than 2 stories	
Remarks: Mention any significant comment	
Survey Time	

2. Questionnaire for FGD

Time: 1.5 hours

Participants: Local People from different class of society

Group 1: Government and non-government individuals working on disaster including Fire service, Scouts, Red Crescent representatives

Group 2: Building construction companies and developers, industries/commercial and building owners

Group 3: Representatives from school/college management committee, hospitals management committee, mosque management committee and general people

1. Name of the locality:
2. What are major hazards in your pourashava?
3. How do you deal with the hazard in your area?
4. How much aware are you of the possible impact of an earthquake emergency in your locality?
5. What is the single most important factor that make Sunamganj Pourashava most vulnerable to earthquake?
6. What do you think about land use planning and its benefits to reduce earthquake risk?
7. Have you ever received any training on DRR/contingency plan /emergency plan preparation? (If yes, please ask detail)
8. Identify the locations/ areas/ zones in map you think to be vulnerable to earthquake or other related hazard; tell us why?
9. How do you supervise/ ensure/ maintain BNBC and Special building standards/codes for earthquake?
10. What is the lacking that put Sunamganj Pourashava at risk of earthquake catastrophe? Discussion on topics below: ✓ Proper land use plan and regulation ✓ Information availability ✓ Lack of communication/ coordination ✓ Lack of awareness and knowledge ✓ Manpower ✓ Technological capability

3. Sample Questionnaire for KII/ IDI

Time: 0.5 Hour

Participants: Authority Representative of Related Different Authorities and Department (List Attached)

1.	Name of the organization:
2.	Name of the respondent:
3.	Designation:
4.	How long have you been in the position?
5.	Are you aware of the Pourashava earthquake emergency/contingency plan with regard to Disaster? (if yes, please check detail)
6.	Are you aware of Standing Order on Disaster and responsibilities of your respected organization mentioned?
7.	How do you think land use planning would help implementing the Emergency/Contingency Plan and responsibilities of SOD 2019?
8.	Have you or your organization ever received any training on DRR/contingency plan /emergency plan preparation? (If yes, please ask detail)
9.	What is the action/ support roles of your department/ organization for land use and disaster management?
10.	What do you think the Pourashava lacks to implement earthquake risk sensitive land use planning (Capability)? Discuss on below topics ✓ Technological ✓ Manpower/ Technical Experts ✓ Equipment
11.	How do you think on what land use planning can bring about to reduce the risk of earthquake hazard?
12.	In relation to your previous response, what do you think land use planning should include?
13.	What are the agencies assist/ collaborate/ supervise you during an emergency?
14.	What would be the best usable and understandable format for any responsible person to utilize the land use planning and communicate with maps easily?
15.	Identify the locations/ areas/ zones in map you think to be vulnerable to earthquake or other related hazard; tell us why?

Annex 3: Generalized Classification of Structure Use

Sl no	Land use Categories	Details	Examples
1.	Agriculture	Any farm land used for agricultural	Paddy fields, jute fields, vegetables fields and other farm lands.
2.	Residential Area	Having buildings used for living purpose	Private residential houses, bungalow, circuit house, quarters, guest house, mess, old home, orphanage, rest house, slum, squatters, hostel and others
3.	Waterbody	Any significant accumulation of water, can be still or water moves from one place to another	Lakes, ponds, wetlands, rivers, canals, haors etc
4.	Restricted Area	Having restrictions on conducting surveys	Cantonment area, port area, govt restricted area (if any) etc.
5.	Industrial Area	Having industries, mills, production factories, godown of raw materials etc.	Flour mill, rice mill, saw mill, oil factories, spice industry, tobacco processing, compressed natural gas, fertilizers and insecticides industry, chemical & cosmetics industry, fabrics industry, handicrafts & sewing/hand loom factories, steel &wooden furniture production factories, bakery, dairy, fish & sea food, salt crushing mill, ready-made garments, leather buying house, tannery & finishing, medicine and drugs factories, bricks kiln/fields cement factories, foam, plastic products, textile, dyeing, packaging industry, automobile industry etc.
6.	Public Facilities	Facilities provided by government	Major roads and rail lines, drainage system, hospitals, police stations, public toilets, public library, govt. offices, post offices, security service office, air ports, bus terminals, rail stations, BIWTA terminal etc.
7.	Educational	Having the educational institutes	Kindergarten & nursery school, primary school, high school, college, university, madrasa, training institutes, polytechnic institutes etc.
8.	Commercial	Area used for economic purpose	Hotel & restaurant, markets, shopping malls, hat-bazars, departmental store, bank, insurance company offices, shops,

			show rooms, tea-stalls, ATM booth, beauty parlor, laundry & dry cleaning, tailor, automobile workshop, warehouse, nursery shed, ticket counter etc.
9.	Religious	Area used for worship	Mosques, temples, church, Eidgah, graveyard, cremation ground/ shamshan ghat etc.
10.	Recreational Area	Used for recreation or entertaining purpose	Park, playground, urban green, sports courts, zoo, cinema hall, entertaining and cultural venue, historical place etc.
11.	Mixed Use Area	Area having two or more use together	Residential & commercial or commercial & industrial or educational & religious etc.

Annex 4: List of Participants

1. List of WDMC Members

SL No	Ward No	Name	Committee's Position	Mobile No.
1.	Ward no 2	Syed Yasinur Rashid	Chairman (Councilor)	01712500512
2.	Ward no 2	Piara Begum	Advisor (Woman Councilor)	01743687933
3.	Ward no 2	Abdul Motin	Member (Representative of Teacher)	01712453061
4.	Ward no 2	Saikatul Islam	Member (Government Employee)	01915216571
5.	Ward no 2	Bijoy Nondi Biku	Member (Representative, Bangladesh Red Crescent Society)	01670566067
6.	Ward no 2	Tanim	Member (Representative, Bangladesh Red Crescent Society)	01728829260
7.	Ward no 2	Sumon Ahmed	Member (NGO Representative)	01762460589
8.	Ward no 2	Abdul Amin	Member (Imam)	01739213010
9.	Ward no 2	Polvob Rai	Member (Priest)	01743952684
10.	Ward no 2	Abdur Rahim	Member (Representative of Autistic People)	01407504072
11.	Ward no 2	Emon Jahan	Member (Representative of Media)	01819964266
12.	Ward no 2	Sadhna Singh	Member (Representative of Local Businessman Community)	01717742316
13.	Ward no 2	Sheuli	Member (Representative of Ethnic Community)	01731355036
14.	Ward no 2	Adv. Shukkur Ali	Member- Secretary (Approved by Ward Committee)	01712515908
15.	Ward no 4	Chonchol Kumar Loh	Chairman (Councilor)	01712375905
16.	Ward no 4	Samina Chowdhury Moni	Advisor (Woman Councilor)	01710984730
17.	Ward no 4	Purobi Rai	Member (Representative of Teacher)	01726146616
18.	Ward no 4	Rezaul Haq	Member (Government Employee)	01785760921
19.	Ward no 4	Alaka Das	Member (Representative, Bangladesh Red Crescent Society)	01731249866
20.	Ward no 4	Gourango Bonik	Member (Representative, Bangladesh Red Crescent Society)	01765218640
21.	Ward no 4	Roma Dhor	Member (NGO Representative)	017313129969
22.	Ward no 4	Hafez Mowlana Mofizur Rahman	Member (Imam)	01714771182
23.	Ward no 4	Mithun Chakraborty	Member (Priest)	01930867457
24.	Ward no 4	Aboni Sorkar	Member (Representative of Autistic People)	01739622394
25.	Ward no 4	Nahian Rahman	Member (Representative of Media)	01760076359
26.	Ward no 4	Samraz Chowdhury	Member (Representative of Local Businessman Community)	01728206322
27.	Ward no 4	Anisimas Chowdhury	Member (Representative of Ethnic Community)	01727528419
28.	Ward no 4	Liton Sorkar	Member- Secretary (Approved by Ward Committee)	01673698332
29.	Ward no 5	Md. Golam Saberin	Chairman (Councilor)	01717130152

SL No	Ward No	Name	Committee's Position	Mobile No.
30.	Ward no 5	Samina Chowdhury Moni	Advisor (Lady Councilor)	01710984730
31.	Ward no 5	Rana Acharjo	Member (Teacher Representative)	01714630111
32.	Ward no 5	Badol Talukder	Member (Government Employee)	01718126127
33.	Ward no 5	Mridul Talukder	Member (Representative, Bangladesh Red Crescent Society)	01726146588
34.	Ward no 5	Emdadul Haq Shahjahan	Member (Representative, Bangladesh Red Crescent Society)	01819984573
35.	Ward no 5	Lipi Rani Kor	Member (NGO Representative)	01737276031
36.	Ward no 5	Abdul Motin	Member (Imam)	01717302352
37.	Ward no 5	Topon Chokroborti	Member (Priest)	01741586858
38.	Ward no 5	Joyonto Chodro	Member (Representative of Autistic People)	01893352637
39.	Ward no 5	Jakir Hossain	Member (Representative of Media)	01711973411
40.	Ward no 5	Raju Shikdar	Member (Representative of Local Businessman Community)	01711361257
41.	Ward no 5	Suvol Pashi	Member (Representative of Ethnic Community)	01718108883
42.	Ward no 5	Iqbal Hossain	Member- Secretary (Approved by Ward Committee)	01721482983

2. List of T.L.C.C Members

SL No	Name	Committee's Position	Mobile No.
1	Mr. Nader Bokht, Mayor, Sunamgonj Municipality	Director	01795286869
2	Mr. Abul Hasnat Mohammad Kawsar, Councilor, 1 no. ward	Member	01711390121
3	Mr. Syed Yasinur Rashid, Councilor, 2 no. ward	Member	01712500512
4	Mr. Mohammad Mosharrof Hossain, Councilor, 3 no. ward	Member	01715237123
5	Mrs. Piyara Begum, Councilor,1,2,3 no. ward's reserved seat	Member	01712375905
6	Mr. Chonchol Kumar Loh, Councilor, 4 no. ward	Member	01717130152
7	Mr. Golam Saberin	Member	01712318413
8	Mr. Ababil Nur, Councilor, 6 no. ward	Member	01717742339
9	Mrs. Samina Chowdhuri, Councilor, 4, 5 & 6 no. ward's reserved seat	Member	01712937422
10	Mr. Ahsan Jamil Anas, Coucilor, 7 no. ward	Member	01761746481
11	Mr. Ahmed Nur, Councilor, 8 no. ward	Member	01743687933
12	Mr. Golam Ahmed, Councilor, 9 no. ward	Member	01710984730
13	Mrs. Syeda Jahanara Begum, Councilor, 7, 8 & 9 no. ward's reserved seat	Member	01718914497
14	Deputy Commissioner's Representative	Member	
15	Executive Engineer, Public works Department's Representative, Sunamganj	Member	
16	Executive Engineer, LGED's Representative, Sunamganj	Member	
17	Executive Engineer, Roads and Highways Department's Representative, Sunamganj	Member	
18	Executive Engineer, Public Health Engineer's Representative, Sunamganj	Member	
19	Assistant Divisional Engineer, BTCL, Sunamganj	Member	
20	District Social Service Officer's Representative	Member	
21	District Cooperative Officer's Representative	Member	
22	Mr. Porimolkanti Dey, Representative of NGO-Transparency International Bangladesh	Member	
23	NGO Representative of ASD/VARD/CNRS/BRAC/ASA	Member	
24	Mr. Panna Dey, Clinic Manager, Representative of Sun Smile Clinic	Member	01733531180
25	Hazi Mohammad Abdul Khalek, Swamp Bank, Udayan-9, Representative of Civil Society	Member	01712254705
26	Mr. Jogesshor Das, Teacher, Notun Para, Representative of Civil Society	Member	01710890579
27	Mr. Mahmud Alam, Hason city, Professional Representative	Member	01712146433

SL No	Name	Committee's Position	Mobile No.
28	Mr. Dr. Saikot Das, Medical Oficer, Sunamgonj Front Hospital	Member	01726701012
29	Mr. Rana Acharjo, Teacher, Notun para, Representative of Civil Society	Member	01714630111
30	Mr. AD. Anup Kumar Dhor, Advocate, Notun para, Representative of Civil Society	Member	01714676379
31	Mr. Jashim Uddin Lal, Banani city, a, Dhanshiri-27, Representative of Civil Society	Member	01712841656
32	Mrs. Mina Begum, Sholghor, Representative of Poor People	Member	01763209292
33	Mr. Ali Khushnur, Hason city, Representative of Civil Society	Member	01715039422
34	Mr. Afzal Nur, Nobinogor, Businessman, Professional Representative	Member	01720165868
35	Mrs. Kohinoor Begum, Head Mistress, Professional Representative	Member	01736346913
36	Mr. M. F.R Forkan, Journalist, Hasonnogor, Representative of Civil Society	Member	01787366101
37	Mrs. Seema Chowdhury, Ukilpara, Representative of Civil Society	Member	01720232684
38	Mr. Adv. Shukur Ali, Advocate, Professional Representative	Member	01712515908
38	Mr. Sohibur Rahman, East Arpin City, Representative of Poor People, Boropara	Member	01738878136
40	Mr. Lipi Balmiki, Uttom Lal Colony, Representative of Civil Society	Member	01731340701
41	Mrs. Tahera Begum, Headmistress, Representative of Poor People, Aftabnagar,	Member	01671895659
42	Mrs. Najma Begum, Arpinnogor, Representative of Poor People, Boropara.	Member	01712710923
43	Mr. Monulal Bormon, Representative of Poor People, Nobinogor	Member	01715453919
44	Mr. Mohammad Shahjahan, Representative of Poor Worker, Old Bus station	Member	01712509997
45	Mr. Adv. Chan Mia, Alipara, Representative of Civil Society	Member	01710341538
46	Mrs. Chadni Gem, Arpinnogor, Representative of Civil Society	Member	01701806097
47	Mrs. Farida Begum, Dhopakhali, Representative of Poor People	Member	01631682400
48	Mrs. Baby Begum, Mollikpur, Representative of Poor People	Member	01727192615
49	Mr. Koli Talukder Arti, Representative of Civil Society	Member	017161145506
50	Mr. Mohammad Ishaq Bhuiyan Secretary, Sunamgaonj Municipality	Member Secretary	017475755464

Annex 5: Project Team

Sl. No.	Name & Designation	Role in the Research
1.	Md. Rejaur Rahman	Team Leader – DRR & Resilience Expert
2.	S S Biddya Baron Sarker	Land use Planner
3.	Abu Saeed	GIS Assistant
4.	Nilanjana Bhowmick	Jr. Urban Planner
5.	Ishteaque Ali Riyasat	Survey Coordinator
6.	Habibur Rahman Pranto	Surveyor

Annex 6: Photographs from Field Survey

Union Land Office

Fire Service & Civil Defense Station

Bangladesh Land Officers Welfare Association

LGED Sunamganj

Upazila Land Office

Temple

Madrasha

Zila Parishad Sunamganj

DC Office, Sunamganj

Bihari Point

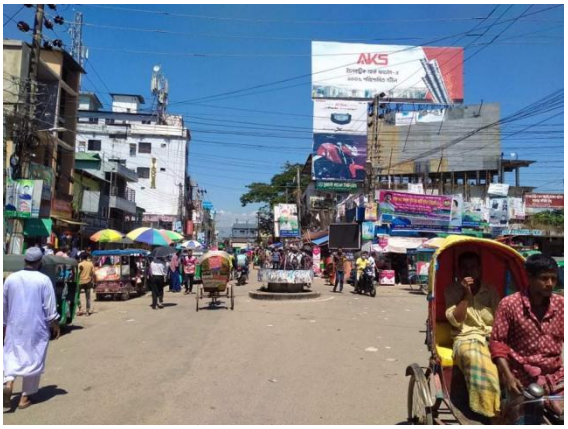
Bokpoint Chottor

Kali bari Point

Kazir Mor

Poura Biponi

Puraton Bus Stand



Traffic Point

Questionnaire Survey, 2021

Questionnaire Survey, 2021

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