Sponsored Thesis Project Competition on
"RE-IMAGINING URBAN RIVERS"
Season- 2

Revitalization of Urban Livelihood through WaTOD, A case of Jhelum River in Srinagar.

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Abstract

Cities aiming to expand their public transportation network and provide an alternative to land-based transportation are increasingly turning towards water transit, with the aim of supplementing the existing transportation network to reduce traffic congestion and thus pollution.

Urban areas have been the epicenter of growth and a destination for employment opportunities. Therefore, they are in constant flux due to migration from the peripheral areas in search of jobs and better living conditions, eventually leading to urban sprawl. According to the Census 2011 projections, cities are expected to accommodate 41% of India's population by 2030, up from 31% in 2011. There are numerous benefits of urbanization, such as economies of scale and access to education, but there are also negative externalities, such as environmental degradation and a reduction in quality of life. Srinagar has seen a rapid surge of urbanization, with increasing population and limited geographical features, the city is expanding horizontally at a very fast pace, resulting in a rise of private vehicle ownership, causing traffic congestion, more road accidents, air pollution, haphazard growth, a decline in the use of public transportation.(Traffic Advisory J&K, 2020) The Urban Sprawl has shown major impacts on waterbodies and wetlands, the haphazard growth resulted in encroachment over water bodies and fragmented them from the wetlands which has made the city more susceptible to floods.(TPO Kashmir, 2015)

The Water Transit-oriented development (WaTOD) model aims at preparing a development plan by directing importance to water bodies as an element of transit-based growth. It plans on creating a water-centric city by developing the urban land use near water transit terminals to boost inland water transportation in conjunction with alternatives such as roadways and rails to make a sustainable urban transportation system. Redevelopment of waterfront district for high-density business, residential and tourism purposes along with Water Transit Terminals and Proposing parks and green spaces that encourage movement along the river. The development model will focus on creating a relationship between livelihood and water bodies to create a sense of attachment by converting water into an asset than a barrier.

Acknowledgement

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1 Introduction

Rivers, canals, backwaters, and creeks make up India's vast network of inland waterways. Compared to the developed countries, India has under-used its rivers for transportation services. The failure to recognise the inland water transportation system's potential impact on national economies continues to be a key issue. Inland waterways in industrialised nations, such as the United States, the European Union, and China, have been modernised, according to the United Nations Economic and Social Commission for Asia and the Pacific, and a substantial commercial IWT sector has emerged. In India, inland waterways account for less than 1% of overall transportation, compared to 8.7% in China and 7% in the European Union.(Government of Assam, 2016) When compared to the Neighbouring countries, IWT transports around 35% of freight in Bangladesh. Rival routes of transportation, such as rail and road, are less established than river ports. In Thailand, inland water transport is second only to road in terms of freight moved, accounting for around 20 million tonnes.(Government of Assam, 2016) In and around Bangkok, passenger travel is considerable, with several sorts of services, including express services.

In many nations, inland waterways provide a more ecological and cost-effective alternative to road and rail cargo transportation. Inland rivers transporting cargo is not only cost-effective, but also fuel-efficient and hence also environmentally friendly. Acc. to a report by the World Bank, the cost of transporting one tonne of freight across one kilometre is Rs. 1.41 for railways with a capacity of 85 tonnes, and Rs. 2.28 for roadways with a capacity of 24 tonnes.(Government of Assam, 2016) Waterways, on the other hand, cost Rs. 1.19 per tonne with a capacity of 105 tonnes. Incoming waterways will become a more ecologically benign option for roads and railways in terms of energy efficiency, noise pollution, and emissions in the next decades as traffic congestion and emissions from road freight transit grow.

Inland water transportation was a significant mode of cargo and passenger movement in India in the early twentieth century, but, as in many other countries, the influence of railways and then road modernization has led to neglect of inland water transportation, which now carries less than 0.5 per cent of India's freight traffic, compared to 66 percent for roads and 27 percent for railways.

The research will concentrate on identifying the various potentials of inland water transportation in India as well as analysing existing water transportation models in India and overseas. The study will look into the laws, policies, and initiatives put in place by government agencies to find out what else is viable. Will also examine the institutional frameworks of important entities in India that are responsible for inland water transportation and point out fundamental problems that are causing inland water transportation to be underutilised.

1.1 Background and Need for Study

Srinagar is the summer capital of the union territory of Jammu & Kashmir. On the banks of the Jhelum River, it is located at an altitude of around 1586 meters above mean sea level. According to the Census 2011, The state's urban population expanded by 36.42% between

2001 and 2011, outpacing the national average of 31.1%. Kashmir region sums for about 63% (2.2 million) of the J&K's urban population out of which Srinagar individually accounts for 55%. The current development tendency appears to be more focused on corridors. The city is expanding along the major roads, hesitantly approaching clogged flood basins. According to research done by Nissar A. Kuchay and M. Sultan Bhat on Urban Sprawl of Srinagar City and its impacts on Wetlands: A Spatio-Temporal Analysis (2014).(Kuchay et al., 2014) It was observed that land-use conversion of natural wetlands to other uses is on a vast scale being converted into residential, commercial, and agricultural activities. The wetland coverage dropped from 5.21% in 1971 to 2.6% in 2014.(Kuchay et al., 2014) As a result, wetlands have been fragmented from the water bodies and increased the city's vulnerability to flooding. The city's northern and eastern wads, are connected by a green belt making any construction illegal, Pampore karewas on the south, and the wetlands on the west. Therefore, Vertical expansion is the only way for the city to endure, but it must be done correctly, taking into account the soil's bearing capacity and providing strong planned foundations for the soil.

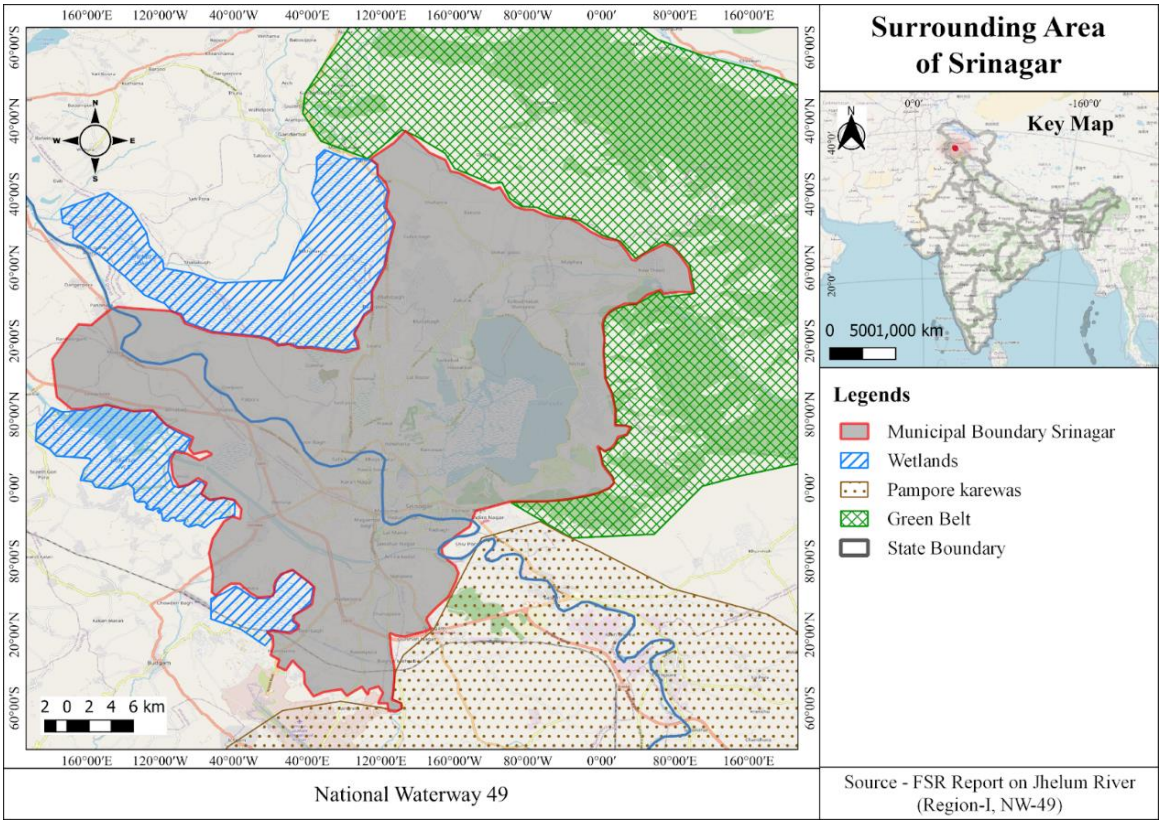

Figure 1: Surrounding area of Srinagar (Source: Google Earth Imagery 2020)

1.2 Waterways

Once known as the "Venice of the East", It has lost its identity somewhere in the pages of history. Srinagar had a deep history of Inland water transportation, being boats the popular

means of transport until the canals were closed in 1970 to make room for roadways. National Waterway-49 is situated in Kashmir, passes through four districts, and covers an area of 110 km (Fig 2)(IWAI, 2017). According to the Inland Waterway Authority of India (IWAI), NW-49 is considered technically feasible for the development of shipping and navigation by carrying out minimal dredging. A Feasibility Report was prepared by IWAI on the Jhelum River and found that this stretch will be developed as a tourism hub because there are tourist places in the vicinity of the stretch. The river stretch is navigable all year, agricultural land exists on both banks of the river along the stretch.

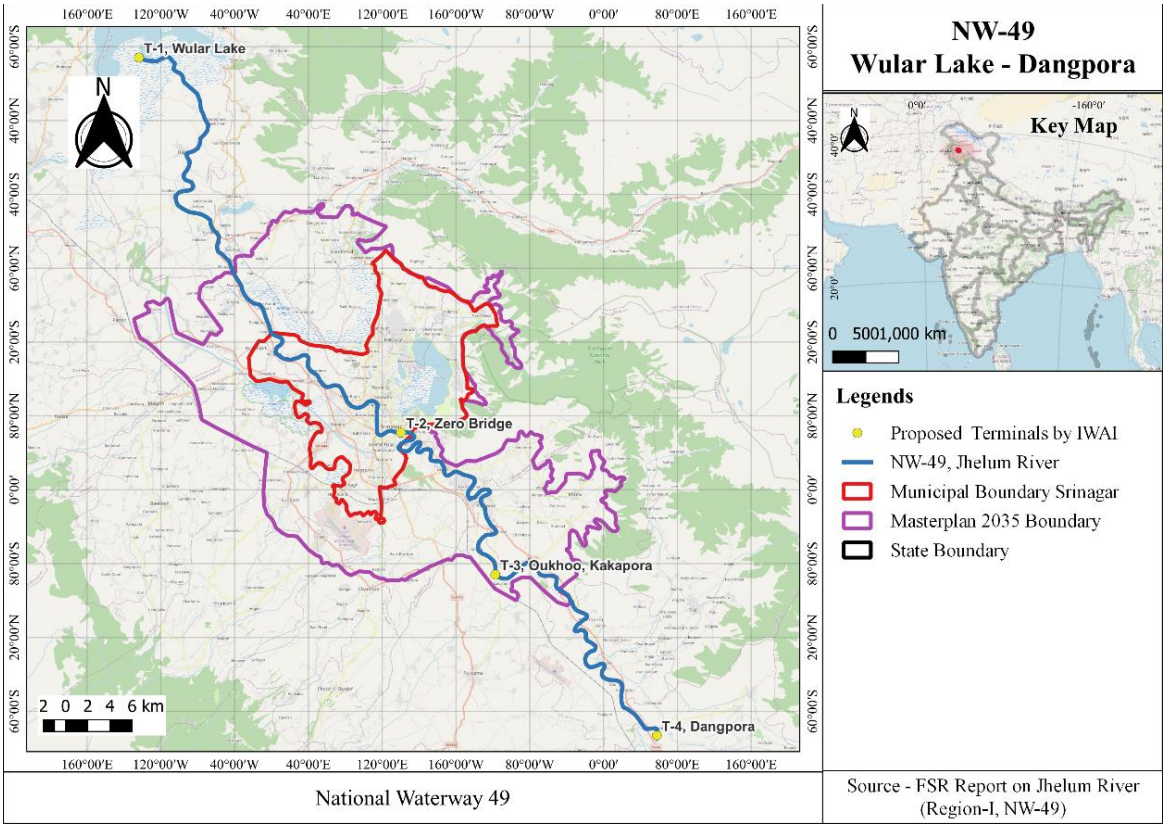

Figure 2: National Waterway – 49 (Source: FSR Jhelum River by IWAI)

Srinagar city has faced uncontrollable migration from the peripheral areas, and traffic in the city is at an all-time high. According to the CMP for Srinagar, roadways with a ROW of less than 20m dominate the road network, 91% of the entire road network has travel speeds of up to 20 km/h.(Traffic Advisory J&K, 2020) This shows congestion in the city, which requires interventions related to road widening, which causes a significant financial commitment, effort, and a significant amount of land acquisition, making it a tough proposition. State Govt. is also making efforts towards rejuvenating the Water transit system of the city, In CMP 2020, five intra city waterways networks (Shown in Fig 3) have been proposed covering the stretch of 60 km with 60 water buses which will be in action by the year 2044.(Traffic Advisory J&K, 2020) During the period of December and

January, the dal lake freezes, but the rails are built to allow for a smooth passage of the boats, and the Jhelum River is navigable all year. December and January, the dal lake freezes, but the rails are built to allow for a smooth passage of the boats, and the Jhelum River is navigable all year.

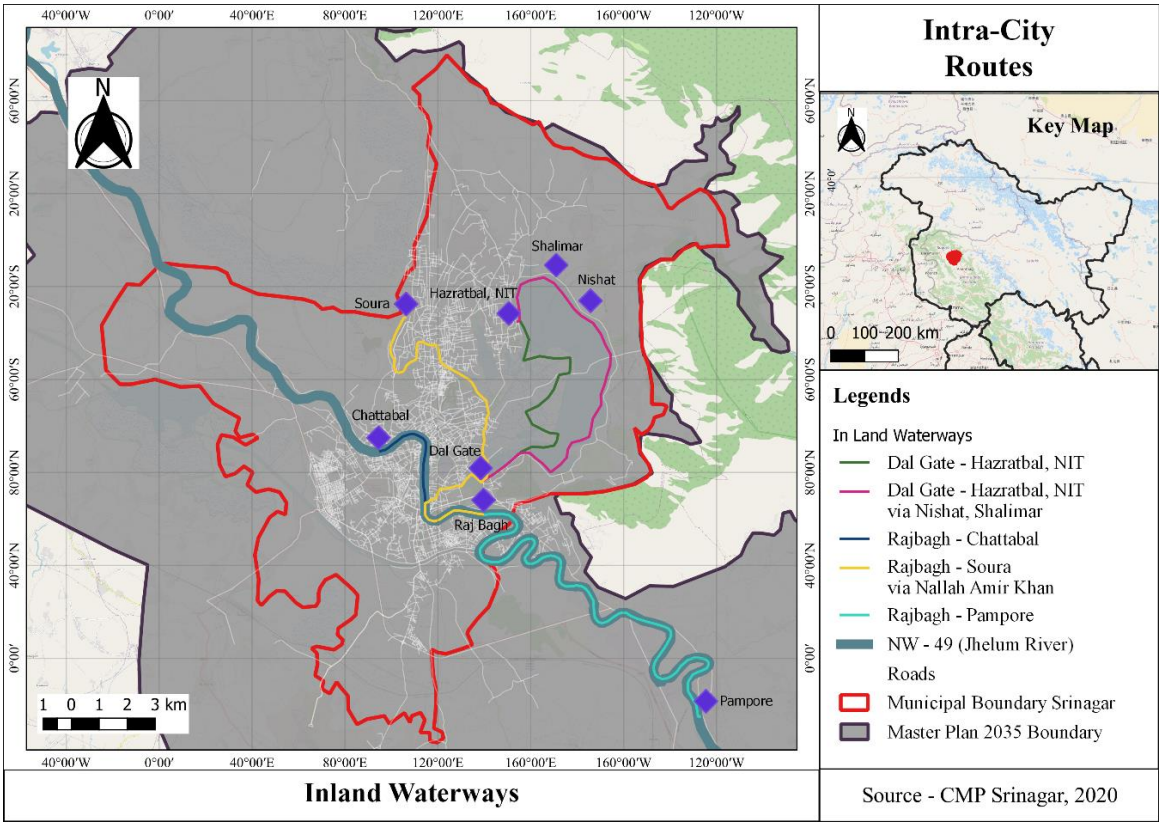

Figure 3: Proposed Intra City Water Routes (Source: CMP Srinagar 2020)

2 Conceptual framework

2.1 Aim

Regeneration of waterfront districts through Water Transit-oriented Development.

2.2 Objectives

- To establish a scenario of transport and existing land use patterns and transport along river.
- To evaluate the TOD framework with existing land use regulations along with water body.
- To formulate a comprehensive WaTOD plan.

These stages will help to achieve the following objectives of the research:

2.2.1 Objective 1

To establish a scenario of transport and existing land use pattern along with water bodies: This is required to create a profile of the present land use pattern along water bodies.

2.2.2 Scope of work:

- Demarcating the influence area.
- Assessing the impact of water body on existing land use development.
- Assessing the population and built form trends in the study **area.**

2.3 Objective 2

To evaluate the TOD framework with existing land use regulations along with water bodies: This includes identification of potentially developable land by evaluating the TOD framework with the land use regulations surrounding the river.

2.3.1 Scope of Work:

- Assessment of land use regulations for development.
- Identifying the land potential for TOD.
- Identifying the deficit between demand and supply of existing infrastructure.

2.4 Objective 3

To formulate a comprehensive WaTOD plan: The proposals part is divided into two parts as follows:

2.4.1 Scope of Work

- Detailed TOD implementation strategy.
- Multimodal integration.

2.5 Scope and Limitations

- The scope of the project is to formulate a WaTOD along the Jhelum River.
- There will be no comprehensive study of the project's economic and environmental viability.
- The research does not focus on evaluating the project's economic opportunities.

2.6 Outcomes of Thesis

The thesis project's final product will be a site plan for the case study region, i.e., a selected river stretch of the Jhelum River along with adjoining canals based on the principles of Water transit-oriented development. Outcomes will be evaluated and based on a set of policies and developmental frameworks, which will be formulated along with the site plan. Land use modification and revitalization of existing water bodies will be part of the Water Transit-oriented Development Plan, and so will be the reconfigured water transit routes, modifying

existing land use to better fit the scenario of road transport, generating a water transit-oriented economy, and dealing with pollution and congestion.

2.7 Methodology

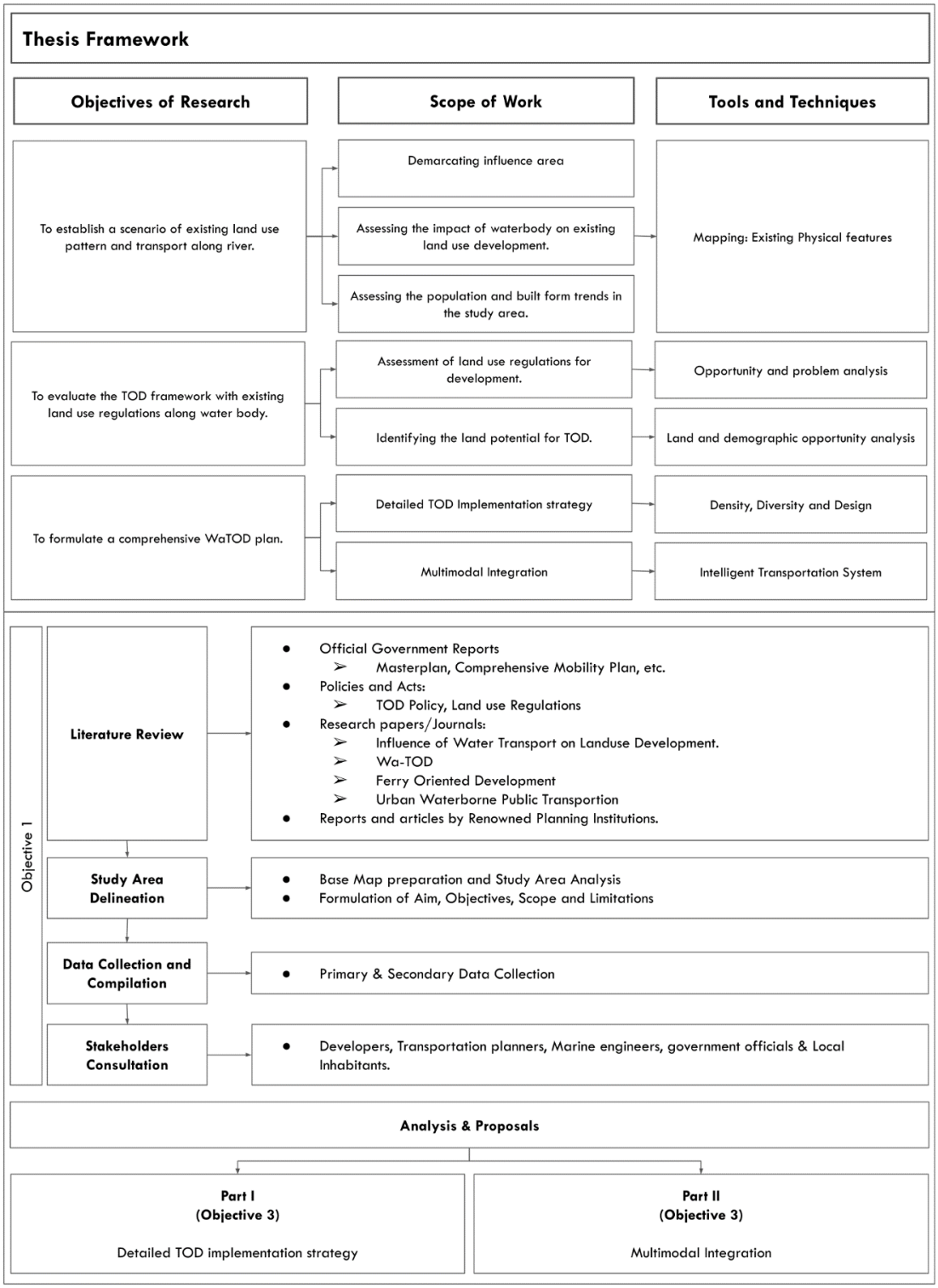

Figure 4: Methodology for conducting the research (Source: Author)

Following is the objective wise methodology, the first step of the research includes reviewing of literature which will aid in concept understanding (definition, cause, impacts and indicators) and also identify parameters affecting waterfront development. The second step includes the identification of potential developable land by evaluating the TOD framework with the land use regulations surrounding the river. The final step of proposals will be divided into two parts city-level level connectivity-based strategies and city Leland-use use based strategies.

3 Literature Review

3.1 WaTOD

Water Transit-oriented Development (Wa-TOD) is a hybrid version of Transit-oriented Development (TOD), the usual TOD approach being more concentrated on MRTS i.e., Railways and BRTS i.e., Buses. Wa-TOD model focuses on integrated water transport and land use development. Development along with Water Transit terminals and corridors, building high-density, mixed Land use such as business/neighbourhood centres. To promote Water Transportation and discourage private vehicle ownership, node-based development (i.e., Commercial, residential, etc.) or corridor development can be prospective approaches. Wa-TOD is based around one-fourth of a mile of the Water transit stations to promote Water Transport and by making the water body the most important element of growth.(Thompson et al., 2006)

To make Water Transportation successful, it needs to compete with or complement the alternative modes of transportation. Ferry transportation is indeed a very cost-effective means of transit when compared to other modes, with ferries alleviating more congestion per cost incurred on other modes. Ferries are similar to buses in that they are a low-cost, quick-to-implement means of transportation, plus they do not increase the traffic congestion.(Tanko et al., 2018)

Predicting ferry ridership has been a difficult task, according to research conducted by the San Francisco Bay Area Water Transit Authority, because ferry ridership is not only dependent on trip time and cost. Pleasure, aesthetics, comfort, and reliability also play an important role in selecting a ferry as a mode. Initially Ferries inability to make multiple stops was a hindrance in the development of water transit due to the long docking times. This disadvantage has resulted in the ferry's lack of ability to connect multiple TODs as a result of which the prospective rider base should grow. With the evolution of marine technology, Water Taxis are being produced which are much quicker and can carry 100-120 passengers at a time with a top speed of 40-50 kms/h like the one implemented in Brisbane, Australia.(Tanko et al., 2018) therefore, making the ferry cost-effective and time-effective at the same time. The long Docking times can also be substantially reduced by implementing the Automatic Intelligent Docking Systems.

The pros of the above-mentioned scenarios highlight Water Transport with the potential of taking a load of urban transport in conjunction with roadways and, integrating multiple TODs/nodes. Water Transport shows up as an alternative which is cost as well as time effective and at the same time provides access to other factors as well, such as reliability, access to open space, Aesthetics, Environment Friendly, etc. Developing a TOD on a Waterfront provides a lot of new challenges that need to be dealt with for the successful implementation of Water Transport which will play an important role in developing the patronage over time. Some of the challenges that can be faced in developing the Wa-TOD model are listed down below

- The existing land use regulations for development along the Waterbody.
- Content with Storm Hazards such as floods.
- High wind pressure near the shore will affect the High-Rise.
- Residential and commercial establishments should be located within a half kilometer of a transit stop.

In the Journal "Exploring the connections between ferries and urban forms: Some Considerations before jumping on board," Robert Thompson was one of the first to link ferry development with land use, recognizing the potential for a network of ferry terminals to function similarly to other transit lines in terms of transit-oriented development (TOD). They claim that for urban water transportation and ferry-oriented development to be effective, more attention should be focused on terminal architecture and offering added facilities like shelter and business settings, as opposed to existing TOD. Ferry services, when combined with waterfront restoration projects, have the potential to be a catalyst for economic revival in American cities. According to the researchers, ferry passengers are often leisure users who are less concerned with time and are more prone to remain at ports and utilize supporting land uses. These traits imply that effective FOD may benefit from the construction of spaces where individuals are more likely to spend time. These should be created in collaboration with the current transportation network and incorporate not just integrated ticketing but also standard signage and navigation to and from other forms of transportation. In a case study of Brisbane's network, it was discovered that 15% of all ferry voyages were made using another mode. As a result, integrating water and land transportation should be a primary focus.

3.2 Effects of Storm Hazards on Water Fronts: Case of Hoboken city, New York

Hoboken had grown into an industrial city and a major people and freight transportation hub by the end of the nineteenth century. After a period of decline in industry, the city has been given a second chance, this time as a wealthy residential outpost of New York City and the surrounding New Jersey labour areas, rather than a blue-collar, industrial port town. Passenger ferries, commuter trains, light rail, and buses connect Hoboken and New York. In the 2000s, "the mile-square city's" population and employment exploded, and it now has

52,034 residents and 17,707 jobs.(Ripple Effects, 2014) Hoboken's attraction stems from its image as a "walker's paradise," with 21 restaurants, pubs, and coffee shops within a five-minute walk of one's home, as well as convenient access to New York City and Jersey City. This dynamic position, on the other hand, has its own set of challenges: much of the modern city was constructed on reclaimed tidal marshes, and two-thirds of the city is located inside FEMA flood hazard zones. Many inhabitants were forced to flee their homes due to flooding during Superstorm Sandy, but flash floods from ordinary rainstorms are still common: in the year after Sandy, Hoboken had four flash floods.

3.2.1 City's continuous exposure to floods

Floods have begun to alter how people use their homes, encouraging them to limit basement and ground-floor activities to those that can tolerate flooding without sustaining significant damage. More green space and permeable surfaces will be added to the city's green-infrastructure strategy plan, allowing the city to catch more stormwater before it enters the sewage system.

3.2.2 For the expense of one, new open spaces provide several benefits

The use of a parking lot to absorb rain, offer green space, and improve the liveability of a neighbourhood. The plan was created using a community interaction technique by the Planning Association. The Park will be part of a wider attempt to minimise precipitation into the combined stormwater/wastewater system, which corresponds to the city's goal of reducing rainfall entrance. Three potential parks are being evaluated as part of the city's green infrastructure strategy plan, which aims to collect, store, and purify 31.4 million gallons of rainwater per year.(Ripple Effects, 2014)

3.2.3 Green Buildings ease the stress on water and sewer systems

Water-conserving fixtures are in use. Less water is drawn from the city's water mains per person when a sink, shower, or toilet is used less, and less water enters the combined sewage system, minimizing overflows, floods, and backups. Interior water faucets use 23% less water than standard fixtures, and a 6,000-square-foot green roof keeps 68,500 gallons of rain out of the city's wastewater system each year.

Due to the high cost of construction, the green building business model is as follows: Residents are contributing with their dollars to demonstrate their gratitude for the efforts made to provide a safe and healthy living environment. More inhabitants in Hoboken mean more customers for local companies, but they're also attempting to be more environmentally friendly by limiting their impact on air, electricity, and, of course, the city's ancient and capricious water system.

3.3 Ferries Appeal: Tourist industry and open space in cities

In the instance of Rhode Island's Quonset Point, Despite the fact that a Quonset-to-Providence ferry would have to compete on price and speed with the highway and the MBTA, commuting by boat out on the water would be tempting, according to past statistics.

Several poll respondents claimed that the newer and plusher fast ferries appealed to them because of their comfort, despite the fact that they were not commuters.(Tsai et al., 2017)

3.4 Integrated Development: Commuter ferry service Tourism industry & Mixed-use development

Discretionary tourist spending looks to be another potentially large source of revenue if a ferry port or enterprises service both commuter and tourist routes. Ferry terminals with a range of purposes or that are related to a mix of uses, according to Weisbrod and Lawson, provide chances for public or private enterprises to profit economically from ferry passengers' discretionary purchases. Despite the fact that these tourists were significantly wealthier than the majority of southern New England residents, we found that ferry passengers were unlikely to spend a significant amount of money at or near the ferry port.

According to the survey, 905 tourists to Martha's Vineyard and Block Island were questioned near Quonset Point in Rhode Island in 2005. The only methods to travel to these islands are by private boats, ferry, or plane. People were surveyed on the islands and aboard the Vineyard Fast Ferry. Both walk-on passengers and those who had carried their cars onboard the ship were subjected to inspections on the islands. Block Island is served by three distinct firms, with five different mainland departure ports. Martha's Vineyard is served by eight separate firms, each with eight distinct departure locations. As a consequence, even if they had to board a boat, visitors to both islands had a range of ferry options to select from.

As part of the study, participants were asked about their spending at or near ferry ports. Beverages (36 percent of respondents) and snacks were the most popular choices among tourists (29 percent). Drinking a cocktail (11 percent), eating a wonderful supper (11 percent), and having a quick lunch (17 percent) all had similar appeal and were clearly less important than the previous things. Gifts piqued the curiosity of some (8 percent). Most crucially, 36% of those questioned had neither made nor planned to make any purchases. According to these statistics, while food and beverage concessions may appeal to ferry passengers, only 13% were interested in purchasing a large lunch. As a result, despite their relatively high wages, these travellers were largely interested in little things. The entire amount of money spent at or near a ferry port will, of course, be determined by the total number of passengers.

By researching the behaviour of ferry passengers, researchers were able to back up the findings of the passenger spending study. When the ferry passengers arrived at their destination, they dispersed swiftly from the area surrounding the vessel. Passengers on the islands appeared to be focused on getting to their hotels or viewing the sights as soon as possible. They usually came to a halt to obtain tourist information and maps. The vast majority of travellers travelled directly to their cars after returning from Martha's Vineyard or Block Island.

Furthermore, all of the ships' passengers arrived close to departure time. Passengers have a limited amount of time to make purchases. Passengers appeared to be saving money until they were on the islands, and they acted as though they would wait until their vacation was really started before making any large purchases. When the passengers arrived to the mainland, their vacation was over, and they were eager to return home.

3.5 The expense of errors and flexibility

However, because of this flexibility, developers may be more hesitant to invest in a boat landing rather than a rail station. According to the report, developers are more interested in investing in long-term infrastructure. Therefore, by investing money in terminals and making permanent infrastructures, we can attract private investments. It was discovered that water transportation requires relatively low capital investment. If no dredging is necessary, the right of way is almost free, allowing the resources to be used for other purposes. In the case of San Francisco, it was also discovered that water transportation offered greater route flexibility, giving it an advantage over roadways and railways. Water transportation also allows for the reuse of infrastructure that was formerly designed for water transportation, and if it is no longer in use, it may be utilised for other purposes like tourism, paid docking stations, and etc.

3.6 Water Transport and TOD

The rising acceptance of the link between urban design and transportation may be seen in the present interest in constructing Transportation Oriented Development (TOD). A TOD technique is being used in a number of waterfront redevelopments in the San Francisco Bay Area. In the case of Quonset Point, it appears that the same strategy will be followed.

There are presently few personnel travelling between Quonset Point and Providence, Rhode Island, to the north. Only 9% of the employees polled live in Providence and have to commute to Quonset Point through Providence traffic, while 20% live in North Kingstown or one of the surrounding communities. A further 31% of the population resides in the "ring" of municipalities to the south and west of Providence, all of which are traffic-free.(Tsai et al., 2017) Despite this, there remains a lot of unused or underutilised area at Quonset Point. In this way, Quonset is akin to the many abandoned and underutilised seaside estates found across the United States. Transportation technology, industry, and military post closures all contributed to the decline of these industries.

Serving commuter and lifeline/tourist ships may be a difficulty with TOD building and ferries from Quonset. The position of a transit station as a transition point for a variety of modes of transportation (trains, buses, vehicles, bicycles, and pedestrians) is continually at odds with its role as an important part of a community. Providing as little room as possible for automotive parking is one strategy to handle this issue. In principle, as the general number of work and residential units within a short walk of a station increases and intermodal linkages improve, the amount of space allocated to automobile parking lots may

decrease. While this makes sense for commuting services, achieving this design aim when a station also has lifeline and tourism services would be more challenging. Because autos, trailers, and freight must be transported into and out of the islands, the core service must include staging locations. The majority of tourists park their cars for the day or overnight along tourist routes, which generally feature large parking lots. These staging fields and parking lots would impair the TOD's urban fabric.

3.7 Transit Oriented Development

Calthorpe (1993) characterized a TOD as "moderate to high-density housing, as well as complementing public uses, jobs, retail, and services, clustered in mixed-use projects at critical sites along regional transportation lines."

Parker et al. (2002) described TOD as "moderate to higher density development within easy walking distance of a major transit station, often with a mix of residential, job, and shopping possibilities built for walkers without eliminating the automobile."

APTA- Transit Oriented Development is defined as any macro or microscale development that encourages people to prefer public transit.

CTOD-Transit-oriented development, or TOD, is a mix of different uses such as housing, office, retail, and/or other commercial development and services that are incorporated into a walkable area and often located within a half-mile of good public transit.

3.8 TOD Analysis for Indian Context – Case studies

Communities around transit stations exhibit some, if not all, of the TOD components of Design, Density, and Diversity, according to the TOD research. A 24-hour environment, a diversity of uses, a mix of income, and a 24-hour environment are provided by a variety of purposes, a network of roadways, and population density in the regions around some or all of the transportation hubs.

The density and diversity components of TOD are currently evident in transportation systems being built in cities with a large population (2 million+) and high population densities.

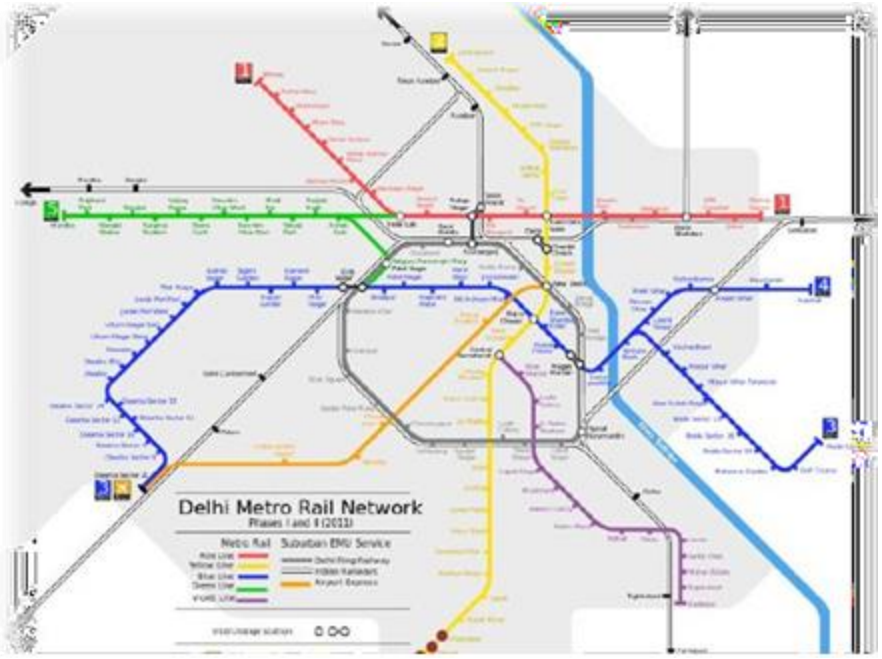

Figure 5 Delhi Metro Rail Network Map (Source: DMRC)

Each neighbourhood in the city has different land use and population mix. Varying regions of cities have different types and sizes of building blocks, as well as different types and widths of roadways. Congestion, delays, and pollution have come from a lack of road capacity and a growth in vehicles and people.

Although population densities around newly introduced transport systems may be sufficient for transit ridership, transit accessibility and multimodal connection are missing. The recommended methods advocate for densification of construction along transport routes and accessibility to transit, but they make no recommendations for increasing existing population ridership.

In comparison to the present intensively built tiny blocks, the proposed development requirements for densification of development along transport routes need substantial block sizes. Along with the transportation stations, there are mature and diversified property uses and densities. Additionally, road widening options are restricted. As a result, additional densification options may vary, and in certain cases, they may be quite restricted. It will take several years to assemble lots to provide suitable block sizes for high-density development. There are no plans in place to incentivize parcel assembly. There are no plans in place to keep existing high densities, phase out existing development, or phase in high-density construction.

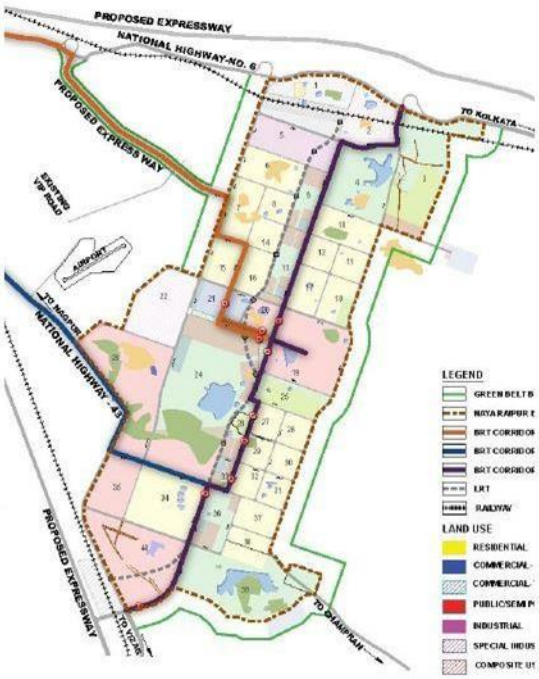

Figure 6 Sector wise TOD at Naya Raipur (Source: Master Plan Raipur)

The plans do address the concerns of investing in vital transportation infrastructure, as well as better traffic, transit, and parking management. Pedestrian convenience and safety are also considered.

The policies do not address urgent and short-term options for increasing transit usage and encouraging individuals to use public transportation instead of driving their cars.

As a result, the recommended measures may not be able to relieve traffic congestion in the medium run. As a result, as the population expands, the congestion problem will worsen. The issue of consistently growing transportation ridership is likewise unaddressed.

3.9 Summary: Literature Study

This chapter discusses important literature on the process of WaTOD. As Ferries are playing a significant part in the revitalization of urban waterfronts. Ferries are increasingly competing with congested bridges, tunnels, and even coastal highways for passengers. Longer on-the-water excursions are being connected by new faster ferries. Apart from rail TODs, attempts are being undertaken to connect boat service to transit-oriented programmes. Because there is significantly less space surrounding ferry landings, higher construction densities are required. Suggestions for extremely dense construction surrounding landings are now being investigated.

While more ferries routes and TODs are conceivable, terminal expenditure should be reduced to a minimum, especially when a new service is launched. Instead, funds should be

used to create attractive neighbourhoods with a mix of residential and retail activity. Ferry landings connected to public markets, such as those recently built in Vancouver, Washington, and Portland, Maine, might be one option. These were constructed to assist in the revitalization of critical neighbourhoods by providing high-quality food, beverages, crafts, gorgeous architecture, and enough seating. With four floors of low-cost housing above it, the Vancouver marketplace is an example of mixed-use construction. Roads will become increasingly congested as coastal cities flourish. As a result, thinking about reserving places along the beach for future ferry landings is crucial. TODs in the region of those designated landings should also be considered by planners.

4 Study area

4.1 History of Kashmir

Kashmir is an Indian state with rich cultural and political history. Kashmir has been ruled by several dynasties and is to date a political interest.

4.1.1 Kashmir before the Islamic influence

Kashmir was a place that was constantly at a strange fork in the path. The rest of Vedic Bharatavarsha was to its south. Gandhara, the unknown land to its west. The hazardous Pamir knot lay to the north, across which just a few people ventured. Tibet was to its east. For millennia, Kashmir had been a centre of Vedic culture. At all periods, Shiva and the Sun God Surya appear to have been the most popular deities in this area. In truth, the area is named after the ancient sage Kashyap, the Gods' Progenitor. Kashmir was formerly known as Kashyap Sar. The Sun God appears to have been extremely popular since His name appears as a suffix '-Aditya' in the names of many prominent Kashmiri monarchs, as well as the presence of sun temples. The Kamboja Kshatriyas of Gandhara appeared to have dominated Kashmir for a long time in the Vedic past, and most of Kashmir's earliest temples may be traced back to the Vedic era, despite their histories being anachronistic.

Kashmir's unique location made it a crossroads for many people, but one thing it did was convert its inhabitants to Hinduism. Kushans, Huns, Mongols, and Uighurs all converted to Hinduism or a syncretic version of Tibetan Buddhism and settled in Kashmir. (Shrivaths, 2017)

4.1.2 Kashmir ruled by Muslim sultan (1320 AD - 1555 AD)

The A Turkic invasion from Central Asia occurred in Kashmir, but it was far lower in scope than the Zulchu invasion. At this juncture, Shah Mir sensed a chance to take control of all of Kashmir's nobles. Tejeh Kakehpuri, one of the most experienced nobles, backed Shah Mir over Udyana because, like many other nobles, he thought that a person's abilities counted more than their faith.

After the Turkic raiders were pushed out of Kashmir, Udyana was compelled to depart under dubious circumstances. When he did go to Tibet to escape Shah Mir, Shah Mir ascended to the throne. Kotarani attempted to usurp the throne at this time, but Shah Mir beat her in battle at Andarkol and forced her into his harem with the help of Tejeh Kakehpuri. Tejeh Kakehpuri realised he had made a grave error when he did this. The other nobles joined Shah Mir when he recruited an army to overthrow him, and Tejeh was murdered.

Shah Mir became the Sultan of Kashmir. When Shah Mir died in 1342, the Dogra Rajput chieftains and other Kashmiri lords had fully accepted that they would be ruled by a non-Hindu. In fact, they appeared to have placed a high value on supporting the Shah Miri dynasty. Shah Mir Alauddin and Jamshid's older sons fought a short civil war, and their reign was uneventful. However, looking back on their reign, it is apparent that the Hindu chieftains and nobles backed this line of Muslim monarchs, and so they could never truly have rejected Rinchan's authority because he was a foreigner, based on the conduct of Shah Mir's descendants.

4.1.3 The Chaks ruling Kashmir (1555 AD - 1586 AD)

In 1339 A.D., Muslim sovereignty was established in Kashmir, setting a precedent in history. There was no bloodshed in the transition from Hindu to Muslim control. In 1561, the Chak dynasty rose to prominence and governed Kashmir till 1586. The country was free of robbers and thieves. Corrupt authorities were shot and killed. The rulers of the time put in place effective grievance mechanisms for the people. The well-planned royal engagements and the regulation of state business were important features of administration. The rulers kept a close check on the state's money and possessions. It is thought that chaks did not bring about any significant changes in the administration, save from a few small adjustments implemented when necessary. As a result, until the chak reign, the existing institutions were preserved and rejuvenated. (Mir, 2021)

4.1.4 Kashmir as a province of the Mughal Empire (1586 AD - 1752 AD)

Kashmir was not directly ruled by the Mughals until the time of Mughal Badshah (emperor) Akbar the Great, who conquered Kashmir in 1586 and annexed it to his Kabul Subah. It was established as a distinct subah (imperial top-level province) by Shah Jahan, with its capital in Srinagar. Many famous gardens, mosques, and palaces were built during the reigns of succeeding Mughal rulers. When Mughal emperor Aurangzeb succeeded to the throne in 1658 CE, religious intolerance and discriminatory taxes resurfaced. The Mughal Empire's power waned after his death. Mo-i Muqqadas (the Prophet's Hair), a relic of Muhammad, was brought to the valley by a servant of a rich Kashmir businessman in 1700 CE. On the shores of Dal Lake, the relic was kept in the Hazratbal Shrine. The invasion of India by Nadir Shah in 1738 CE reduced Mughal power over Kashmir even further.

4.1.5 The Afghans ruling over Kashmir (1752 AD - 1819 AD)

During the Afghan control over Kashmir, from 1752 to 1819, Kashmiris suffered greatly as a result of Afghan conduct and other circumstances. Political, social, religious, and cultural developments resulted from these influences. They adopted the Afghan dress code "Shalwar, Qameez," and Afghan society's compositions directly influenced the culture, women's position, early marriages were common, food and drinks, issuance of the Noor-ud-Din Rashi coin, leisure activities, art and folk songs, sufiyana kelam, music, theatre, and Dastan Goi were all common influences on Kashmiri culture. Despite being Muslims, Afghans never recognised religion as a national policy. Most Afghan governors appointed from Kabul to Kashmir exhibited complete separation from the centre, which reveals a lot about your personality and delicate concessions. The main characteristics of government in Kashmir were wealth, power, and authority. Women have decided to "purdah" and stay at home. This study also aids us in comprehending the various political conduct of rulers who shaped Kashmiri culture during the 18th and 19th centuries. (Jahangir, 2017)

4.1.6 Kashmir under the Sikhs (1846 – 1848)

During the reign of Maharaja Ranjit Singh, the greatest of the Sikh warrior-emperors, the Sikhs and Afghans fought a series of engagements. Meanwhile, the British East India Company had progressively solidified its dominance in the subcontinent by the late 18th and early 19th centuries. As these three empires played out their power games in northern India and abroad, Jammu and Kashmir became one of the battlegrounds. The Afghans were the first people to be pushed out.

Ranjit Singh's armies seized Kashmir in 1819, ending Afghan authority and more than four centuries of Muslim control in the Valley. The Sikh rulers were typically tolerant of diverse faiths, although some of their policies enraged the Valley's mainly Muslim populace. For example, Diwan Moti Ram, the first governor under Sikh authority (who also happened to be a Hindu), demanded that public azan and Friday prayers in the Jama Masjid be halted. Nonetheless, the Sikhs ensured that Hindus, Muslims, and Sikhs were all adequately represented in the government. (Kaul, 2018)

4.1.7 The Dogras in Kashmir (1848 – 1947)

Following Ranjit Singh's death in 1839, the British created a cantonment in Sindh and conquered Sindh a few years later, believing this was an opportune time to begin their long-awaited ambition of annexing Punjab.

Infighting within the Sikh empire made things simpler for the East India Company, and Punjab was seized in 1849 following two decisive wars with the Sikhs.

But, even before the demise of the Sikh kingdom, the Treaty of Amritsar in 1846 gave the British control over Kashmir. Following an agreement with the British, Gulab Singh became the first Dogra king of Jammu and Kashmir. Under Dogra's dominion, the current state of Jammu and Kashmir arose. In 1857, Gulab Singh was replaced by Ranbir Singh.

In 1885, Pratap Singh was the next in line. Hari Singh was crowned king in 1925. The Kashmiri Pandits dominated the state government during Dogra rule (Brahmins). Muslims, with the exception of a few wealthy families, were socially and economically backwards. To quash any unrest in the valley, Muslim warriors were frequently recruited from Poonch. Shortly after India attained independence, the Dogra Empire came to an end. Jammu and Kashmir is currently a part of India's democratic republic. (Kaul, 2018)

4.1.8 Jammu & Kashmir as an Indian state (1947 – Present)

India and Pakistan have been at conflict over Kashmir, a mostly Muslim region in India's northwestern tip, since 1947. Previously, the 86,000-square-mile mountainous region was a royal domain. It is presently claimed by both India and Pakistan.

The conflict derives from the two countries' shared colonial past. From the 17th through the 20th century, Britain governed much of the Indian subcontinent, first indirectly through the British East India Company and then directly starting in 1858. Over time, Britain's influence over its colony deteriorated, and a growing nationalist movement threatened the monarchy's dominion.

Both India and Pakistan claim Kashmir, a contested area with an estimated population of 18 million people. The territory south of the Line of Control is administered by India, while northern Kashmir is administered by Pakistan. In a 1962 conflict, China seized eastern Kashmir from India. (Blakemore, 2019)

4.1.9 Jammu & Kashmir after the removal of Article 370

The Indian government "read down" Article 370 and revoked Article 35A on August 5, thereby erasing the final vestiges of "autonomy" and "special status" granted by the Instrument of Accession and the Delhi Agreement. The repeal of 35A allows Indian people to live in Kashmir, which has been a long-standing RSS goal. The NC and PDP leaders have been detained. Kashmir was completely cut off from the outside world, with no means of communication. On October 31, the Jammu Kashmir Reorganization Act, which was passed on August 9, split the old state of Jammu and Kashmir into two "Union Territories." The "Union Territory of Jammu and Kashmir," which will have a legislative assembly with severely limited powers, and the "Union Territory of Ladakh," which will not. While Indian officials speak of creating "Israeli-style settlement enclaves" in Kashmir, the Indian government retains ultimate control over land use and residence restrictions. Due to a strong crackdown and a communication ban, Kashmiris are unable to demonstrate. Pakistan and China have condemned India's action. Diasporic Kashmiris in the West have emerged as significant resistance figures. (Junaid, 2020)

4.2 Legends of Kashmir

The famed valley of Kashmir is around 135 kilometres long and 32 to 40 kilometres wide, hidden firmly within the Himalayas at an average height of 1,829 metres above sea level. Range after range of mountains shield the valley from the outside world on the north, east, and west, and stony obstacles block it off from Punjab on the south. The river Jhelum and the tributaries are fed by the mountain snows, and the Jhelum's catchment area in the Valley is estimated to be roughly 10,240 square kilometres.

According to folklore, the Kashmir Valley was once a large alpine lake known as Satisar, which geologists confirm to. It's most likely that volcanic activity played a role in the development of the original lake or its subsequent desiccation, as evidenced by the mountains around the valley. Freshwater fish and fossil oysters may be found in the soil, and the black shells of the water-chestnut can be found in strata entrenched in the earth to a height of 457 metres above the Valley's level. These characteristics point to a fluvial origin. On the edges of the mountains, there are also traces of beaches. The only explanation for the flat and uniformly smooth surface of karewas or plateaus is that they were buried for aeons beneath the motionless, tranquil waters of a massive lake.

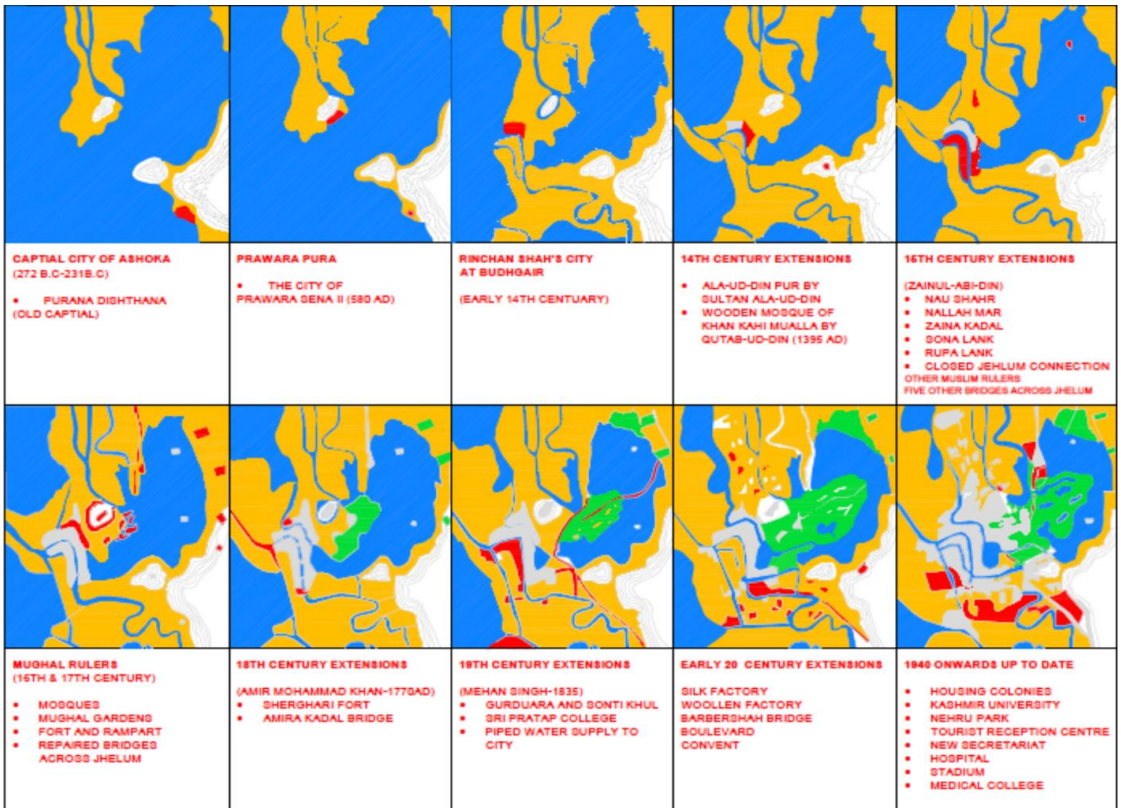

Figure 7: Evolution of Srinagar (Source: Masterplan for Srinagar 2035)

According to legend, an ascetic named Kashyapa drained the lake, and the reclaimed region was termed Kashyap-pur or Kash-yap-mar, and eventually Kashmir. It was known to the

ancient Greeks as Kaspeirial, and in classical literature, Herodotus refers to it as Kaspatyros, while Hekataim refers to it as Kaspalyros or Kaspapyros. In To Yeng and Sung Yan's story, it's referred to as Shie-mi (578 AD). Kia-shi-mi-lo is the name given to Kashmir by Heun Tsiang, who visited the region in 631 AD. The Kashmiris have further abbreviated Kashmir to Kashir in their own language. The Tibetans refer to it as Khachal (snowy mountain), whereas the Dards refer to it as Kashrat.

4.3 History of Kashmir

If you interpret Kashmir literally, it means "desiccated land": "Ka" (water) and "shimeera" (desiccated land) (to desiccate). According to legend, Kashmir was once a lake that was drained by Kashyap, an ancient Indian saint. It was part of Ashoka Maurya's kingdom, which is credited with laying the foundations of Srinagar circa 250 BC. During this time, Buddhism flourished in Kashmir, thanks to the Kushans. The third Buddhist council took held in Kashmir during Kanishka's reign, according to Hien Tsang, a 7th-century Chinese explorer. Hinduism, on the other hand, held dominance in the region. Durlabhavarrdhana laid the foundation stone for the Karkota dynasty in the seventh century AD. Lalitaditya Muktapid, the most renowned emperor of this dynasty, erected the world-famous sun temple (Martand) in Kashmir. In 855 AD, the Karkotas were joined by the Utpalas. Avanti-verman was the most powerful ruler of this dynasty. He brought Kashmir out of the abyss of political and economic chaos that had descended upon it under his predecessors' leadership. Didda, a widowed Gupta queen, governed Kashmir until the Lohara dynasty took control in 1003 AD. Udyan Dev was Kashmir's final Hindu monarch. Kota Rani, his Chief Queen, was the de-facto ruler of the realm. With her death in 1339, Hindu sovereignty in Kashmir came to an end, and Muslim control was established in the valley by Sultan Shamas-ud-din, whose dynasty reigned for 222 years.

Sultan Zain-ul-Abdin was without a doubt the greatest monarch of this dynasty. Kashmir was at its cultural and political pinnacle under his reign. He was mainly a secular individual who patronised people of all faiths and traditions. He made Kashmir the epicentre of a wonderful culture and worked tirelessly to promote the study and the people's economy. Badshah was not interested in expanding his empire, but he was also apprehensive about giving up the important lands that belonged to Kashmir. During Ali Shah's feeble administration, the Chiefs of Ladakh and Baltistan, who had pledged loyalty to Shahab-ud-Din and Sikandar's ancestors, proclaimed themselves independent. As a result, he marched out with his troops and established a Bumlde IV, Raja of Ladakh, to accept his authority. Baltistan's king followed suit and submitted as well. He next took the town of Kulu, which had previously been held by the Ladakhis. Following these victories, Badhshah went on to conquer the monarch of Ohind, who had declared his independence during Ali Shah's reign. The monarch of Ohind was vanquished once again and decided to recognise the king of Kashmir's power. Badshah has swapped embassies with a number of other nations. His envoys to Khurasan, Egypt, and Mecca, Rukh, son of Timur, were especially kind. Budshah

took a number of steps to boost agriculture trade and commerce. He built a lot of irrigation canals. Kashmir became food self-sufficient as a consequence of these efforts and the reclamation of enormous swaths of land. According to Moorcroft, during Badshah's reign, Kashmir produced up to 5.50 lakh tonnes of rice every year. In 1586, the Kingdom was captured by the Mughal Empire. In 1757, Ahmed Shah Durrani, an Afghan who had previously invaded India, took possession of Kashmir.

In 1819, Ranjit Singh captured Kashmir and incorporated it into his Sikh kingdom. Sikh sovereignty in Kashmir was destroyed in the two Anglo-Sikh wars fought between the Sikhs and Ranjit Singh. Under the Treaty of Amritsar, the British sold Kashmir to Ghulab Singh for 75 lakhs of rupees. By annexing Ladakh, he expanded his dominion. Ghulab Singh died in 1857, and Ranbir Singh took his position (1857-1885). Partab Singh (1885-1925) and Hari Singh (1885-1925) were the next two Marajahs to govern. In 1925, Maharaja Sir Hari Singh succeeded to the throne. He remained the state's governor until 1950. Sheikh Abdullah founded the All–Jammu and Kashmir Muslim Conference, Kashmir's first political party, in 1932. In 1939, the party was renamed the National Conference, and it is still a key political force in Kashmir today. Maharaja Hari Singh, the monarch of the princely state of Kashmir, refused to submit to either India or Pakistan after India's independence in 1947. When Pakistan attacked Kashmir the next year, the king of Kashmir requested assistance from the Indian government and promised to surrender Kashmir to India's control. Kashmir was admitted to the Indian Union in 1956, thanks to a new constitution. However, Pakistan's unlawful occupation of PoK Kashmir continues. During the 1970s and early 1980s, Kashmir was a tourist paradise. However, due to unrest in Kashmir in the late 1980s and 1990s, tourism dropped. The situation has improved, and tourists who recall Kashmir's lovely parks, rolling meadows, stunning mountains, and picturesque sites with fondness are hoping for peace to return.

4.4 Diverse Culture of J&K

According to the 1972 "line of control," Pakistan controlled 83,806 square kilometres in the north western region, while India controlled 138,992 square kilometres.

The State has the lowest population density in India, with 4,616,632 people living on the Indian side of the line of control. Because, unlike the rest of the nation, Kashmir is predominantly mountainous, rising in multiple levels from the plains in the south to high-altitude valleys and peaks in the north, enclosing some of the world's highest inhabited hamlets. With such a wide range of physical characteristics, the state is certain to have noteworthy variances in soil, elevation, geological formation, climate, vegetation, and population. Apart from having impacted and significantly formed the State's history, this variation in aspect is an intriguing study in and of itself.

Kashmir is strategically important because of its central location in Asia, bordering north western Afghanistan, the Sinkiung-Uighur Autonomous Region of China, and western

Pakistan. It is located on a historic Central Asian trade route, and the Kashmir Valley has served as a rest stop for caravans travelling between India's plains and Central Asia's highlands since ancient times.

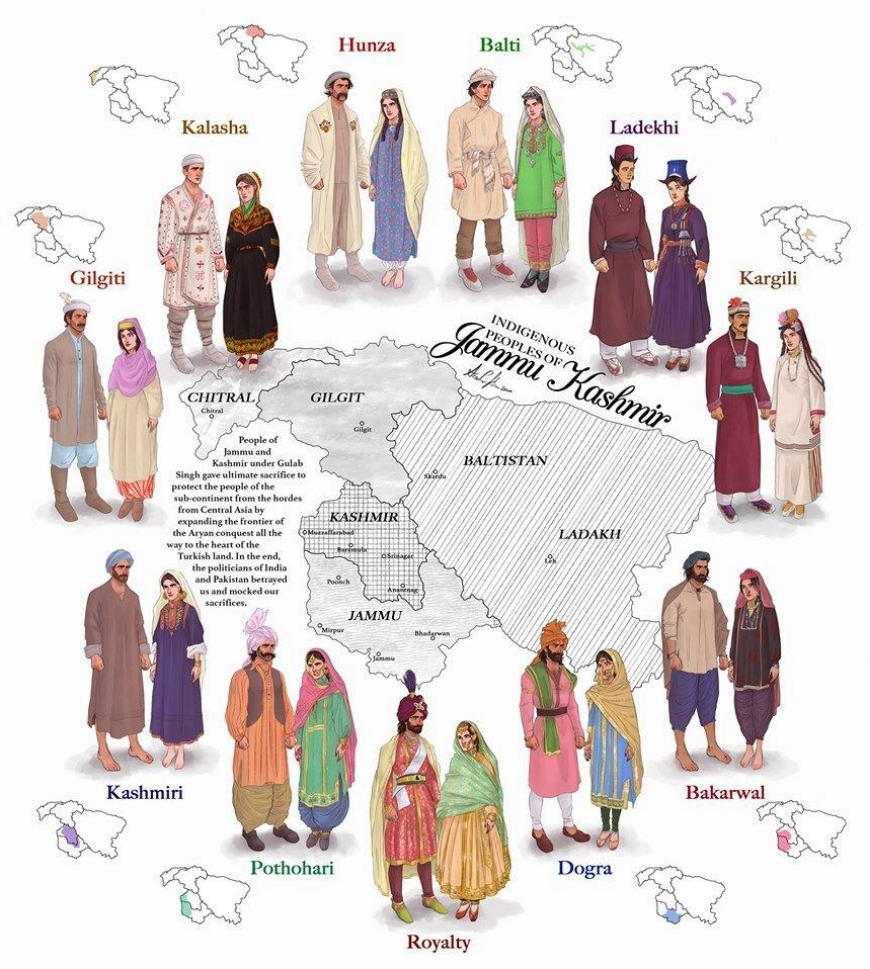

Figure 8: The Indigenous people of Jammu & Kashmir. (Source: travelthehimalayas.com)

4.5 Demography

In 2011, Jammu and Kashmir had a population of roughly 12.54 million people and was India's 19th most populous state. The state has a population density of roughly 56 people per square kilometre, which is lower than the national average of 382 people per square kilometre. From 2001 to 2011, the state grew at a decadal pace of around 23 percent above the national average of roughly 17 percent. In Jammu and Kashmir, urban areas account for 27 per cent of the total population (3,433,242). There has been a 36.42 per cent faster increment in the urban population than the national average during the previous decade. According to Census 2011, the Kashmir region, which accounts for 16 per cent of the State's total geographical area, accounts for 43 percent of its total population burden. Kashmir Region has 32 per cent of its population residing in urban areas, compared to the state's

average of 27 percent. According to the 2011 census, the Kashmir Region accounts for 63 percent of the state's total urban population. Srinagar is the most urbanised of the 22 districts, with 99 percent of the population residing in urban areas. (Anon., 2011) The city's influence has grown in scope and impact as the pace of urbanisation has accelerated. The rapid growth of the Srinagar Urban Agglomeration (13.26 lac) may be seen in the pattern of decadal change of 2.66 per cent in urban population over the previous decade. Many villages in the Budgam, Pulwama and Ganderbal tehsils have been overrun by Srinagar's urban development. In light of this, the Metropolitan reach of Greater Srinagar, notified as to the SDA Local Area Limit, has expanded from 416 to 766 square kilometres to include the municipal area of Srinagar Municipal Corporation, as well as the ULBs of Budgam, Pampore, Ganderbal, and Khrew, as well as other 160 villages as outgrowths in 12 tehsils across 6 districts. The proposed Srinagar Metropolitan Region, which covers an area of 766 square kilometres, is home to a population of 17.27 million people, eliminating the population of about 3.0 million people, which includes the Defence Forces, Service population, and Darbar Move population, as follows:

- Darbar Move has a population of 40,000 people.
- Defence Population = 2,00,000 (based on a density of 100 PPH for 2200 hectares currently in use by the military)
- Service Population (at 3%) = 50,000

As a result, for the base year 2015, the total population calculated for the planned area of 766 sq. km is 20.0 lac (approx.). The population density for the region is predicted to be 2600 people per square kilometre (including overhead population) and 2300 people per square kilometre (net of the overhead population). During the previous decade (2001-2011), the population of the Local Area rose from 14.51 [2001] lac to 17.27 lac in 2011, with an estimated growth rate of per cent to 18.50 lac in 2015. Moreover, 77 percent of households [2,05,224] are now urban, with an average household size of 6.46. According to Census 2011, there are 2,65,023 households in the planning zone, with 59,799 in rural regions. The rate of household formation in the region [2.5 per cent] is higher than the rate of population increase, which will have an impact on housing demand in that area. In each region or nation, the sex ratio is an essential indicator of the social and economic progress of the female population. According to Census 2011 data, the Srinagar Metropolitan Region's urban sex ratio is 892, while the rural sex ratio is 934. Another key demographic factor is the literacy rate. According to Census 2011, the literacy rate in the area is 70% the in regions region and 56% in rural areas. The local area's average literacy rate percent] must be enhanced by promoting universal elementary and secondary education as a possible ingredient for strengthening local economic growth. (Anon., 2011)

4.5.1 Population Projection

After the synthesis of the existing database available on the socio-economic parameters the for local area, future projections of these parameters are among essential inputs for the

allocation of land for different activities. Projections are an extrapolation of historical data (population v/s time) into the future. The accuracy of population projections is generally considered directly proportional to the size of the existing population and the historical rate of growth, and inversely proportional to the length of the time projection. It helps to develop the policy and strategies for the future development.

This section will cover the population and employment estimations of the Local Area for the future. The projections of all relevant inputs including population have therefore, been made for the horizon years 2015, 2020, 2025, 2030 and 2035. In view of rapid transportation, flux in economic activity and extraneous inputs, the population projections have been based on following major assumptions:

- Up to 2020, population growth in the Srinagar Metropolitan Region will be more or less stable at the current pace of [1.8 percent].
- Between 2020 and 2030, the population of both urban and suburban regions is expected to expand at a rate of 2.0 percent.
- Finally, growth rate for local areas is expected to drop to 1.80 from 2030 for the remainder of the plan period up to 2035.

According to statistics, the population of the Srinagar Metropolitan Region was 17.28 lac in 2011, up from 14.51 lac in 2001, indicating a 2.76 lac population increase at a 1.76 percent annual growth rate. After subtracting 3.0 lac for overhead population such as defence, Darbar Move, and Service Population, the overall base year population for the region in 2015 is projected to be 18.90 lac. The basic population of the Srinagar Metropolitan Region is expected to rise from 18.90 lac in 2015 to about 28.50 lac by 2035, based on approved growth rates.

The Srinagar Metropolitan Region's differential growth rates were calculated based on the region's urbanisation and economic development. The estimated growth rates are cautious projections that are comparable to other cities in the same category. These statistics are also predicated on the assumption that the Master Plan's recommendations will help the area flourish. To summarise, the Srinagar Metropolitan Region is forecast to hold a total population of 32.50 lac in 2035, up from 20.25 lac in 2011, with an estimated overhead population of 4.0 lac.

The total number of households in Kashmir stand at 1,82,829 with a household size of 5.7 and the total population of Kashmir stands at 11,80,570 with a male population of 6,18,790 and female population of 5,61,780. The sex ratio of Kashmir is 908 females per 1000 males. Total persons aged 0 to 6 are 1,52,445 out of which 81,795 are males and 70650 are females. The total SC and ST population in Kashmir is 936 and 5769 respectively.

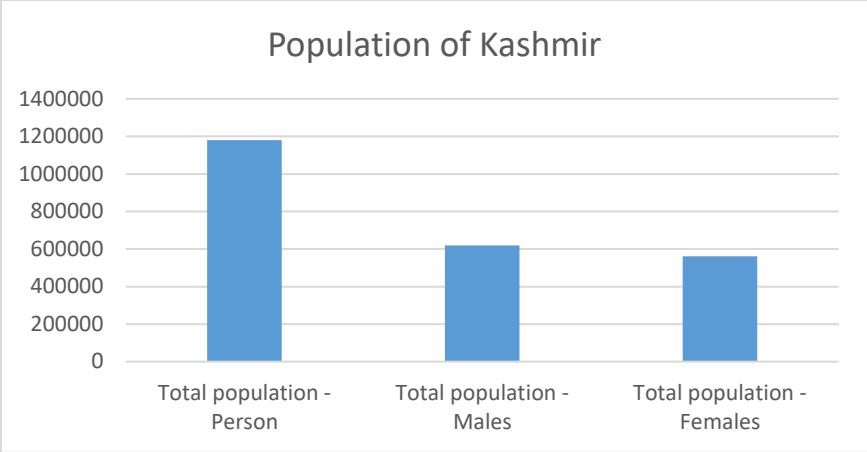

Figure 9: Population of Kashmir valley. (Source: Census 2011)

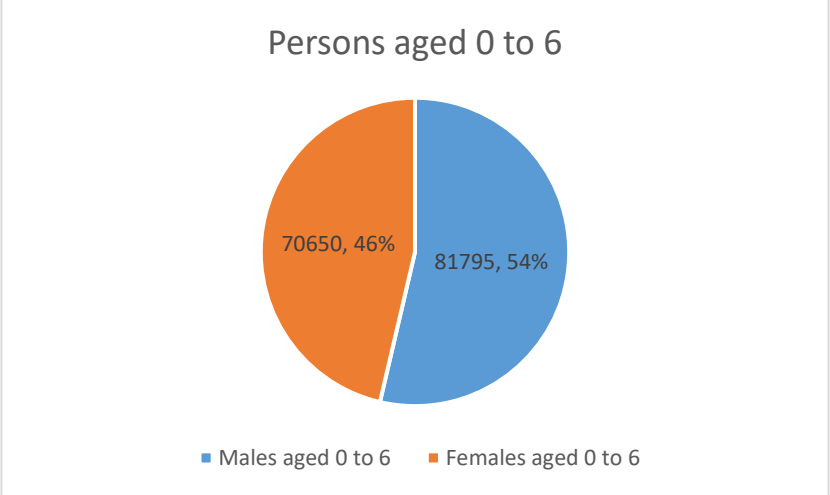

Figure 10: Population of Kashmir aged 0-6. (Source: Census 2011)

The literacy rate of Kashmir stands at 69.15% with male and female literacy rates of 75.87% and 61.81% respectively.

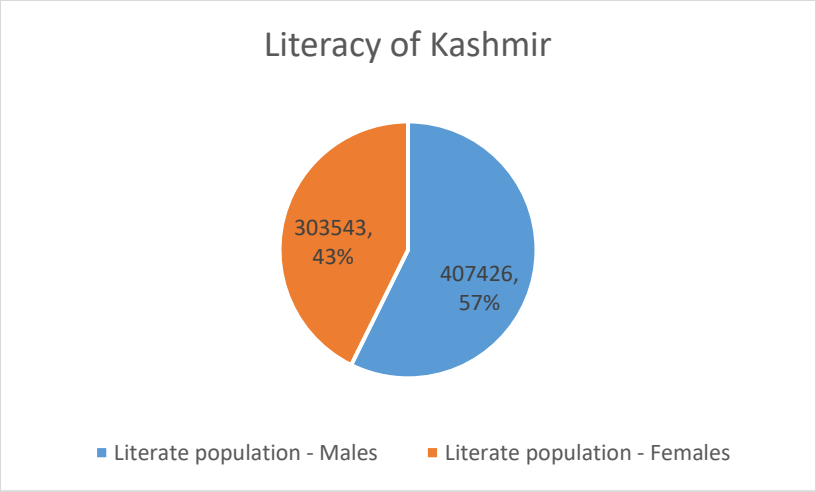

Figure 11: Literacy Rate of Kashmir. (Census 2011)

The total working population of Kashmir is 3,83,093 which is divided into 3,11,396 main workers and 71,697 marginal workers.

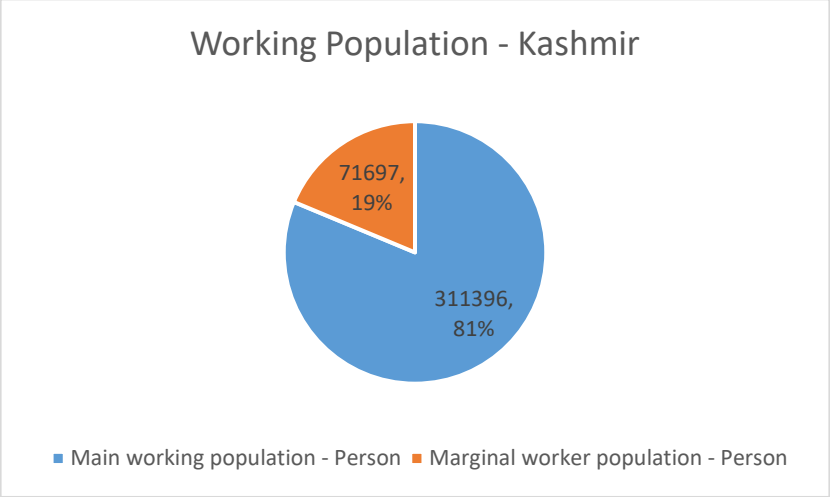

Figure 12: Working Population of Kashmir (Source: Census 2011)

4.5.2 Religious Distribution:

According to the 2011 census, Muslims make up the majority in Jammu & Kashmir. Muslims account for 68.31% of the population of Jammu and Kashmir. They are followed by Hindus at 28.44%, Sikhs at 1.87%, Buddhists at 0.90%, Christians at 0.28%, and Jains at 0.02%. Other religions account for about 0.01% while 0.16% remain unstated.

4.6 Geography of Kashmir valley

Pakistan, India, and China are now fighting for control of Kashmir. Pakistan is responsible for the northwest, while India is responsible for the center and south, and China is responsible for the northeast. India is home to 101,338 square kilometers, Pakistan to 85,846 square kilometers, and China to 37,555 square kilometers.

The Kashmir area spans 224,739 square kilometers, much of it undeveloped and dominated by large mountain ranges like the Himalayan and Karakoram. The Kashmir Vale is surrounded by mountain ranges and is home to multiple large rivers. Jammu and Azad Kashmir are the most populous areas. Mirpur, Dadayal, Kotli, Bhimber Jammu, Muzaffarabad, and Rawalakot are the important cities in Kashmir. (Briney, 2019)

4.7 Urbanization in Kashmir

In the state of Jammu and Kashmir, urbanization has expanded from 8.46 percent in 1901 to 27.37 percent in 2011, an almost three-fold increase in less than a century. The number of towns in the state has grown from ten in 1901 to 122 in 2011.

According to the 2011 Census of India, Kashmir has the highest proportion of the state's urban population at 63.42 percent, followed by Jammu (34.77 percent) and Ladakh (1.81 percent). The most urbanized district is Srinagar, with 98.6% urban population, followed by Jammu, with 50% urban population. The least urbanized districts are Ramban with 4.16 percent and Shopian with 6.15 percent. (Khan & Mondal, 2018)

4.8 Climate of the valley

4.8.1 Average temperatures and precipitation

With an average daily maximum temperature of about 30 degrees Celsius, Kashmir is one of India's coldest locations. Several months of the year are warm to hot, with temperatures consistently over 25 degrees Celsius, and occasionally exceeding 40 degrees. (Anon., 2022)

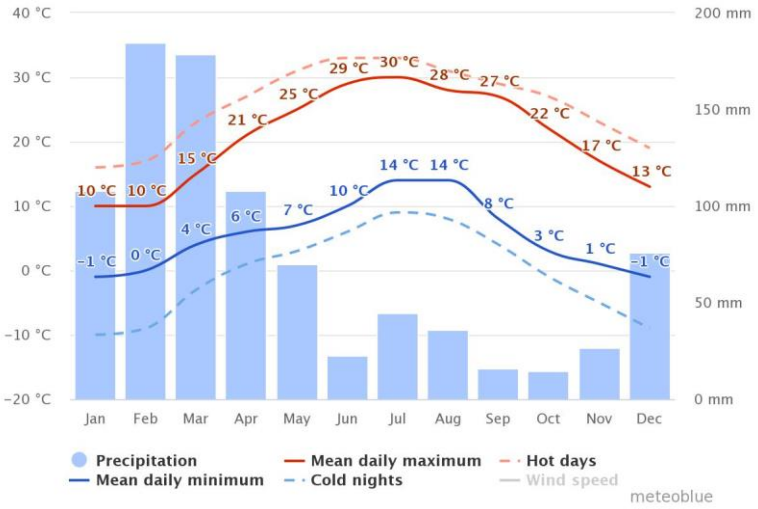

Figure 13: Average Temperatures & Precipitation of Kashmir (Source: Meteoblue)

4.8.2 Hours of sunshine per day

The length of time the sun is visible is referred to as the number of hours of sunshine. That is, no clouds, fog, or mountains are obstructing visibility. May is the sunniest month in

Kashmir, with 11 hours of sunlight each day. The sun shines the shortest in January. (Anon., 2022)

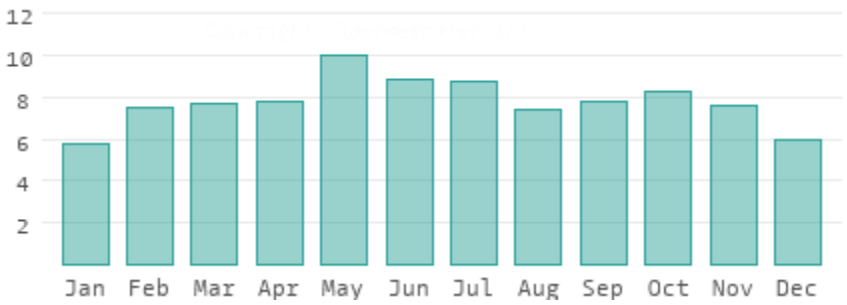

Figure 14: Hours of sunshine per day in Kashmir (Source: Laenderdaten)

4.8.3 Rainy days per month

A rainy day is one in which at least 0.1 mm (=0.1 litre) of precipitation falls per square meter. Rain, snow, hail, or even dew might cause this. As a result, it does not have to rain all day. July has the most rainy days, with 13, and November has the least, with only two. (Anon., 2022)

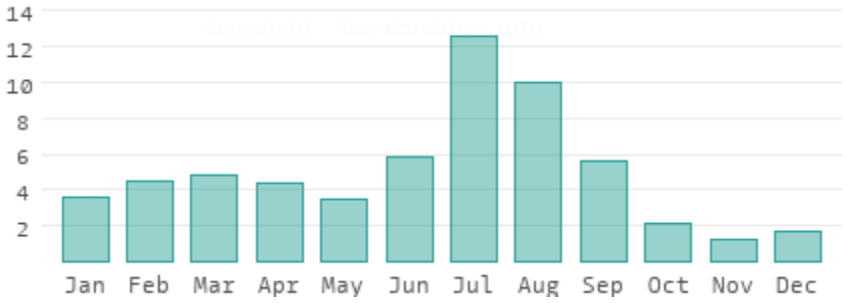

Figure 15: Rainy days per month in Kashmir (Source: Laenderdaten)

4.8.4 Precipitation in mm/day

Millimetres per square metre is the unit of measurement for precipitation. At a rate of 2 millimetres per day, 2 litres of water fall on one square metre every 24 hours. November had the least rain, with only 0.29 mm. On the other side, July is the wettest month. (Anon., 2022)

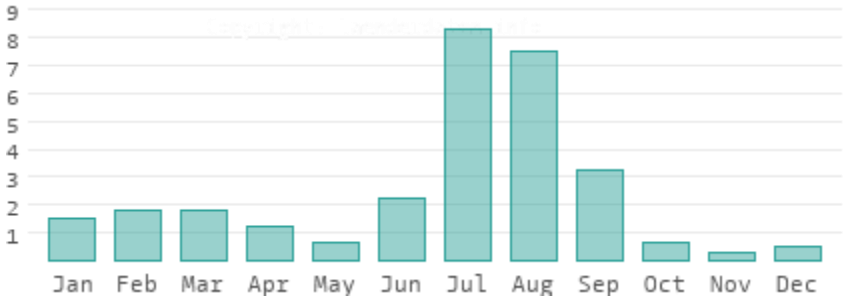

Figure 16: Precipitation in Kashmir (Source: Laenderdaten)

4.8.5 Wind Rose

The Srinagar wind rose shows the number of hours per year that the wind blows in a particular direction. Example SW: Wind is blowing from South-West (SW) to North-East (NE). (Anon., 2022)

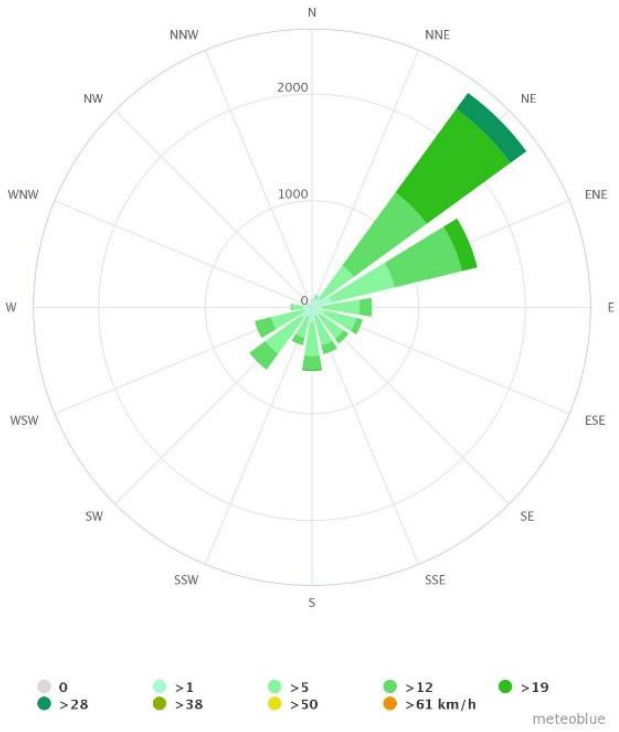

Figure 17: Wind Rose Diagram (Source: Meteoblue)

4.9 Mobility Characteristics

4.9.1 Existing Transport System -

The NH-44 (formerly NH-1A) connects Srinagar to the rest of the country by a road network that runs from Jammu to Leh, passing through highly inhabited districts. Major district roads link Srinagar to districts like as Anantnag, Baramulla, Badgam, and Pulwama. The city is also connected to other metropolitan regions like as Chadoora and Ganderbal by a road system that goes through crowded portions of Srinagar. Srinagar's present road network is primarily radial in design. Srinagar-Leh Highway, M.A Road, Qamarwari-Batamalo Road, and Dr. Ali Jan Road are four routes that converge in the city from various directions.

Currently, travelling to Baramulla and Banihal is made easier by using the Srinagar or Nowgam railway stations. Srinagar Airport, also known as Sheikh-Ul-Alam International Airport, is located on the outskirts of the city near Humhama. Srinagar is roughly 14

kilometres distant from the airport. Spice Jet, Go Air, Vistara, Air Asia, Air India, and Indigo are among the public and commercial airlines that fly from Srinagar. Srinagar's airport is well connected to the airports of major cities like as Mumbai, Delhi, Chandigarh, and Leh, among others.

The CMP's aim is to make Srinagar a model city by achieving safe, efficient, dependable, and seamless transportation of people and products. CMP's goals are to maximise "people and commodities movement patterns" rather than vehicle mobility.

- To develop and promote public transportation, non-motorized vehicles, and pedestrians as key forms of transportation in Indian cities.
- To provide a well-known and efficient platform for combining land use and transportation planning.
- To concentrate on improving the flow of products.
- A city-wide low-carbon mobility growth scenario.
- Equity for all members of society, especially the urban poor and people with disabilities.
- Incorporation of service level benchmarks.

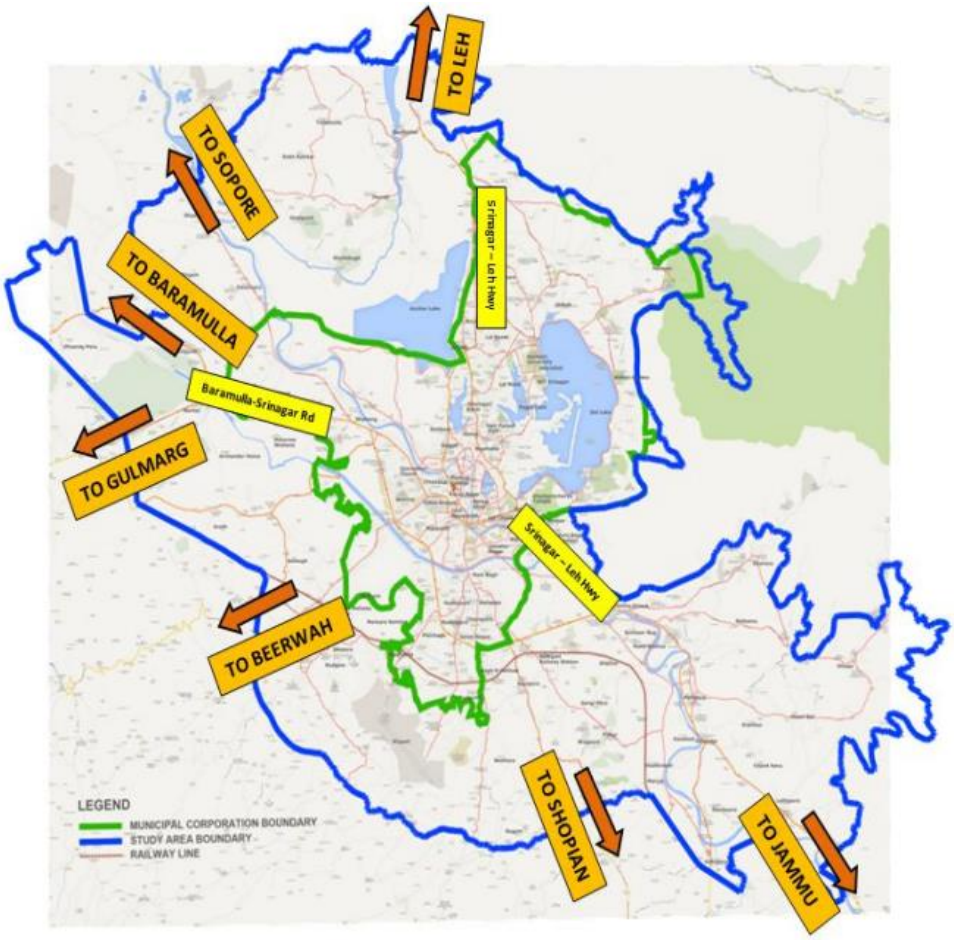

Figure 18 Regional Connectivity (Source: CMP Srinagar)

Srinagar's road network is characterised by roadways with a ROW of less than 20 metres. Approximately 86 percent of the road system has a ROW of less than 20 metres. There are no sidewalks on city streets. Only 15% of the measured road network includes a pedestrian walkway, indicating the city's weak pedestrian infrastructure. During peak hours, approximately 91 percent of the whole road network has trip speeds of up to 20 kmph. This implies traffic congestion on roadways mostly within the city's centre. During peak hours, only roughly 6% of roadways were found to have speeds above 30 km/h. The city's average running speed during peak and off-peak periods is 14.1 km/h and 19.1 km/h, respectively.

The overall number of daily travels in the study region is estimated to be around 40.56 lakh. Vehicle journeys account for 79 percent of all trips, while walking trips account for 21%. The average travel length is 5.5 kilometres (with the walk) and 6.51 kilometres (excluding the walk).

Figure 19 Traffic Situation at Important Roads (Source: CMP Srinagar)

4.9.2 Mobility Characteristics:

Public transportation facilities: A Level of Service (LOS) of 14 indicates that the city's public transportation system is disorganised and that it needs to be organised citywide.

Figure 20 City Bus Routes (Source: CMP Srinagar)

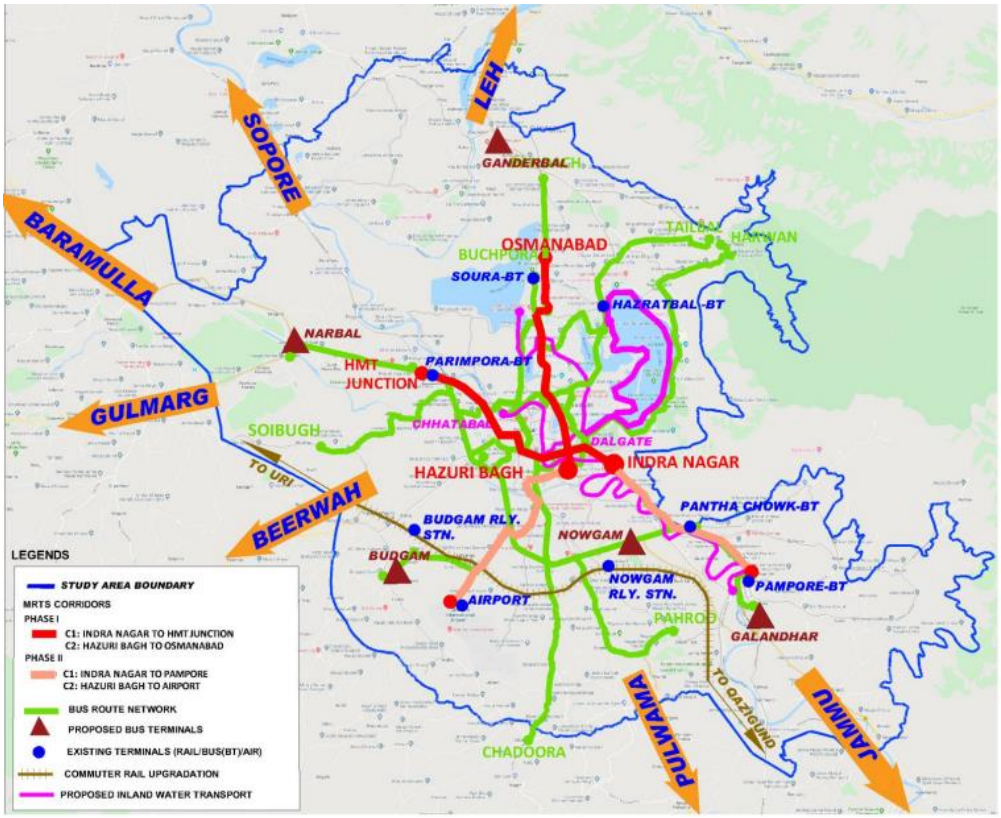

Figure 21 IPT Network (Source: CMP Srinagar)

Figure 22 Proposed MRTS Corridor (Source: CMP Srinagar)

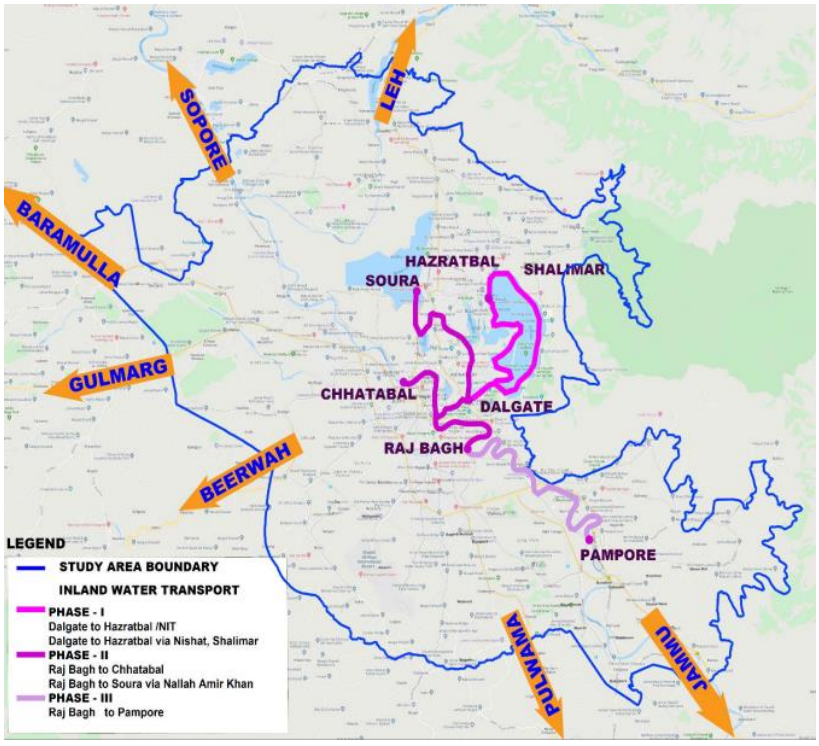

Figure 23 Inland Water Routes (Source: CMP Srinagar)

Pedestrian infrastructure facilities: A Level of Service (LOS) of 11 to 12 indicates that the city does not have enough pedestrian infrastructure.

Level of Service (LOS) 12 for non-motorized transport (NMT) facilities, indicating that the city lacks suitable NMT infrastructure.

Level of use of Intelligent Transportation System (ITS) facilities: 20 LOS, indicating that the city lacks basic infrastructure traffic management controls; the majority of junctions are unsignalized, and some intersections have traffic lights installed, although they are frequently out of service.

Travel speed along main routes (motorised and mass transit): The total LOS of travel speed achieved is 7. Based on the total LOS, it can be determined that the city's large number of uncontrolled crossings causes considerable delays. Due to traffic congestion, high levels of encroachment, and haphazard on-street parking, key routes operate at low speeds.

Parking spot availability: The availability of parking spaces has a level of service (LOS) of 5. The total LOS indicates that the city has a parking shortage.

Road safety has a Service Level of 6 for road safety. The aggregate LOS indicates that the city's Level of Fatality rate is extremely high. Absence of traffic control, particularly at junctions, lack of an organised public transportation system, and lack of enforcement are all factors that contribute to a high death rate.

Pollution levels: The Pollution Levels Service Level is 5. Because the city's vehicle population is minimal, SO2 and NOX levels are observed to be under permitted limits, according to the general LOS. RSPM levels, on the other hand, are found to be quite high.

Integrated land use transport system: The integrated land use transport system has a Service level of 19, indicating that there is some coherence between the city structure and the public transportation system.

Financial viability of public transportation: The level of service for financial viability of public transportation by bus is 12, indicating that the city's public transportation is not financially viable.

5 Analysis

5.1 Inland water Transportation

The National Waterway-49 is located in Kashmir, travels through four districts, and spans 110 kilometres. NW-49 is considered technically possible for the development of shipping and navigation by the Inland Waterway Authority of India (IWAI) with minimal dredging. IWAI identified four potential terminals on NW-49, which are depicted on the map; terminal 2, i.e., the zero bridge, is located in Srinagar. In addition, the river flows from south to north.

5.2 Intra city water Transport

The river Jhelum has served as the city's historical spine, and its banks can be exploited for inland water transportation. The country's road-based transportation infrastructure must be supplemented with water transit. It will also serve as a key tourist attraction for visitors interested in the city's history and beauty. The famed Mughal Gardens, Dal Lake, Hazratbal, NIT, Soura, Chhattabal, and other locations can all be reached by IWT. For the establishment of a sustainable IWT system in Srinagar, the following routes, totalling roughly 60 kilometres in length, have been identified and proposed.

Table 1: Inland water transportation in Srinagar (Source: CMP, Srinagar 2020)

S.no.	Proposed inland water transport routes	Length (km)	Phasing
1	Dalgate to Hazratbal /NIT	10	Phase I
2	Dalgate to Hazratbal via Nishat, Shalimar	13	Phase I
3	Raj Bagh to Chhatabal va (along Jhelum River)	7	Phase II
4	Raj Bagh to Soura via Nallah Amir Khan and Khushalsar	10	Phase II
5	Raj Bagh to Pampore	20	Phase III
	Total	60	

5.3 Proposed Integrated Transportation Infrastructure

Inter-modal integration is the coordinated employment of two or more modes of transportation in urban settings for efficient, quick, safe, pleasant, and comfortable passenger transit. It connects numerous forms of transportation in a simple and cost-effective manner to complete the journey from point of origin to point of destination. The proposed transportation infrastructure for the city is shown in the map, which was designed in 2020 as part of Srinagar's Comprehensive Mobility Plan. From the map shown below the Water Transit Stretch of Jhelum River has been taken for the further study, due to its characteristics which traverse the city of Srinagar in two parts and flows through the city.

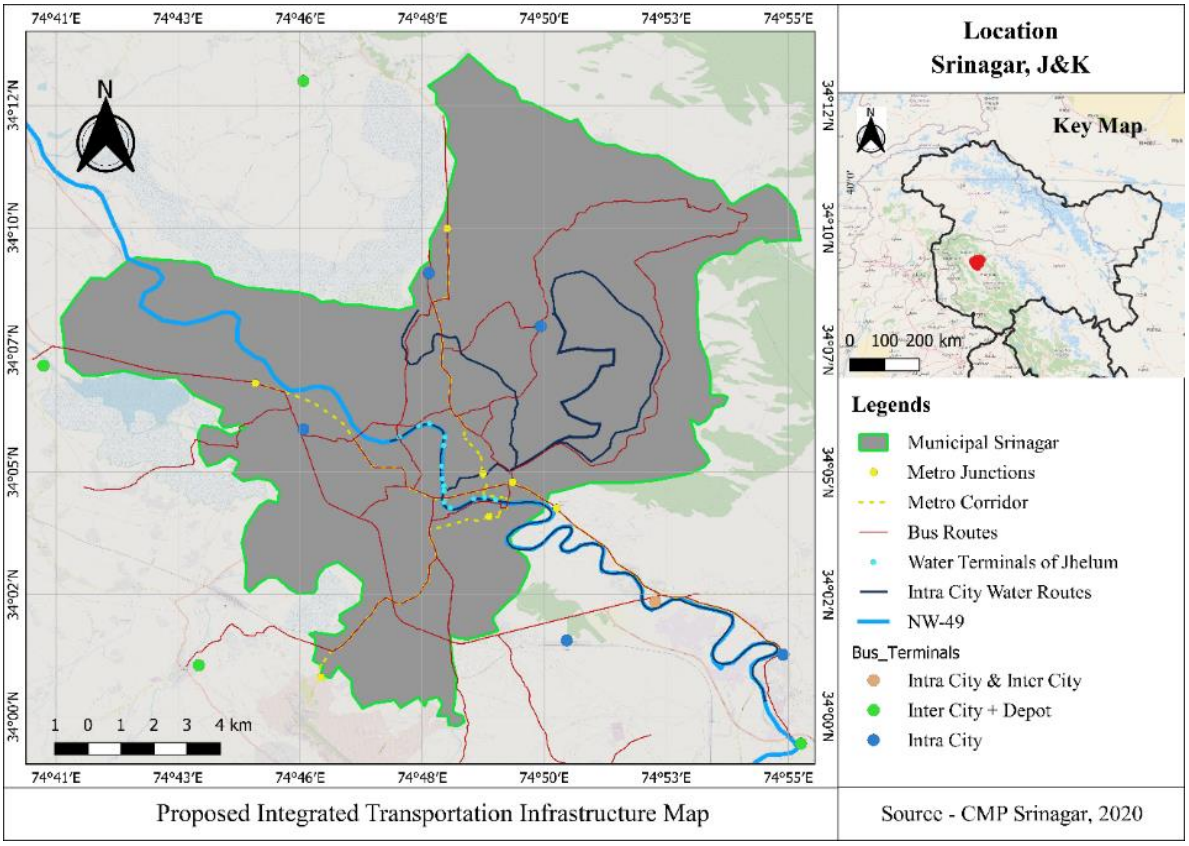

Figure 24: Proposed Integrated Transportation Infrastructure of Srinagar. (Source: CMP, Srinagar 2020)

5.4 Terminal Wise Land Use Assessment

The water transit route of the Jhelum River runs from south to north and comprises a total of 16 terminals. To better understand the terminals' characteristics, a land use evaluation was conducted for each terminal.

The city is split into two sections: the old city and the new city. The new city is from terminal 1 to 5, and the old city is from terminal 6 till downstream. The characteristics of the two sides of the city vary considerably based on a variety of factors that will be examined further.

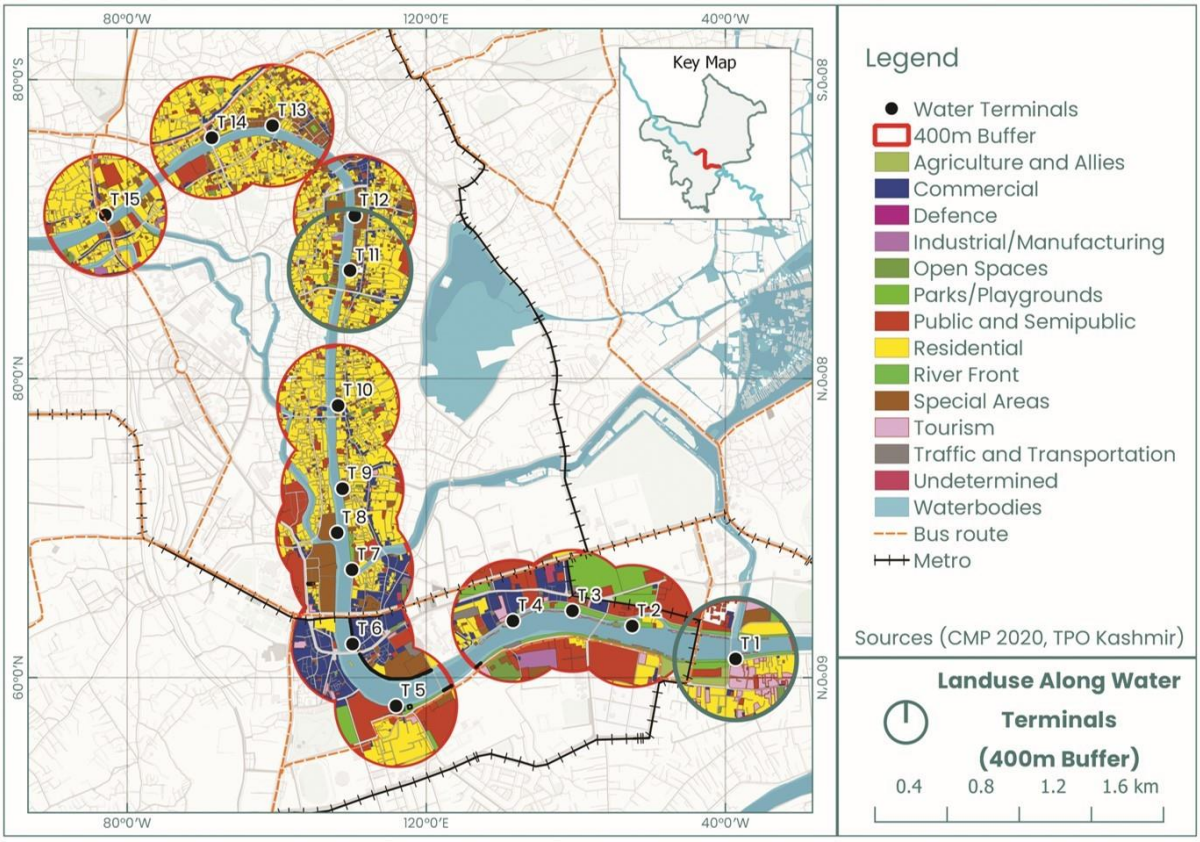

Figure 25: Land use map of Terminals of Jhelum water transit stretch. (Source: Secondary Survey)

5.4.1 Terminal 1: Zero Bridge

It's a terminal for National Waterway 49. Hostels and hotels are the most common land uses in the region. Because the region has all of Srinagar's major coaching centres, PGs and Hostels dominate. In addition, it is well-known among travellers as a place to stay. The majority of the structures resemble villas with big gardens.

Figure 26: Land use assessment of Terminal 1 (Source: Primary Survey)

5.4.2 Terminal 2: Peerzu

Peerzu, Terminal No. 2, is known for its cafes and places to relax, as well as its large open spaces.

Figure 27: Land use assessment of Terminal 2 (Source: Primary Survey)

5.4.3 Terminal 3: Regal Chowk

Terminal no.3 is the regal chowk. This area is dominated by land uses such as commercial due to its proximity to CBD. The area has mixed-use as ground floors are used for commercial purposes, whereas upper floors are occupied by offices.

Figure 28: Land use assessment of Terminal 3 (Source: Primary Survey)

5.4.4 Terminal 4: LD Hospital

Terminal no. 4 is the LD hospital. The major uses in the area are the commercial area surrounding the hospital. And also has a considerable number of offices.

Figure 29:Land use assessment of Terminal 4 (Source: Primary Survey)

5.4.5 Terminal 5: Amira Kadal

Terminal no.5 is dominated by commercial areas as it is the CBD of Srinagar. The buildings in the area are mixed-use. The ground floor for commercial and upper floors are either used as go downs or offices. The characteristics of the area are roads parallel to Jhelum, ROW of 10 meters. Widest ROW 16m.

Figure 30: Land use assessment of Terminal 5 (Source: Primary Survey)

5.4.6 Terminal 6: Basant Bagh

Terminal no. 6 is the Basant Bagh. According to the master plan, it is an unplanned residential area.

Figure 31: Land use assessment of Terminal 6 (Source: Primary Survey)

5.4.7 Terminal 7: Div. comm. Office

Terminal no.7 is the divisional commissioner's office. This terminal is dominated by public semi-public offices. The current div. comm. office is an old secretariat building. Historically is Seher-e-Garhi palace built by Dogra rulers. And was their summer home. It was converted into a secretariat building due to its proximity to the river which was major highway.

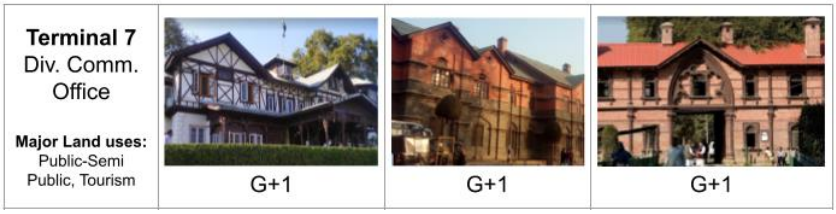

Figure 32: Land use assessment of Terminal 7 (Source: Primary Survey)

5.4.8 Terminal 8 & 9: Ganpathyaar & old Habba kadal.

From here till the downstream is the old city. The area is dominated by residential use.

Figure 33: Land use assessment of Terminal 8 & 9 (Source: Primary Survey)

1.1.1. Terminal 10, 11 & 12: Old Fateh kadal, khanqah-e-maula & Maharaj gunj

The area is dominated by residential and commercial buildings. Home of two historical markets of the city Zaina kadal market famous for brass utensils and Maharaj gunj market famous for Spices. Maharaj Gunj Is the old CDB of the Srinagar, situated on the side of Jhelum. The characteristics of the area are narrow streets, a dense circulation network, high density. buildings with vernacular architecture and religious places. Widest Row was observed to be 6m, whereas the minimum ROW was observed to be 1m. The old city of Srinagar was the area least affected by the 2014 floods as it sets on a higher elevation than rest of the city.

Figure 34: Land use assessment of Terminal 10,11 & 12 (Source: Primary Survey)

1.1.2. Terminal 13, 14, 15 & 16: Bul Bul Lankar, Nawa Kadal, Safa Kadal & Chattabal Weir

According to the master plan, the principal land uses in this region are unplanned residential and mixed use. This area of the city is a mix of old and recent growth.

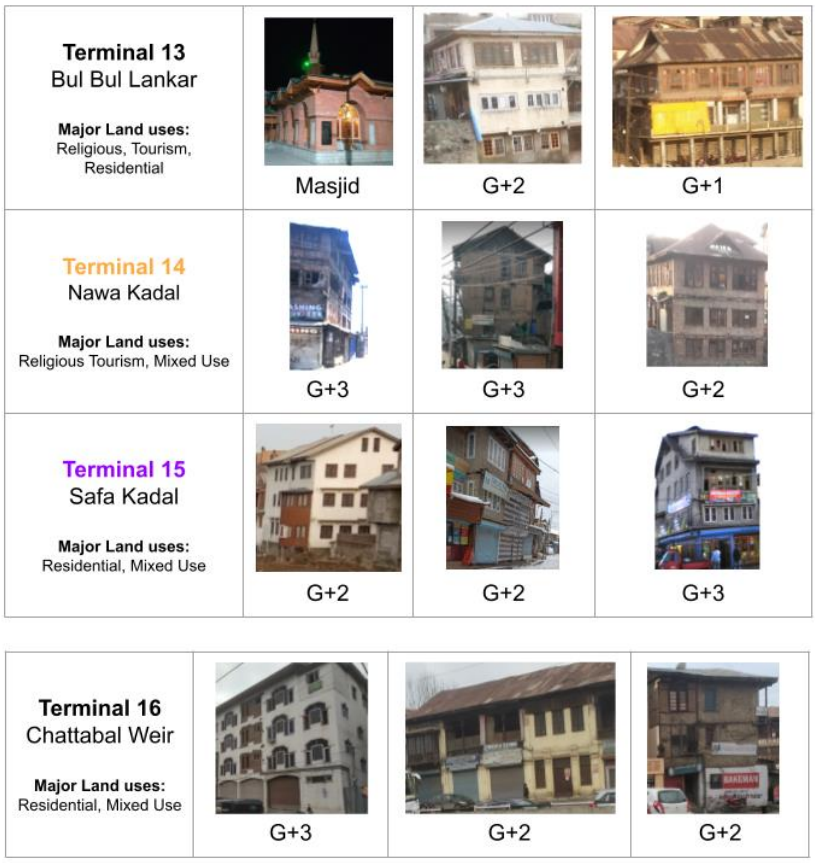

Figure 35: Land use assessment of Terminal 13,14, 15 & 16 (Source: Primary Survey)

1.2. Site Selection

From the terminal wise analysis done two terminals were selected based on the factors shown in the table below.

Table 2: Parameters for site selection (Source: Author)

Parameters	New City (Zero Bridge)	Old City (Khanqah-e-maula)
Plot Size	Max (200 sq.m) Min (100 sq.m)	Max (70 sq.m) Min (40 sq.m)
Road Network Density	1.5 %	4.2 %
Min. ROW	3m	1m
Max. ROW	16m	6m
Parallel road to Jhelum	Yes	No
Congestion	No (Enough ROW)	Major (Encroachment, Parking)

Two terminals were chosen from the terminal-by-terminal analysis: one from the new city, the zero-bridge terminal, and the other from the ancient city, Khanqah-e-maula. These two terminals were chosen to demonstrate the difference between the two. And how can WaTOD function in these two scenarios? Because the old city is densely populated, has a small ROW, and is dominated by heritage buildings, it only requires a regularised framework, whereas the new city terminal Zero Bridge has completely different characteristics, such as a sparse road network, minor congestion issues, large plot sizes, and so on.

5.5 Land use Distribution

The maps below provide a good representation of the current percentage land use at each terminal. In both situations, the ratio of residential is higher, although tourism plays a significant element in the case of the Zero Bridge terminal. In Khanqah-e-maula terminal, special areas, such as heritage structures, constitute a dominant factor.

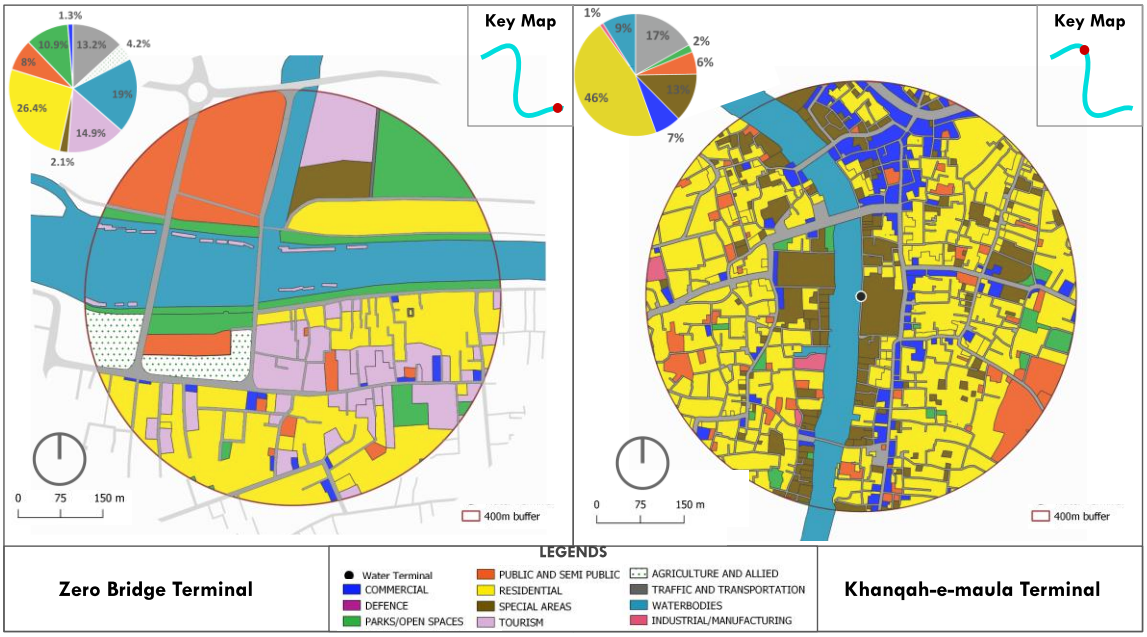

Figure 36: Map showing the land use distribution of the two terminals. (Source: Secondary Survey)

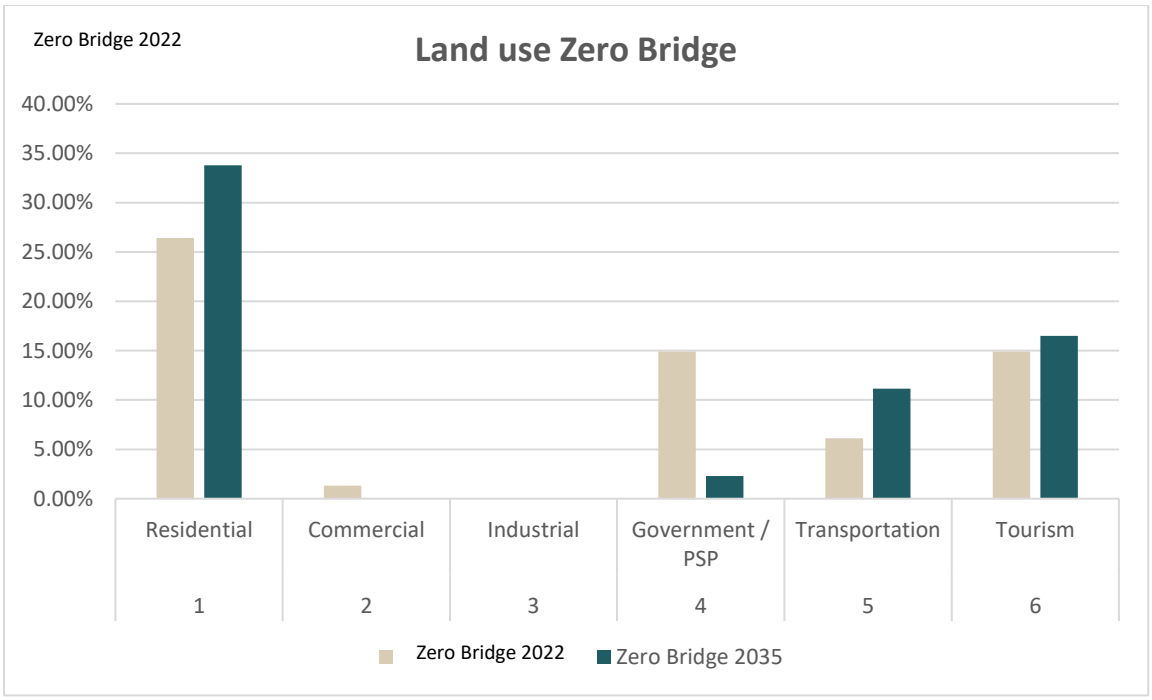

Figure 37: Land use distribution of Zero Bridge terminal for the Year 2022 & 35 (Source: Masterplan 2035 and primary survey)

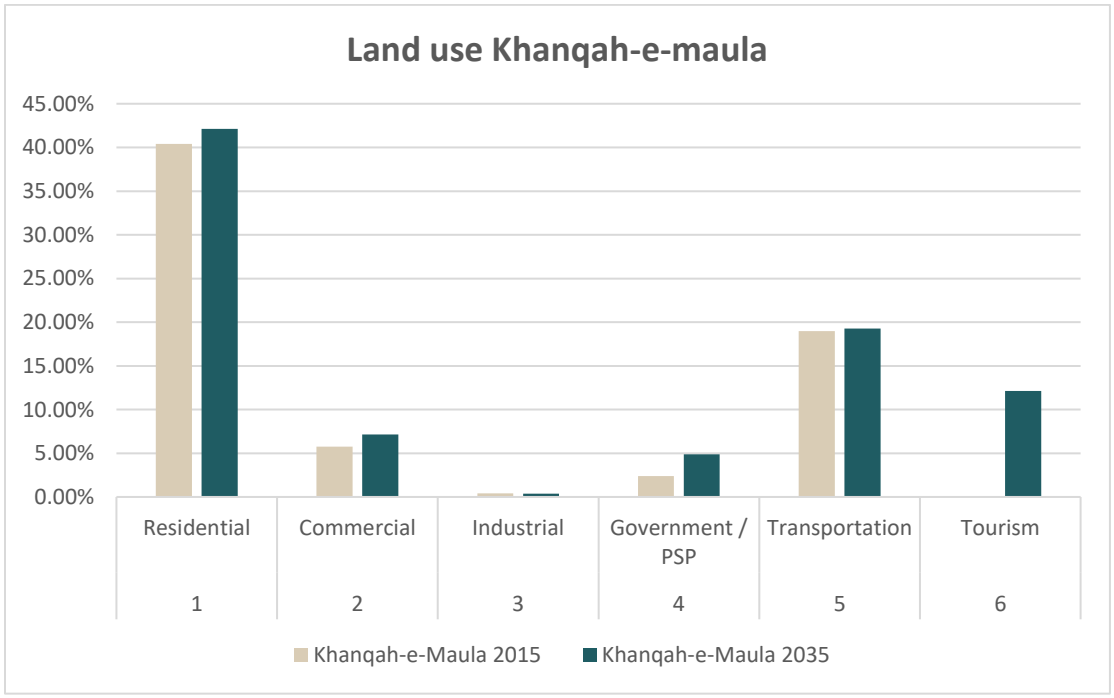

Figure 38: Land use distribution of Khanqah-e-maula terminal for the Year 2022 & 35 (Source: Masterplan 2035 and primary survey)

5.5.1 Assessment of Circulation Network

The photographs are crucial because they show the current road conditions, density levels, and other issues that are not suitable to any form of development. The images show that roads may be extended, pedestrian routes can be found but are encroached upon, and development is dense in some areas but low in others.

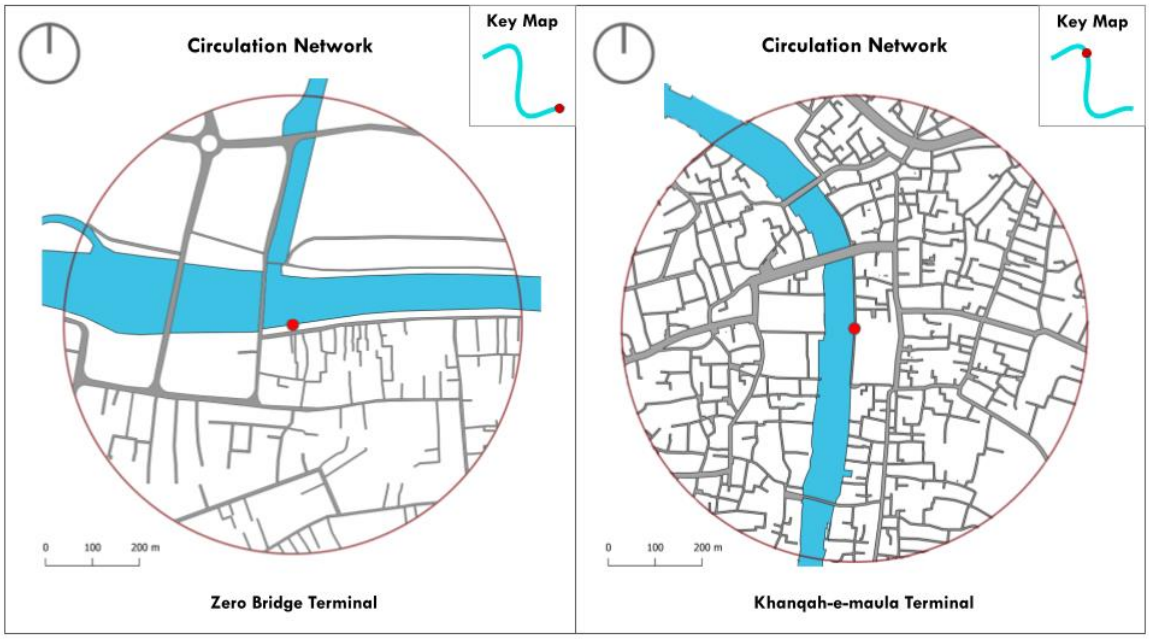

Figure 39: Circulation network of the two terminals (Source: Primary Survey)

Figure 40: On left is the Photo of road in zero bridge terminal and on right is the photo of a road in Khanqah-e-maula terminal. (Source: Primary Survey)

5.6 Assessment of Road Hierarchy

The site's road hierarchy is split into three sections: arterial, sub-arterial, and collector roads. Which is shown in the map below.

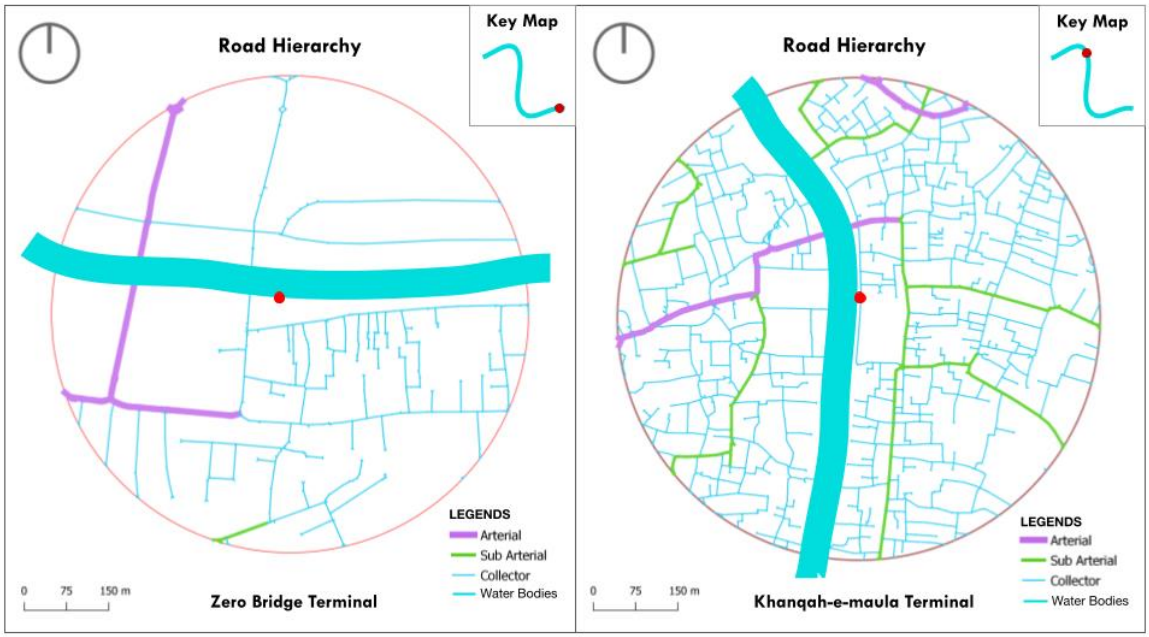

Figure 41: Road Hierarchy Map (Source: Primary Survey)

5.7 Assessment of Built Typology

According to the analysis, the build typology of the old city terminal, i.e., Khanqah-e-maula, already resembles Transit Oriented Development (TOD), as shown in the map below, but it requires a more regularised framework, which will be developed further.

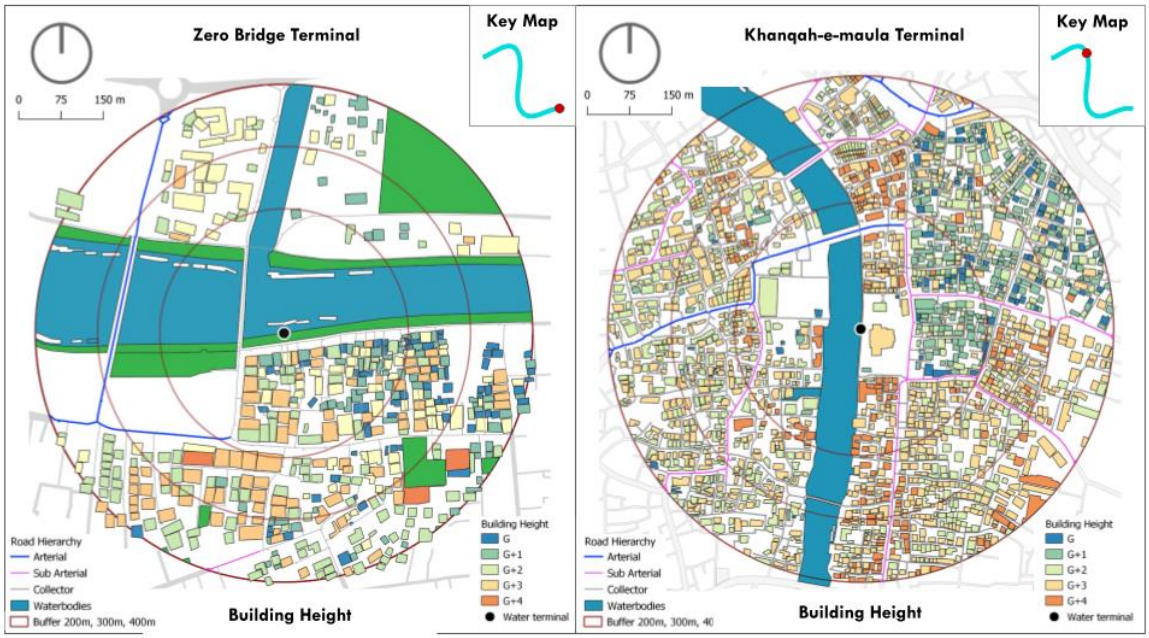

Figure 42: Build Typology Map (Source: Primary Survey)

5.8 Density

5.8.1 Population Projection

Initially, the demographic predictions projected in the Master Plan 2035 were examined to forecast the population for 2030. The population predictions in the plans are for Srinagar M. Corp + OG (outgrowths), however, we are primarily interested in the two 400-meter buffer zones around the two water terminals, namely Zero Bridge and Khanqah-e-Maula, thus the population projections in Master Plan 2035 were not considered.

An appropriate method for population projection is adopted to approximate the demand gap analysis for the horizon years, i.e., 2022, 2025 and 2030. The population forecasts have been made for the horizon years 2022, 2025 and 2030 by using the compound interest formula. The master plan 2035 provided the growth rate. "The population forecasts have been based on the following major assumptions from masterplan 2035 in consideration of quick mobility, flux in economic activity, and extraneous inputs.:

- Up to 2020, population growth in the Srinagar Metropolitan Region will be almost stable at the current rate of [1.8 per cent]. (TPO Kashmir, 2015)
- Between 2020 and 2030, the population of both urban and suburban areas is expected to expand at a rate of 2.0 per cent. (TPO Kashmir, 2015)
- Finally, the growth rate for the local region is expected to drop to 1.80 per cent from 2030 onwards for the remainder of the plan period up to 2035.(TPO Kashmir, 2015)

Table 3: Growth rate of Srinagar City; Source: Masterplan for Srinagar 2035

Growth Rate acc. To Master Plan for the Horizon Year	
2015-2020	1.8%
2020-2030	2%
2030-2035	-1.8%

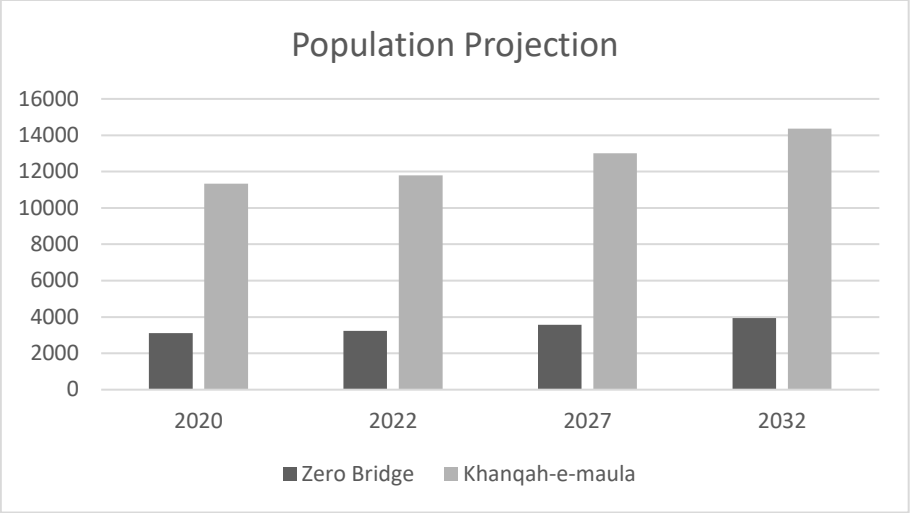

Figure 43: Population Projection of the Two terminals for the horizon years

Two scenarios have been developed for population projection. The first is Moderate, while the second is Dynamic. For the moderate scenario, the density specified in the Masterplan 2035, i.e., 241 PPH, is being used, while for the dynamic scenario, a 25% increase in density was assumed. The density of the vision document increases by 25% in the case of TOD, according to the case studies.

Table 4: Density for different scenarios

Scenario	**Density (PPH)**	
	Zero Bridge	**Khanqah-e-maula**
Existing	52.75	192.1
Moderate	241	241
Dynamic	300	300

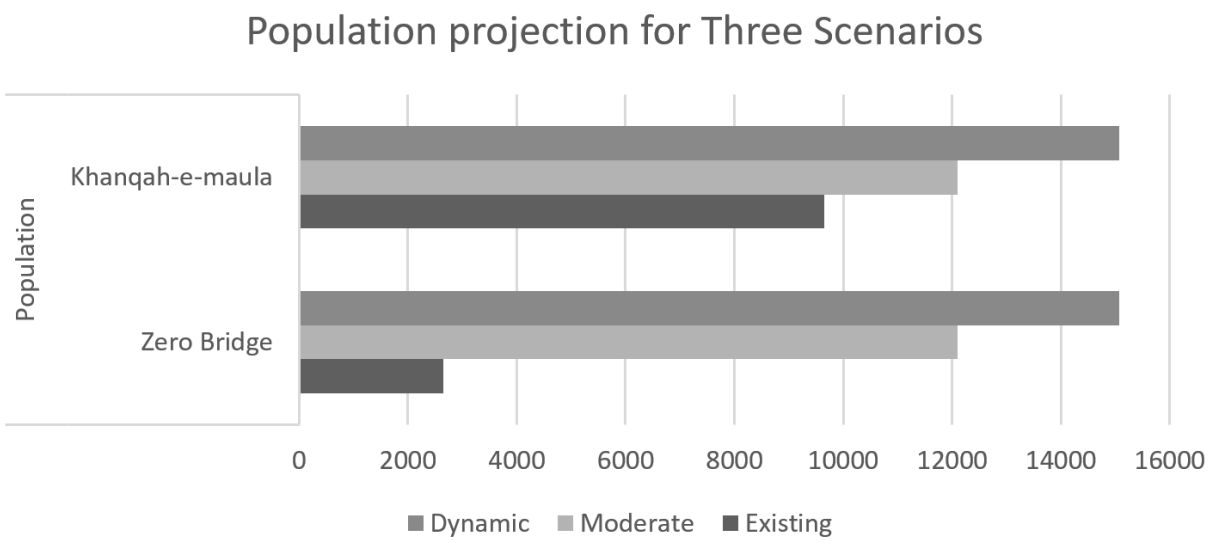

Figure 44: Population projection for Three Scenarios.

5.8.2 Floor Area Ratio (FAR)

Building footprints in the buffer zones were digitised along with their building heights, which were gathered from the primary survey, to compute the existing and projected FAR of the area.

Table 5: Developable land in two terminals.

S.no.	Category	Zero Bridge	Khanqah
1	Built-up Area	0.42	0.64
2	Area of Buffer	0.50	0.50
3	Area of Waterbody	0.10	0.05
4	Available land for Development	0.41	0.45

For FAR we have developed four scenarios as follows:

- Scenario 1: In this scenario total area of the buffer zone has been taken as the plot area.
- Scenario 2: In this scenario, the water bodies have been excluded to get the land left for development.
- Scenario 3: In this scenario all the natural features have been excluded to get the rest of the developable land.

- Scenario 4: In this scenario, only the major land uses were considered such as Residential, Public semi-public, commercial, Industrial & Tourism.

Table 6: FAR Scenarios

Land use	Terminal	Scenario 1	Scenario 2	Scenario 3	Scenario 4
		FAR	**FAR** (exclude waterbody)	**FAR** (exclude waterbody, defence, ecological reserves, heritage)	**FAR** (Major Land uses)
Existing	**Zero Bridge**	0.8	1.0	1.0	1.4
	Khanqah	1.3	1.4	1.6	2.6
Proposed	**Zero Bridge**	0.8	1.1	1.2	1.6
	Khanqah	1.3	1.4	1.5	1.9

For FAR projections we have developed Three scenarios to better understand the TOD development in the buffer zones. The scenarios developed are showed in the table below.

Table 7: Scenarios for FAR Projections.

Develop three scenarios	
Pessimistic	1.50
Realistic	2.00
Optimistic	3.00

5.8.3 Income Mix

The unit sizes were drawn from the NIUA's Transit Oriented Development Guide for Smart Cities in order to provide affordable housing. Primary surveys were used to determine the population mix of Zero bridge and the Khanqah-e-maula terminal.

Table 8: Residential demand of the terminals for different Income groups

Terminal	Parameters	EWS	LIG	MIG	HIG
Zero Bridge	Percentage	15%	23%	45%	17%
	Population	1775.212522	2721.993	5325.638	2011.908
	Dwelling Units	355.0425045	544.3985	1065.128	402.3815
	Unit size (sq.m)	27.8	46.4	83.6	165
	Built up (Sq.m)	9870.181625	25260.09	89044.66	66392.95
Khanqah	Percentage	15%	50%	25%	10%
	Pop	492.3453789	1641.151	820.5756	328.2303
	Dwelling Units	98.46907578	328.2303	164.1151	65.64605
	Unit size (sq.m)	27.8	46.4	83.6	165
	Built up (Sq.m)	2737.440307	15229.88	13720.02	10831.6

From the above tables the total built up required for other land uses than residential have been identified which have been shown in the table below.

Table 9: Terminal wise existing and proposed built-up scenario.

Units = Sq.km					
Terminal	Proposed Built up	Existing Built-up	Total Built Up	Dynamic Scenario Built Up	Proposed built up identified for other uses than residential
Zero Bridge	0.19	0.42	0.61	0.81	0.21
Khanqah-e-maula	0.04	0.64	0.68	0.91	0.23

6 Proposals

6.1 Diversity

The proposed FAR has been adjusted based on the land use distribution of the two terminals. The TOD Policy 2021 provided the FAR allocation of Transit Oriented Development. As shown in the following table.

Table 10: Mix of Uses/ Distribution of FAR in TOD; Source: TOD Policy 2021

Land use masterplan	Minimum FAR for Residential uses	Minimum FAR for Commercial uses	Minimum FAR for PSP and/or utilities	Other uses
Residential	50%	10%	20%	20%
Commercial	30%	50%	10%	10%
Industrial	30%	10%	10%	50%
Government	30%	10%	10%	50%
Transportation	30%	10%	10%	50%

The distribution of FAR has been done on three scenarios based on the analysis: pessimistic, realistic, and optimistic. The FAR for the pessimistic scenario is 1.5, based on the built-up demand of the two terminals, whereas the realistic scenario has a FAR of 2 and the optimistic scenario has a FAR of 3 based on the Transit oriented development case studies. In the table below, the three scenarios are listed.

Table 11: Scenarios developed for the Distribution of FAR

FAR Scenarios	
Pessimistic	1.50
Realistic	2.00
Optimistic	3.00

6.1.1 Pessimistic Scenario

The FAR taken for the pessimistic scenario is 1.5. the distribution of FAR has been done for the land uses mentioned in the TOD policy. The calculations of zero bridge terminal are shown in table below.

Table 12: FAR Distribution Table for Zero Bridge Terminal in Pessimistic Scenario.

	Zero bridge							
Land uses	**Masterplan proposed land use (sq.km)**	**%**	**Built up acc. To TOD FAR**	**Minimum FAR for Residential uses (Sq.km)**	**Minimum FAR for Commercial uses (Sq.km)**	**Minimum FAR for PSP and/or utilities (Sq.km)**	**Remaining built up for other uses (sq.km)**	**Total built up (Sq.km)**
Residential	0.17	34	0.25	0.13	0.03	0.05	0.05	0.25
Commercial	0.08	16	0.12	0.04	0.06	0.01	0.01	0.12
Industrial	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00
PSP	0.01	2	0.02	0.01	0.00	0.00	0.01	0.02
Transportation	0.06	11	0.08	0.03	0.01	0.01	0.04	0.08

In the case of zero bridge the total built up for all land uses was observed to be 0.48 sq.km. The FAR distribution of Khanqah-e-maula terminal is shown in the table below.

Table 13: FAR Distribution table for Khanqah-e-Maula terminal in a pessimistic scenario

	Khanqah-e-maula							
Land uses	**Masterplan proposed land use (sq.km)**	**%**	**Built up acc. To TOD FAR**	**Minimum FAR for Residential uses (Sq.km)**	**Minimum FAR for Commercial uses (Sq.km)**	**Minimum FAR for PSP and/or utilities (Sq.km)**	**Remaining built up for other uses (sq.km)**	**Total built up (Sq.km)**
Residential	0.21	42	0.32	0.16	0.03	0.06	0.06	0.32
Commercial	0.10	7	0.15	0.04	0.07	0.01	0.01	0.15
Industrial	0.00	0.4	0.00	0.00	0.00	0.00	0.00	0.00
PSP	0.02	5	0.04	0.01	0.00	0.00	0.02	0.04
Transportation	0.10	19	0.15	0.04	0.01	0.01	0.07	0.15

In the case of zero bridge the total built up for all land uses was observed to be 0.65 sq.km.

6.1.2 Realistic Scenario

The FAR taken for the pessimistic scenario is 2. the distribution of FAR has been done for the land uses mentioned in the TOD policy. The calculations of zero bridge terminal are shown in table below.

Table 14: FAR Distribution table for zero bridge terminal in a realistic scenario

	Zero bridge							
Land uses	**Masterplan proposed land use (sq.km)**	**%**	**Built up acc. To TOD FAR**	**Minimum FAR for Residential uses (Sq.km)**	**Minimum FAR for Commercial uses (Sq.km)**	**Minimum FAR for PSP and/or utilities (Sq.km)**	**Remaining built up for other uses (sq.km)**	**Total built up (Sq.km)**
Residential	0.17	34	0.34	0.17	0.03	0.07	0.07	0.34
Commercial	0.08	16	0.17	0.05	0.08	0.02	0.02	0.17
Industrial	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00
PSP	0.01	2	0.02	0.01	0.00	0.00	0.01	0.02
Transportation	0.06	11	0.11	0.03	0.01	0.01	0.06	0.11

In the case of zero bridge the total built up for all land uses was observed to be 0.64 sq.km. The FAR distribution of Khanqah-e-maula terminal is shown in the table below.

Table 15: FAR Distribution table for Khanqah-e-Maula terminal in a realistic scenario

	Khanqah-e-maula							
Land uses	**Masterplan proposed land use (sq.km)**	**%**	**Built up acc. To TOD FAR**	**Minimum FAR for Residential uses (Sq.km)**	**Minimum FAR for Commercial uses (Sq.km)**	**Minimum FAR for PSP and/or utilities (Sq.km)**	**Remaining built up for other uses (sq.km)**	**Total built up (Sq.km)**
Residential	0.21	42	0.42	0.21	0.04	0.08	0.08	0.42
Commercial	0.06	7	0.12	0.04	0.06	0.01	0.01	0.12
Industrial	0.00	0.4	0.00	0.00	0.00	0.00	0.00	0.00
PSP	0.02	5	0.05	0.01	0.00	0.00	0.02	0.05
Transportation	0.10	19	0.19	0.06	0.02	0.02	0.10	0.19

In the case of zero bridge the total built up for all land uses was observed to be 0.79 sq.km.

6.1.3 Optimistic Scenario

The FAR taken for the pessimistic scenario is 3. the distribution of FAR has been done for the land uses mentioned in the TOD policy. The calculations of zero bridge terminal are shown in table below.

Table 16: FAR Distribution table for zero bridge terminal in the optimistic scenario

	Zero bridge							
Land uses	**Masterplan proposed land use (sq.km)**	**%**	**Built up acc. To TOD FAR**	**Minimum FAR for Residential uses (Sq.km)**	**Minimum FAR for Commercial uses (Sq.km)**	**Minimum FAR for PSP and/or utilities (Sq.km)**	**Remaining built up for other uses (sq.km)**	**Total built up (Sq.km)**
Residential	0.17	34	0.51	0.25	0.05	0.10	0.10	0.51
Commercial	0.08	16	0.25	0.07	0.12	0.02	0.02	0.25
Industrial	0.00	0	0.00	0.00	0.00	0.00	0.00	0.00
PSP	0.01	2	0.03	0.01	0.00	0.00	0.00	0.01
Transportation	0.06	11	0.17	0.05	0.02	0.02	0.08	0.17

In the case of zero bridge the total built up for all land uses was observed to be 0.94 sq.km. The FAR distribution of Khanqah-e-maula terminal is shown in the table below.

Table 17: FAR Distribution table for Khanqah-e-Maula terminal in a optimistic scenario

	Khanqah-e-maula							
Land uses	**Masterplan proposed land use (sq.km)**	**%**	**Built up acc. To TOD FAR**	**Minimum FAR for Residential uses (Sq.km)**	**Minimum FAR for Commercial uses (Sq.km)**	**Minimum FAR for PSP and/or utilities (Sq.km)**	**Remaining built up for other uses (sq.km)**	**Total built up (Sq.km)**
Residential	0.21	42	0.63	0.32	0.06	0.13	0.13	0.63
Commercial	0.08	7	0.25	0.08	0.13	0.03	0.03	0.25
Industrial	0.00	0.4	0.01	0.00	0.00	0.00	0.00	0.01
PSP	0.02	5	0.07	0.02	0.01	0.01	0.04	0.07
Transportation	0.10	19	0.29	0.09	0.03	0.03	0.15	0.29

In the case of zero bridge the total built up for all land uses was observed to be 1.26 sq.km.

6.2 Design

To ensure that TOD does not merely become a high-density development along the transit, which may result in higher concentration of private vehicles and congestion, it is important that the ULBs make sure that all the important aspects of TOD, as given in earlier sections, are implemented in totality.

Cities should provide transparency and clarity in the policy and procedures for TOD, as well as the economic incentives for all stakeholders. This would allow multiple landowners to come together and build a consensus and save time in implementation of TOD.

For long term commitment of public agencies and private sector in implementing TOD, cities should create clear and fair rules for sharing of costs, benefits, and risk among the stakeholders.

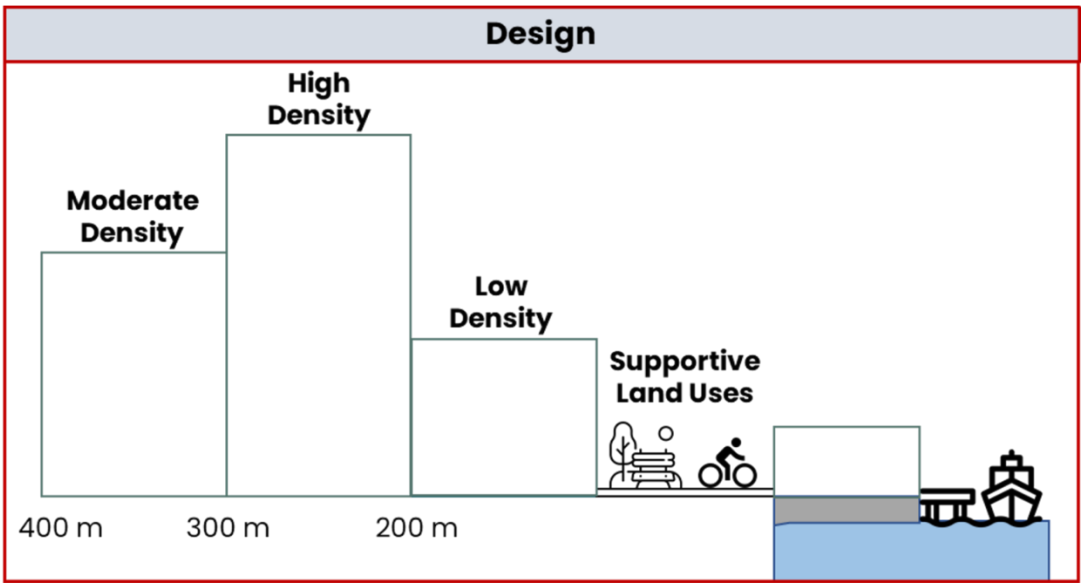

Figure 45: Density diversification in WaTOD.

As per TOD design proposals the supportive land uses are nearest to the river where we can find some open spaces for social gatherings as well as common activities by the people. After this buffer the densities are arranged into three categories ie. High, Low and Moderate which scaled by 200m to 400m respectively. The proposal suggests Low density is closer to the river because of the overflow of the water from the banks majorly in the rainy season. And moderate density is arranged distant from the river. Another reason is to merge the density according to the population of the city, Hence High density is arranged in the centre of both for a suitable land use zoning.

Figure 46: Intersection of WaTOD (source: Author)

In the figure mentioned above the water transport mode is essential because of people moving alongside the river so we have proposed ferry to best and specious mode of transportation. In the front of the bank there is a ferry terminal to stay and rest.

To enhance the riparian buffer along the river banks, The sole intervention under this objective is to develop and implement a riparian buffer development strategy for the river banks, and implement this strategy. These simple strips of vegetated land can offer an enormous number of environmental benefits, including:

- Stabilizing stream banks resulting in reduced erosion and sedimentation
- Providing infiltration of stormwater run-off
- Maintaining base flow of streams
- Contributing organic matter that serves as a source of food and energy for the aquatic ecosystem
- Providing tree canopy to shade streams and regulate temperature

However, cities may also implement a three-zone riparian buffer (more of riparian flora in the riverside, small and medium shrubs in the middle zone, pathway along with native trees in the landward portion) as per availability of land in the river zone.

6.3 Multi Modal Integration

People have become more active than ever before, and they use transportation amenities on a regular basis. There is no way to establish an end-to-end transportation system. As a result, difficulties such as traffic congestion and pollution arise. Multi-modal integration is used to seamlessly connect numerous transport modes and maximise the potential of mass transportation to clear the congestion and establish a sustainable system, as well as to ease people's mobility. The main principles are to reduce the number of interchanges and, if that

isn't possible, to make the transition as smooth as possible. For this reason, transportation services are separated into two types: mass transit and feeder services. The idea is to make it easier for people to get to the mass transit system in a timely and comfortable manner.

The fundamental steps in the logical interpretation of transportation modalities would be to –

- Increase accessibility and coverage.
- Shorten the journey and save time
- Decrease the number of interchanges.
- Make the system long-term.

The success of the mode is determined by how well it is received by the general audience. The willingness to change modes will be determined by the length of time and frequency of service, trip distance, walk time and distance, level changes between services, ambiance of the surroundings (rain, sun, etc.), convenience of transfer, and overall trip cost. Walking is preferable for distances under 0.5 km, and NMT is recommended for distances between 0.5 and 1.5 km.

There are three types of integration that are necessary to generate a beneficial response -

1. Physical Integration: Physical infrastructure is completely integrated. The pedestrian and NMT environment, as well as their connectivity to feeder services and, ultimately, the mass transport system. Providing parking and other common services at the stations where the interchange will take place.
2. Information Integration: To provide information about the service, such as a timetable, route maps, and real-time information, in a simple and uniform manner.
3. Fare Integration: Commuters benefit from an integrated fare system across the system, which includes a common card and integrated ticket.

6.3.1 Zero Bridge

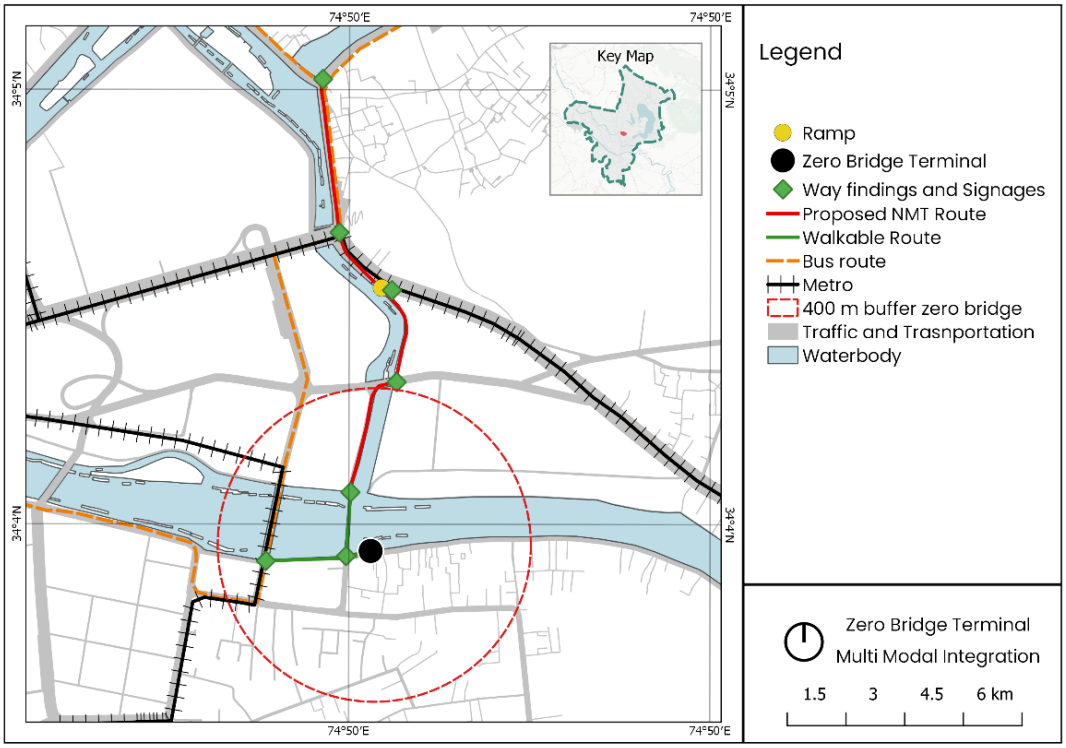

Figure 47: Multimodal Integration of Zero Bridge terminal; Source: Author

At the zero-bridge terminal intermodal system has been proposed form the terminal to the nearest mass transit station. There are two mass transit points which can be reached.

To reach the first point commuter would have to walk 200 meters walking path through park.

In second scenario the commuter would have to walk over pedestrian only zero bridge for approx. distance of 200m and will board a NMT to reach the dal lake which would be a 1.1 km trip. On this route there are steps located near Krishna Dhaba, parallel to the footpath which has been proposed to be converted into a ramp for the NMT.

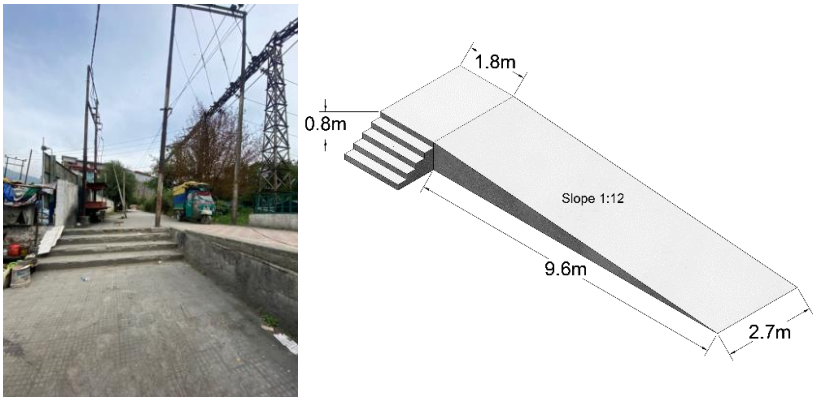

Figure 48: Ramp provided for the easy accessibility of NMT; Source: Author

For the dimensions of the ramp, Indian National Building Code 12.18.1 was referred. The width of 2.7 m was available which is completely utilised as the ramp width. The height is 0.8 meters. The slope ratio of 1:12 is given in accordance with IRC 011 (2015). Form this the length of ramp was calculated which came up to be 9.6 meters. A staircase has also been proposed perpendicular to the ramp for people to access the lower level. There will be 5 steps with riser of 0.15 meters and tread of 0.3 meters.

6.3.2 Khanqah-e-Maula Terminal

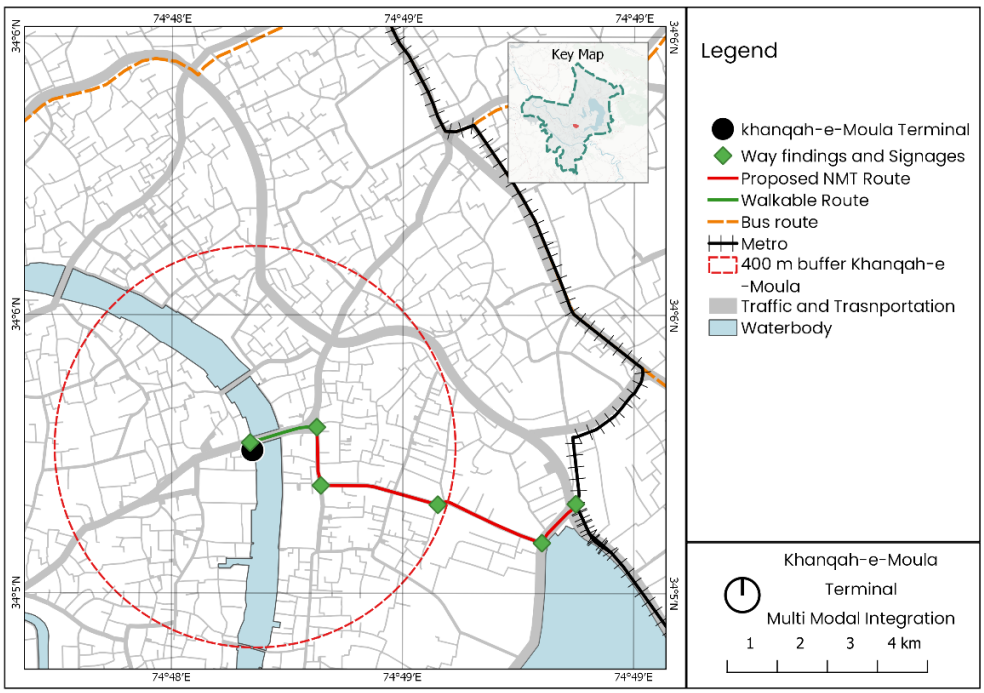

Figure 49: Multimodal Integration of Khanqah-e-maula terminal; Source: Author

At The Khanqah-e-Maula terminal intermodal system has been proposed form the terminal to the nearest mass transit station which is at approx. 650 m displacement. The route selected is of an approx. length of 800 m.

The commuter will have to walk approx. 150 meters via. New Zaina Kadal Bridge and will board the NMT to reach the station which would be a 650 m direct trip.

6.3.3 Wayfinding and Signages

For the ease of navigation and locating of the terminals and key nodes. Signages have been proposed. The key aspects of signages were to provide clear and consistent signages at junctions for higher visibility. The signages will provide information regarding the location and distance of terminal, routes etc. 6 locations have been identified to provide the signages at both zero bridge and khanqah-e-maula terminal and identified route.

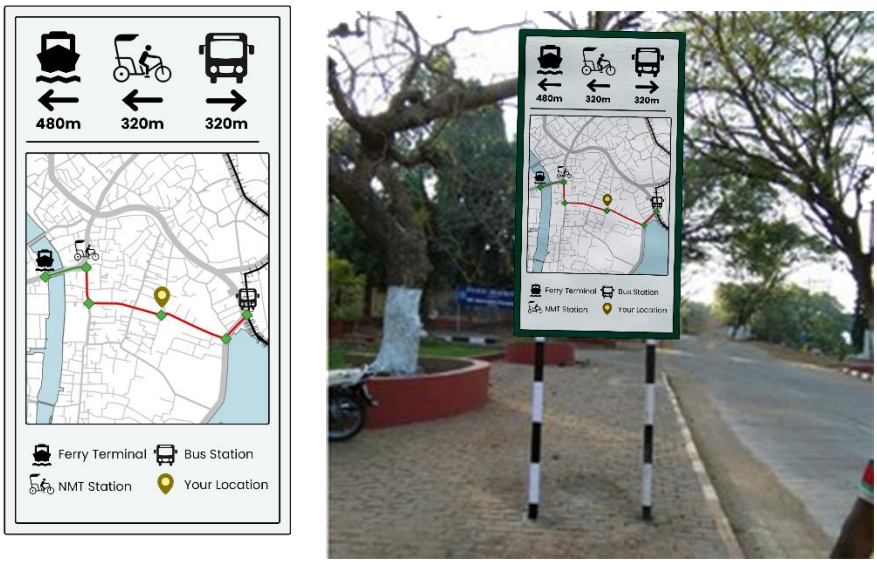

Figure 50: Signages for Ferry Terminals; Source: Author

6.3.4 Ticketing

For ticketing, integrated fair card system has been proposed which will allow commuters to use any service without buying a new ticket of different card. These cards will be available to purchase at the ferry terminal. It will make it easier for customers to use the whole system and allow easy switching of modes. As the route for the NMT is fixed the pricing will be done on the basis of distance travelled on that route. Customers will be able to pay directly to the NMT operator using the card on the spot.

7 Abbreviations

WaTOD: Water Transit Oriented Development

IWT: Inland Water Transport

IWAI: Inland Waterway Authority of India

CBD: Central Business District

CMP: Comprehensive Mobility Plan

CDP: City Development Plan

MP: Master Plan

TPO: Town Planning Organization

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CERTIFICATE OF COMPLETION

This is to certify that this thesis project titled "**Revitalization of Urban Waterfronts through WaTOD, A case of Jhelum River in Srinagar**" was carried out by Sh. **Daman Dogra**, a student of **Bachelors of Planning**, at the **School of Planning and Architecture, Bhopal**. The research for this project was undertaken under the guidance of the afore-mentioned institute and completed during the period of **03/01/2022** to **03/06/2022**.

This project was shortlisted under the *Sponsored Thesis Project Competition on "RE-IMAGINING URBAN RIVERS" (Season- 2)* hosted by the National Institute of Urban Affairs (NIUA) and the National Mission for Clean Ganga (NMCG).

This report has been submitted by the student as a final deliverable under the competition. All parts of this research can used by any of the undersigning parties.

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