Atal Mission for Rejuvenation and Urban Transformation

AMRUT Centre of Urban Planning
for Capacity Building
A-CUPCB-SPAV

Preparation Of A Local Area Plan (Lap) Incorporating Transit-oriented Development (TOD) For SR Nagar and LB Nagar of Hyderabad Metro

INTERIM
REPORT

MARCH, 2026

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1. Project Overview

1.1 Project Background

A request letter was received from the Hyderabad Metro Rail Limited, under the Municipal Administration & Urban Development Department, Government of Telangana (henceforth referred as 'HMRL' in this document), dated 17.06.2025, by the Director, School of Planning and Architecture, Vijayawada. The request entailed for 'Institutional Support for Preparation of Local Area Plan with Transit Oriented Development in Hyderabad'. Subsequently, SPAV formulated a working team with domain-specific experts of the AMRUT Centre of Urban Planning for Capacity Building (henceforth referred as ACUPCB-SPAV) to deliberate on the matter.

Thereafter, 02 specific discussions were held between the ACUPCB-SPAV Team of experts and the HMRL experts. First online meeting with HMRL was held on 24.06.2025 for preliminary discussions. Subsequently, another detailed meeting was held on 11.07.2025 discussing the scope of work, the possible timeline and financial implications. As an outcome of the two meetings, and in response to the letter from HMRL, ACUPCB-SPAV submitted a concept proposal document for 'Preparation of Local Area Plan with Transit Oriented Development' on 25 July 2025. The proposal indicated the two pilot study areas, the scope of work, the concept, the timeline and budget, amongst other details. Consequently, a telephonic call from HMDA-HUMTA on 31 Oct 2025 was received, indicating to send the proposal and a draft MoU to HMDA for perusal. In this regard, we have forwarded/re-submitted our proposal. Upon confirmation of this project proposal being agreeable, SPAV signed a MoU (Memorandum of Understanding) on 28th November, 2025 with **the Hyderabad Metro Rail Limited, Govt. of Telangana., for initiating works related to the said study**. Following this an inception report was submitted on 24th January 2026.

1.2 About ACUPCB at SPA Vijayawada

Figure 1-1 SPA Vijayawada Campus

The AMRUT Division of Ministry of Housing and Urban Affairs (MoHUA, Government of India) has recognized SPA Vijayawada as one of the few centers in the country, that shall undertake top-notch, cutting-edge research, projects, and training in the field of urban planning and climate sensitive development. SPA Vijayawada (under Ministry of Education, Government of India) has entered into a MoU with MoHUA Govt of India, and has set up the **"AMRUT Centre of Urban Planning for Capacity Building" at SPA Vijayawada (**Figure

1-1**) (ACUPCB-SPAV), which acts like a Hub of Excellence in the field of Urban Planning.** This Centre is a hallmark of SPAV's capability, resources and potential in leading the path of research and advocacy in the domain of Urban Planning in India.

The ACUPCB-SPAV has already undertaken several capacity building programmes and is carrying on several projects with ULBs and local governments. The ACUPCB-SPAV specializes on aspects of innovation in Urban Development and Planning and is working closely with many agencies and think-tanks in India with application-oriented evidence-based projects and advisory. For details about the ongoing activities of the Centre, please visit - www.acupcb.spav.ac.in

School of Planning and Architecture, Vijayawada (SPAV) is an Institute of National Importance, under the Ministry of Education (MoE), Government of India, offering education in the fields of Planning and Architecture. The school has distinguished itself and has grown as a role model in the professional education offering undergraduate, post graduate and doctoral programmes in the fields of Planning and Architecture, while at the same time fostering quality research in these domains. SPAV is ranked as one of the best technical institutes in the country by National Survey and Ranking, India Today Group as well as holds the 16th position in the 2024 NIRF Ranking nationwide for Architecture and Planning. The campus is green rated and is equipped with state-of-the-art infrastructure such as hostels, central library, ICT enabled teaching atmosphere, high end digital surveillance systems, modern laboratories, spacious studios, classrooms, open air theatres, auditorium, cafeteria, outdoor sports facilities, etc. Since the inception of SPAV, Research and Consultancy projects has been an important domain of the Institute affairs, aimed to provide the promotion and enhancement of professional knowledge and intellectual inputs with the prime objective to provide and offer design and planning services for the societal development. Currently, SPAV is engaged in various Research and Consultancy projects within and outside Andhra Pradesh.

1.3 Background and Purpose of the LAP for TOD

Indian metropolitan regions are witnessing rapid spatial expansion, increasing travel demand, and rising dependence on private motorized transport, resulting in congestion, environmental stress, and inequitable access to urban opportunities. In response, Transit-Oriented Development (TOD) has emerged globally as a planning and development approach that integrates high-quality public transport with compact, mixed-use, and walkable urban form (Calthorpe, 1993; Newman & Kenworthy, 2015). TOD emphasizes concentrating people, jobs, amenities, and public spaces within comfortable walking distance of mass transit stations, thereby reducing automobile dependency while enhancing accessibility, livability, and environmental sustainability. In the Indian context, the Ministry of Housing and Urban Affairs (MoHUA) has formally articulated TOD as a key strategy for sustainable urban development through the National TOD Policy (MoHUA, 2017), advocating higher densities, mixed land use, non-motorized transport (NMT) prioritization, and land value capture mechanisms around transit corridors. However, while city-level Master Plans increasingly acknowledge TOD principles, their translation into implementable, plot-level and street-level interventions remains limited.

Local Area Plans (LAPs) serve as an effective intermediate planning instrument to bridge this gap. LAPs operationalize broader Master Plan and TOD policy directions at the micro scale, enabling context-specific land use reorganization, built form controls, mobility improvements, and public realm enhancements (MoHUA, 2016). When aligned with TOD principles, LAPs facilitate coordinated land use-transport integration, optimize infrastructure investments, and enable phased implementation through regulatory and financial tools.

Against this background, the present consultancy project 'Preparation of Local Area Plan with Transit-Oriented Development' seeks to prepare LAPs for selected Hyderabad Metro stations. The project is undertaken by the AMRUT Centre of Urban Planning for Capacity Building (ACUPCB) at the School of Planning and Architecture, Vijayawada (SPAV), in collaboration with Hyderabad Unified Metropolitan Transport Authority (HUMTA) under Hyderabad Metropolitan Development Authority (HMDA), as per the agreed Concept Proposal and Memorandum of Understanding.

1.4 The Study Area

The **Hyderabad Metropolitan Development Authority (HMDA)** is the apex planning and development body responsible for the integrated and sustainable development of the **Hyderabad Metropolitan Region (HMR)**. Established in **2008** under the **HMDA Act, 2008**, it was formed by merging multiple urban development bodies including the Hyderabad Urban Development Authority (HUDA), Cyberabad Development Authority (CDA), Hyderabad Airport Development Authority (HADA), and others to ensure cohesive regional planning. HMDA oversees a vast jurisdiction of approximately **5,965 sq. km**, covering parts of **Hyderabad**, **Medchal-Malkajgiri**, **Ranga Reddy**, **Sangareddy**, **Yadadri Bhuvanagiri**, **Medak**, **Siddipet**, and **Mahbubnagar** districts. The HMDA master plan is shown in the figure Figure 1-2

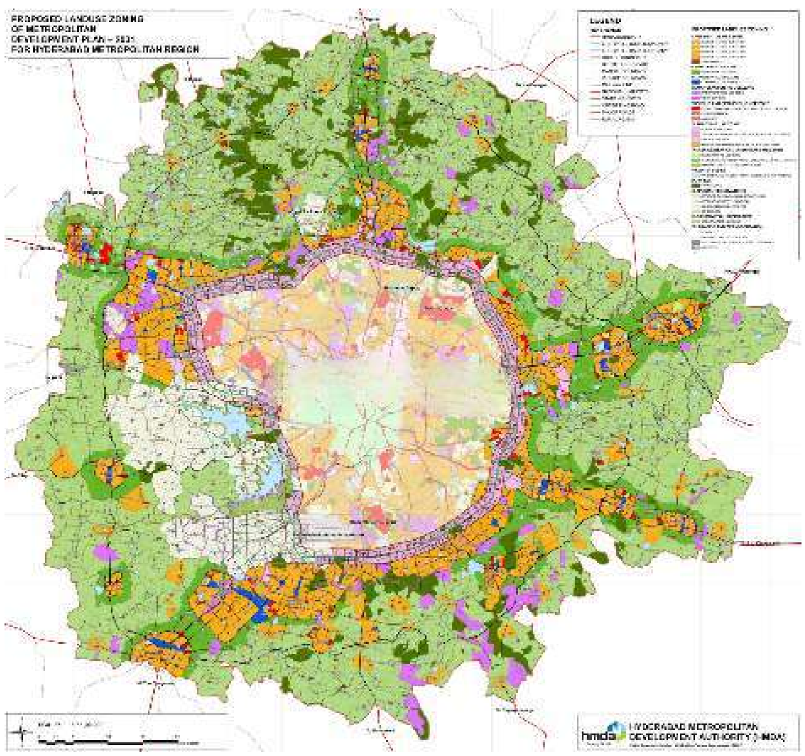


Figure 1-2 HMDA Master Plan 2031   Source: Hyderabad Metropolitan Development Authority (HMDA)

The Phase I of the Hyderabad Metro Rail (HMR) is a fully operational, high-capacity rapid transit network spanning approximately 69 km across three major corridors. It was designed to connect the city's major residential, commercial, and educational hubs, significantly reducing cross-city travel times.

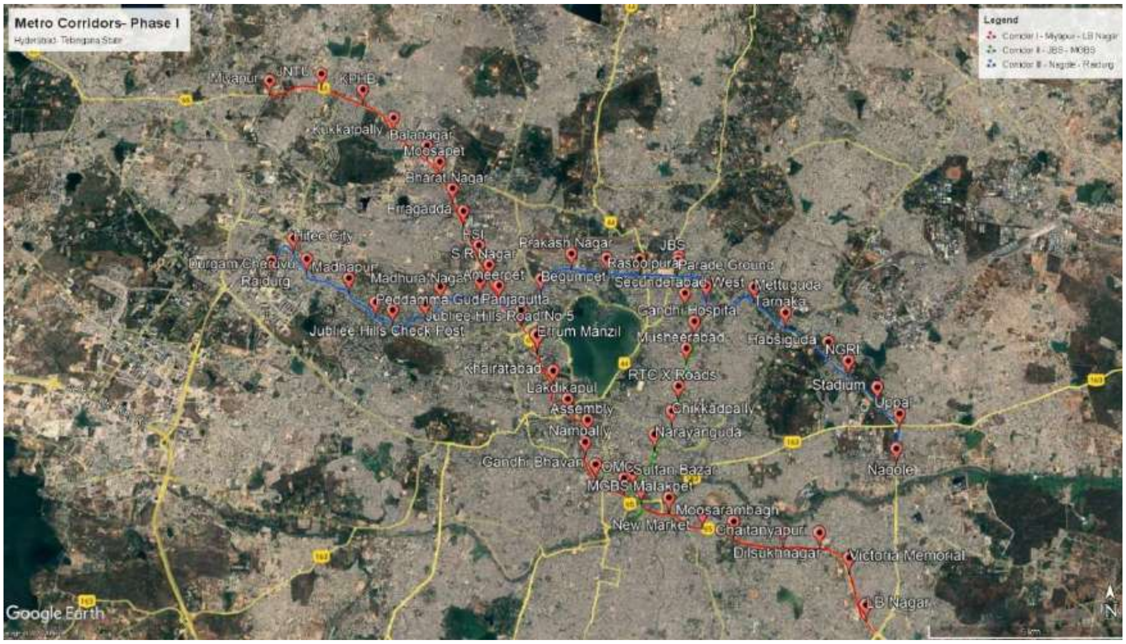


Figure 1-3 Metro Corridors- Phase I- Hyderabad

(Source: HMRL)

The LB Nagar Anchor (Corridor I): As seen in the operational maps, LB Nagar serves as the critical terminal point for the Red Line. This corridor facilitates the daily commute of thousands from the high-density eastern suburbs to central business districts like Ameerpet and industrial zones in Miyapur.

Interchange Hubs: The system utilizes a "hub-and-spoke" model with three major interchange points:

- Ameerpet: Connects Corridor I and III.
- MGBS (Mahatma Gandhi Bus Station): Connects Corridor I and II.
- Parade Grounds: Connects Corridor II and III.

Transit-Oriented Foundation: The Phase I corridors (Figure 1-3) were aligned along existing high-traffic arterial roads (like NH 65) to maximize accessibility. This alignment has triggered the vertical growth and commercial intensification observed in the LB Nagar study area, where institutional and commercial uses are now concentrated within the 800m station catchment.
The Hyderabad Metro Rail (HMR) network is evolving through a multi-phase expansion strategy designed to transform the city into a transit-oriented metropolis. This network serves as the backbone of the city's transport system, connecting primary residential suburbs like LB Nagar to major employment hubs and the international airport.

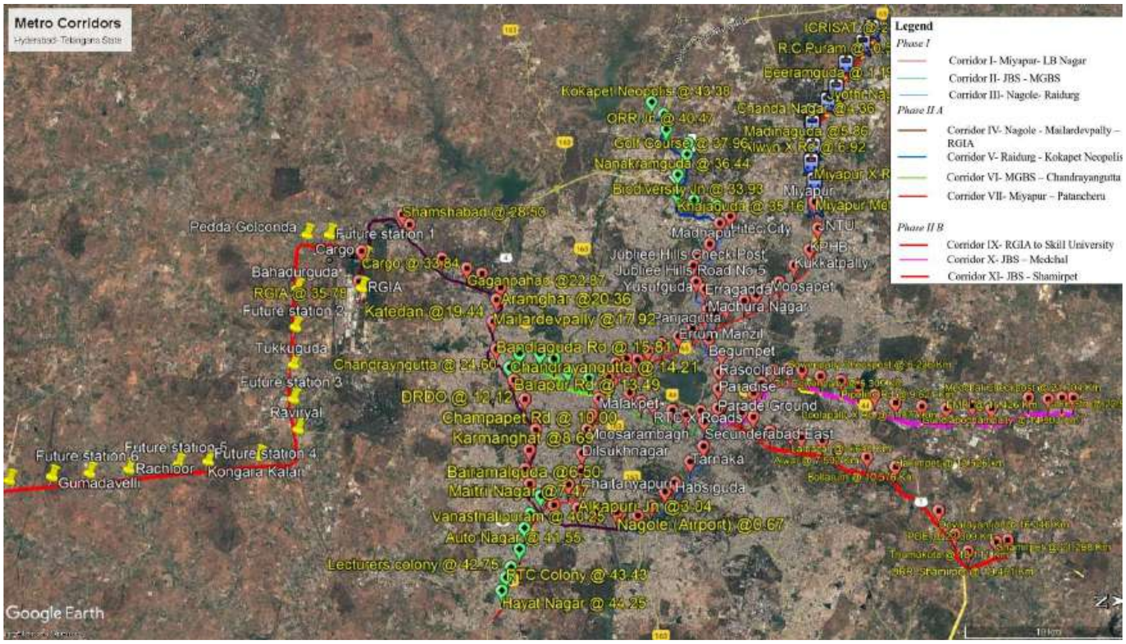


Figure 1-4 Metro Corridors (Phase I, IIA & IIB)- Hyderabad

(Source: HMRL)

Spatial Distribution and Connectivity Patterns:

- The spatial layout of the corridors as shown in Figure 1-4 follows a Radial-Circular pattern intended to decentralize the city's growth:
- The East-West Backbone (Corridor I): This operational line (Miyapur–LB Nagar) is the most critical for the study area. It traverses the city's core, linking the heavy residential density of the East (LB Nagar) with the institutional and commercial zones of the Northwest (Miyapur).
- Airport Integration (Phase IIA): The proposed extensions emphasize "Metropolitan Integration." By linking Nagole/LB Nagar to RGIA (Airport), the network aims to reduce travel time from the eastern suburbs to the airport from 90+ minutes to approximately 30–40 minutes.
- IT-Fintech Expansion (Corridor V): The extension from Raidurg toward Kokapet Neopolis reflects a "Transit-Follows-Development" strategy, providing high-capacity transit to the city's newest and highest-density financial districts.
- Peripheral Reach (Phase IIB): The proposed lines toward Medchal and Shamirpet indicate a strategy to manage future urban sprawl by providing transit corridors before these areas reach peak saturation.

The project: focuses on two strategically important metro stations on the Hyderabad Metro Red Line - L B Nagar (Figure 1-5) and S R Nagar (Figure 1-6) - each representing distinct urban contexts and development pressures. The LAPs will cover an influence zone of up to 500 m around each station, consistent with national and international TOD practice (MoHUA, 2017; ITDP, 2017).

Figure 1-5 L B Nagar Metro Station- Hyderabad

Source: Project Team, SPAV

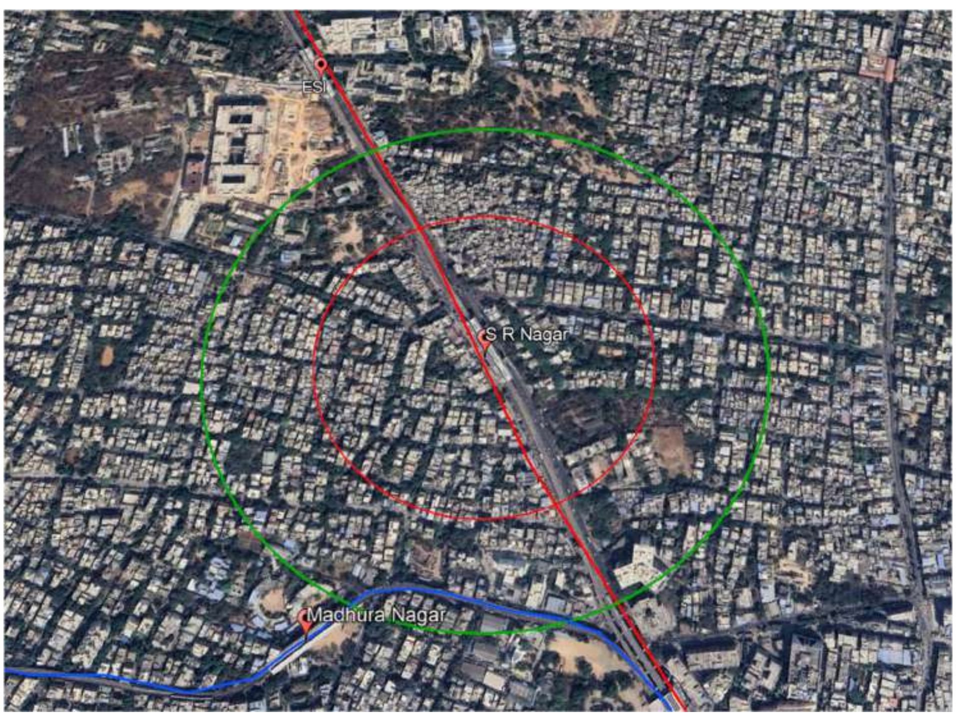


Figure 1-6 S R Nagar Metro Station- Hyderabad

Source: Project Team, SPAV

1.5 Objectives

The objectives of preparing LAPs for the selected TOD zones as part of this project are presented below.

1. To explore the potentials for Transit-Oriented Development (TOD) through preparation of Local Area Planning within the influence zones of selected metro stations.
2. To integrate urban form characteristics and associated functions to enable compact, mixed-use, and transit-supportive development for the station precincts.
3. To improve multi-modal accessibility and first-last mile connectivity, prioritizing non-motorized transport, and feeder systems.
4. To enhance public realm quality and universal accessibility within station influence areas, ensuring safe, inclusive, and active urban precincts.

1.6 Expected Outcomes and Alignment with the City-Level Master Plan

The primary outcome of the project is a set of detailed, spatially grounded LAPs for L B Nagar and S R Nagar Metro station areas, comprising land use plans, development control guidelines, mobility, public realm and land optimization proposals, and an implementation framework. These outputs are expected to support HMDA and HUMTA in guiding station-area re-development in a coordinated and sustainable manner.

The LAPs will be aligned with the statutory provisions and spatial strategies of the HMDA Master Plan 2031, which emphasizes compact development, transit integration, and sustainable mobility. By detailing TOD-supportive zoning overlays, density allocation, and street design based on the Master Plan, the LAPs will function as implementation-focused instruments rather than standalone conceptual plans.

Expected outcomes of this consultancy project '**Preparation of Local Area Plan with Transit-Oriented Development**' include:

1. Enhanced integration of metro infrastructure with surrounding land uses and urban form with minimized traffic impact.
2. Improved walkability, NMT infrastructure, and multi-modal accessibility within station influence areas.
3. Optimized utilization of land and infrastructure through context-specific densification and mixed-use development.
4. Identification of land-based financing and revenue generation mechanisms to support TOD investments.
5. Strengthened institutional capacity for LAP integrating TOD.

1.7 Overall Approach to LAP Formulation and Conceptual Framework

The overall approach to LAP formulation is grounded in globally recognized TOD and LAP principles, adapted to the regulatory and socio-spatial context of Hyderabad. The proposed framework integrates spatial analysis, regulatory review, stakeholder consultation, and design-led planning, as outlined in the approved Concept Proposal and MoU.

1.7.1Guiding Principles

The LAPs will be guided by the following core principles, drawing from global best practices and national guidelines (Figure 1-7) (MoHUA, 2017; ITDP, 2017, CRDF, 2022).

- **Transit Integration:** Prioritizing development intensity and activity concentration within walking distance of metro stations.
- **Land Optimization:** Strategic intensification of underutilized parcels, redevelopment of brownfield and aging built stock, and efficient use of FSI to maximize the benefits of transit investment.
- **Compact and Mixed-Use Development:** Encouraging a balanced mix of residential, commercial, institutional, and recreational uses to support daily needs locally.
- **Non-Motorized Transport (NMT) Priority:** Designing safe, continuous, and universally accessible pedestrian and cycling networks.
- **Public Realm and Place-Making:** Creating active streets, public spaces, and station precincts that enhance urban quality and social interaction.
- **Equity and Inclusivity:** Ensuring accessibility for all users, including women, children, elderly, and persons with disabilities.
- **Revenue Generation:** Identification of land value capture mechanisms - such as premium FSI, betterment levies, and development charges - to fund public infrastructure and public realm improvements, consistent with national TOD policy directions.

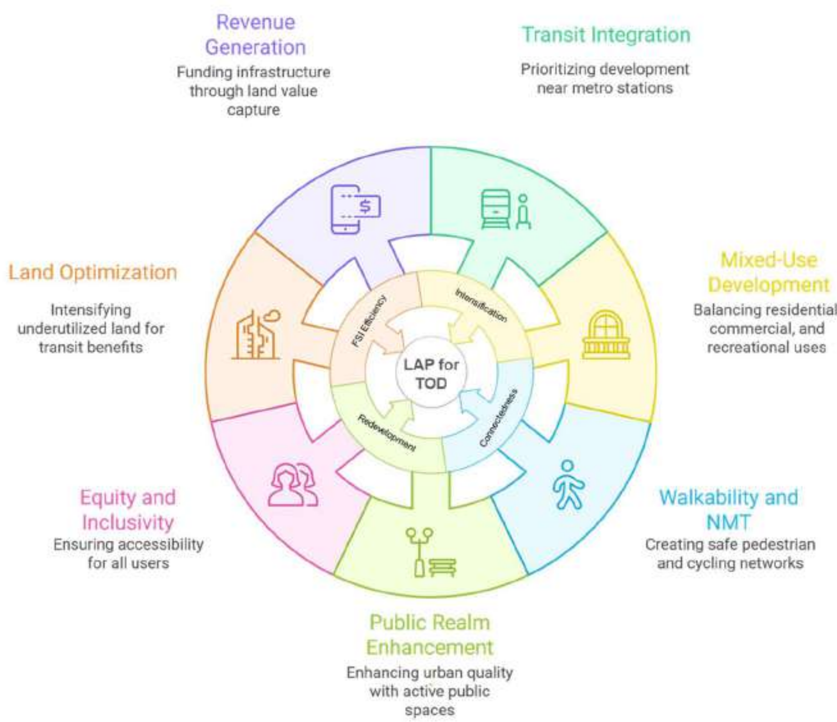


Figure 1-7 Concept Diagram for LAP for TOD for Hyderabad

Source: Project Team, SPAV

1.7.2Methodological Framework

The LAP preparation process will follow a staged methodology (Figure 1-8) comprising:

1. **Baseline Assessment:** Detailed mapping and analysis of existing land use, built form, mobility networks, infrastructure, and socio-economic characteristics within the station influence areas.
2. **Spatial and Regulatory Framework:** Formulation of a station-area vision and spatial structure, including land use reorganization, density distribution, and built form envelopes.
3. **Transport Demand Management and Accessibility Planning:** Design of pedestrian-first street networks, NMT infrastructure, feeder connectivity, parking management, and public spaces.
4. **Traffic Impact Assessment:** As an added analytical output, traffic and mobility impacts of proposed development scenarios will be examined using simulation-based assessment to evaluate changes in travel demand, modal split, and network performance, supporting evidence-based decision-making.
5. **Financing and Implementation:** Development of a realistic implementation roadmap, including Land Optimization strategies, regulatory tools, financial mechanisms, and project prioritization.

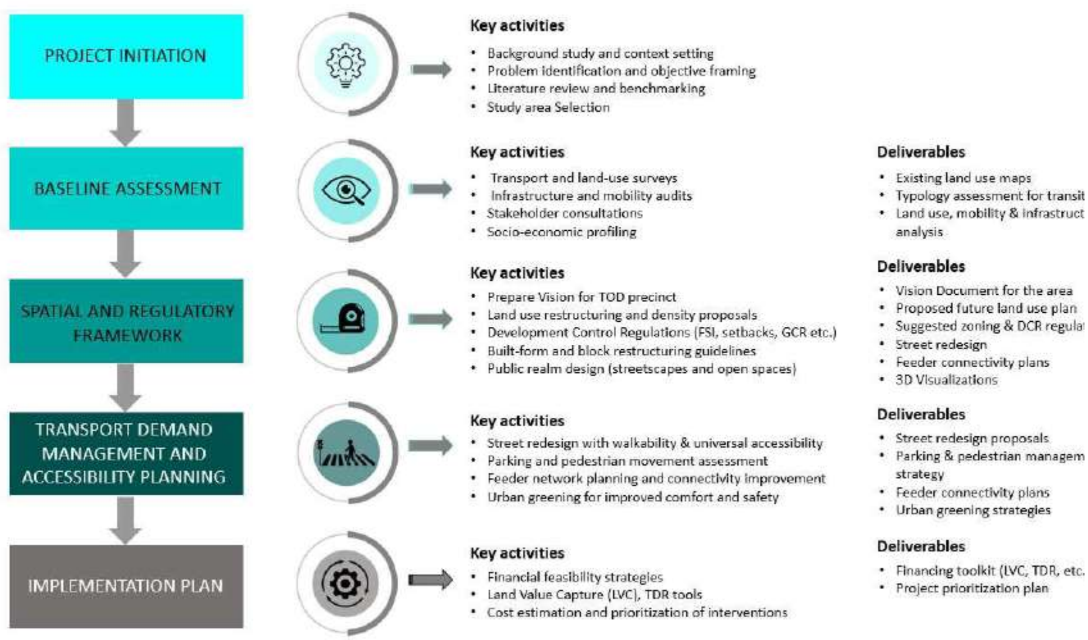


Figure 1-8 Approach and Methodology

Source: *Project Team, SPAV*

1.7.3Scope & Deliverables

The scope of the Local Area Plan (LAP) preparation for Transit-Oriented Development (TOD) zones would encompass a comprehensive range of activities aimed at transforming transit influence areas into well-integrated, accessible, and sustainable urban environments. It shall include:

a) **Baseline Assessment:** This would be conducted to map the existing land use patterns, built form, physical and social infrastructure, transportation systems, and socio-economic characteristics. This stage would also involve a thorough inventory and gap analysis of infrastructure provisions and a review of current development plans, zoning regulations, and applicable planning frameworks to understand the regulatory and spatial context.

b) **Spatial and Regulatory Framework:** This would be developed to define the LAP vision, goals, and strategic interventions. This would include spatial based and calculation supported proposals for land use rationalization, optimizing density, and maximizing development potential in a context-specific manner. A proposed land use shall be suggested that indicates higher utilization of each plot and building in terms of missed uses. Built form regulations - covering FSI allocation, permissible building heights, active frontages, and orientation of structures - would be integrated into the plan and indicated through maps and report.

c) **Transport Demand Management and Accessibility Planning:** The LAP would promote multimodal integration with a pedestrian-first approach, prioritizing seamless first- and last-mile connectivity to transit systems. First- and last-mile connectivity solutions would be outlined to ensure seamless access to transit systems. It would adopt universal design standards to ensure accessibility for all age groups and abilities, fostering inclusive mobility. The plan would enhance the public realm through complete street networks, open spaces, vending zones, and walkable, accessible infrastructure. To manage rising vehicular demand, strategies such as demand-responsive and podium parking, real-time data utilization, and dynamic pricing for on-street parking would be introduced.

d) **Financial and implementation framework***:* The plan would explore the possible use of land-based financing mechanisms such as Land Value Capture, Betterment Levies, and Transferable Development Rights and give suggestions as possible in the context. The LAP would prioritize proposed projects based on impact and feasibility, and provide phasing strategies to guide implementation over time.

The proposed scope of work and the stage-wise deliverables, including the key activities, expected outcomes and specific data required is discussed in Table 1-1.

Table 1-1: Project Scope and Deliverables

Scale of Analysis	Key Activities	Expected Deliverables
Baseline Assessment	- Land use - Road Inventory - Parking and NMT - Perception Survey - Stakeholder Consultations.	- Existing land use maps - Typology assessment for transit nodes. - Socio-economic profiling. - Land use, mobility, and infrastructure audits with gap analysis.
Spatial and Regulatory Framework	- Land use and density assessment. - Built form assessment. - Public realm assessment.	-Vision Document for the Area - Proposed Land Use - Zoning & DCR regulation w.r.t to FSI, setback, ground coverage, etc. - 3D views

Transport Demand Management and Accessibility Planning	- Estimating parking demand - NMT Infrastructure gaps - Infrastructure and mobility audits.	- Street redesign (including concepts of complete streets, and universal accessibility) - Parking and Pedestrian management - Streetscape etc. - Feeder connectivity plans - Urban greening strategies for enhanced mobility of all modes and humans
Implementation Plan	- Financial impact assessment - Phasing and cost estimation	- LVC appropriation - Project Prioritizations

Through this integrated and principle-led approach, the project aims to demonstrate how LAPs can serve as effective instruments for implementing TOD at the local scale, while remaining aligned with city-level planning frameworks and institutional realities.

The Project Overview defines the conceptual framework, scope, and guiding principles that underpin the entire study. Subsequent work streams are structured to ensure a clear progression from policy and evidence review to area-specific analysis and planning outputs. Established national and international practices related to Local Area Planning and Transit-Oriented Development inform the selection of planning parameters, indicators, and regulatory considerations relevant to station-area development.

These planning principles are then applied to the selected metro station areas through a structured spatial approach, including delineation of the station influence zones and assessment of existing land use, development intensity, mobility characteristics, and infrastructure provisions. This provides a common analytical baseline for formulating context-sensitive planning proposals. Primary surveys and secondary data collection are integrated to support detailed assessment of traffic, pedestrian movement, parking demand, and access conditions within the influence areas. The findings from these assessments directly guide the formulation of land use, mobility, and public realm proposals, as well as supporting analysis such as traffic impact assessment.

The overall workflow is designed to ensure continuity across study components and timely delivery of outputs, enabling the preparation of implementable Local Area Plans aligned with the agreed scope, timelines, and institutional requirements.

2. Literature Review

2.1 Concept of LAP and TOD

Cities today face rapid urbanization and escalating demands on infrastructure, leading to challenges such as traffic congestion, pollution, and inadequate access to services. In this context, simply expanding road networks or transit lines is not sufficient - there is a pressing need to integrate land use planning with transportation.

2.1.1Local Area Planning (LAP)

A Local Area Plan (LAP) is a detailed, small-area planning tool designed to connect city-level strategies with local needs. It focuses on a specific urban pocket-such as a transit station catchment-to guide development and infrastructure upgrades in alignment with broader master plans. LAPs support planned urban renewal by improving streets, public spaces, and local infrastructure while promoting mixed-use, street-oriented development. As a participatory, bottom-up approach, LAPs actively involve local communities, ensuring that planning decisions reflect real on-ground requirements for accessibility, amenities, and services, making the process more responsive and context-specific.

A key advantage of a Local Area Plan (LAP) is its implementation mechanism, which creates benefits for both public authorities and private landowners. LAPs use regulatory incentives-such as additional floor area or planning relaxations-in exchange for land or public-realm improvements. This market-responsive approach enables the creation of new streets, open spaces, and utilities while encouraging private redevelopment. By linking the city's master plan vision with localized interventions, LAPs provide a clear regulatory framework to convert land use and mobility strategies into actionable neighborhood projects(Figure 2-1). With many Indian states adopting LAPs for planned redevelopment, the tool ensures that growth around transit is locally relevant, inclusive, and feasible. Ultimately, LAPs help deliver neighborhood-level improvements-better street networks, public spaces, housing, and infrastructure-in alignment with wider urban development goals.

2.1.2Transit Oriented Development (TOD)

Transit-Oriented Development (TOD) is a planning approach that promotes compact, mixed-use, and walkable neighborhoods centered around high-quality public transport. By concentrating housing, jobs, and daily amenities within walking distance of transit stations, TOD encourages people to use public transport, walking, and cycling instead of private vehicles. This not only reduces congestion and pollution but also enhances urban livability by creating vibrant, accessible communities. A well-implemented TOD creates a mutually reinforcing cycle: dense development around transit increases ridership, while strong transit access makes these areas attractive for living and working. TOD also optimizes infrastructure investments, limits urban sprawl, and supports environmental sustainability by lowering carbon emissions. In rapidly growing countries like India, TOD provides a pathway toward low-carbon, efficient, and people-friendly urban development. Its core principles-density, diversity, and design-guide the creation of inclusive, connected, and pedestrian-oriented urban form.

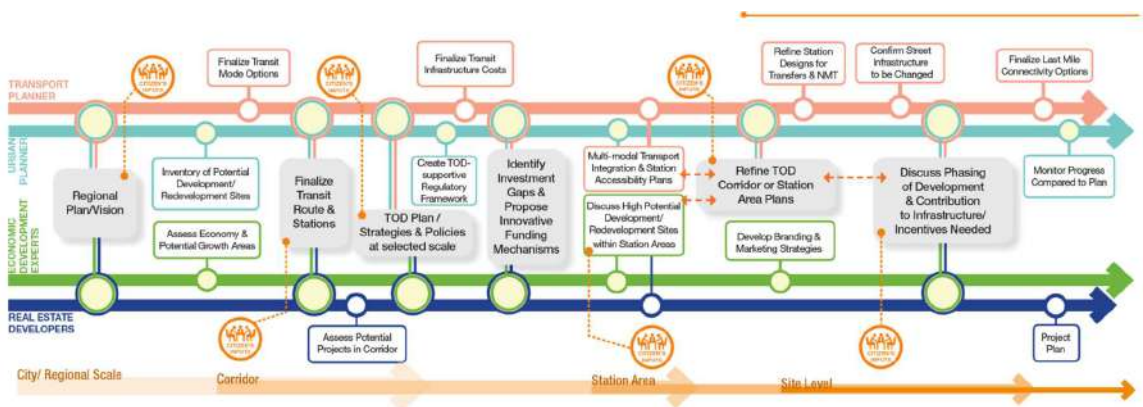


Figure 2-1 Integrated TOD Decision-Making Framework

2.2 Integration of LAP and TOD

Integrating Local Area Planning (LAP) with Transit-Oriented Development (TOD) brings together a detailed neighborhood-level tool and a citywide development vision (Figure 2-2). While TOD sets the goal of creating compact, mixed-use, transit-focused cities, LAP provides the regulatory and design mechanisms to implement these principles around specific transit stations. This integration helps reduce the disconnect between where people live, work, and access amenities by shaping walkable, transit-served neighborhoods.

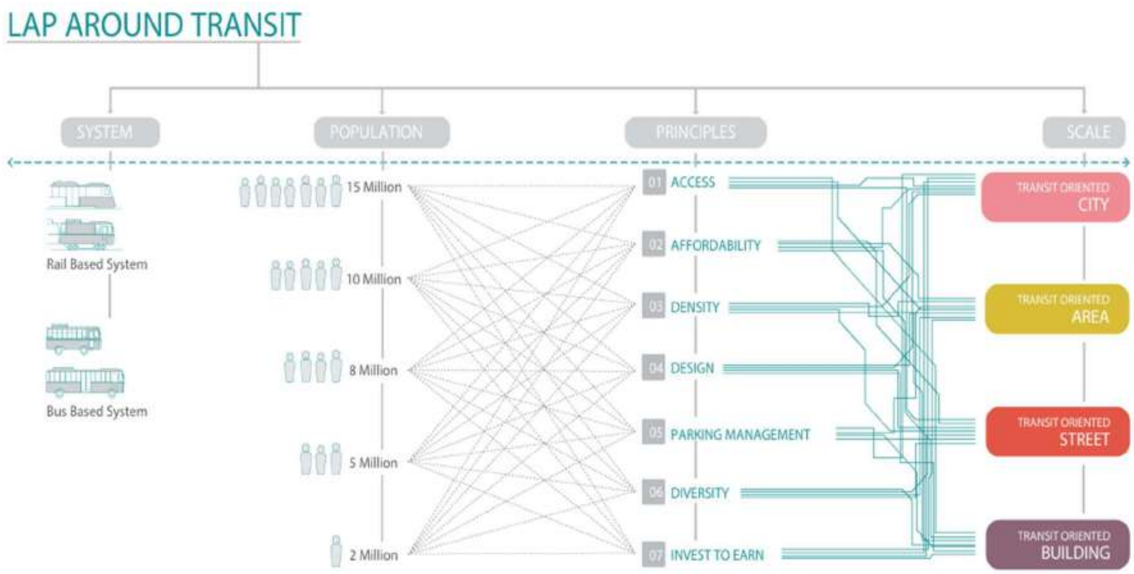


Figure 2-2 LAP Around Transit

Source: LAP for TOD Handbook (2022)

In practice, an LAP-TOD approach prepares a localized plan around each station to guide development, regulate building form, and upgrade infrastructure. It promotes a connected street network, higher densities, mixed-use development, enhanced pedestrian and cycling facilities, and effective parking management. LAP also adapts TOD components to local conditions, ensuring that development is genuinely transit-oriented rather than simply adjacent to transit. By bridging master plan vision and on-ground implementation, LAP-TOD integration creates vibrant, accessible, and human-scaled precincts supported by resilient utilities, sustainable water systems, and efficient waste management.

2.2.1Principles

In the context of Local Area Plans (LAP) around transit stations, seven core principles guide planners and stakeholders in reshaping urban areas for maximum benefit. These principles - **Access, Design, Density, Diversity, Affordability, Parking Management, and Invest to Earn** - provide a comprehensive framework to ensure that development around transit nodes is efficient, inclusive, and future-ready.

2.2.1.1 Access

Access forms the foundational principle of LAP around transit, ensuring that people of all age groups and abilities can comfortably reach public transport. The images (Figure 2-3) break this principle into four spatial scales- city, area, street, and building- each contributing to a seamless movement experience.

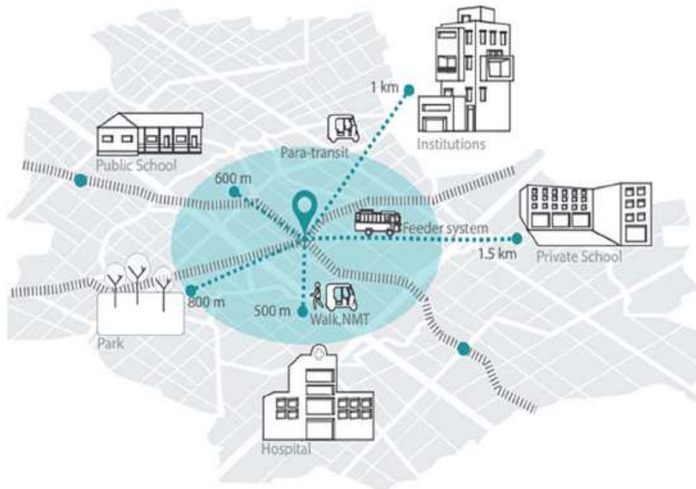


Figure 2-3 Principles - Access

Source: LAP for TOD Handbook (2022)

- At the **city level**, the goal is multimodal integration, where public transport systems are woven together to provide smooth transfers. The key feature highlighted is universal accessibility, ensuring all citizens can use transit without barriers. The expected outcome is increased public transport usage as the mobility network becomes more coherent and user-friendly.
- At the **area level**, first and last mile connectivity becomes essential. The features include feeder systems and shared mobility modes that link neighborhoods to major transit stations. These interventions create inclusive mobility, especially beneficial for people who would otherwise depend on private vehicles.
- At the **street level**, safe NMT (non-motorized transport) corridors are emphasized. Streets are designed to be pedestrian friendly with dedicated zones that allow uninterrupted walking and cycling. According to the outputs shown, this leads to seamless walking and cycling environments, reducing conflicts with motorized traffic.
- At the **building level**, direct access from the street to the ground floor is prioritized. This means entrances should align with sidewalks and accommodate universal access needs. The result is accessibility for all users, allowing elderly persons, children, and differently-abled individuals to reach transit without difficulty.

2.2.1.2 Design

Design within LAP-TOD focuses on shaping the built environment so that it supports walkability, safety, and livability. The Figure 2-4 present a clear hierarchy of design actions across the city, area, street, and building levels.

Figure 2-4 Principles - Design

Source: LAP for TOD Handbook (2022)

- At the **city level**, the goal is to create a complete street network. Integrated arterial roads ensure that transit corridors, local streets, and public spaces connect cohesively. This improves citywide navigation and leads to safe, livable cities.
- The **area level** emphasizes connected public realms. Plazas, open spaces, and greenery are used as features to enhance the character and usability of neighborhoods. These elements increase transit ridership by making station areas pleasant and comfortable.
- At the **street level**, the focus is on designing shared and shaded streets. Streets must be equitable and functional for all users-pedestrians, cyclists, vendors, and transit riders. Shaded pathways reduce heat stress, and shared zones promote inclusivity. The outcome is inclusive design, enabling streets to function as both mobility corridors and social spaces.
- At the **building level**, street facing active frontages are encouraged. Removing compound walls, ensuring shops and activities face the street, and promoting active uses energize the public realm. This creates a vibrant street edge, attracting more people and improving passive surveillance.

2.2.1.3 Density

The density principle aims (Figure 2-4) to optimize urban form so that population and activities are concentrated around transit stations, enhancing service efficiency.

Figure 2-5 Principles - Density

Source: LAP for TOD Handbook (2022)

- At the **city level**, compact urban growth is the primary goal. The main feature supporting this is the regulation of FSI/FAR to allow higher intensity development where it is most needed. As illustrated, this helps reduce vehicle kilometers travelled (VKT) and supports sustainable urban mobility.
- The **area level** seeks to use land optimally around stations through node-specific density. Concentrating development intensity near transit increases carrying capacity and encourages transit-oriented behavior.
- At the **street level,** efficient land consumption is highlighted. Managing crowds and promoting balanced usage ensures that streets remain functional despite higher footfall. The outcome is balanced usage, preventing overcrowding while maximizing potential economic and social benefits.
- At the **building level**, high occupancy rates and context-appropriate unit sizes are encouraged. This produces affordable and efficient housing units close to transit, improving accessibility while preventing sprawl.

2.2.1.4 Diversity

Diversity promotes a healthy mix of land uses, housing types, and user groups, ensuring that transit-oriented areas are vibrant throughout the day (Figure 2-6Figure 2-5 and Figure 2-7).

- At the **city level**, the focus is on balancing jobs and housing to minimize long commutes. Zoning flexibility is the main feature used to promote *social inclusion*.
- At the **area level**, mixed land-use zones supported by public and private amenities help create *vibrant neighborhoods*. These neighborhoods offer a variety of services, reducing the need to travel far for daily needs.
- At the **street level**, diversity means accommodating different types of users, including vendors. Shared streets with vendors create *safe, interactive streets* that are lively and economically robust.

- At the **building level**, vertical mixing of functions-residential, commercial, and service uses-is emphasized. This ensures *all-day activity and footfall*, making buildings more productive and enhancing urban safety.

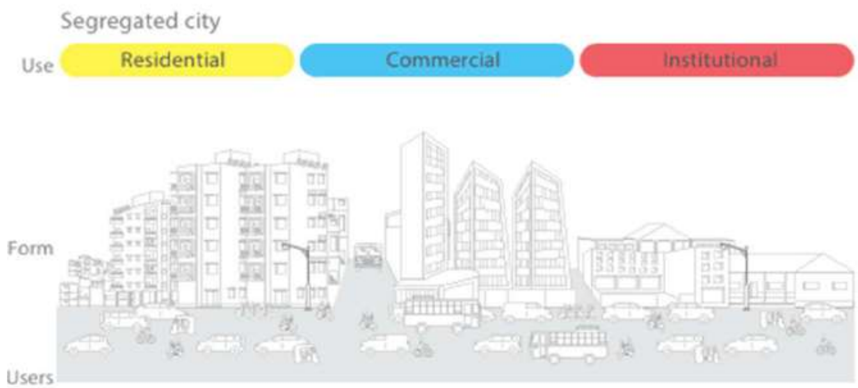


Figure 2-6 Principles - Diversity (Segregated City)

Source: LAP for TOD Handbook (2022)

Figure 2-7 Principles - Diversity (Mixed City)

Source: LAP for TOD Handbook (2022)

2.2.1.5 Affordability

Affordability ensures that low- and middle-income groups can access housing and transit without financial burden (Figure 2-8).

- At the **city level**, the goal is affordable access by linking housing schemes such as PMAY with transit. This promotes equitable development by ensuring that lower-income families live near transit.
- The **area level** recommends a mix of housing types supported by EWS quotas. This reduces displacement and supports inclusion within redeveloping transit precincts.
- At the **street level**, the emphasis is on last-mile affordability, reducing travel costs. This leads to time and cost savings for daily commuters.

- At the **building level**, in-situ redevelopment with small unit sizes and shared amenities makes housing economically accessible. The outcome is an inclusive housing stock.

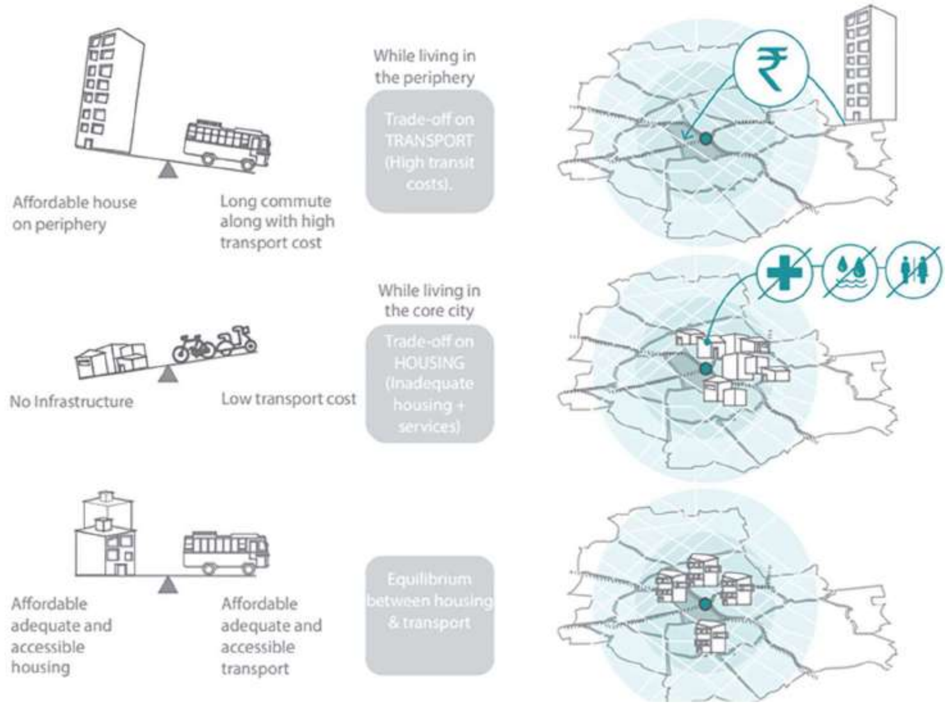


Figure 2-8 Principles - Affordability

Source: LAP for TOD Handbook (2022)

2.2.1.6 Parking Management

Parking management is essential for reducing private vehicle dependency and reclaiming space for people (Figure 2-9).

- At the **city level**, demand-based pricing is highlighted. By adjusting parking fees according to demand, cities can discourage excessive car use, leading to less car use overall.
- At the **area level**, rationalizing supply through better on-street/off-street management frees up valuable urban space. This results in more space for people and public realm uses.
- At the **street level**, reclaiming street space involves prioritizing walking and public transport. The outcome is a walkable public realm, essential for successful TOD.
- At the **building level**, unbundled private parking and maximum parking norms ensure that housing costs do not rise due to excessive parking requirements. This results in no cost-burdened housing.

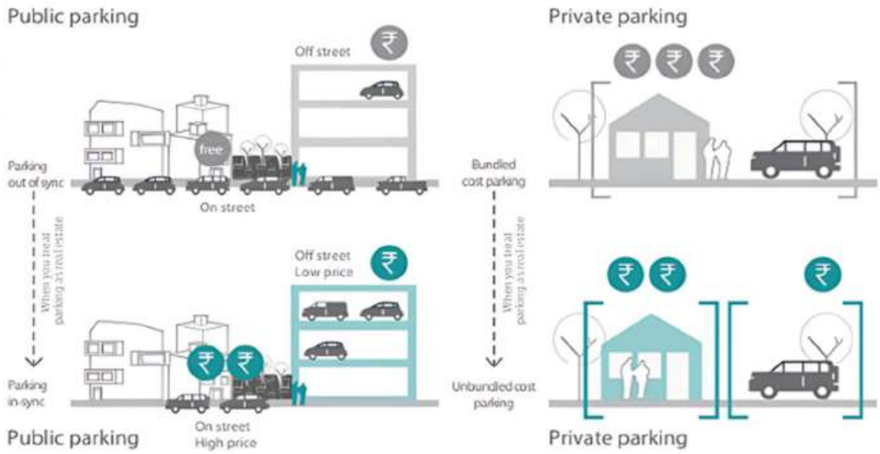


Figure 2-9 Principles - Parking Management

Source: LAP for TOD Handbook (2022)

2.2.1.7 Invest To Earn

This principle emphasizes generating value from transit-oriented development to support long-term fiscal sustainability (Figure 2-10).

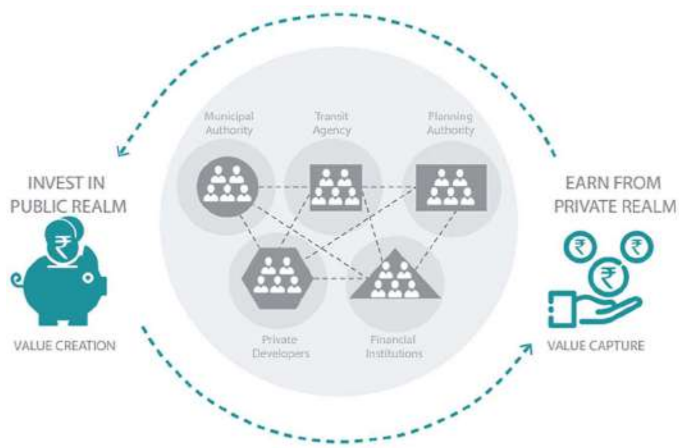


Figure 2-10 Principles - Invest to Earn

Source: LAP for TOD Handbook (2022)

- At the **city level**, the goal is to leverage tools like Land Value Capture and PPPs. Public investment in infrastructure boosts citywide revenue and strengthens fiscal sustainability.
- At the **area level**, TOD-based redevelopment supported by institutional coordination can generate revenue for the city through increased land and development value.
- The **street level** focuses on prioritizing public realm improvements before private gain. Investing in high-quality public spaces enhances the urban fabric and stimulates surrounding development.
- At the **building level**, developer incentives trigger private investment. The outcome is high return and equity, benefitting both the public and private sectors.

2.3 Comprehensive LAP-TOD Principles Matrix

Table 2-1 TOD Principles

Principles	Major Focus Areas	Key Strategies	Intended Outcomes
Access	• Universal reach to transit • Safe NMT environment • Multi-modal integration • Efficient last-mile systems	• Redesign street hierarchy ensuring continuous pedestrian network • Integrate feeder buses, shared mobility, cycle stations • Barrier-free pedestrian access at buildings/stations • Improve signage, lighting and shading for safety and comfort	Increased transit ridership; reduced dependency on private vehicles; inclusive mobility for all
Affordability	• Affordable housing near transit • Affordable last-mile travel • Socio-economic inclusion	• Introduce rental and small-unit housing models near stations • Incentivize EWS housing via FAR benefits • Reduce last-mile travel cost through shared mobility and fare integration • In-situ redevelopment without displacement	Balanced social mix and reduced transport expenditure for low-income households
Density	• Station-area densification • Efficient land resource use • Optimal FSI utilization	• Implement graduated FAR-higher near stations, gradual tapering outward • Promote vertical development with multifunctional spaces • Minimum occupancy norms for TOD housing • Avoid overcrowding via pedestrian capacity checks	Compact urban growth, reduced VKT, improved viability of transit
Design	• Connected street and public realm network • Human-scaled environment • Active and safe frontages	• Prioritize complete street design standards • Shade and landscape streets for comfort and heat resilience • Activate ground-floor edges with commercial and community services • Remove visual/physical barriers - compound walls, blank façades	Greater vibrancy and passive surveillance; improved walkability experience
Diversity	• Mixed-use development • Economic activities at street-level • Mixed-income communities	• Flexible land-use zoning (vertical and horizontal mixing) • Integrate workspaces + retail + housing within station area • Vendor-inclusive, shared mobility streets • Diversified community infrastructure (schools, clinics, markets)	Full-day activity cycles; reduced long-distance commute; social inclusivity
Parking and Travel Demand Management	• Reduced private parking footprint • Efficient parking policy	• Unbundle parking from real-estate cost • Demand-based parking pricing	More public spaces; less traffic congestion and car reliance

Principles	Major Focus Areas	Key Strategies	Intended Outcomes
	• Space reclaimed for people	• Maximum parking caps near stations • Convert curbside parking → pedestrian/NMT areas	
Invest to Earn	• Transit-linked value capture • Public-realm led regeneration • Public-Private collaboration	• Land Value Capture tools (Betterment levy, TOD premium) • PPP-based redevelopment of station precincts • Prioritize public realm upgrades to trigger private interest • Monetize development rights transparently	Sustainable financing for precinct improvements; higher land values and revenue returns

2.4 Comparison of different TOD Policies

2.4.1National TOD Policy

The National Transit Oriented Development (TOD) Policy, 2017 is a central guidance document issued by the Ministry of Housing and Urban Affairs (MoHUA) to help states and cities reorganize urban growth around mass transit rather than private vehicles. It seeks compact, mixed-use, walkable neighborhoods within the influence zones of metro, BRT and other high-capacity transit corridors, with a strong focus on affordable and inclusive development. The policy's vision (Figure 2-11) is to shift Indian cities from car-oriented sprawl to public-transport-oriented, high-density, low-carbon urban form. Key objectives include reducing private vehicle ownership, cutting congestion and pollution, improving access to jobs and services by public transport, and integrating affordable/EWS housing within walking distance of transit.

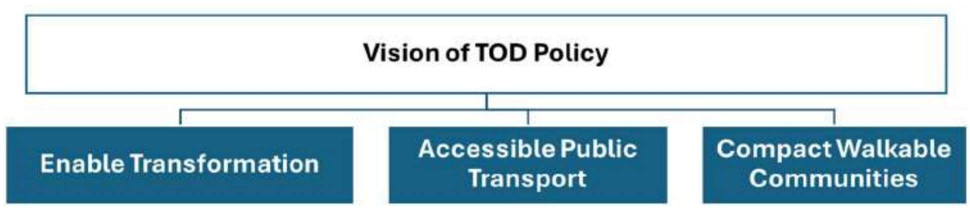


Figure 2-11 Vision of TOD Policy
Source: National TOD Policy document published by the Ministry of Housing & Urban Affairs (Government of India)

2.5 Comparison of State TOD Policies

The Table 2-2 below compares TOD guidelines for different states in India.

Table 2-2 Comparison of State TOD Policies/TOD Plans

Parameters	Delhi	Ahmedabad	Bangalore
Development Authority	Delhi Development Authority	Ahmedabad Urban Development Authority	Bangalore Development Authority
Scale of TOD	MRT Station	BRT corridor, proposed MRT corridor	MRT corridor
Approach	Centralized approach	Market-friendly approach	NA
Influence Zone Area	800 m around transit station, intense	200 m on either side along BRTS,	500 m on either side: Intense TOD zone; 500-

	development area - 500 m around station	proposed metro corridor	1,000 m: standard TOD zone
FSI	Maximum 5 (minimum 3); uniform FSI approach	Maximum 4 (base 1.8), differential FSI approach	Intense TOD zone: 50% more than base FSI; standard TOD zone: 25% more; graded FSI based on distance from transit corridor
Land Use	Minimum FSI for each land use is fixed, remaining FSI as per zonal development plan, strict norms for FSI mix	Decided by market, flexible norms for FSI mix	Minimum FSI for land use is fixed, remaining FSI as per zoning/market demand, slight FSI mix restrictions, flexible based on market
Ground Coverage	Maximum 40%	No ground coverage restrictions apart from required setbacks	Policy does not specify ground coverage limits
Height	No height restrictions	ROW < 60 m: Maximum height 45 m; ROW ≥ 60 m: Maximum height 70 m	No height restrictions
Residential Zone	Mixed use up to 30%	Mixed use based on market	NA
Commercial Zone	Mixed use up to 10%	Mixed use based on market	NA
Public and Semi-public and/or Social	Mixed use up to 10%	Mixed use based on market	NA
Roads	Maximum 20%	Mixed use based on market	NA
Parking	1.33 ECS per 100 sq m of floor area; mandatory	10% parking for bicycles, 50% shared parking, 10% relaxation for commercial parking	1.33 ECS per 100 sq m of floor area
Public Open Spaces	Maximum 20%	Mixed-use based on market	NA

3. STUDY AREA- HYDERABAD, INDIA

Hyderabad's transport scenario is a mix of public and private modes catering to its growing population of over 10 million. The Hyderabad Metro Rail system spans 69 kilometers (km) and connects major areas, easing congestion and reducing travel time. The Telangana State Road Transport Corporation (TGSRTC) also operates an extensive bus network within the Hyderabad metropolitan area with a fleet of around 3,000 buses. However, private vehicle ownership has surged, leading to traffic congestion despite infrastructure like the Outer Ring Road.

Suburban rail services, a multimodal transit system (MMTS) spanning around 123 km provide limited connectivity to peripheral areas. Ride- sharing services like Ola and Uber are popular for first- and last-mile connectivity. Despite growing efforts to promote cycling and walking, nonmotorized transport infrastructure remains underdeveloped.

3.1 Hyderabad Metro Rail

Hyderabad Metro Rail (HMR) is recognized as the world's largest metro rail project developed under a Public-Private Partnership (PPP) model. It aims to transform urban mobility through a well-integrated, modern, and environmentally sustainable transit system. With the city's rapid growth, metro rail and other Mass Rapid Transit Systems (MRTS) have become vital for addressing urban transport challenges.

The HMR system is designed to integrate seamlessly with other modes of transport, featuring eco-friendly operations, skywalks, and metro stations linked to malls, retail spaces, office hubs, and VFS services. This offers commuters a smooth, accessible, and efficient travel experience.

Currently covering a network of 69.2 kilometers, the Hyderabad Metro operates across three corridors:

- Corridor I (Red Line): Miyapur to LB Nagar
- Corridor II (Green Line): JBS to MGBS
- Corridor III (Blue Line): Nagole to Raidurg

With continuous upgrades in infrastructure, energy efficiency, and commuter services, HMR is paving the way for a smarter, greener, and better-connected Hyderabad.

3.2 Context Area: Hyderabad, India

Hyderabad is the capital and largest city of the Indian state of Telangana, located on the Deccan Plateau in southern India. Founded in 1591, it has evolved into a major metropolitan center known for its historical heritage and its modern role as an IT and biotechnology hub. The city proper spans about 650 km² and, as per the 2011 Census, had a population of approximately 6.9 million, making it the fourth-most populous city in India. Including its suburban agglomeration, the Hyderabad metropolitan region had about 9.7 million inhabitants in 2011, a figure which has since grown to over 10 million by the mid-2020s. This rapid growth (around 2.8% annually in recent years, outpacing many other Indian metros) reflects Hyderabad's expanding economy and in-migration.

Hyderabad's urban footprint is undergoing a strategic transformation, guided largely by comprehensive planning and infrastructure investments of the Hyderabad Metropolitan Development Authority (HMDA). City growth is being structured in radial, concentric, and cluster-based patterns. The HMDA Master Plan 2031 envisions radial-concentric development - a core-to-periphery expansion that radiates outward from the historic city center. New urban nodes are planned along radial corridors (for example, Chevella, Sangareddy, Bhongir, Chotuppal, and others) to decentralize development and balance growth across the region. This approach, coupled with concentric ring roads and emerging suburban clusters, aims to manage Hyderabad's expansion in a sustainable, balanced manner.

3.2.1Administrative Areas: GHMC and HMDA Jurisdictions

Administratively, Hyderabad is governed at the city level by the Greater Hyderabad Municipal Corporation (GHMC) and at the metropolitan level by the Hyderabad Metropolitan Development Authority (HMDA). The GHMC oversees civic administration for the core city

("Greater Hyderabad") and is subdivided into six municipal zones (Figure 3-1): Charminar (South Zone), L.B. Nagar (East Zone), Serilingampally (West Zone), Kukatpally (North Zone), Secunderabad (Northeast Zone), and Khairatabad (Central Zone). These zones are further divided into 30 circles and encompass a total of 150 municipal wards. GHMC is responsible for local infrastructure and services - including city roads and drains, town planning and building regulations, parks, solid waste management, and other civic amenities. The GHMC in its present form was created in 2007 by merging the erstwhile Municipal Corporation of Hyderabad with surrounding municipalities, bringing the city area to about 650 km².

The HMDA is the regional planning authority that covers the entire Hyderabad Metropolitan Region. HMDA's jurisdiction extends far beyond the GHMC limits - it is one of the largest metropolitan jurisdictions in India (the second largest by area, after the NCR of Amaravati). As of the 2010s, HMDA oversees about 7,257 km², covering 7 districts around Hyderabad. Specifically, its mandate spans all of Hyderabad District and parts of six adjoining districts: Medchal-Malkajgiri, Rangareddy, Sangareddy, Yadadri Bhuvanagiri, Siddipet, and Medak. Within this area lie 70 *mandals* (sub-districts) and approximately 1,032 villages. In practice, the HMDA encompasses the GHMC area, several municipal towns, and rural hinterlands, making it an apolitical urban planning agency coordinating growth across the metropolitan area. HMDA prepares the Master Plans and major infrastructure projects for the region, and it works in coordination with GHMC and other local bodies to implement plans. The overlapping governance ensures that while GHMC handles everyday municipal functions in the city, HMDA provides strategic regional planning, zoning regulation, and development of large-scale projects.

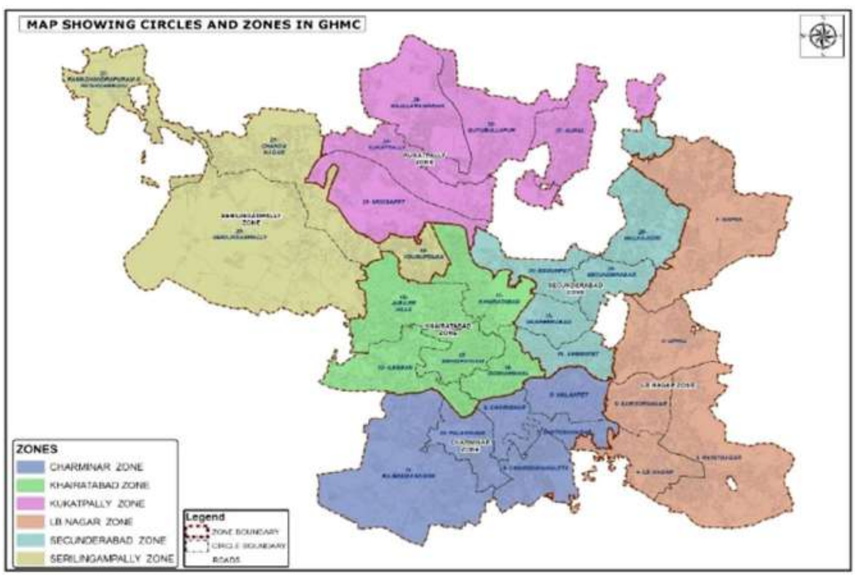


Figure 3-1 Circles and Zones of GHMC

Source: hyderabadmail.com

3.2.2 Regional Context

Hyderabad is the nucleus of a larger Hyderabad Metropolitan Region (HMR), which encompasses the city and its surrounding urbanizing areas across multiple districts. The HMR includes both urban and rural territories under the influence of Hyderabad and is governed and planned by the HMDA. In spatial terms, the metropolitan region spans a vast area (recent estimates put it over 10,000 km² after extensions) and had a population around 10 million by the mid-2020s. This region is not a single contiguous city, but rather a network of Hyderabad and satellite towns, outer suburbs, and intervening rural pockets. Key surrounding municipalities and towns such as Secunderabad, Cyberabad (HITEC City area), Patancheru, Shamshabad, Ghatkesar, and others fall within this metropolitan area.

Administratively, the HMR cuts across several districts as noted above, reflecting Hyderabad's regional pull. The metropolitan region's boundary today reaches well beyond the Outer Ring Road (ORR) and is anticipated to extend outward to the proposed Regional Ring Road (RRR) in the future. This expansion strategy is meant to accommodate rapid urban growth by bringing new peripheral areas into the planned fold. Surrounding district centers and towns (for example, Sangareddy to the west, Bhuvanagiri (Bhongir) to the east, Shankarpalle/Chevella to the west, Shamshabad to the south, etc.) are being integrated as part of a multi-nodal metropolitan structure. The regional context of Hyderabad is therefore characterized by a dominant primary city (Greater Hyderabad) and a constellation of emerging nodes that are connected via highways and rail, all under a unified planning regime. This structure aims to diffuse economic activity and housing across the region, reducing pressure on the city core while fostering development in outlying areas.

3.2.3Demographic profile

Hyderabad's population has grown rapidly in recent decades, transforming it into one of India's most populous urban centers. According to the 2011 Census, the GHMC (city) population was 6.8 million. The broader urban agglomeration (including surrounding municipalities) had about 7.7 million people in 2011, and the metropolitan region (HMDA area) population was roughly 9.7 million. By 2018, the city's estimated population had crossed 9 million, and by 2024 the metro-region population is estimated around 11 million. This makes Hyderabad the sixth-largest metropolitan area in India by population.

Population Density: The core city is very dense, reflecting urban characteristics. The GHMC area (650 km²) has an average density on the order of 18,480 persons per km², with older neighborhoods in the central city far exceeding that average. In contrast, the overall Hyderabad Metropolitan Region - which includes large rural expanses - has an average density below 1,000 persons per km². This highlights the stark urban-rural gradient: the inner city is compact and bustling, whereas the outer areas under HMDA include sparsely populated zones that are still urbanizing.

Urbanization and Growth: Hyderabad's growth rate has been consistently high. In the decade 2001-2011, the city's population boom was partly due to jurisdictional expansion (merging suburbs into GHMC) and natural growth, resulting in a very high decadal increase. In recent years (2020s), the metropolitan population has been growing at roughly 2.5-3% per annum, which is faster than Mumbai or Chennai and slightly higher than Bangalore's growth rate. This robust growth is fueled by Hyderabad's diversified economy (IT, pharma, manufacturing) and its reputation for affordable living costs relative to other metros, which attracts migrants. The urban population of Telangana is heavily concentrated in Hyderabad - the city alone accounts for roughly one-third of the state's urban residents. The city is cosmopolitan, with a mix of linguistic and ethnic communities; Telugu and Urdu are official languages, reflecting the cultural blend. Hyderabad's literacy rates and human development indicators are among the better ones in India, owing to its status as an educational and economic center (though pockets of the old city have lower socio-economic indicators in contrast to the affluent western suburbs). Overall, the demographic profile is one of a growing city: a large working-age population, increasing population density in new growth corridors, and ongoing urbanization of peripheral villages as the city expands.

3.2.4Network Connectivity (Road, Rail, Air, and Metro)

Hyderabad is well-connected both internally and with the rest of India through a network of roads, railways, air routes, and an expanding metro rail system. The city's strategic central location in the Deccan region means it serves as a major transport node in south-central India.

3.2.4.1 Hyderabad Metro Rail

The Government of Telangana has established a special purpose vehicle (SPV) in the form of Hyderabad Metro Rail Limited (HMRL) as a fully owned undertaking. It is handling the largest metro project in the world in a public private partnership (PPP) mode implemented on a design-build-finance-operate-transfer basis; Larsen and Toubro Metro Rail. Hyderabad Private Limited (LTHMRL) is the concessionaire of the project. It spans across following three corridors with a total length of approximately 69 km(Figure 3-2).

- Corridor I (Red Line): Miyapur to LB Nagar (29 kms; 27 stations)
- Corridor II (Green Line): JBS to MGBS (12 kms; 10 stations)
- Corridor III (Blue Line): Nagole to Raidurg (28 kms; 23 stations)

The metro system was developed to cater to the growing transportation needs of the city, which has witnessed rapid urbanization in recent years. The Hyderabad Metro connects key areas of the city, including residential, commercial, and industrial zones, making it a crucial component of the city's transportation infrastructure.

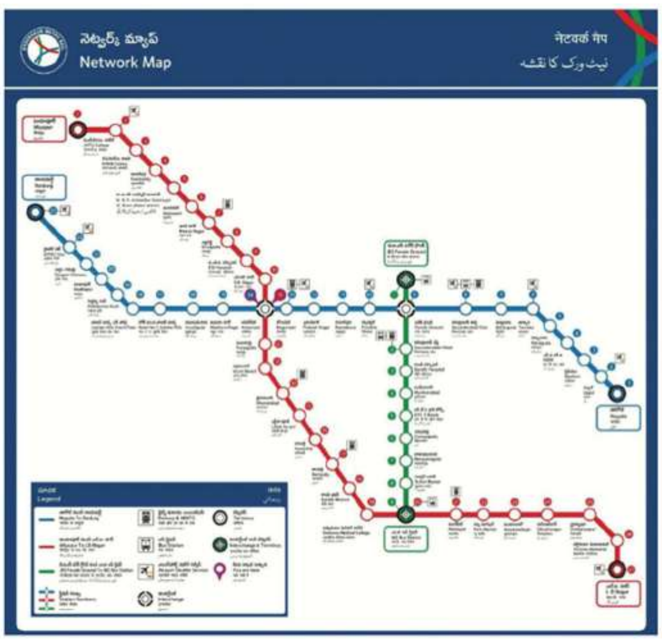


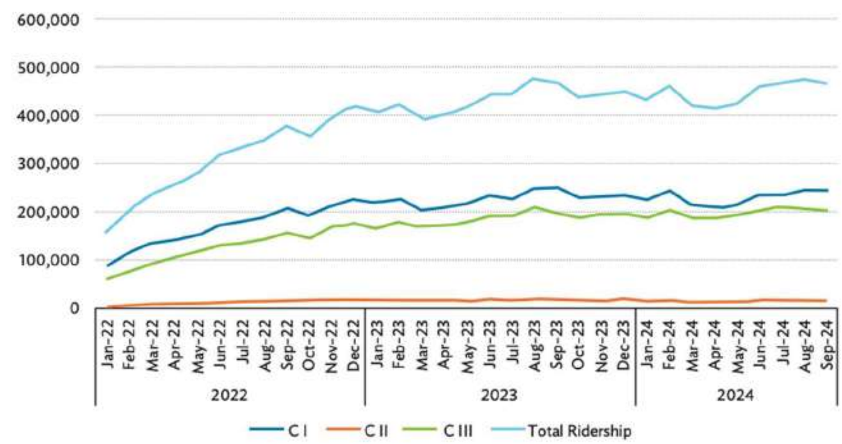
Figure 3-2 Alignment of Hyderabad Metro Corridor

(Source: HMRL)

3.2.4.1.1 Alignment, Ridership, and Stations

The Hyderabad Metro's alignment was strategically planned to connect major employment centers, educational institutions, and residential neighborhoods. The three corridors-Red Line, Blue Line, and Green Line (Figure 3-3)-cover key areas of the city, providing efficient and reliable public transport. The metro system has seen an average daily ridership (Figure 3-4) of over 400,000 passengers, which indicates its importance in meeting the city's transportation needs.

The metro stations are designed to be accessible and user-friendly, with modern amenities and facilities. The stations include features such as elevators, escalators, and ramps, ensuring accessibility for people with disabilities. Additionally, the stations are integrated with other modes of transport, such as bus terminals (at Mahatma Gandi Bus Station and Jubilee Bus Station) the railway network at Secunderabad Railway Station, Nampally Railway Station with MMTS network Begumpet, Bharat Nagar MMTS, and Khairtabad MMTS Station. In addition, the last and first-mile connectivity is provided by auto rickshaws and shared mobility, etc.



C I = Corridor I, C II = Corridor II, C III = Corridor III.

Figure 3-3 Average Daily Ridership for each corridor and Total Daily Ridership across all three corridors

(Source: LTHMRL, 2023)

Corridor	Route (km)	Ridership 2022 (Daily)	Ridership 2024 (Daily)	Percentage Growth (2022-2024) (%)	Passenger per km (2024)
Corridor I	29	167,828	230,690	37.46	8,000
Corridor II	12	12,935	16,564	28.05	1,400
Corridor III	28	126,541	198,745	57.06	7,000

Note: Overall, the average trip length is 12 kilometer (km) and average fare is ₹37.

Figure 3-4 Ridership Trends across corridors

(Source: LTHMRL, 2023)

3.2.4.2 Network Connectivity (Road, Rail, Air, and Metro)

3.2.4.2.1 Roadway Connectivity:

Ring Roads and Expressways

Hyderabad's road infrastructure has seen major upgrades to keep pace with urban growth. The ring roads and expressways are critical components of the city's transport system:

- **Outer Ring Road (ORR):** The ORR is a flagship project of HMDA and a backbone for regional road transport. It is a 158 km, 8-lane access-controlled expressway forming a giant loop around Hyderabad. The ORR passes through or near towns like Patancheru, Shamshabad, Hayathnagar, Ghatkesar, and Medchal, encircling the metro. Designed for high-speed travel (permissible speeds up to 100-120 km/h), it has dramatically reduced travel times around the city. For example, someone driving from the northern suburb of Medchal to the western IT area of Gachibowli can take ORR and bypass city traffic entirely. ORR interchanges connect with all the major radial highways, effectively acting as a beltway that distributes traffic and diverts heavy vehicles away from city roads. Along ORR, growth corridors have been planned (for logistics, commercial, and residential projects at certain exits). The ORR was fully completed by 2018 and also features service roads and a planned cycle track in some stretches. It stands as a key infrastructure facilitating Hyderabad's *concentric expansion* model.

- **Inner Ring Road (IRR):** Closer to the city, the Inner Ring Road is an amalgamation of key arterial roads approximately 50 km in length that form a secondary loop. It runs through areas like Mehdipatnam, Khairatabad, RTC X Roads, and circles around to connect back near Secunderabad. The IRR helps channel cross-city traffic so that vehicles can go from one end of the city to another without entering the congested core. Parts of the IRR are being upgraded to signal-free corridors through grade separators. It's not a continuous grade-separated expressway like ORR, but an important arterial system.
- **Expressways/ Flyovers:** In addition to ring roads, Hyderabad has invested in several expressway segments and a network of flyovers under the "Strategic Road Development Plan (SRDP)" by GHMC. The P.V. Narasimha Rao (PVNR) Expressway, as mentioned, is a notable 11.6 km elevated expressway connecting Mehdipatnam area to the International Airport at Shamshabad. It allows airport-bound traffic to bypass 20+ traffic junctions, cutting travel time. Similarly, a series of flyovers and underpasses have been built at major intersections (for example, multiple two-level flyovers in the Hitec City area, Biodiversity Junction, Mindspace, etc., and at intersections along the Inner Ring Road) to enable smoother flow. There is also the Nagole Flyover and others which function like mini-expressways for particular stretches. Furthermore, a proposal for a Regional Ring Road (RRR), roughly 30 km beyond the ORR, is in planning - it would be a ~330 km circuit intended to eventually form a third ring to accommodate future growth and connect satellite towns, enhancing inter-city connectivity around Hyderabad.

City Bus Services (TSRTC)

Buses have long been the backbone of public transport in Hyderabad. The Telangana State Road Transport Corporation (TSRTC) operates an extensive city bus network in the Greater Hyderabad region. Key points about the bus system:

- **Network Coverage:** TSRTC's Greater Hyderabad zone runs hundreds of routes crisscrossing the city and suburbs. Approximately 3,151 buses are in operation for city services daily, making around 32,422 trips and carrying about 2.5 million passengers per day on average. These buses connect virtually every neighborhood, from central areas to peripheral colonies, and also provide links to suburbs and outgrowths beyond the GHMC limits. The network is hub-and-spoke to some extent - major bus stations/terminals like Mahatma Gandhi Bus Station, Jubilee Bus Station, Mehdipatnam, Koti, Secunderabad, Ameerpet, etc., act as hubs where many routes originate or terminate.

- **Bus Types:** The fleet includes ordinary city buses, Metro Express and Metro Deluxe services (with limited stops for faster travel), AC buses branded “Metro Luxury”, and special services. One notable service is the “Pushpak - Airport Liner” buses which provide dedicated air-conditioned connectivity from various city points to the airport. As of 2025, TSRTC has also been adding electric buses to its city fleet; hundreds of electric buses are being deployed to move towards greener transit. The fleet operations are divided among multiple depots across the city for efficient management.
- **Ridership and Initiatives:** Daily ridership on Hyderabad’s city buses has historically been in the range of 2-3 million, though recent initiatives (like the state government’s scheme of free bus travel for women launched in late 2023) have given a significant boost to usage. TSRTC is continuously working on improving services-introducing a mobile app “TGSRTC Gamyam” for real-time bus tracking, deploying more buses to newly developed colonies, and upgrading bus stops. Despite increasing private vehicles, buses remain crucial for low- and middle-income commuters. The affordability (fares as low as ₹5 for short hops) and extensive reach of the bus system ensure it carries the largest share of public transport trips in the city daily. TSRTC also coordinates with GHMC and traffic police to create dedicated bus lanes on some busy stretches (pilot tested on corridors like KPHB to Cyber Towers) to improve speed.

3.2.4.2.2 Rail Connectivity:

Hyderabad is an important rail junction on the Indian Railways network. The metropolitan area is served by multiple major railway stations - the twin city of Secunderabad Junction (SC) is one of India’s largest and a divisional headquarters for South Central Railway, while Hyderabad Deccan (Nampally) station lies in the old city, and Kacheguda station in the east - all three are important passenger terminals. These stations collectively connect Hyderabad to all parts of the country via long-distance trains. For instance, there are direct rail links from Hyderabad/Secunderabad to Delhi, Mumbai, Chennai, Bengaluru, Kolkata, and other major cities. Secunderabad is a key intersection for north-south and east-west rail routes. In addition, numerous smaller stations around the city handle suburban and regional traffic (e.g., Lingampalli, Begumpet, Falaknuma, etc.). This heavy rail connectivity not only serves inter-city travel but also supports a suburban commuter system (MMTS, discussed later). The presence of multiple rail routes and junctions has historically made Hyderabad a transit point for trade and movement across central India.

MMTS-Suburban Rail (Multi-Modal Transport System)

Hyderabad’s Multi-Modal Transport System (MMTS) is a suburban rail network that supplements the metro and bus services, primarily serving the twin cities of Hyderabad and Secunderabad and some suburban areas. It is essentially a commuter rail service running on existing Indian Railways tracks, jointly operated by South Central Railway and the Telangana state. Key features:

- **Network and Phases:** MMTS Phase I was introduced in 2003, covering about 44 km with routes along two main corridors: Lingampally-Hyderabad (city’s western IT area to the old city station) and Lingampally-Falaknuma (western IT hub to southern old city) via Secunderabad, as well as Hyderabad-Secunderabad. Phase I had 27 stations and served important hubs including HITEC City, Begumpet, Necklace Road, Malakpet, etc. Phase II, long delayed, was finally completed in 2023, adding around 90 km of additional routes. Phase II extended MMTS service to more distant suburbs like Medchal (north), Umdanagar (south, near airport), Ghatkesar (east), and

Shankarpalli (west) by utilizing existing railway lines and adding new stations. With this expansion, MMTS now spans roughly 135 km over multiple routes and has around 70+ stations in total.

- **Ridership and Service:** The MMTS trains, commonly 6 to 9 coaches, run with a frequency of 30 minutes to 1 hour on each route. They are designed for intra-city travel but have longer spacing between stations than the metro. The fare is highly subsidized - tickets range from about ₹5 to ₹15 for most trips, making it the cheapest mode of motorized transport. Daily ridership pre-COVID for Phase I hovered around 150,000 passengers; with Phase II operational, the combined MMTS network is estimated to serve between 1.5 to 3 lakh (150k-300k) commuters per day. The wide range accounts for potential ridership increases as new sections mature. MMTS is particularly useful for longer-distance commuters (for example, from Secunderabad to distant suburbs like Medchal or from Lingampally to Falaknuma) and for decongesting roads. It integrates with other systems: several MMTS stations coincide with metro stations (e.g., at Ameerpet, Falaknuma (future), Nampally, etc.) and with bus terminals, providing multi-modal connectivity.
- **Challenges:** While MMTS is a valuable addition, its usage has been limited by factors like longer intervals between trains, less coverage in core areas (the metro now overlaps some of its function), and the delay in phase II. Efforts are on to improve frequency and last-mile connectivity at stations. Nonetheless, as an affordable rail-based option, it significantly benefits daily commuters, especially in areas not yet covered by the metro. Going forward, there are proposals to integrate MMTS into a larger suburban rail network for the Hyderabad region (sometimes dubbed “Hyderabad Circular Railway” concept) if feasibility and funding allow.

3.2.4.2.3 Air Connectivity:

Air connectivity for Hyderabad is primarily handled by the Rajiv Gandhi International Airport (RGIA), with a secondary role played by the old Begumpet Airport for non-commercial operations:

- **Rajiv Gandhi International Airport (RGIA):** Opened in 2008 at Shamshabad, RGIA replaced Begumpet as the main airport. It is one of India’s busiest and best-rated airports, consistently ranking in the top for service quality. As noted, RGIA is the 6th busiest airport in India by passenger volume. The airport features a modern terminal with 12 million passenger per annum capacity (currently being expanded to handle ~34 million per annum in the next phase). It serves ~70+ destinations worldwide (pre-pandemic), including nonstop long-haul flights to Europe and the Middle East, and one-stop connections onward to the Americas and East Asia via hubs. Domestic connectivity is excellent, with high frequencies to all Indian metros and tier-2 cities. For cargo, RGIA has a dedicated cargo terminal, making it a cargo hub as well. Notably, the airport’s south location spurred the development of road infrastructure like the PVNR Expressway and has been the center of an Aerotropolis, with logistics parks, hotels, and business zones emerging in its vicinity. The airport is approximately 20-25 km from the city center, reachable via the ORR and NH-44. Public transport to the airport is provided by Pushpak Airport buses from various city points and there are plans for a direct Airport Metro Rail link by 2028.
- **Begumpet Airport:** This airport is located in the heart of the city. It was Hyderabad’s commercial airport until 2008 when it was shut for passenger flights. Today, Begumpet

is used by the Indian Air Force, as well as for VIP flights, general aviation, and pilot training. It has a much shorter runway and cannot handle large modern jets regularly. No scheduled airlines fly from Begumpet now. However, its presence means Hyderabad has an additional airfield for emergency use or special purposes. The Master Plan preserves Begumpet's area largely as an aviation/aerospace zone (and there have been talks of converting parts of it into a possible aviation museum or business district, though nothing concrete has materialized). In practical terms, travelers all use RGIA, but the existence of Begumpet Airport is sometimes leveraged for city events (e.g., air shows, defense expo) given its accessible location.

3.2.4.2.4 Metro (Urban Rail) Connectivity:

Hyderabad's internal connectivity was historically road-dominated, but since 2017 the Hyderabad Metro Rail has become a game-changer for intra-city travel. The metro network currently consists of three lines (Red, Green, and Blue), all fully elevated, spanning a total of about 69 km across the city. There are 57 stations in operation, covering key areas of the city and offering park-and-ride and feeder services at many stops. The Metro connects major residential and commercial nodes: for example, the Red Line runs from Miyapur (northwest) to LB Nagar (southeast) covering the dense core, the Blue Line from Raidurg (HITEC City area in the west) to Nagole (east) connecting IT hubs to residential zones, and the Green Line links Jubilee Bus Station in Secunderabad to Falaknuma in the old city (though a southern extension is pending). Metro rail has greatly improved east-west and north-south connectivity, cutting travel times that were previously very long by road. As of mid-2023, daily ridership on the metro was around 5.36 lakh (536,000) passengers, reflecting its popularity as the third-longest metro system in India by route length. The metro is integrated with other transport modes - for instance, several metro stations interface with MMTS (Multi-Modal Transport System) suburban rail stations and major bus terminals, facilitating transfers. Overall, the metro has added a high-capacity, rapid transit option that complements the road network and is gradually expanding-plans are in place to extend lines and add a new airport express line in the coming years.

3.2.5Land Use

Existing Land Use Patterns: Hyderabad's land use is a mix of historical urban fabric and planned new development (Figure 3-5). The older parts of the city (the historic core around Charminar and along the Musi River) are densely built, with a predominance of mixed-use areas - narrow residential neighborhoods entwined with traditional bazaars and small-scale commerce. As the city expanded, newer planned areas were developed, especially towards the west and northwest. The city's land use today can be broadly characterized as:

Residential: By area, residential use is the largest component, encompassing a variety of housing from old city dense neighborhoods to modern gated communities. Many central zones are high-density residential (often mixed with retail), whereas outer suburbs are rapidly converting from agricultural land to residential townships. It's estimated that roughly *half* of the developed land is residential or community spaces.

Commercial and Institutional: Hyderabad has multiple business districts. The traditional CBD around Abids Nampally Secunderabad hosts government offices, markets, and institutions. In the last two decades, a second major commercial hub has developed in the west (Madhapur-HITEC City-Gachibowli area) focused on IT/ITeS, corporate offices, and finance. Commercial land use (offices, retail, services) makes up roughly a quarter of the land use mix. Large campuses like Universities (Osmania, Hyderabad Central University) and research centers also occupy significant land, especially in the city's periphery.

Industrial: Older industrial estates (e.g., Patancheru, Jeedimetla in the north-west; Cherlapally, Uppal in the east) were set up outside city limits but are now within the urbanized area due to city growth. Additionally, an Hardware/Manufacturing Park exists towards the south (Fab City/Maheshwaram area) and a Pharma City is planned. Many traditional industrial areas near the core (like along the Musi) have given way to other uses or are in transition.

Open/Recreational and Environmental spaces: Hyderabad is dotted with large man-made lakes (such as Hussain Sagar in the center, Osman Sagar and Himayat Sagar to the west, Shamirpet to the north). These water bodies and their catchment areas are protected to some degree, though there are pressures of encroachment. The city also has forested tracts like KBR National Park in Jubilee Hills and the University of Hyderabad campus that act as urban green lungs. Parks, gardens, sports grounds, and the campus areas account for a smaller share (under 10%) of land use but are crucial for livability. Notably, the city's expansion has put open spaces under strain, and the Master Plan emphasizes conserving these natural features.

Transportation and Utilities: A noticeable portion of land is occupied by roads, rail corridors, the airport, etc. The Outer Ring Road corridor itself spans a wide swath of land circling the city.

Overall, current land use is characterized by polycentric development - a high-density old city and Secunderabad, a newer business core in the west (Cyberabad area), and other sub-centers (like Kukatpally, LB Nagar, etc.) all connected by major roads. The urban form is a blend of radial corridors and ring roads with clusters of intense land use around transport nodes.

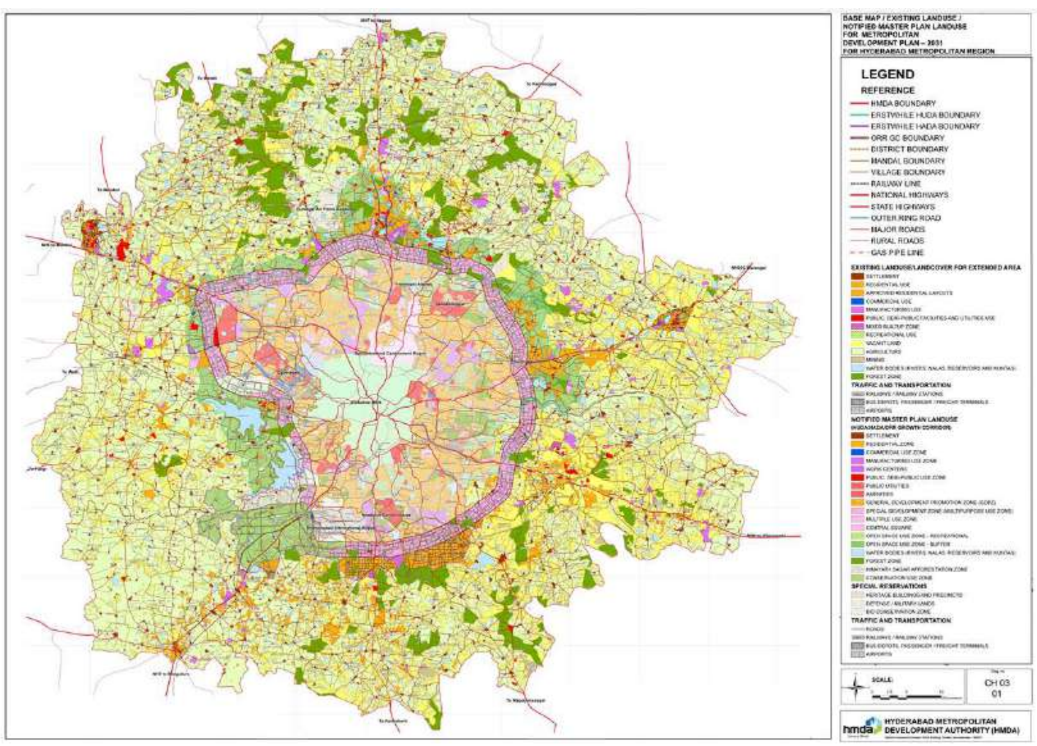


Figure 3-5 Existing Land use-2020

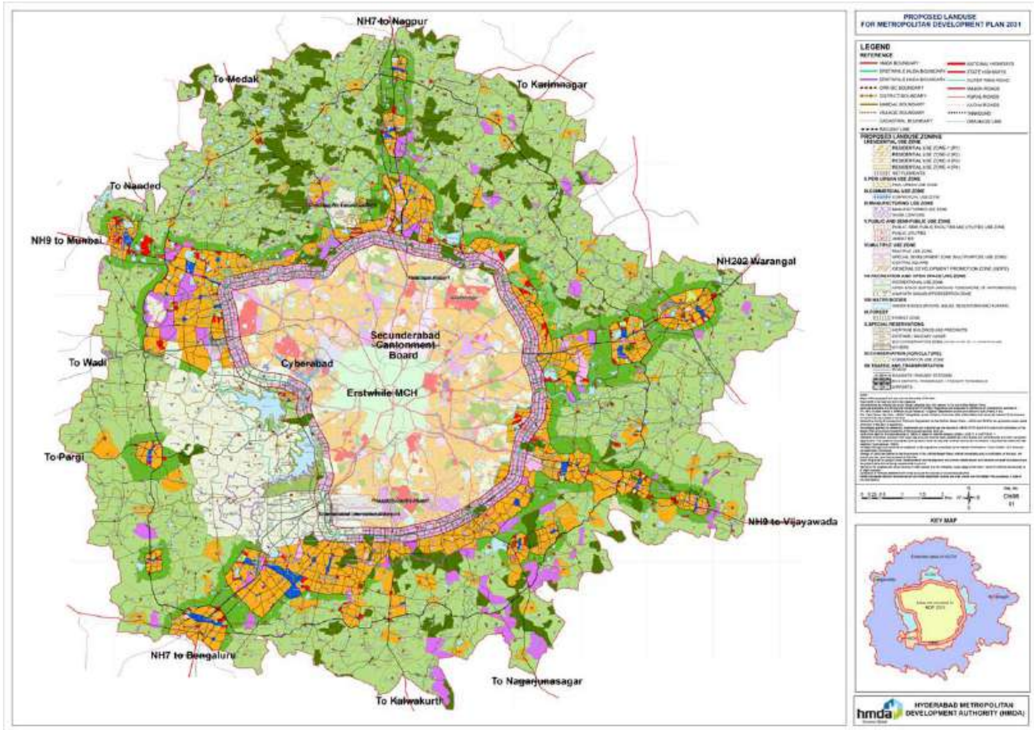


Figure 3-6 Proposed Land use-2031

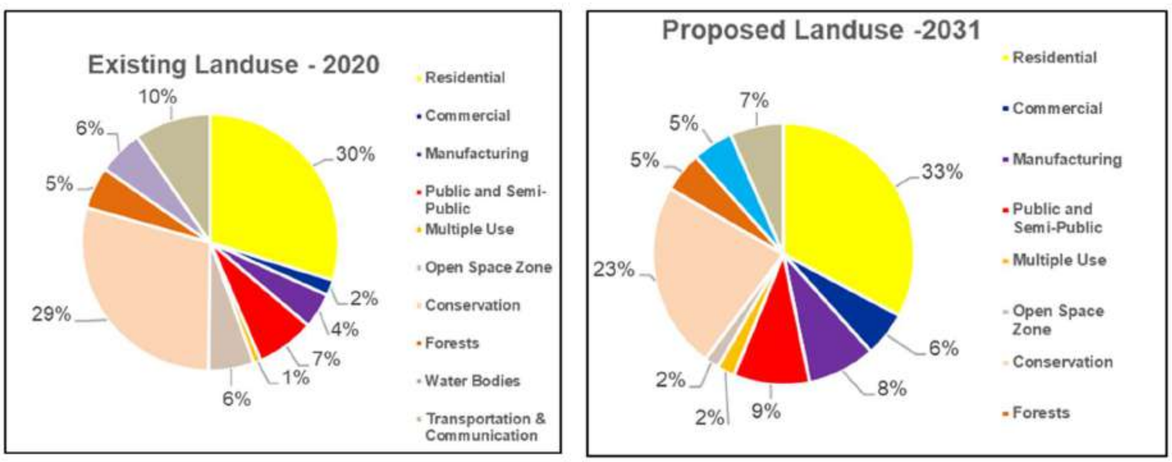


Figure 3-7 Figure 62 Existing Land use - 2020 - Area & Proposed Land use - 2031-Area

Master Plan 2031: The HMDA Master Plan 2031 is the guiding framework for land use and infrastructure development in the Hyderabad Metropolitan Region up to the year 2031(Figure 3-6). It provides a strategic vision to accommodate growth while ensuring sustainable and orderly development.

Key features of the Master Plan 2031 include:

- **Structured Expansion:** The plan reinforces radial-concentric expansion. As noted, it proposes development of new urban nodes along radial corridors emanating from Hyderabad. Towns like Chevella (west), Sangareddy (northwest), Bhongir (east), Shadnagar/Kandukur (south) and others are earmarked as growth centers. This is to create counter-magnets so that population and economic activities do not congest only the core city but spread outward. The ORR and a future RRR are used as delineators for phased urban expansion - areas within ORR are to be consolidated by 2031, while areas between ORR and RRR are for longer-term growth (some of which is now being considered in a prospective Master Plan 2041/2050 as well).

- **Land Use Zoning:** The plan introduces a detailed zoning regulation for the metropolitan area. There are about a dozen land use zones defined, including multiple categories of residential zones (R1 to R4 of varying densities), commercial zones, industrial zones, transportation zones, public/semi-public use, open space/recreational zone, conservation (forests, water bodies) etc. (Figure 3-7) Each zone has development control rules regarding FSI (Floor Space Index), building heights, and usage.
- **Infrastructure Emphasis:** Master Plan 2031 is closely tied with major infrastructure projects. It incorporates the completion of the Outer Ring Road, expansion of the metro rail network, creation of Bus Rapid Transit (BRT) routes, new arterial roads to connect emerging suburbs, and improvements in utilities like water supply and sewerage. For example, it lists projects such as expanding the ORR (which was completed in 2018) and a planned Integrated Bus Rapid Transit system on select corridors. The plan also proposes new logistics hubs and truck terminals outside the city to relocate goods traffic, and emphasizes preserving the network of lakes by designating buffer zones around them.
- **Policy Initiatives:** The plan embeds sustainable practices - protection of blue-green network (water bodies and greenery) is highlighted, and development around lakes is restricted to prevent flooding and pollution. It also encourages Transit-Oriented Development (TOD) around metro stations and major transit nodes, with higher permissible densities in those influence zones to promote public transport usage. Another aspect is affordable housing zones to accommodate all income groups. The plan identifies certain areas for future affordable housing projects and slum redevelopment, integrating them into the city fabric.
- **Phased Development and Review:** Master Plan 2031 is intended to be implemented in phases, with periodic review. Given that Hyderabad’s context is dynamic (for instance, Telangana was formed as a new state in 2014, after the plan’s formulation, leading to new priorities), the plan is a living document. In fact, by 2025, the government has initiated steps to formulate a *Master Plan 2041/2050*, extending the vision further and possibly expanding HMDA limits to the RRR. Nonetheless, the 2031 Plan remains the operative blueprint, and most development permissions and land conversions must conform to this plan’s zoning and road network proposals.

3.3 Selection of Station Areas

The selection of case study stations for Transit-Oriented Development (TOD) in Hyderabad was guided by a structured, multi-criteria evaluation framework rooted in global best practices. A fundamental approach adopted in the initial screening was the 3V framework (Figure 3-8), which evaluates stations along three core dimensions:

- **Node Value:** Reflecting the strength of transport connectivity, multimodal integration, and potential ridership. Stations were assessed for their role as transit interchanges, frequency of services, and accessibility across multiple modes including metro, bus, and intermediate public transport.

- **Place Value:** Capturing the intensity and diversity of surrounding land uses, built environment quality, and public realm conditions. This includes metrics such as built density, mix of uses, availability of public spaces, and walkability.
- **Market Value:** Considering the area's real estate activity, development potential, and the scope for land value capture. Areas with rising land demand or ongoing commercial/institutional development were seen as favorable under this dimension.

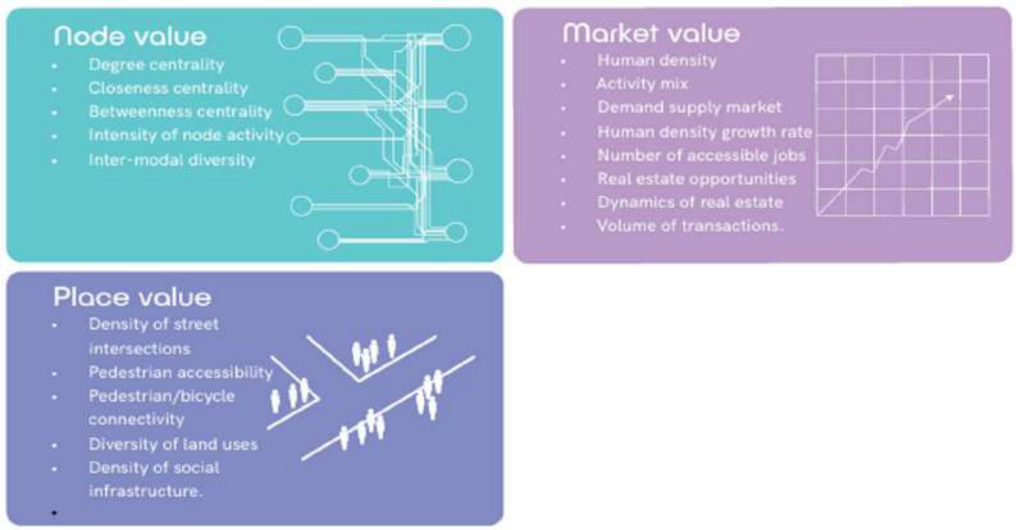


Figure 3-8 Node-Place-Market Framework for TOD Evaluation

Source: LAP for TOD Handbook (2022)

3.3.1Quantitative Scoring Framework

To complement the 3V assessment, a comprehensive parameter-based scoring matrix was applied for evaluating the TOD suitability of all metro stations. This scoring method involved assigning codified values ranging from 1 to 3 for each criterion, enabling transparent comparison across stations. The framework measured performance under three core attributes-Node Value, Place Value, and Market Value-ensuring that both transit accessibility and urban development potential were objectively reflected in the final ranking. Through this system, every station was evaluated numerically, and the combined coded values formed the overall suitability score that guided the shortlisting process.

3.3.2Node Value Scoring Parameters

The Node Value assessment focuses on evaluating the level of transit accessibility and connectivity offered by stations within the network. Key parameters (Figure 3-9) such as major mass transit linkages (Table 3-1), spacing between adjacent stations (Table 3-2), travel time to primary activity centers and current ridership (Table 3-4) levels were analysed against predetermined threshold values. Wider station spacing and longer travel times to the Central Business District (CBD) result in higher coded scores, indicating greater opportunity for future development and increased transit utilization. Likewise, stations with lower existing ridership or limited feeder connectivity scored higher, signifying untapped potential. Complementary transport modes (Table 3-5)-including buses, autos, shared mobility, and IPT facilities-were also assessed, with stations offering fewer modal choices assigned higher scores due to the scope for intermodal enhancement. Overall, the Node Value framework highlights how effectively a station integrates with the broader mobility network while identifying critical gaps to be addressed for improving accessibility and transit-oriented transformation.

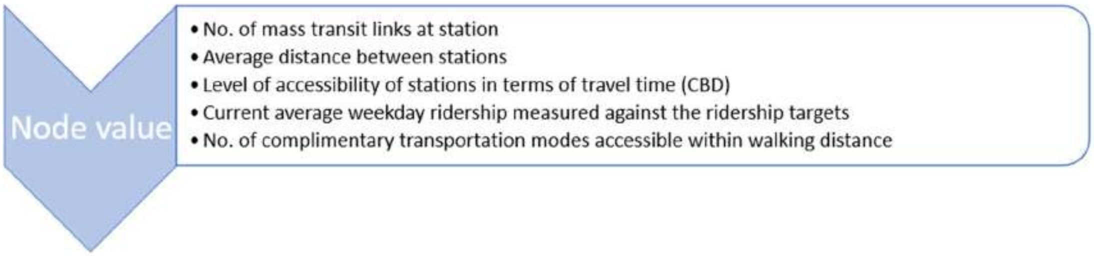


Figure 3-9 Node value

Table 3-1 Scoring logic - No. of mass transit links at station

No. of mass transit links at station		
	Description	**Code**
Low	No connection	1
High	2	0

Table 3-2 Scoring logic - Average distance between stations

Average distance between stations		
	Description	**Code**
Low	> 2 km	3
Medium	800mts-2km	2
High	400-800mts	1

Table 3-3 Scoring logic - Distance from CBD

Distance from CBD		
	Description	**Code**
Low	more than 15 min	3
Medium	in 15 min	2
High	less than 15 min	1

Table 3-4 Scoring logic - Ridership

Ridership		
	Description	**Code**
Low	0-4	3
Medium	4-7%	2
High	7-10%	1

Table 3-5 Scoring logic - Complimentary transportation modes

Complimentary transportation modes

	Description	Code
Low	1 mode	3
Medium	2 modes	2
High	3 modes	1

3.3.3Place Value Scoring Parameters

Place Value parameters (Figure 3-10) examine the physical and functional characteristics of the built environment within 500 m pedestrian-accessible radius around each station. Key indicators include the density(Table 3-8) and connectivity of the road network(Table 3-6), presence of trip-attracting and trip-generating land uses (Table 3-7) such as commercial, institutional, and mixed-use activities, and the level of urbanisation measured through NDBI values (Table 3-9). Areas with well-distributed active land uses and higher node counts were scored higher, as they demonstrate strong place intensity and support for daily transit ridership. In contrast, stations located in environments with excessively high built-up densities, limited road permeability, or weak land-use diversity were assigned lower scores, reflecting challenges in ensuring walkability and public realm enhancements. Overall, the Place Value assessment highlights how the existing spatial structure and land-use configuration influence accessibility, vibrancy, and readiness for future TOD-oriented redevelopment around station areas.

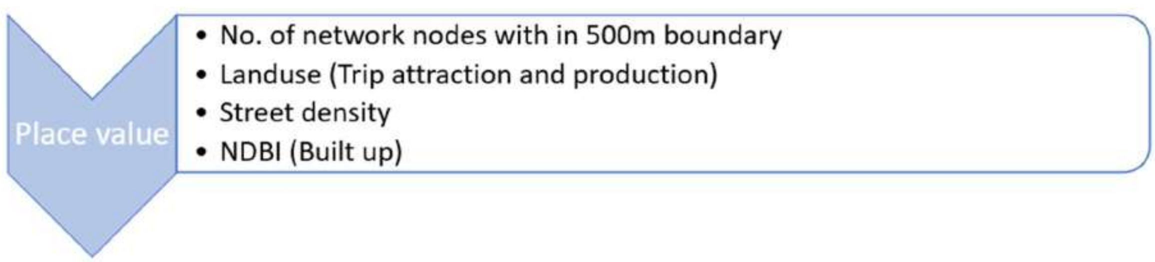


Figure 3-10 Place value

Table 3-6 Scoring logic - Network nodes (number)

Network nodes (number)		
	Description	**Code**
Low	197-464	3
Medium	464-731	2
High	731-998	1

Table 3-7 Scoring logic - Trip attraction and production Land Use

Trip attraction and production Land Use		
	Description	**Code**
Low	11-38%	1
Medium	38-65%	2
High	65-93%	3

Table 3-8 Scoring logic - Road Density (km/sq.km)

Road Density (km/sq.km)		
	Description	**Code**
Low	15-21	3
Medium	21-27	2
High	27-33	1

Table 3-9 Scoring logic - NDBI (built area %)

NDBI (built area %)		
	Description	**Code**
Low	35-54%	3
Medium	54-73%	2
High	73-92%	1

3.3.4 Market Value Scoring Parameters

The Market Value assessment (Figure 3-11) examined land price variations around each station to evaluate development feasibility and economic attractiveness. Station areas with comparatively lower prevailing land values were assigned higher scores, as they offer greater potential for transformative redevelopment with reduced acquisition costs and minimal risk of displacement(Table 3-10). These locations present more flexibility for introducing high-density, mixed-use development as part of TOD implementation. Conversely, stations situated in zones where land values are already high received lower scores, reflecting limited economic viability for large-scale interventions and the possibility of affordability challenges. Integrating market dynamics into the evaluation framework thus ensured that shortlisted stations represented financially practical and socially balanced opportunities for TOD, aligning development potential with equitable urban growth objectives.

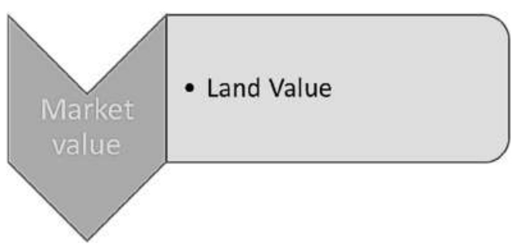


Figure 3-11 Market Value

Table 3-10 Scoring logic - Land Values

Land Values		
	Description	**Code**
Low	< 10k	3
Medium	10 -30k	2

High	>30k	1

3.3.5Finalization of Case Areas

Upon completion of the scoring process, all 57 metro stations were classified into distance-based rings from Nampally Railway Station-the city's core-to ensure spatial diversity in the analysis. Four distance bands were considered: 0-8 km, 8-12 km, representing varying levels of urban development intensity. Within each band, stations were ranked based on their combined TOD suitability scores derived from Node, Place, and Market Value assessments.

To capture contrasting planning challenges and redevelopment opportunities, two stations were selected as case areas: one from the inner-urban zone with established development and another from the transitioning outer-urban growth corridor. This systematic and comparative approach ensured that the selected locations provide meaningful insights into how TOD principles can be adapted to different spatial contexts, thereby strengthening the relevance and transferability of LAP-TOD planning strategies across the metro corridor.

3.3.6Site 1: S.R. Nagar

S.R. Nagar recorded the highest overall TOD suitability score (24) (Figure 3-12) within the 0-8 km distance band, making it the most appropriate representative of mid-urban station areas. The station benefits from strong multimodal connectivity, with seamless integration of metro services, bus routes, and intermediate public transport, ensuring efficient accessibility to major employment centers and residential catchments. The surrounding street network is dense, highly connected, and walkable, contributing to superior Place Value by enabling smooth pedestrian movement and shorter access trips. In addition, the presence of diverse, trip-attracting land uses-including commercial establishments, institutional facilities, and mixed residential blocks-supports consistently high ridership levels. The area is already characterised by a well-established urban fabric, reducing the need for extensive structural intervention while still offering scope for gradual densification and urban realm enhancement. Together, these factors position S.R. Nagar as an ideal case for demonstrating TOD-LAP planning in a well-established urban context.

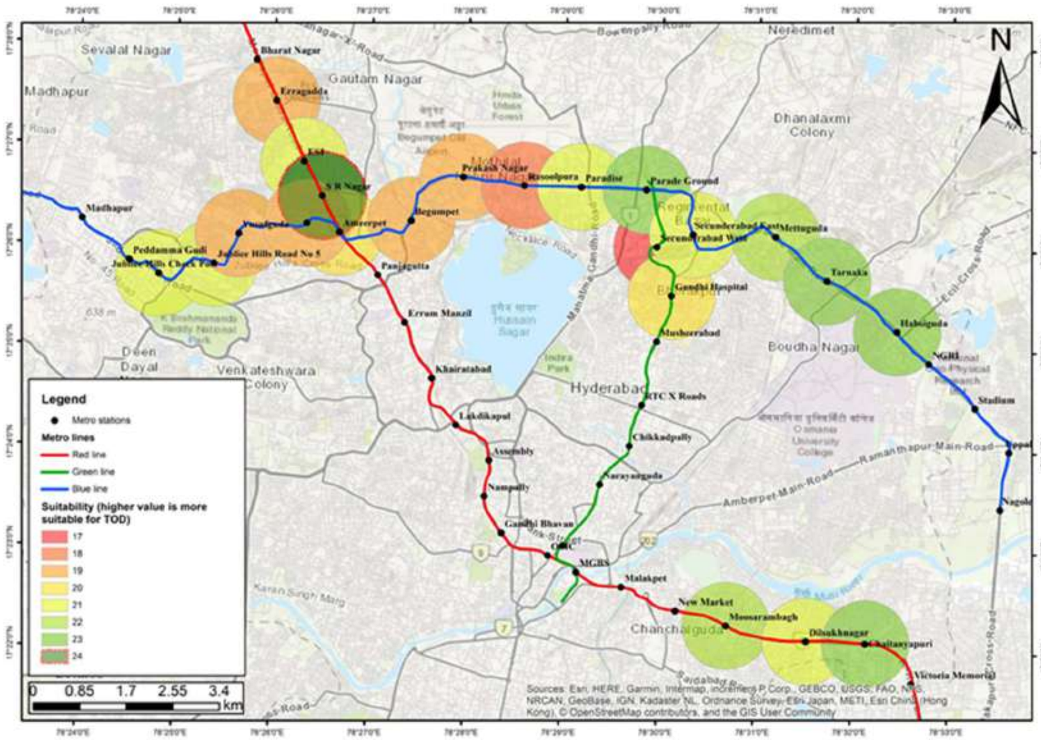


Figure 3-12 SR Nagar Station (0-8 kms buffer)

Source: Project Team, SPAV

3.3.7Site 2: L.B. Nagar

L.B. Nagar achieved the highest overall TOD suitability score within the 8-12 km band (Figure 3-13), primarily due to its strategic role as the southern terminal of Corridor-I, where metro services integrate with city and regional bus operations. This strong intermodal accessibility elevates its Node Value, reinforced by high daily ridership and continuous commuter demand. Dense residential neighborhoods and concentrated commercial activity along NH-65 contribute to substantial Place Value, generating active urban edges and trip-attracting functions. The area also reflects clear redevelopment momentum, with ongoing transformation toward high-rise mixed-use development near the metro corridor. However, current mobility gaps-such as limited pedestrian facilities and a high share of narrow streets-present strong justification for TOD-oriented public realm upgrades. Additionally, available vacant and convertible land parcels in the vicinity provide opportunities for structured densification. Collectively, these characteristics position L.B. Nagar as an ideal case for demonstrating TOD strategies in a rapidly urbanizing, high-mobility outer-urban context.

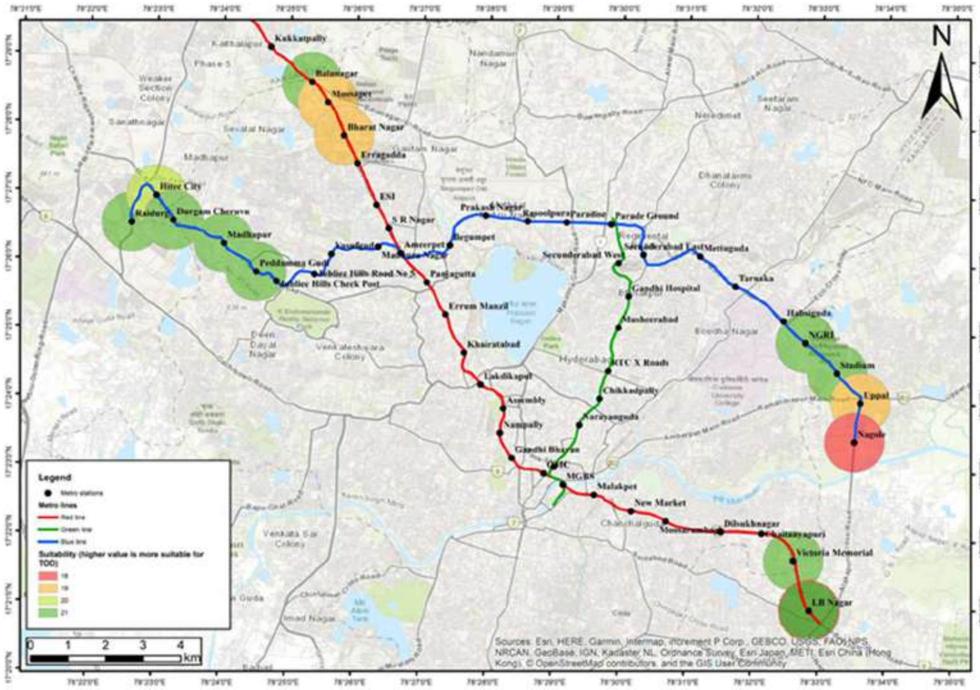


Figure 3-13 LB Nagar Station (8-12 kms buffer)

Source: Project Team, SPAV

3.3.8b) Approach for delineation of Influence Zone

Defining the boundaries of the metro station influence zones involved two conceptual approaches. The first approach is morphological, using the road network to determine logical boundaries, while the second approach considers plot size and development patterns as criteria for inclusion. Both LB Nagar and SR Nagar were evaluated with these approaches to arrive at a delineation that balances proximity with practical on-the-ground divisions.

Approach 1: Road Network and Block-Based Delineation - This delineation method begins with establishing a standard radial buffer of 500 m around the metro station, representing the primary Transit-Oriented Development (TOD) influence zone. Rather than applying this buffer rigidly, the boundary is subsequently modified to align with the existing street and block structure of the surrounding urban fabric. Blocks are delineated using roads with a minimum right-of-way of 9 m as defining edges, recognizing these corridors as legible, functional, and administratively enforceable boundaries. Where the circular buffer intersects a block, the entire block is included within the influence zone, resulting in the boundary “snapping outward” to the farthest block edge and avoiding the subdivision of blocks. In both S.R. Nagar and L.B. Nagar, the 500 m influence zone has thus been reshaped based on overlapping blocks, ensuring continuity and preventing fragmentation of regulatory control.

This block-responsive approach has been applied in TOD-based Local Area Planning exercises, notably in the Lower Parel-Elphinstone Road precinct in Mumbai, where influence zones were adjusted to follow block edges and arterial road hierarchies rather than strict geometric buffers. Such an approach ensures that the delineated planning area respects the inherent grain and hierarchy of the city. Using recognizable road edges as boundaries is particularly advantageous for Local Area Plans (LAPs), as it enables uniform application of development controls, mobility interventions, and public-realm improvements across entire blocks, thereby supporting cohesive, implementable, and enforceable TOD planning outcomes.

Approach 2: Plot Size and Built-Form Criteria - The second delineation method refines the station influence zone based on the morphological character of the built environment, rather than relying solely on radial distance or road alignment. This approach evaluates plot sizes, land-use intensity, and the continuity of pedestrian-oriented built form to determine which areas genuinely function as part of the station's effective walkable catchment. The underlying premise is that not all land within a geometric buffer contributes equally to transit use; instead, areas with fine-grained plots, dense built-up fabric, and active, trip-attracting land uses play a more direct role in supporting metro ridership.

In practice, this involves identifying clusters of small to medium plot sizes, high building coverage, mixed or commercial land uses, and continuous active frontages that sustain pedestrian movement toward the station. Such areas are retained within the Influence Zone even where they extend marginally beyond the nominal buffer distance. Conversely, peripheral tracts comprising large institutional campuses, industrial estates, vacant parcels, or single-ownership plots significantly exceeding TOD-friendly thresholds may be excluded, as these environments typically lack permeability, active edges, and meaningful last-mile connectivity. As a result, the boundary is allowed to flex inward or outward depending on the functional relationship of a zone to the metro station, rather than its absolute distance alone.

This approach aligns with LAP-TOD guidance that urban blocks within TOD precincts should not exceed 1.5 hectares (15,000 sq.m), reinforcing compact block structures and walkable street networks. Practically, this may lead to trimming portions of the buffer where a single oversized landholding dominates the edge condition, while extending the boundary along linear corridors of vibrant commercial or mixed-use plots where pedestrian activity and transit-supportive functions naturally continue.

This plot- and built-form-based delineation logic has been explicitly applied in the Karkardooma TOD precinct in Delhi, where the influence area was not treated as a uniform 500 m radius. Instead, delineation was informed by block size, development grain, and pedestrian permeability, ensuring that compact mixed-use blocks were prioritized while large, low-permeability parcels were carefully managed or structured for phased redevelopment. The Karkardooma example demonstrates how built-form-sensitive delineation helps align TOD boundaries with areas most capable of supporting walkability, ridership generation, and high-quality public realm outcomes

Implications for TOD Planning: Using block-based boundaries yields a more rational planning unit for the influence zone. It avoids situations where a single property is split by a boundary. It also means planning interventions can be applied uniformly within whole neighborhoods. However, as noted, it can slightly enlarge the area beyond the strict walking distance. This requires TOD plans to pay attention to last-mile connectivity - for instance, areas near the edge of the zone might be 10-12 minutes' walk from the station, which is longer than ideal. TOD planning can mitigate this by proposing better internal paths or cycle-rickshaw services to connect those portions to the station. The delineation of the study area was based on a combination of both block-based and plot/development-based approaches, ensuring a balanced understanding of the station's influence. While the plot-level approach helps identify areas most likely to be directly impacted, the block-based method allows inclusion of peripheral or underutilized parcels that may hold future redevelopment potential. This integrated approach enables a more comprehensive planning framework by capturing both current activity zones and emerging growth areas, while addressing their integration through appropriate planning strategies.

3.3.9Delineation of Study area along Hyderabad metro

Following the station selection, a buffer of 500 m Influence Zone was delineated for both S.R. Nagar and L.B. Nagar, aligning with standard TOD principles. Within these boundaries, detailed digitization of plots, buildings, and road networks was undertaken to understand block structure and accessibility patterns. A minimum road width of 9 m was adopted as the block-forming threshold to ensure service accessibility for public transport, pedestrians, and emergency movement. This approach respected the existing road hierarchy while ensuring that delineated Local Area Plan (LAP) boundaries remained viable for TOD implementation and future mobility improvements.

Delineation Approach (500m Buffer Method)

Step 1: Definition of Station Influence Zone: For each target metro station (S.R. Nagar and L.B. Nagar), the station locations were identified on the city map, and a circular influence zone with a 500-metre radius was established around each station. This fixed 500 m buffer was adopted to uniformly capture the immediate station catchment area, corresponding to an approximate 5-10-minute walking distance.

Step 2: Delineation of the Buffer Boundary: Delineation of the Buffer Boundary: Using available base maps and station coordinates, the study area boundary was delineated by following the minimum f 7 m road network surrounding the metro station, ensuring a realistic and accessible influence area rather than a simple radial buffer.

Step 4: Finalization of Study Area Extent: The final study area for each station was defined by the portions of the identified GHMC wards lying within the 500 m buffer. For reporting and analysis purposes, and given the availability of ward-level datasets, the names of the intersecting wards were listed and their data were used to characterize the study area.

Step 4: Compilation of Area and Population Data: Key spatial and demographic statistics for the delineated areas were compiled. The total geographic area covered by the 500 m buffer was approximately 0.79 km² (around 79 hectares) for each station. Population figures within the study area were estimated using ward-level population data, either by aggregating or proportionally allocating populations of the intersecting wards. As ward populations extended beyond the buffer boundary, the population within the buffer was treated as an estimate, providing a reasonable approximation of the resident and user base.

3.3.10 Final Selected Study Area

3.3.10.1 S.R. Nagar

At SR Nagar, the influence zone delineation considered both but primarily followed Approach 1 (block-based), as explicitly described in the planning documents. The initial 500 m buffer (considered a comfortable walking distance) and the 1500 m buffer (feeder distance) were “reshaped according to the overlapping blocks”. The plot size criteria (Approach 2) in SR Nagar might have been used to ensure that all high-density residential areas near the station were included even if slightly beyond 500 m, while perhaps excluding a few large institutional compounds at the fringe that do not interact strongly with the metro. Indeed, SR Nagar has a notable amount of public/semi-public land (around 31% of the area), some of which comprises big campuses. If one of those lay partially inside 500 m, one could consider only counting the portion likely to generate ridership (e.g., built-up part of campus) - but for simplicity, the block method kept the entire plot inside. The planning justification is that SR Nagar station’s ridership and node influence extend to these institutional uses as well, and including them opens opportunities for long-term redevelopment or integration.

Delineated Study Area around SR Nagar Metro Station (Figure 3-14) illustrating the 500 m Intensive TOD Zone and the 800 m Influence Zone, along with the defined study area boundary and existing road right-of-way hierarchy forming the spatial basis for the Local Area Plan (LAP).

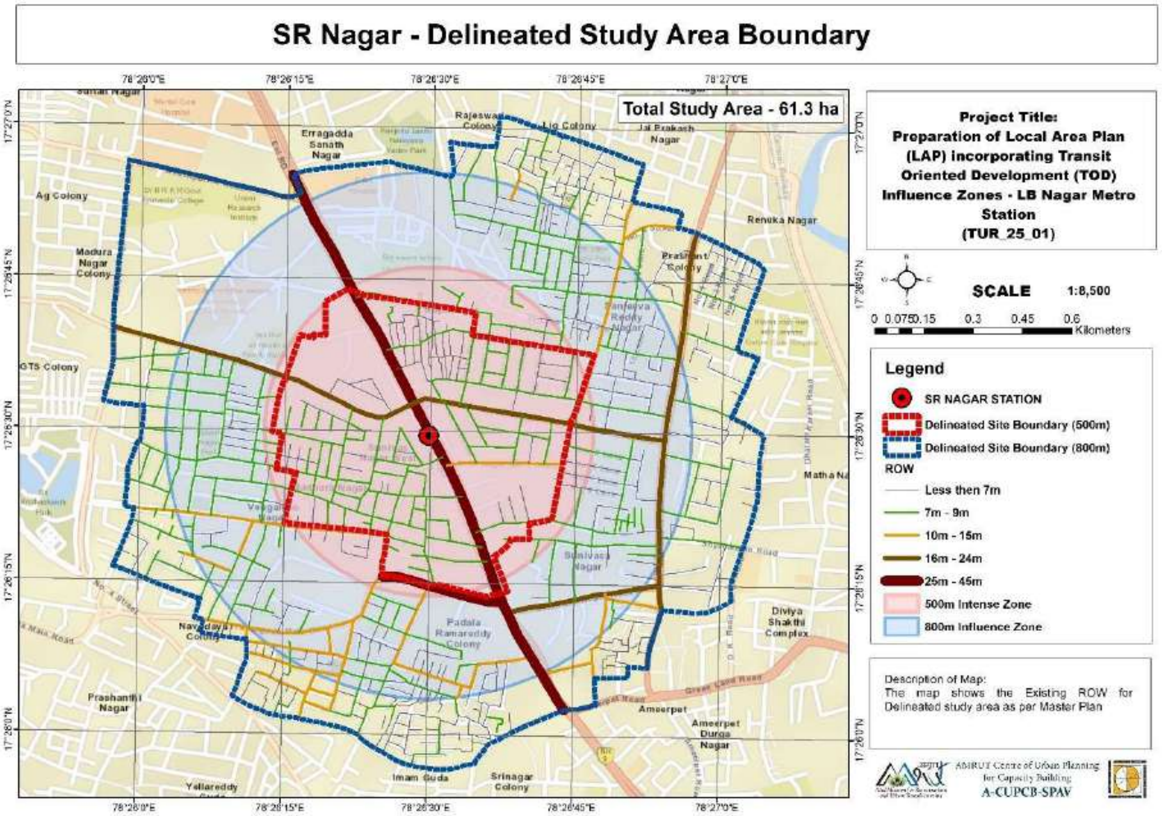


Figure 3-14 Delineated Study Area around SR Nagar Metro Station illustrating the 500 m Intensive TOD Zone and the 800 m Influence Zone

Source: Project team, SPAV

Wards within 500m Buffer: The 500m radius around S.R. Nagar station covers parts of several GHMC wards, namely Ameerpet, Vengal Rao Nagar, Sanath Nagar, and Erragadda. These are the administrative divisions that overlap with the circular study zone. All localities and neighbourhoods within this half-kilometre circle (falling in those ward areas) constitute the S.R. Nagar station's study area.

Total Area of Study Zone: It is of an area of approximately 61.3 hectares. This is the area of a circle with 500m radius.

3.3.10.2 L.B. Nagar

In the case of LB Nagar, the built-form analysis suggested that just beyond the 800 m mark, the area starts to include some large parcels (vacant land and industrial uses) and low-density development. A plot-size based delineation might have slightly contracted the influence area to exclude these fringe large plots, keeping the focus on the dense mixed-use core closer to the station. However, the road/block approach was prioritized incorporating entire blocks even if they caused the zone to extend a bit further. This was justified because LB Nagar's blocks are so large that excluding part of a block could omit areas that are within walking distance on the nearer side. By including the whole block, the plan can address its internal connectivity comprehensively. The trade-off is that some land just beyond the optimal walk radius is inside the zone; however, those areas can be targeted for improved connectivity (e.g., adding pedestrian shortcuts across the big block) to effectively bring them “closer” in travel time. Similarly, the 1500 m secondary zone was adjusted outward to align with major roads, simplifying the boundary for zoning enforcement.

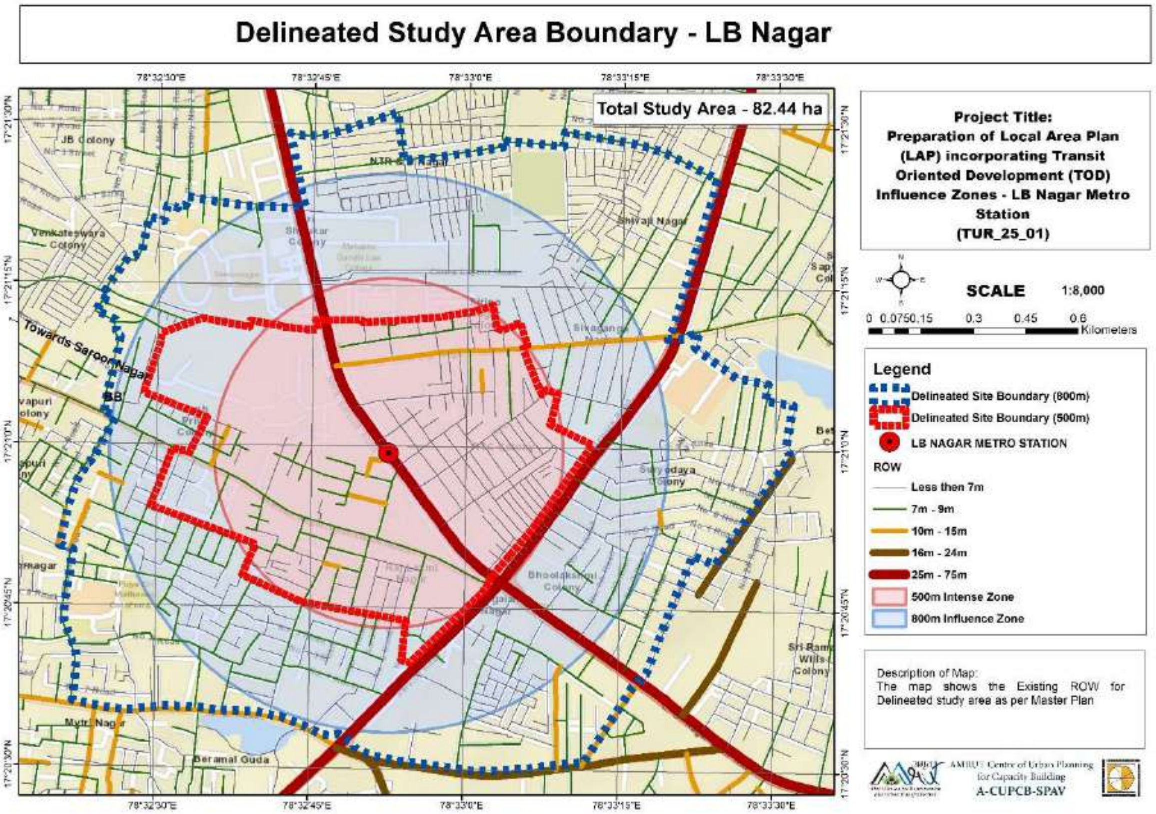


Figure 3-15 Delineated Study Area around LB Nagar Metro Station illustrating the 500 m Intensive TOD Zone and the 800 m Influence Zone.

Source: Project team, SPAV

Delineated Study Area around LB Nagar Metro Station (Figure 3-15) illustrating the 500 m Intensive TOD Zone and the 800 m Influence Zone, along with the defined study area boundary and existing road right-of-way hierarchy forming the spatial basis for the Local Area Plan (LAP).

Wards within 500m Buffer: The study area around L.B. Nagar metro station (Vasavi L.B. Nagar) falls at the junction of multiple GHMC wards. The key wards intersecting the 500m buffer here are RK Puram, Kothapet , Saroornagar and Lingojiguda. These ward names correspond to the neighbourhoods in each direction from the station. All these areas within the half-kilometre radius are included in the L.B. Nagar station’s study area.

Total Area of Study Zone: Approximately,82.43 hectares, similar to the S.R. Nagar case, given the same 500m radius criterion.

4. EXISTING SITUATION ANALYSIS

The baseline assessment of the LB Nagar and SR Nagar station areas has been carried out based on key Transit Oriented Development (TOD) principles such as **Access, Diversity, Density, Design, and Parking & Travel Demand Management**. These parameters provide a comprehensive framework to evaluate how effectively the station areas support transit-oriented mobility, compact development, and pedestrian-friendly environments. The objective of the baseline assessment is to establish a clear understanding of the physical, functional, and mobility characteristics of the station areas before identifying strategies for future improvement.

The accessibility and mobility component of the study areas is examined through an analysis of the road hierarchy, right-of-way distribution, block configuration, intersection density, and network connectivity analysis. The assessment also considers the condition of pedestrian infrastructure and operational characteristics of the road network including travel speeds, delays and level of service. This evaluation highlights how the internal street network and major corridors collectively influence the effectiveness of last-mile connectivity to the metro stations, while also identifying pressures on key corridors and junctions that affect overall mobility performance.

The functional composition of the station areas is analysed through the examination of existing land use distribution, vertical land use patterns and building height characteristics. This analysis helps understand how residential, commercial, institutional, and mixed activities are spatially organized within the station influence zones and how these activities interact with major transit corridors. The study also reflects how economic activities tend to cluster along primary mobility corridors and around transit nodes, while interior neighbourhoods often maintain a predominantly residential character.

The intensity of development and land utilization patterns are further evaluated through figure–ground analysis and assessment of plot utilization levels. This component provides insights into the compactness of the urban fabric, the degree of built density, and the availability of underutilized or redevelopment-prone parcels. The analysis reveals differing spatial development conditions across the two station areas, where some neighbourhoods exhibit highly consolidated built forms and limited open space availability, while others display fragmented development patterns with potential opportunities for infill and future densification.

The urban form and spatial character of the station areas are also examined to understand the quality of the public realm and the structural organization of streets and activity nodes. This includes an assessment of block morphology, pedestrian loop structure, built-use condition, junction hierarchy and the distribution of activity generators within the neighbourhoods. Such an evaluation helps in identifying how street environments, built form configuration and node activity patterns influence pedestrian experience, safety and the overall functionality of the urban environment surrounding the metro stations.

The study evaluates parking conditions and travel demand characteristics by analysing the availability of organized parking facilities and the extent of informal or on-street parking within the station influence areas. Understanding the relationship between parking supply and street capacity is essential in identifying how parking pressures influence congestion levels, effective carriageway width, and the functioning of important mobility corridors.

Overall, the baseline analysis provides a comprehensive understanding of the existing mobility conditions, development patterns, land utilization efficiency, and public realm characteristics within the LB Nagar and SR Nagar station areas. The insights derived from the on-field data collection form the foundation for identifying key challenges, evaluating opportunities for TOD-oriented transformation, and guiding the formulation of appropriate planning strategies in the subsequent sections of the report.

4.1 Data Collection

After the submission of the inception report, the next stage of survey and data collection was planned and executed. As part of this process, the project officers met with officials at HUMTA on 4th and 7th February to gather and verify information related to plot details and development regulations. Simultaneously, a primary survey was conducted in LB Nagar and SR Nagar between. The survey was conducted during 4th and 7th of February by the students of SPA Vijayawada and the project officers. During this period, the survey team undertook field observations, on-site verification, and data collection to capture ground realities related to urban infrastructure and land use (Figure 4-1).

Figure 4-1 Field Survey Photographs

Image Credit: Project team

The primary survey focused on collecting detailed information on floor-wise land use, building condition, building heights, and vacant or under-utilized plots within a 500-meter boundary of the study area around LB Nagar and SR Nagar. Students of SPA Vijayawada in coordination with project officers, conducted on-site verification and systematic field observations to record the functional use of buildings at both ground and upper floors, assess structural and maintenance conditions, and document building heights to understand vertical density. Vacant and under-utilized plots were identified and mapped. Survey team observed and recorded the condition and continuity of footpaths, availability of non-motorized transport (NMT) facilities and pedestrian infrastructure. Street-level activities such as commercial activity, informal vending, parking patterns, and peak-hour pedestrian flows were also monitored to understand the functional vibrancy of the area.

4.1 SR NAGAR

4.1.1 Access

4.1.1.1 Road Hierarchy

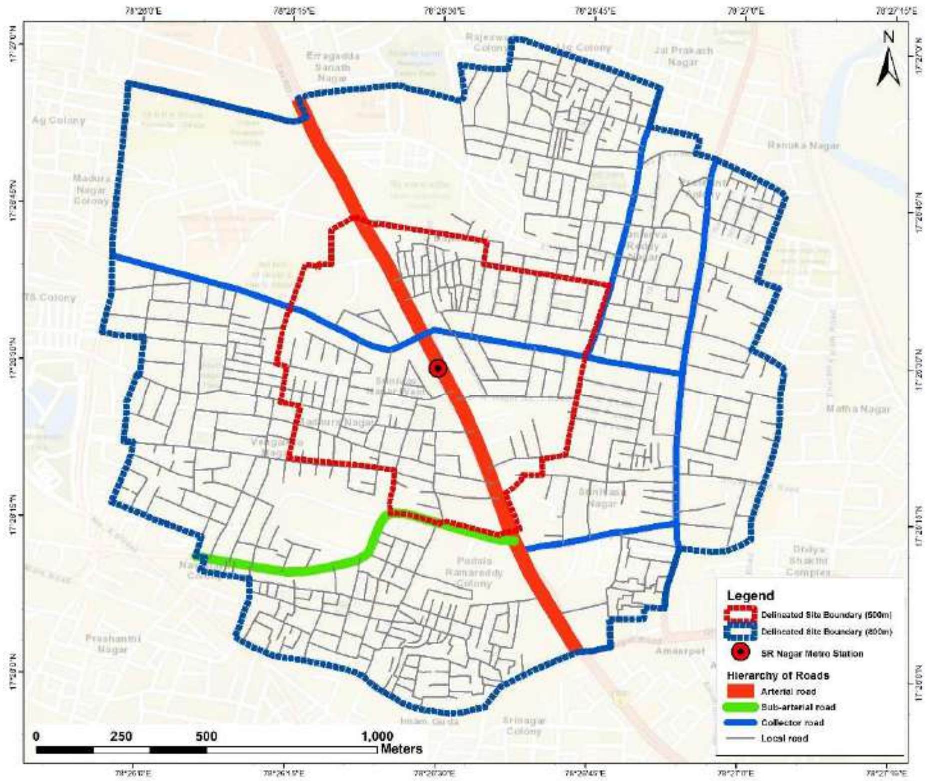
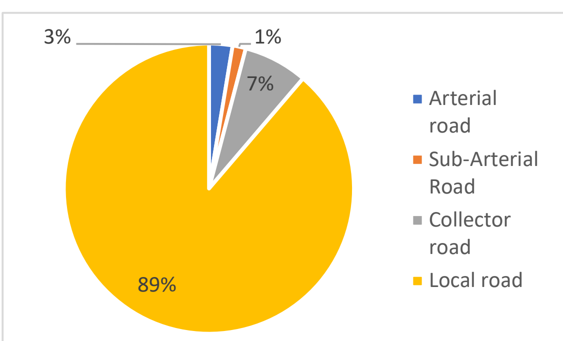


Figure 4-2 Hierarchy of roads

Source: Output of the project team, SPAV

Table 4-1Composition of Road hierarchy

Percentage distribution of Road Hierarchy	Road hierarchy	Length in km
	Arterial road	1828.95
	Sub-Arterial Road	1033.63
	Collector road	5017.85
	Local road	62216.5

Based on the traffic capacity, purpose and level of connectivity the road network is classified as the arterial, sub-arterial, collector and local road. Figure 4-2 shows road hierarchy in SR Nagar. The Table 4-1 shows the road composition.

- The Mumbai highway (NH – 65) forms the arterial road of SR Nagar which runs straight through the area as a spine and divides the region into two halves. This makes it a primary mobility corridor. This arterial road is makes 3% of the total road network.

- The Yousufguda Main Road which is the sub-arterial road accounts for about 1% of the total road network. It connects SR Nagar with Yousufguda, providing an important secondary linkage between these areas.
- The collector road makes around 7% of the road network. The collector roads like SR Nagar Main Road and Sathyam theatre Road leads to the Balkampet road which is again a collector road and a busy commercial corridor. The Vengal Rao Nagar Road leads to Moti Nagar, a nearby residential region. These roads carry a significant portion of the traffic within the SR Nagar and distribute the traffic from the arterial corridor to the internal streets.
- The local road makes up 89% of the total road length. These roads provide direct access to neighbourhood leading to the residential, commercial and institutional destinations within the area.

4.1.1.2 Existing ROW with Cross Sections

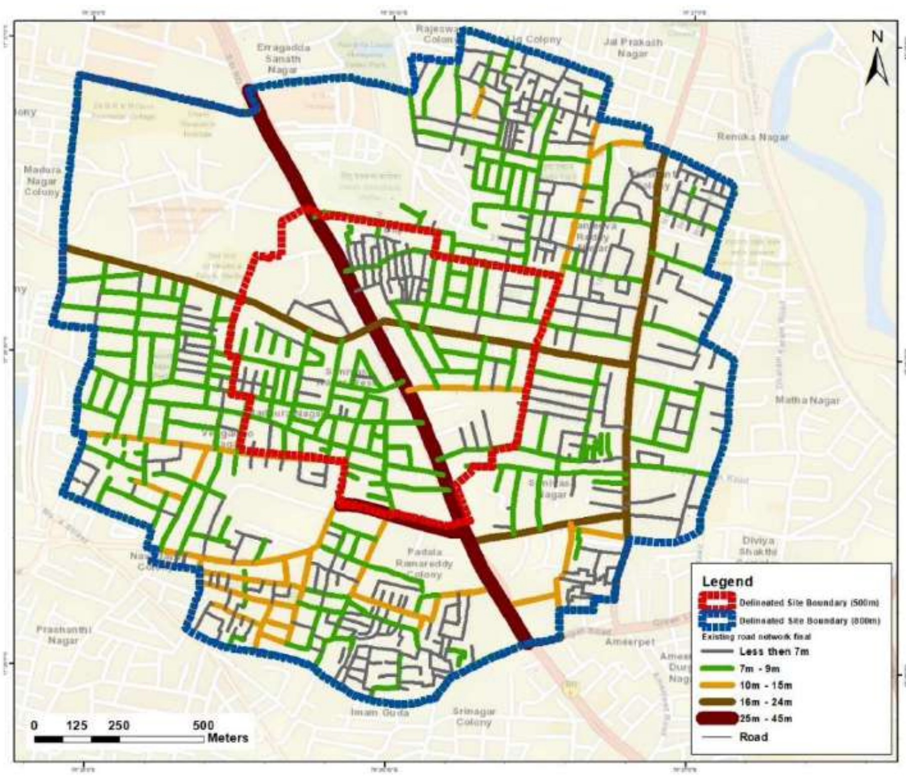


Figure 4-3 Existing Right of Way

Source: Output of the project team, SPAV

The Figure 4-3 shows the existing Right of Way (ROW) of SR Nagar. The existing Right of Way (ROW) distribution (Figure 4-4) shows that the road network is dominated by the roads with ROW ranging between 7m to 9m roads which forms about 47% of the total road network. Roads having ROW less that 7m makes up around 34% of the road network. This indicates that majority of the road network serves the purpose of internal distribution rather than area-wide connectivity. roads with ROW ranging between 10m to 15m forms 10 percent while roads having ROW between 16m to 24m constitute 6% of the total road network. The 24m to 45m ROW road forms only 3% of the road network. This limited proportion of intermediate roads indicates a shortage of secondary corridors for smooth traffic distribution across the region.

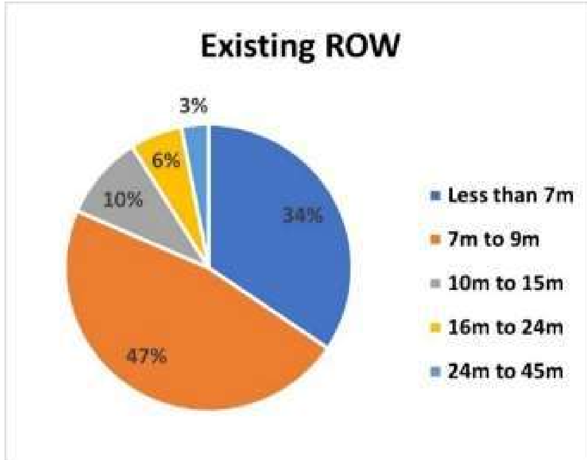


Figure 4-4 Percentage distribution of existing Right of Way

Source: Output of the project team, SPAV

The following road cross sections provide an overview of the existing road features and their ROW utilization. The Figure 4-5 indicates the location of cross sections.

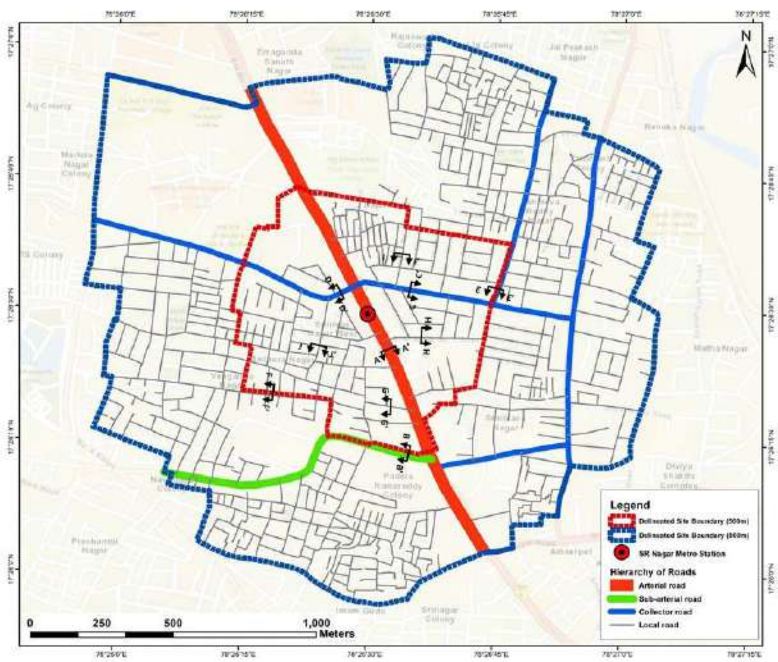


Figure 4-5 Map indicating location of Cross section

Source: Output of the project team, SPAV

Cross Section of NH 65 - Arterial Road

The arterial road NH 65 has a Right of Way (ROW) of 45 meters and functions as a four-lane divided carriageway (Figure 4-6). It is the primary traffic corridor carrying the regional and local traffic in and out of the region. This corridor remains highly active throughout the day due to continuous commercial activity along the road stretch and significant demand for accessing public transport nodes like bus stop and metro station contributing to heavy pedestrian traffic along this stretch (Figure 4-6).

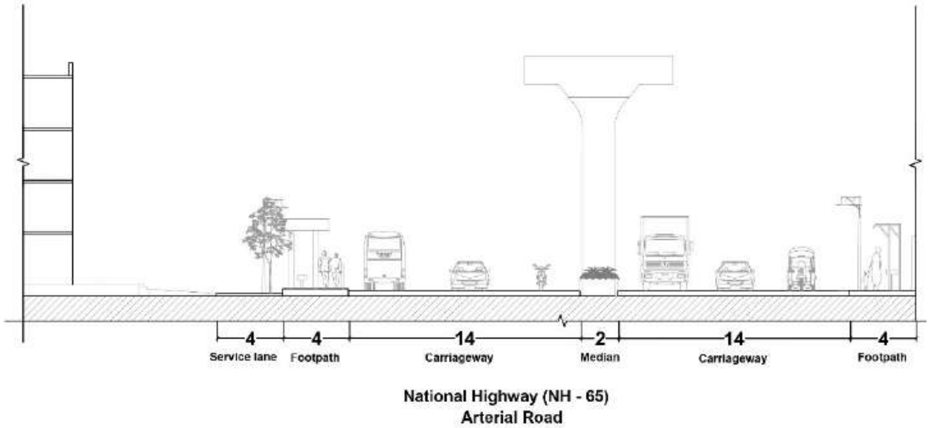


Figure 4-6 Cross section of NH-65 near SR Nagar bus stop (A - A')

Source: Output of the project team, SPAV

Figure 4-7 NH 65 Site picture

Image credit: Google Street view

The cross-section reveals that the pedestrian footpath is partially obstructed and occupied by utilities such as light poles and bus stop facilities affecting the continuity of the footpath. The road stretch has a good presence of trees and the median is landscaped with small plantation. The service lane is present only at one side of the road and is occupied by street vendors and parked vehicles, limiting the access for local residents.

Cross Section of Yousufguda Road - Sub-arterial road

Even after having a ROW of 25m the Yousufguda road has uneven carriageway width on both sides. The road is intended to function as a four-lane divided road but the road converges into two lane undivided road and widens again to four-lane divided road (Figure 4-8). At some locations the placement of metro pillar divides the carriageway into two sections having unequal road width (Figure 4-9). This inconsistency affects the traffic flow and creates operational challenges. The road width varies across the road stretch ranging from 25m to 14m. Pedestrian facilities are discontinuous, present primarily near the metro station, leaving large sections of the road stretch unsafe for walking.

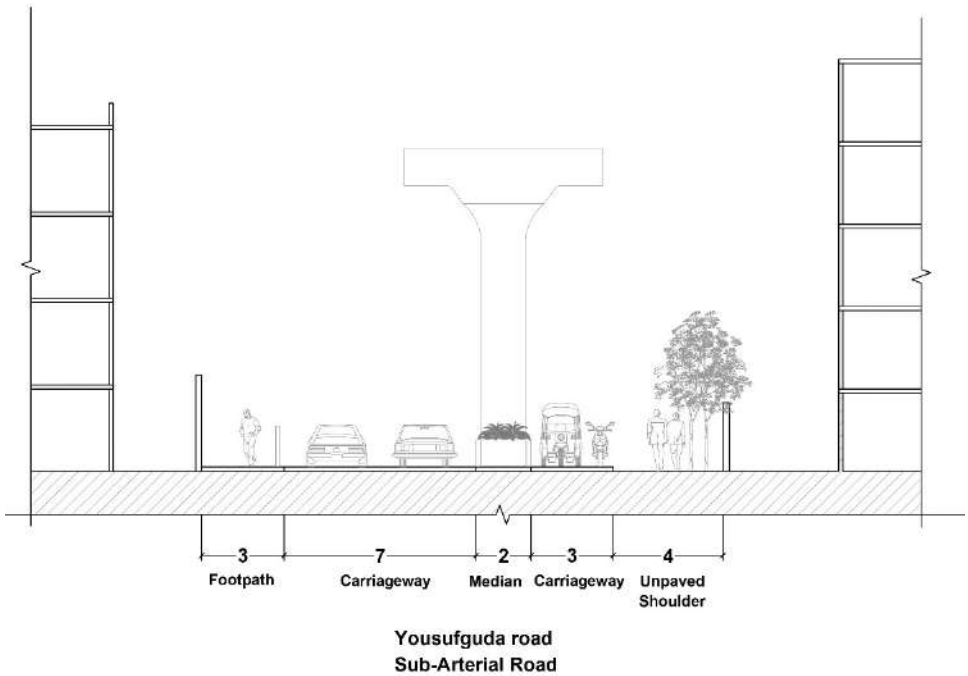


Figure 4-8 Cross section of Yousufguda Road near Sri Chaitanya IIT Campus (B - B')

Source: Output of the project team, SPAV

Figure 4-9 Yousufguda road site picture

Image credit: Google Street view

The traffic mix is dominated by two-wheelers, cars, auto-rickshaws and buses. Vegetation is well-maintained, with landscaped medians and roadside plantation. The corridor is active during the peak hours. Presence of Madhuranagar metro station within the 800m radius is also a contributing factor for high activity during the peak hours.

Cross Section of SR Nagar main road - Collector Road

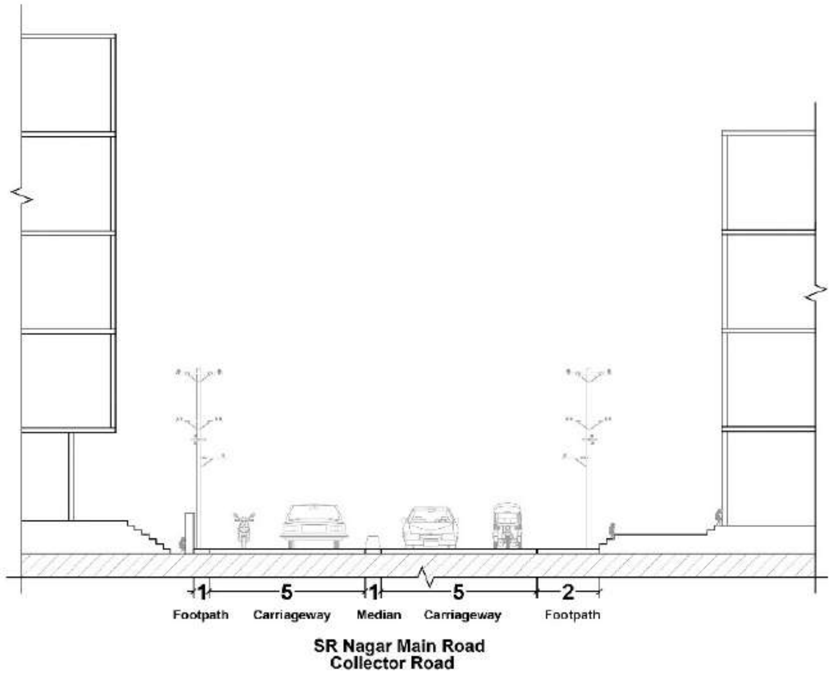


Figure 4-10 Cross section of SR Nagar Main Road near IDFC First bank (C-C')

Source: Output of the project team, SPAV

SR Nagar main road (Figure 4-10) is 4 lane divided road with a ROW of 18m. It plays an important role in distributing the traffic from the arterial road to the internal roads and towards the Balkempet road. The carriageway width is irregular ranging from 6.5m to going down to 4.5m. The footpath width is insuffecient and the footpath is not continous along the stretch. The traffic mix is primarily two-wheelers, auto-rickshaws, and cars, with occasional light commercial vehicles and very few heavy commercial vehicles. The presence of institutional zone nearby contributes to high pedestrian flow throughout the day especially during peak hours. Informal vendors are minimal. Vegetation is limited as few trees are present along the road stretch in unequal interval. This stretch is dominated by commercial landuse and most of the establishments present along the stretch provide parking facility. Inspite of that on street parking of vehicles expecially during peak hours can be observed (Figure 4-11).

Figure 4-11 SR Nagar main road site picture

Image credit: Project team

Cross Section of Vengal Rao Nagar road - Collector Road

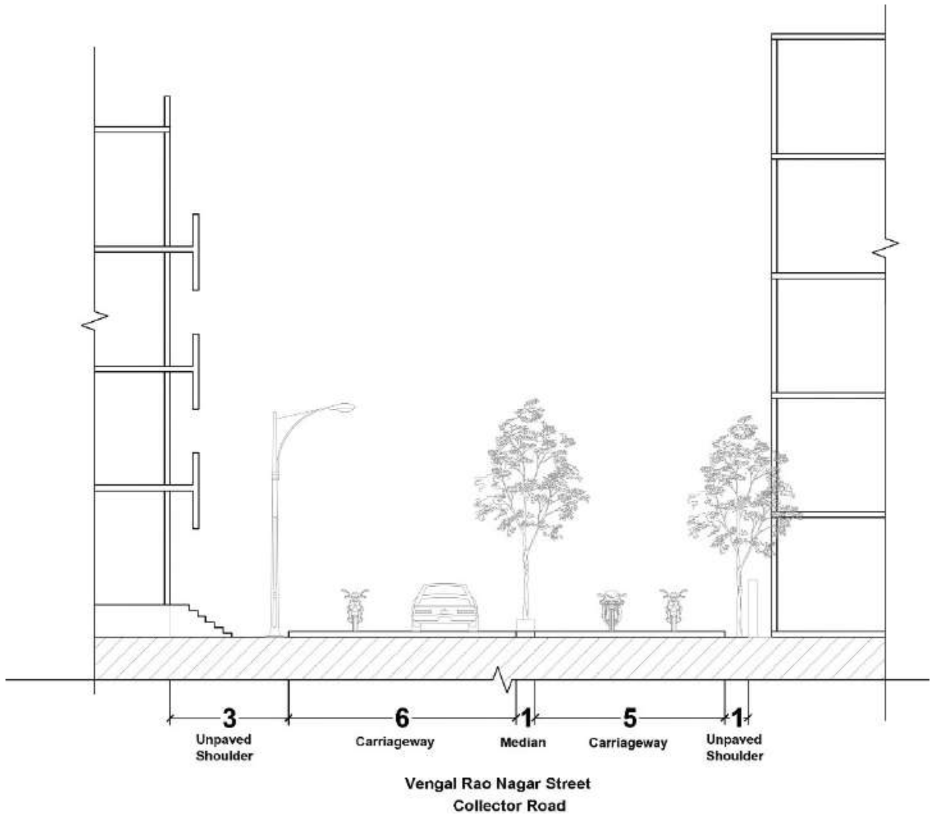


Figure 4-12 Cross section of Vengal Rao Nagar Road before Federal Bank (D – D'

Source: Output of the project team, SPAV

Vengal Rao Nagar road (Figure 4-12) is a four-lane divided corridor with a median separating the two sides. It has a ROW of 18m. The stretch has significant amount of tree cover present along the road and on the median. The footpath is absent in the initial part of the stretch and is present towards the end of the road stretch which is again encroached or used for dumping waste. The overhead cables are poorly maintained. Street vendors are scarcely present along the road stretch. The presence of retail shops and educational institutions attracts significant pedestrian flow. Due to which the street remains active throughout the day. On-street parking is particularly high during the peak hours contributing to congestion

Cross section of B.K Guda road – Collector Road

B.K Guda road (Figure 4-13) is a two lane undivided road with ROW 10m. It is the only collector road running north to south of the study area (Figure 4-14). Dominated by mixed land use, this stretch is active and possess a varity of commercial and retail shops including local departmental stores. This road serves as a link to various local streets. The traffic mix consists of two-wheelers, cars and auto-rickshaws with occasional light commercial vehicles. Footpath is not continuous and is mostly absent along the road stretch. Vehicle parking by commuters along the shoulders can be observed.

Figure 4-13 BK Guda road Site picture

Image credit: Google Street view

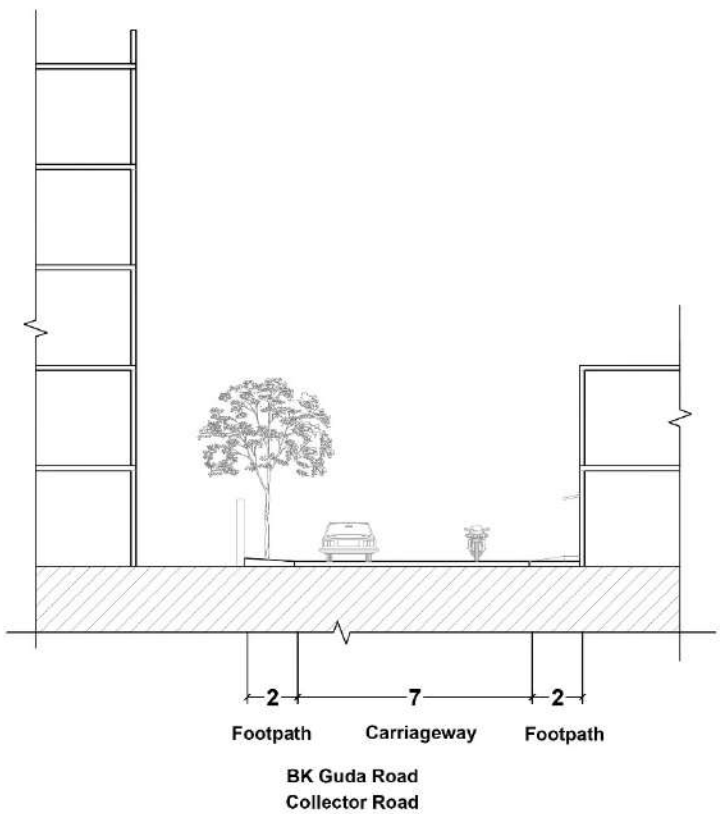


Figure 4-14 Cross section of BK Guda road near SBI Bank (E – E')

Source: Output of the project team, SPAV

Cross section of Madhura Nagar main road – local road

Madhura Nagar main road is a two-lane divided road with a ROW of 14m (Figure 4-15). Dominated by mixed landuse, this road experiences high parking demand. The vehicles are often parked at the centre of the road along the median affecting the carriageway width. Two-wheelers, auto rickshaws and cars are the vehicles mainly contributing to the traffic flow. The street is active during the peak hours. Pedestrian infrastructure is absent making pedestrians to usage of carriageway for walking (Figure 4-16).

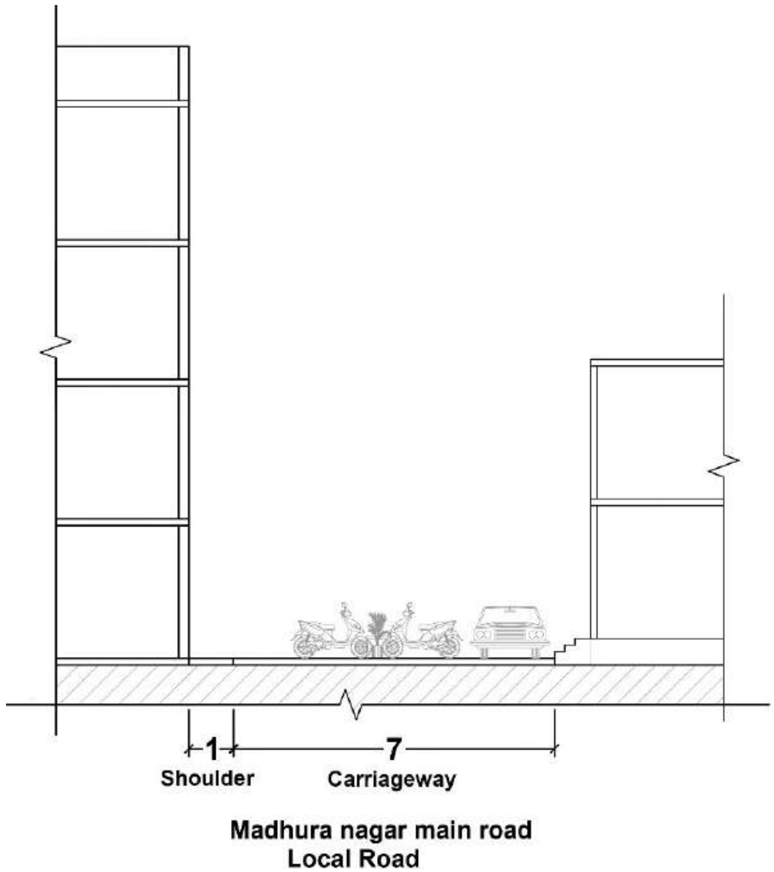


Figure 4-15 Cross section of Madhura Nagar Main Road (F – F')

Source: Output of the project team, SPAV

Figure 4-16 Madhura Nagar Main Road Site picture

Image credit: Google Street view

Cross section of Srinivasa Nagar West Main Road – local road

Srinivasa Nagar West Main Road is a two-lane undivided road (Figure 4-17). This stretch is dominated by mixed use zone. Footpath is absent. On-street parking of vehicles can be seen along both the sides of the road. The traffic mix consist of two-wheelers, auto rickshaws and cars (Figure 4-18).

Figure 4-17 Srinivasa Nagar West Main Road site picture

Image credit: Google Street view

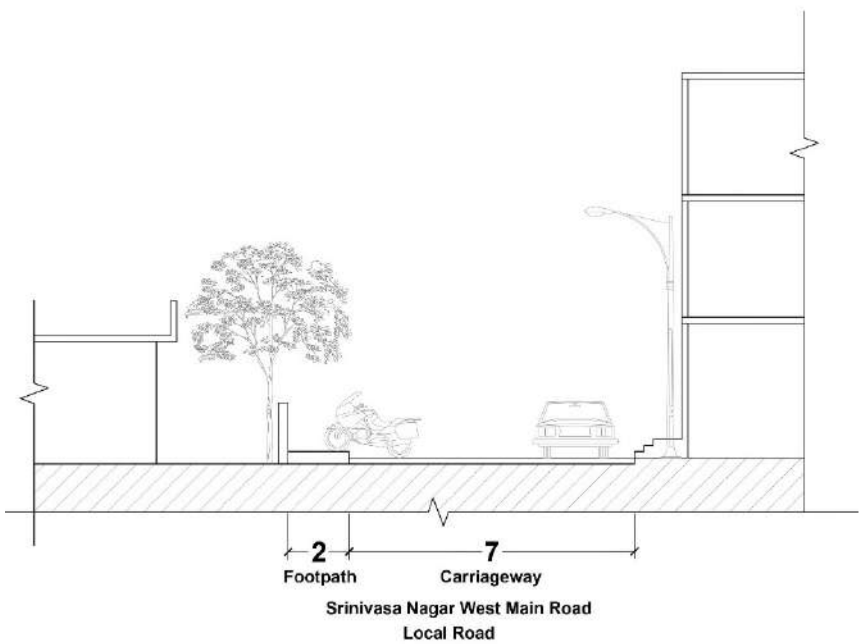


Figure 4-18 Cross section of Srinivasan Nagar West Main Road (G - G')

Source: Output of the project team, SPAV

Cross section of SR Nagar 1st main road – Local Road

This is a two-lane undivided road with a ROW of 10m as shown in the Figure 4-19 primarily serving as a local road which connects directly to the arterial road. Landuse pattern consist of residential stretch with few mixed-use on one side while the other side is the State health transport office. Both has a continuous compound wall frontage. Traffic is mainly dominated by two-wheelers, auto rickshaws and cars. The street is inactive due to absence of engaging commercial points. Parking of LCV, HCV and water tanker is continuously observed along one side of the which road. On the opposite side the footpath is either encroached by parked vehicles of residents or due to its poor maintenance. Both result in restricts the use of footpath. This street has a potential to grow and connect the other roads so it requires good pedestrian infrastructure proper parking space (Figure 4-20

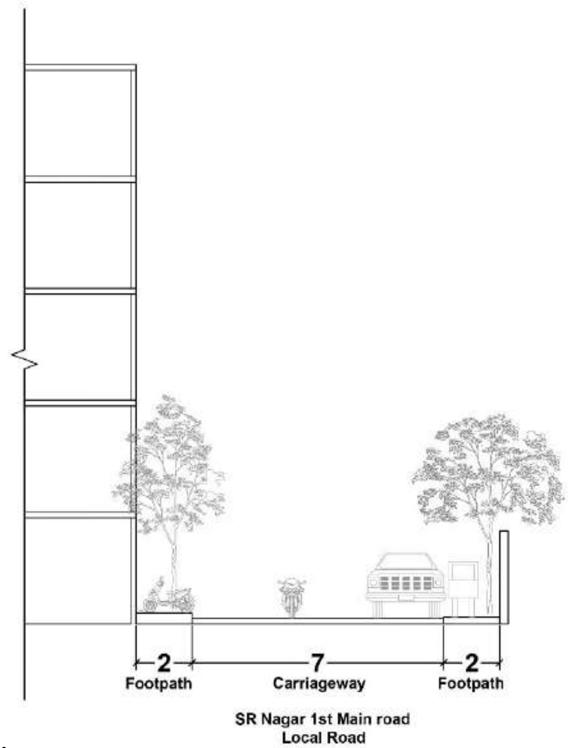


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Figure 4-19 Cross section of SR Nagar 1st Main Road (H – H')

Source: Output of the project team, SPAV

Figure 4-20 SR Nagar 1st Main Road

Image credit: Google Street view

Cross section of Local Road – SR Nagar 14th Street

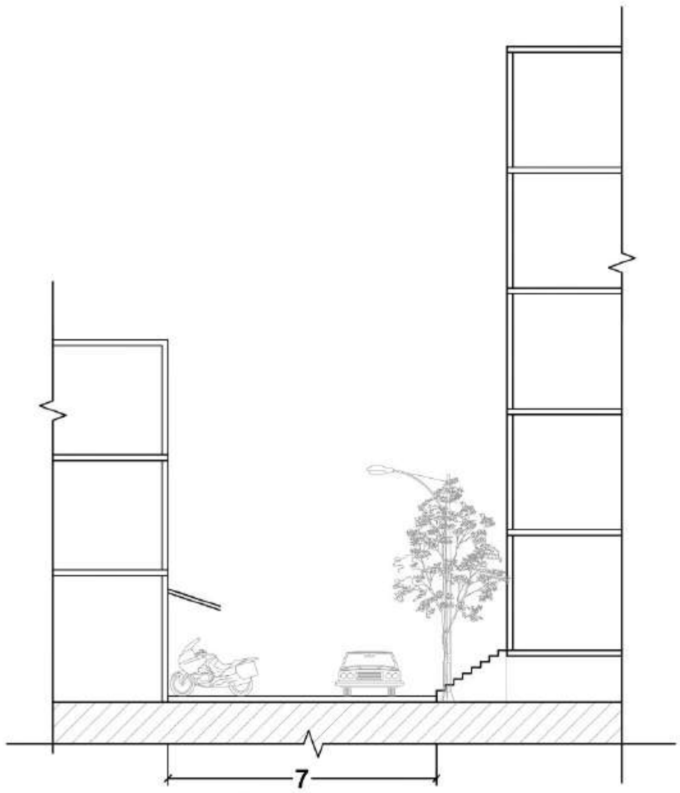


Figure 4-21 Cross section of SR Nagar 14th street (I - I')

Source: Output of the project team, SPAV

Figure 4-22 SR Nagar 14th street site picture

Image credit: Google Street view

SR Nagar 14th street have ROW of 7m (Figure 4-21). This street passes through a variety of mixed use and institutional zone, making it highly active throughout the day. Traffic is mainly dominated by two-wheelers, auto rickshaws and cars. High pedestrian flow is observed but footpaths are not available. High on street parking can be observed along the shoulders of both sides of the road (Figure 4-22).

Cross section Madhura Nagar- Vengal Rao Road – Local Road

This is a two-lane undivided road having a ROW of 10m (Figure 4-23). The road stretch is dominated by mixed use zone. Commercial spots along the street creates an active and engaging street frontage during peak hours. Traffic is mainly dominated by two-wheelers, auto rickshaws and cars. Few LCV and school vans can be observed. Pedestrian pathways are absent. The residents as well as the commuters park their vehicle along the shoulders of the road (Figure 4-24).

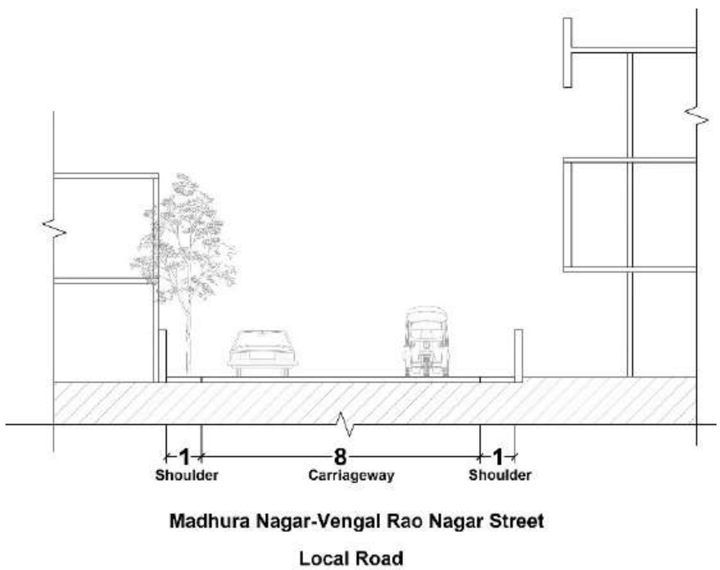


Figure 4-23 Cross section of Madhura Nagar- Vengal Rao Road (J – J)

Source: Output of the project team, SPAV

Figure 4-24 Madhura Nagar Vengal Rao Nagar Street

Source: Output of the project team, SPAV

4.1.1.3 Block Section

Block section examins the physical extent of the blocks. Smaller blocks encourage walkability and better connectivity between streets. Langer blocks reduces accessibilty by increasing the travel distance. The Figure 4-25 shows the existing block of SR Nagar.

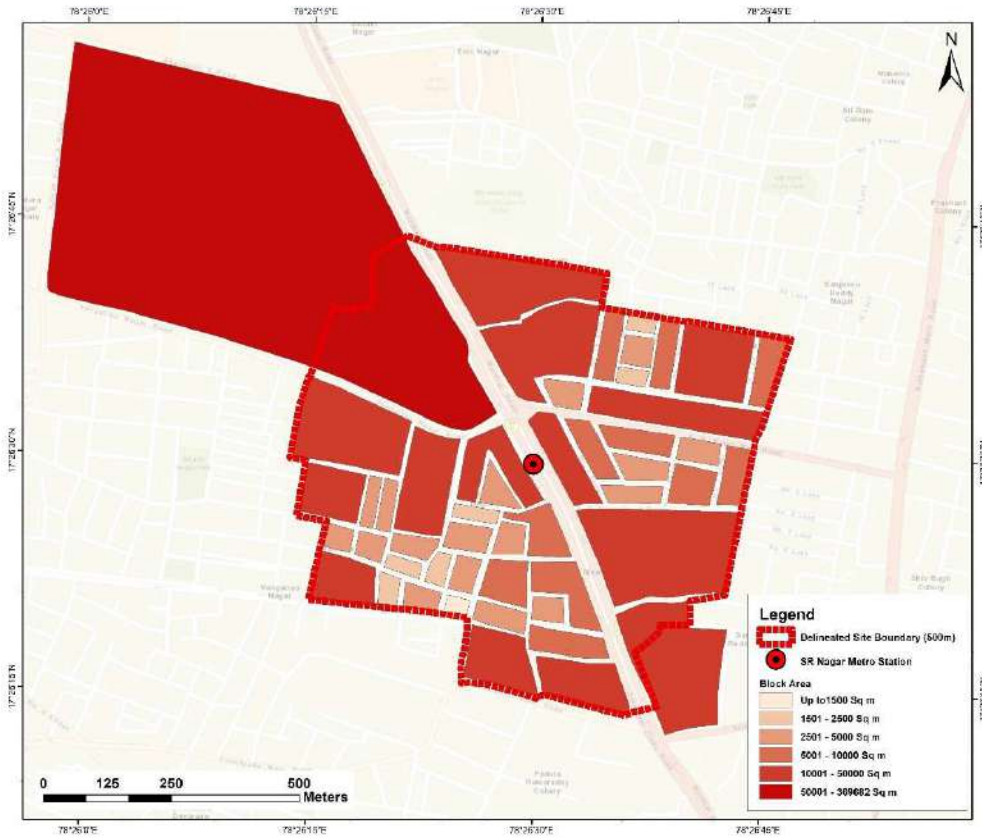


Figure 4-25 SR Nagar Existing Blocks

Source: Output of the project team, SPAV

SR Nagar is delineated into a total of 50 blocks using a minimum road width of 9m. This approach respects the existing road hierarchy while ensuring that the delineated Local Area Plan (LAP) boundaries remained viable for TOD implementation and future mobility improvements. The block size varies extensively with the smallest block size measuring 1467.60 sqm and the largest block size measuring 369681.97 sqm. Around 34% of the total blocks fall within the range of 5001 – 10000 sqm and around 28% of the block fall under the 10001 – 50000 sqm range. A single block in the norther part of the study area measures 369681.97 making it the largest block in the zone. Since the study area consists of medium sized blocks strengthens the suitability for TOD implementation.

4.1.1.4 Intersection Density

The intersection density indicates the concentration of intersections within the block area. It is an essential indicator of connectivity and accessibility. Higher intersection density provides the possibility for multiple route and shorter travel distance.

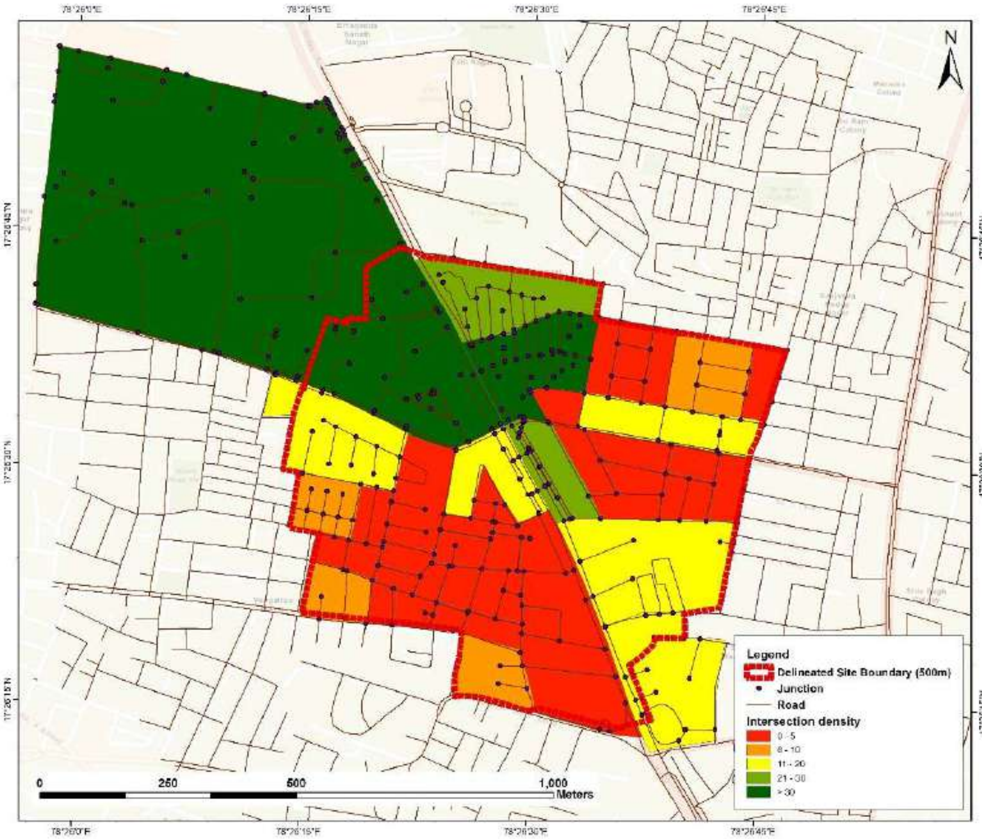


Figure 4-26 Network density

Source: Output of the project team, SPAV

Higher intersection density is observed (Figure 4-26) at the norther part of the study area where there is a greater number of intersection nodes which could have better connectivity. The average alpha index for the blocks is 8.8 denoting low intersection density. Most of the blocks fall under the 0 to 5 category denoting need for intersection improvement and street connectivity. The existing blocks are often dominated by long continuous stretches.

4.1.1.5 Network Connectivity

4.1.1.5.1 Alpha Index

Alpha Index measures how connected a network is and represents the availability of multiple paths. It ranges from 0 to 1. The Figure 4-27 shows the alpha index of SR Nagar blocks. Most of the blocks fall under the 0.20 range which indicate very low connectivity among the blocks. Even though the area has a very dense local network, there are only few alternative routes available for travel. Some blocks display better connectivity compared to the rest but overall, it denotes less connectivity among the blocks.

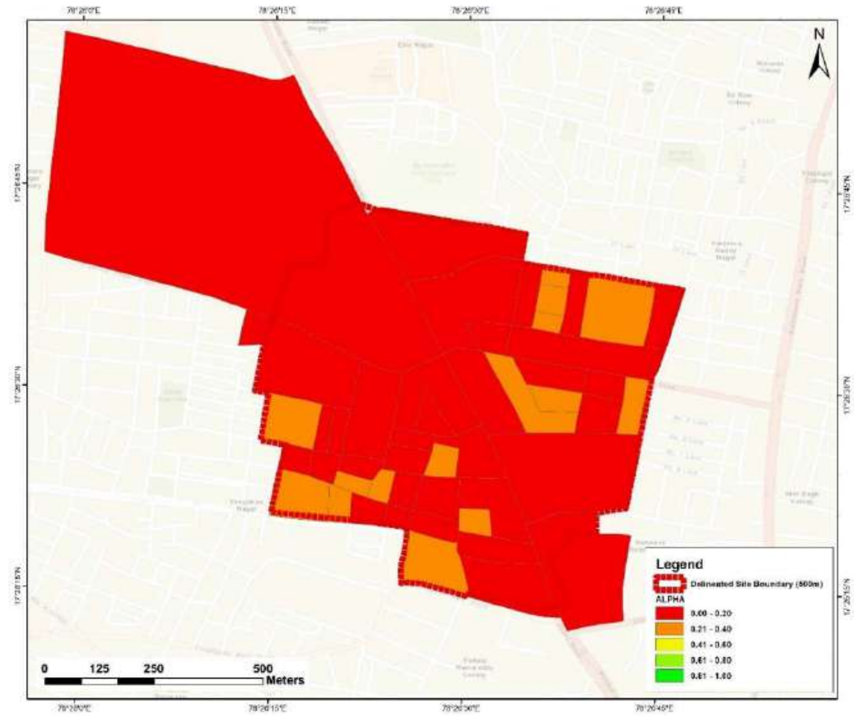


Figure 4-27 Alpha index

Source: Output of the project team, SPAV

4.1.1.5.2 BETA Index

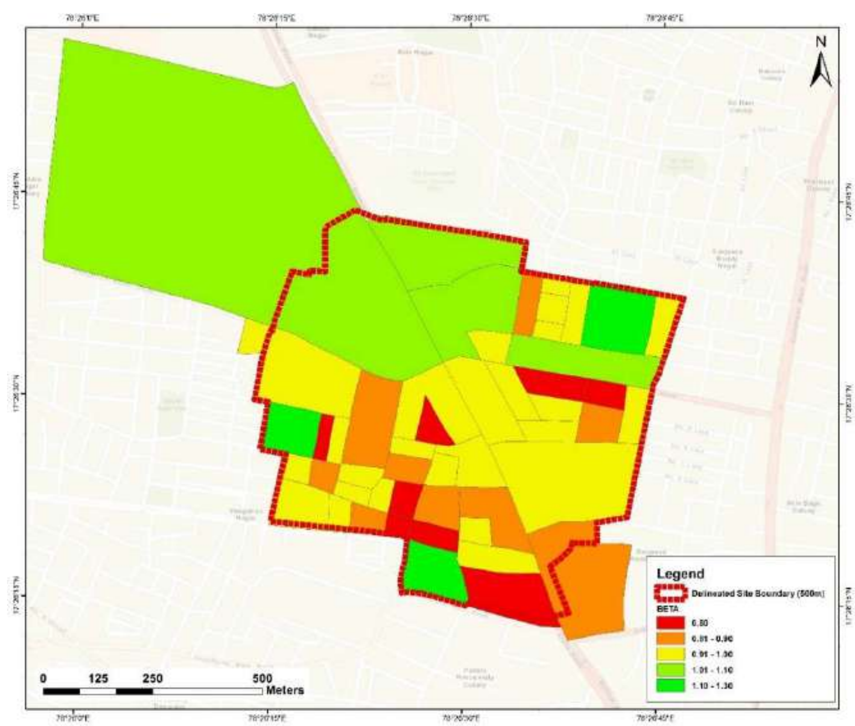


Figure 4-28 Beta Index

Source: Output of the project team, SPAV

The Beta Index varies across the block (Figure 4-28). It represents the complexity of the network. The network score ranges from a minimum of 0.20 to maximum values of 0.80. The streets are comparatively complex in few blocks. Most areas fall within the **0.91–1.00 and 0.81–0.90 ranges,** indicating moderate complexity within the blocks. While areas with **lower values of 0.80** reflect weaker complexity.

4.1.1.5.3 Gamma index

Gamma index measures the extent to which the nodes are connected. As shown in the Figure 4-29 most of the blocks has score which is less than or equal to 0.40 denoting the network connectivity is poor. Limited blocks alone denote good connectivity. This again reinforces the requirement for street intersection improvement and enhance connectivity of the region.

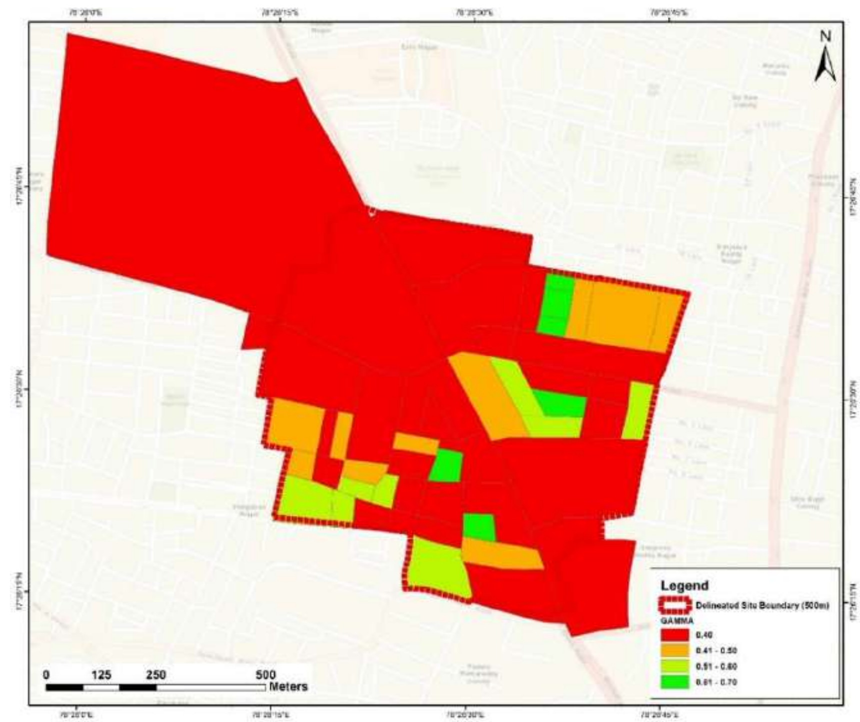


Figure 4-29 Gamma Index

Source: Output of the project team, SPAV

4.1.1.5.4 Cyclomatic Index

This measures the number of Independent closed loops in a transport system. The Figure 4-30 shows the cyclomatic index for the existing blocks. A large section of the study area falls within the 0.00 to 1.40 range denoting few road loops and poor internal circulation. High cyclomatic value can be observed in few blocks in the northern part (6.00 - 7.00) and western part (4.20 - 5.90) indicating better connected street networks and multiple route options.

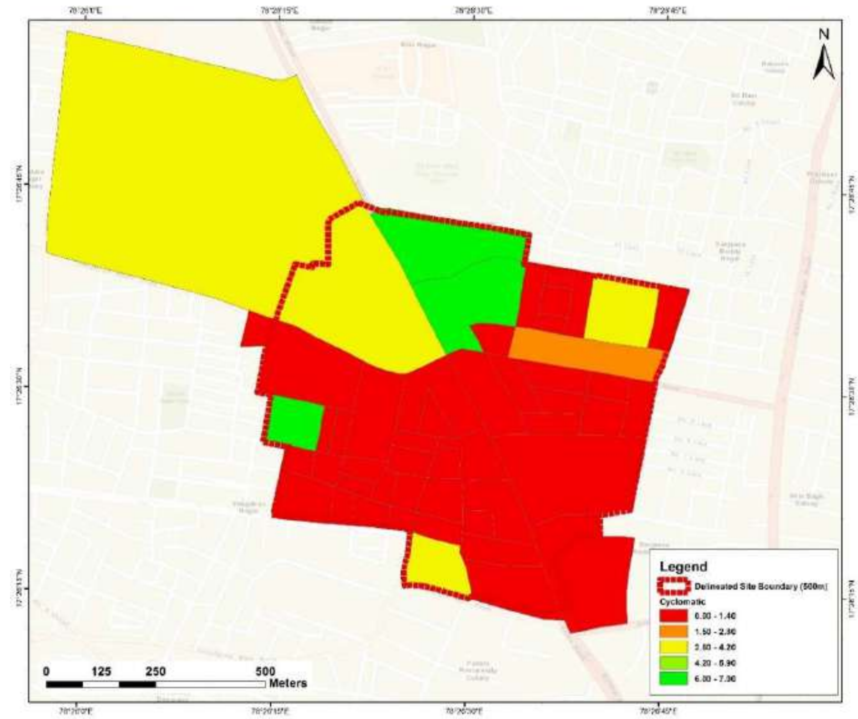


Figure 4-30 Cyclomatic number

Source: Output of the project team, SPAV

4.1.1.5.5 ETA Index

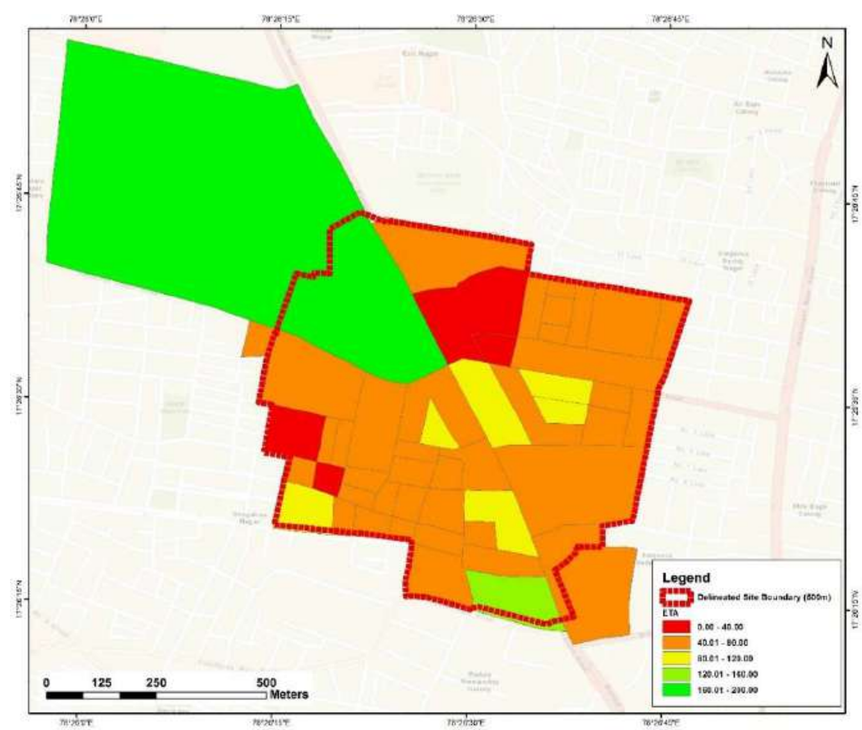


Figure 4-31 ETA

Source: Output of the project team, SPAV

The Eta index measures the average length of links in a road network**.** The Figure 4-31 shows the Eta index map for the existing blocks. Most blocks lie in the 40 - 80 range denoting moderate link lengths and average accessibility within the network. Areas shown in red (0 - 40) indicate shorter links and denser intersections. While internal accessibility is reasonable in most parts, some peripheral areas having larger blocks displays few intersections.

4.1.1.5.6 Overall Connectivity Index

The overall connectivity index represents the overall efficiency of the road network in different blocks. As denoted in the Figure 4-32 a large portion of the study area falls within the low connectivity range (1.20 – 2.00) denoting limited linkages and lack of alternative routes across many blocks. Blocks coming under the orange range (2.40 – 4.00) indicate moderate connectivity. Even though internal road connections are present, it does not provide sufficient redundancy leading to restricted accessibility. The blocks under the moderate connectivity range (4.60 – 6.00) reflects better connectivity compared to the other two zones. The northern blocks express high connectivity range (6.10 – 10) indicate well connected blocks grids with good interconnectivity. Overall, the study area displays a low to moderate connectivity with only few well connected blocks. This demands finer street network and restructuring of the large blocks to improve connectivity

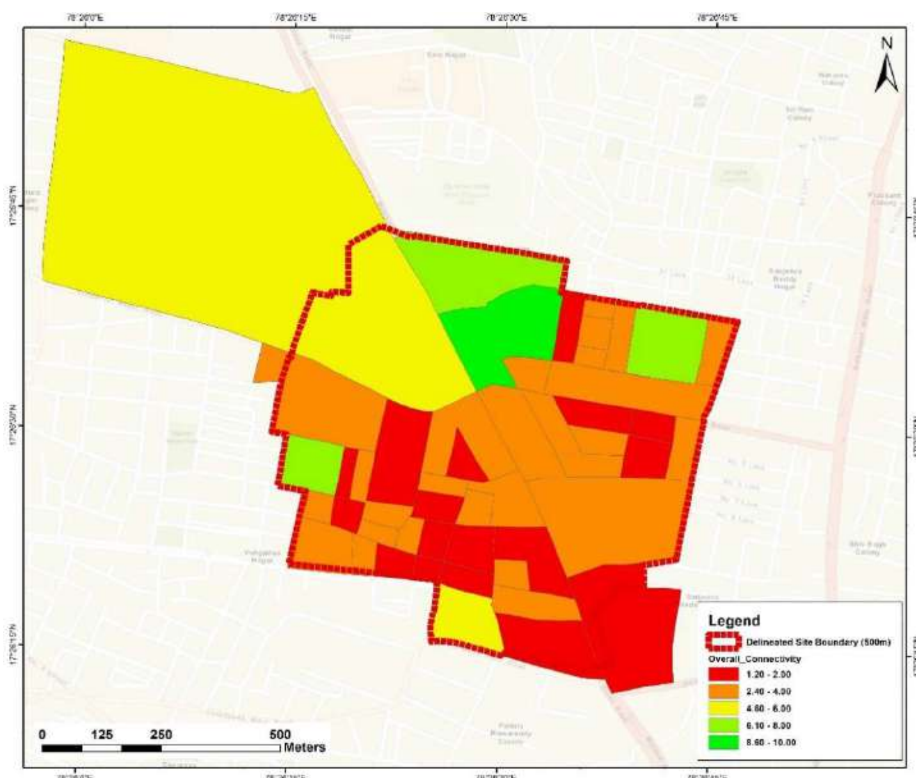


Figure 4-32 Overall Connectivity index

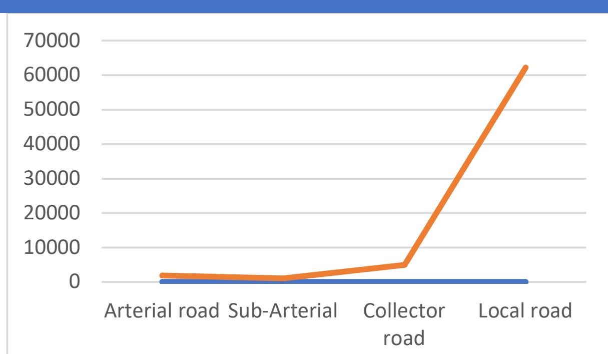
Source: Output of the project team, SPAV

4.1.1.6 Existing NMT Infrastructure

Figure 4-33 Existing NMT Infrastructure

Source: Output of the project team, SPAV

Table 4-2 Composition of NMT Infrastructure and road network

Distribution of road network and Footpath	Hierarchy	Length
	Footpath along Arterial Road	1828.95
	Footpath along Sub-Arterial Road	1033.63
	Footpath along Collector Road	5017.85
	Footpath along Local Road	62216.75
	Total Footpath	7100.89

The pedestrian infrastructure (Figure 4-33) withing the 500 m radius shows an uneven and inadequate distribution of footpaths. The footpaths composition (Table 4-2) shows that the footpaths are primarily concentrated on the Arterial Road along the metro corridor and along few institutional zones. This stretch has relatively continuous pedestrian pathway with adequate width and railings. But as we move further from the metro corridor towards the internal streets, it lack adequate footpath. Many internal roads including collector roads either lack dedicated footpath or have discontinuous footpath along the road stretch. Traffic calming measures are also not widely present along the collector roads. Encroachment and poor maintenance have resulted in deterioration of the footpath. This forces the pedestrians to travel on the carriageway disrupting the on-going traffic as well as making it dangerous for pedestrian themselves.

4.1.1.7 Pedestrian Catchment area

Pedestrian Catchment area measures the area that can be comfortably accessed by people from a designated location such as transit stop or commercial centre. The pedestrian catchment area has been calculated by the service area analysis where public transport accessibility has been evaluated based on the walking distance from the public transport nodes. Bus stops has been considered for the accessibility study. The Figure 4-34 illustrates the pedestrian catchment area. The walking intervals have been categorized into different walking distance.

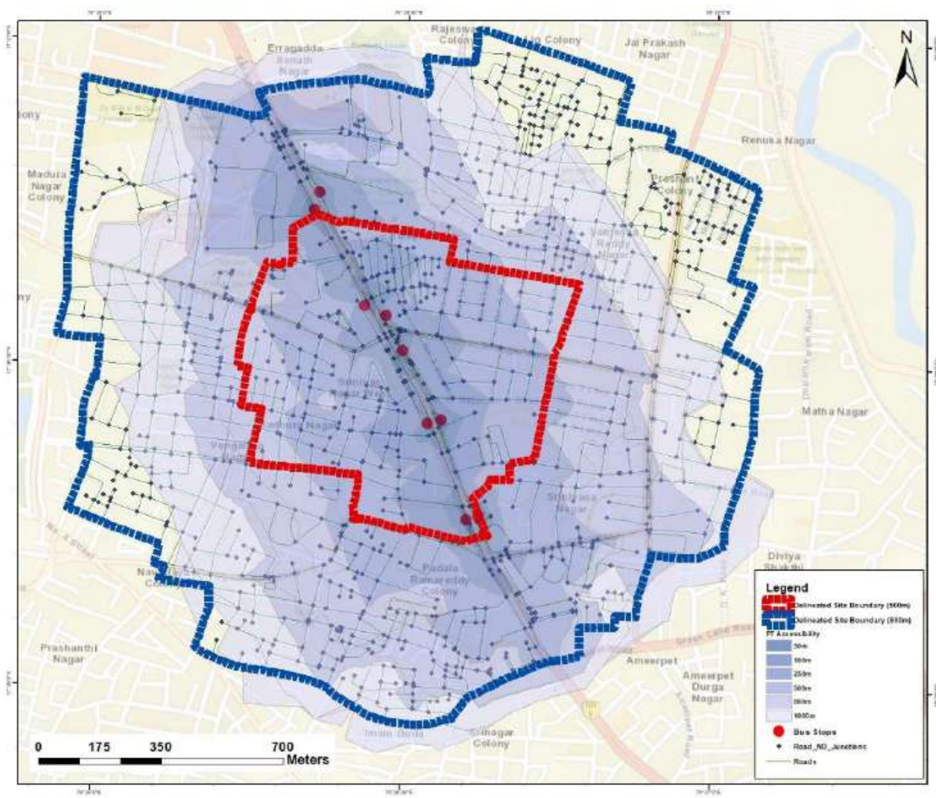


Figure 4-34 PT Accessibility

Source: Output of the project team, SPAV

- High Accessibility: Area located withing the 50m to 250m of the transit nodes. This accounts for about 0.68sq.km area representing the most transit integrated area of the neighbourhood. These areas are readily accessible and can be reached through very short walk.
- Medium accessibility: Area located withing the 250m to 500m of the transit nodes. This is generally considered as a comfortable walking distance. This accounts for about 3.24 sq.km area
- Low accessibility: The distance beyond 500 are less convenient and requires a long time to walk. IPT travel services may provide easy access to the internal zones. This accounts for about 23.79 sq.km area

Over 85% of the of the neighbourhood's land area falls under the low accessibility category. The root cause of modal mismatch is when residents rely on private vehicle to bridge the gap to reach the metro and public transport stations.

4.1.1.8 Walkability

Pedestrian Movement potential

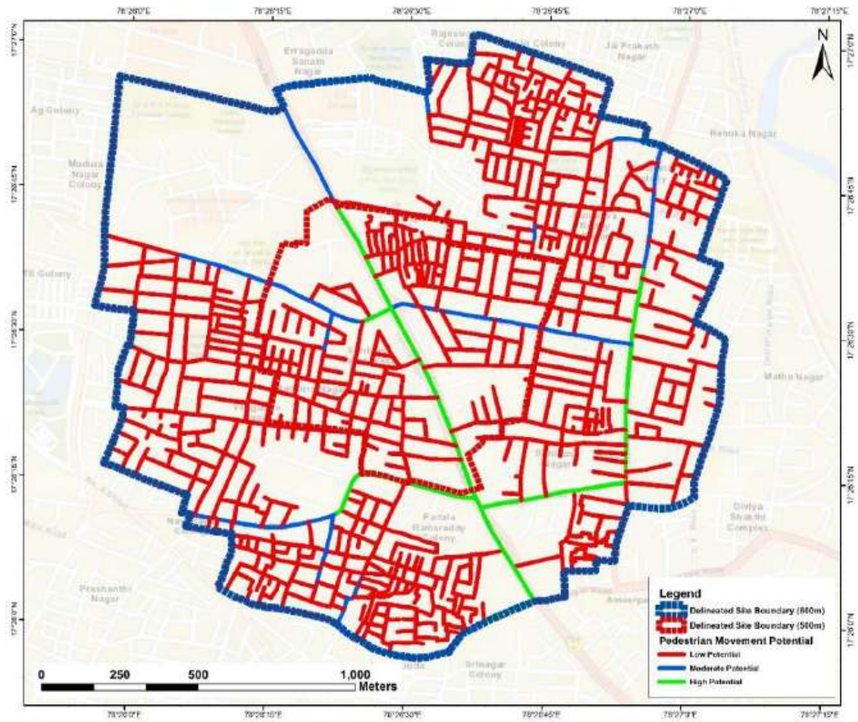


Figure 4-35 Pedestrian movement potential map

Source: Output of the project team, SPAV

As the Figure 4-35 depicts high potential for pedestrian movement can be observed along the metro corridor of the region – NH 65, Yousufguda road and along the Balkempet road indicating that these corridors act as a primary movement route with high accessibility and visibility. Around 43% of the total network have high potential. Followed by this, the collector road corridors which accounts for 29% act as the secondary connectors possessing moderate potential. SR Nagar main road, Vengal Rao Nagar street and a part of the Yousufguda stretch falls under this range. The majority of the internal streets (28%) fall under low pedestrian movement potential region. This indicates poor spatial integration within the study area and limited through movement. High concentration of low potential local streets indicates the presence of disconnected and dead-end streets. This reduces the overall network mobility.

Road connectedness

This map Figure 4-36 shows a mixed pattern of road connectedness. High connectivity streets form almost form 67% of the road network which suggest good internal accessibility. Moderately connected streets form around 30% of the road network which act as important linkages between highly connected local street and major movement corridors. Low connectivity is observed mostly along the dead-end roads. The highly connected streets have greater potential to support mobility

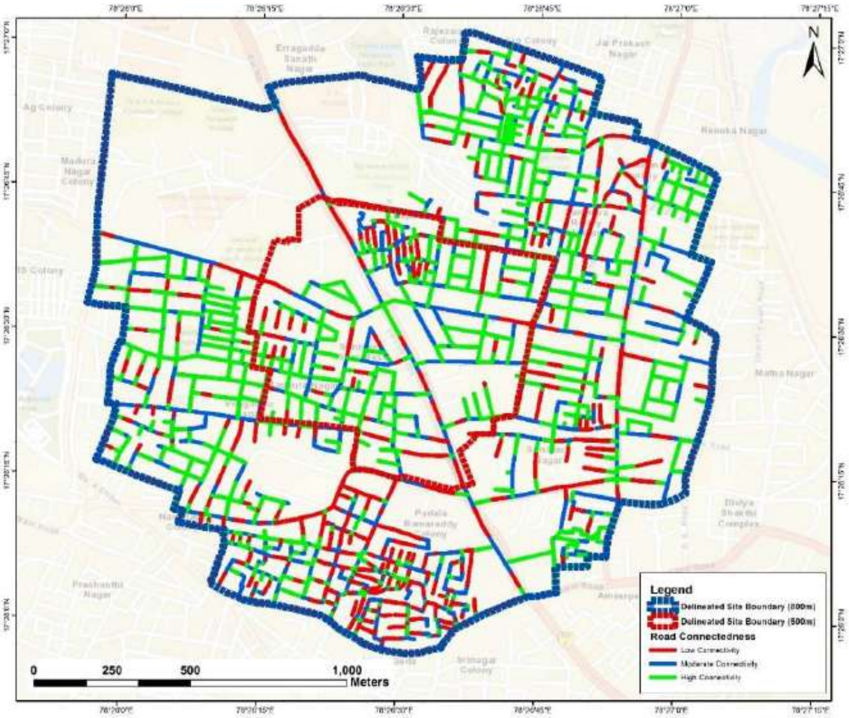


Figure 4-36 Road connectedness map

Source: Output of the project team, SPAV

Network accessibility

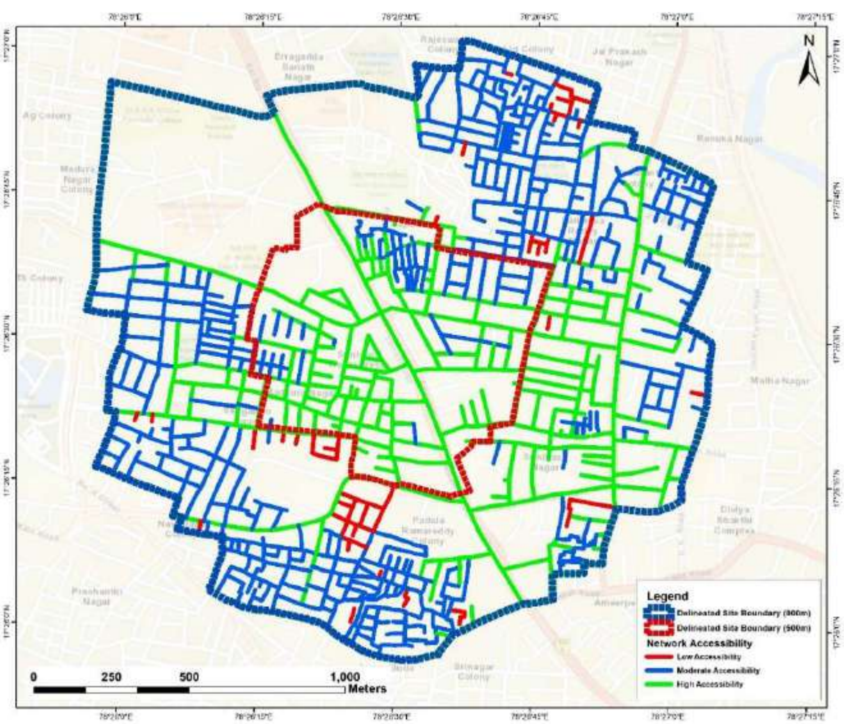


Figure 4-37 Network accessibility map

Source: Output of the project team, SPAV

From the Figure 4-37 we can observe that high accessible streets (48%) are mainly concentrated around the metro station and the corridor connecting the metro station. This functions as the primary access routes and support higher pedestrian and vehicular movement. The peripheral road networks are largely dominated by moderately accessible streets (51%) denoting that the areas depend on the main connectors to access the core road network. Low accessibility streets (1%) are mostly observed along the inner pockets of the region. This denotes that as we move further from the Metro hub, the network becomes less efficient indicating narrower lanes and disconnected footpaths.

4.1.1.9 Speed and Delay

Speed and delay analysis serves as a performance indicator for the road network. It highlights how effectively vehicles navigate around the area. By mapping travel speeds and identifying delays, the critical congestion hotspots, gaps are network efficiency could be estimated.

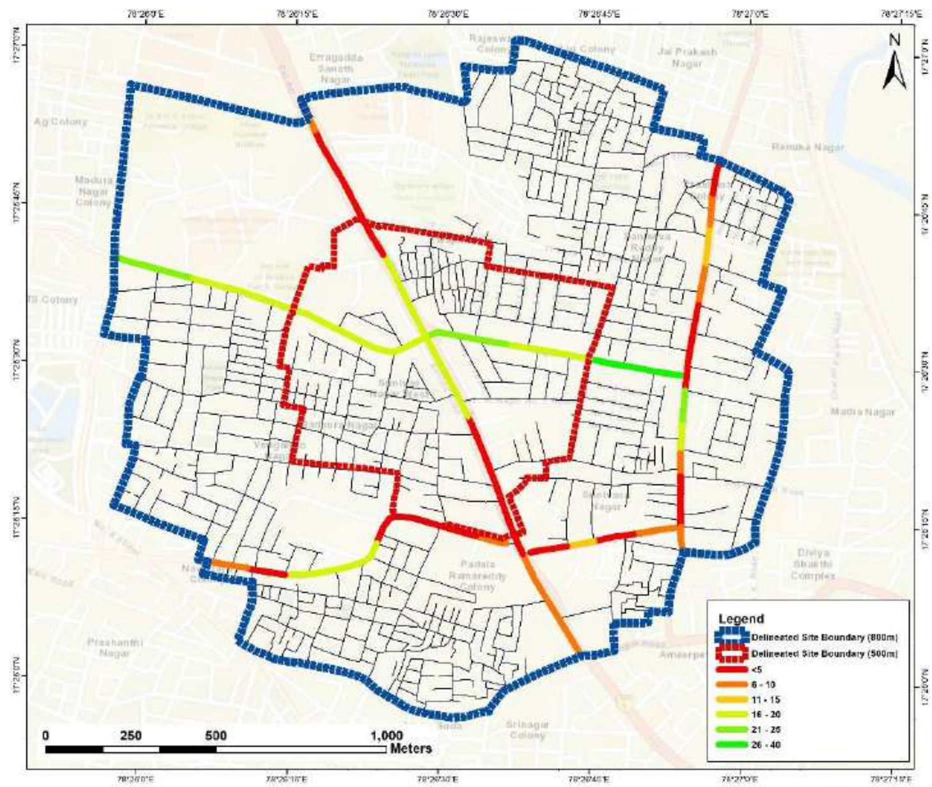


Figure 4-38 Speed and delay map

Source: Output of the project team, SPAV

The Figure 4-38 shows the speed and delay map for major corridors of the region.

Madhura Nagar Road also known as Yousufguda road recorded an average running speed of 13 km/h, while the average journey speed is 10 km/h. Six delay points were identified out of which two are fixed delay – traffic signals at the stretch and four are operational delay due to the sudden decrease in the road width.

The Vengalrao Nagar Road recorded an average running speed of 13 km/hr and an average running speed of 16 km/hr. Five delay points has been observed throughout the stretch of which, two are fixed delay and three are operational delay.

The SR Nagar main road recorded an average running speed of 24 km/hr and an average running speed of 22 km/hr. A total of two delay points were observed. Both were operational delay occurred due to vehicles approaching from crossroads.

The NH 65 road recorded an average running speed of 17 km/hr and an average journey speed of 14 km/hr. Six delay points were observed in which two were fixed delay and four were operational delay. Fixed delay was due to the presence of traffic signal and operational delay was due to the queue build-up to take U-turn.

The Balkempet road recorded an average running speed of 10 km/hr and an average journey speed of 8 km/hr. 18 operational delays were observed throughout the stretch which occurred due to high vehicular flow, narrow road and railway crossing bridge.

The Sathyam theatre Nagar Road recorded an average running speed of 8 km/hr and an average journey speed of 5 km/hr. A total of 11 delay points were observed of which two were fixed delay and nine were operational delay. The operational delay was due to the presence of on-street parking of vehicles due to the activity generated by the adjacent land use.

From the speed and delay analysis, we can infer that there is a high fluctuating speed profile indicating poor traffic flow management. The Sudden drop in speed can be observed which indicate inconsistency in the traffic flow. The red and orange patches represent primary bottlenecks zones where average speed drops below the design speed.

4.1.1.10 Network Level of Services

Level of service is an important indicator of efficiency and performance of traffic flow within a road network. The Figure 4-39 illustrates the Network level of service for the study area.

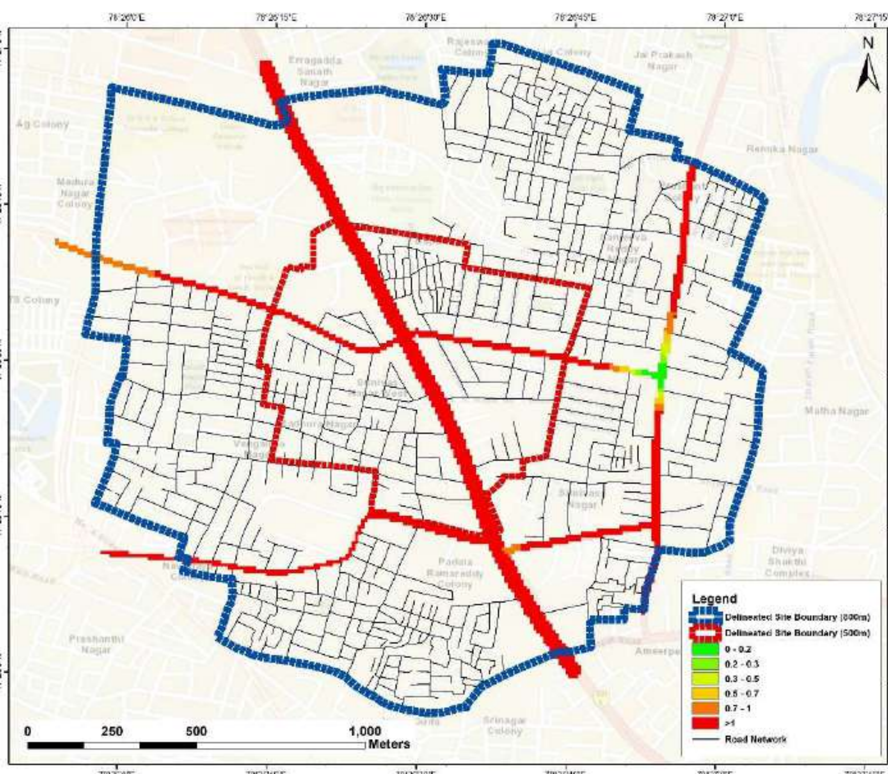


Figure 4-39 Heat map of Network Level of service

Source: Output of the project team, SPAV

The Traffic volume count is tabulated in Table 4-3. The major arterial and sub-arterial roads, which run along the north-south and east-west roads, are coloured deep red denoting the service capacity to be greater than 1. This proves that these roads are over stressed. There is no free flow on the major arterial road. Performance of the corridors immediate to metro station as well as corridors away from the metro stations remains poor.

Table 4-3 Traffic volume count analysis

Location	Time	Total Vehicle	PCU	Base capacity	V/C ratio	LOS
SR Nagar Metro	5 to 6	13677	13677	13600	1.695923	F
Vengal Rao Nagar	5 to 6	3529	7338.33	5400	1.941358	F
Near ESI Metro Station	5 to 6	15408	26945.52	13600	3.302147	F
SR Nagar Road	5 to 6	4497	10078.94	5400	1.86647	F

S.R Nagar and Balkampet Junction: This junction performs efficiently, operating at LOS A. Low V/C ratio at both the arms (0.1) indicates that traffic demand is within the design capacity, allowing for smooth, free-flowing movement without significant delay or queuing.

Satyam Theatre and Balkampet Road Junction: This intersection operates at LOS F, with V/C ratios (1.01) consistently prominent the 1.0 threshold. The junction is highly occupied by mixed-use traffic, resulting in reduced operational efficiency and determined queuing that carry forwards into adjacent streets.

Vengal Rao Nagar Junction: This node is currently failing at LOS F. The analysis indicates V/C ratios reaching 1.0 and above, confirming that the junction is unable to manage the intense vehicle volumes. This failure is further deteriorated by heavy interaction with local commercial activity, preventing effective throughput.

Madhura Nagar Junction: Operating at LOS F, this node shows V/C ratios above 1.0. The This junction lacks signalized control denoting the junction cannot effectively process the high volume of traffic, leading to systemic gridlock and an adversely affect the of movement flow.

Ameerpet Junction: As a critical signalized city node, this junction operates at LOS F. With V/C ratios frequently recorded above 1.0 (some peaks reaching 1.86), the demand is nearly double the intersection's capacity. This is the primary failure point for the network, where signal cycle times are no longer sufficient to clear the accumulated volume.

Near ESI Metro Station (Midblock): This critical segment operates at LOS F. The high interaction between dense vehicular traffic and station-bound pedestrians pushes the V/C ratio to 3.0, creating a breakdown condition where traffic movement becomes extremely slow and unpredictable.

SR Nagar Road (Midblock): This major artery is in a state of complete breakdown (LOS F). With V/C ratios of 1.8 exceeding 1.0, the road is operating at maximum saturation. This segment acts as the main arterial choke point for the entire study area, where no further capacity is available to absorb additional traffic.

Vengal Rao Nagar (Midblock): This segment operates at LOS F, with V/C ratio indicating a state of forced flow. The road is hindered by high vehicular volumes and intense roadside friction such as unauthorized parking which further reduces the effective capacity of the road.

4.1.2Diversity

4.1.2.1 Existing Landuse 2026

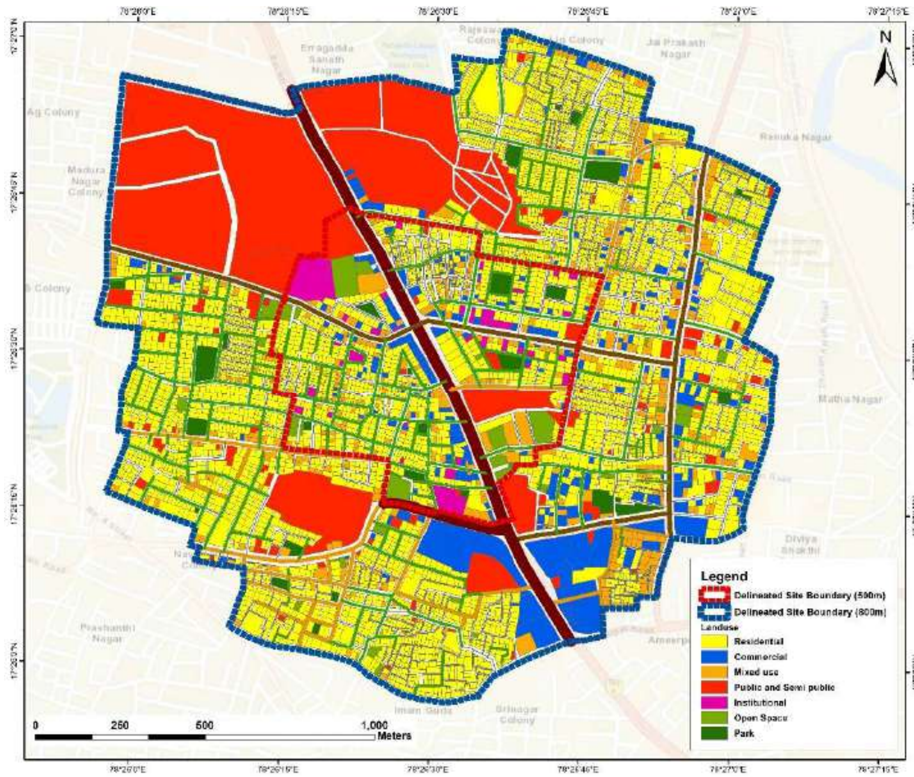
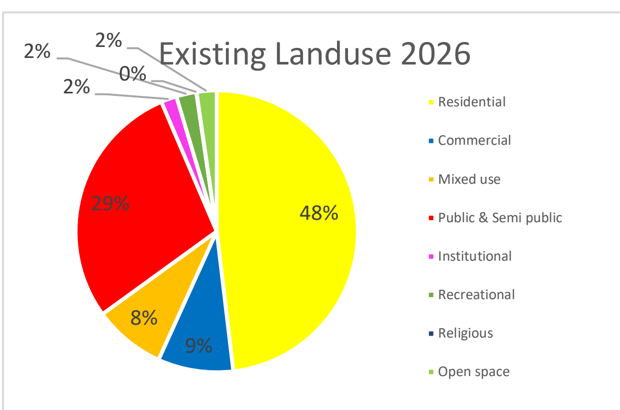


Figure 4-40 Existing Landuse map 2026

Source: Output of the project team, SPAV

Table 4-4 Landuse Composition



Landuse composition	Land Use	Area in Ha.
	Residential	99.15039147
	Commercial	17.85567951
	Mixed use	16.91766987
	Public & Semi Public	58.84542253
	Institutional	3.7822611
	Recreational	4.7008594
	Religious	0.0392867
	Open Space	4.72954403

The Existing land use map presented in the Figure 4-40. The landuse composition (Table 4-4) indicated the study region is dominated by residential land use which represents around 48%

of the total area indicating that the region is a dense residential cluster. Commercial landuse (9%) has been seen along the major road corridors and limited its penetration into the internal residential zone. Mixed use development (8%) is observed across the study region but is mainly observed along the arterial and collector roads as well as along few nearby local roads. It is observed that both commercial and mixed-use development gets clustered around the metro station. Public and semi-public landuse (29%) forms a large cluster especially at the north of the study area towards the ESI hospital. A large chunk of area is under the hospital, government facility and educational institutions. Open space and parks (2%) are scarcely scattered throughout the study area indicating the lack of parks and open space for the residents. Vacant land is minimal indicating that the region is a well-established urban fabric where future growth to be focused on densification and redevelopment.

4.1.2.2 Floor wise Landuse

Ground floor landuse

The Figure 4-41 shows the ground floor land use map. The ground floor land use of SR Nagar is characterized by a dense residential settlement (41%) with a mix of commercial (19%) and institutional zone (4%) indicating that the area is primarily a residential neighborhood.

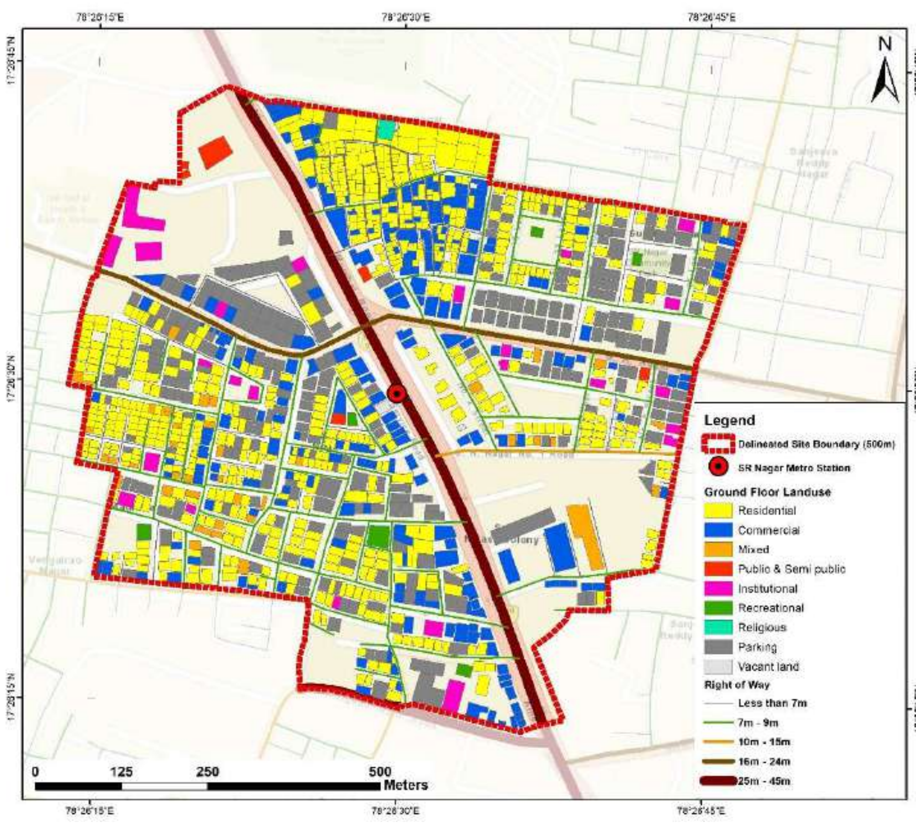


Figure 4-41 Floorwise landuse - Ground floor

Source: Output of the project team, SPAV

The strong residential dominance is interrupted by commercial land use which is dispersed along the arterial road and a few internal residential zones. Mixed use development (3%) is also observed at few spots across the study area. Strong residential share creates an imbalance in the overall land use share. Commercial growth is linear which indicates that the metro corridor and the main roads form the corridor for economic activity. Vacant land (1%)

and recreational space (1%) is very minimal indicating that the neighborhood has highly built-up dense. There is an optimum amount of parking space is available in the ground floor level contributing to around 29% of the total land use share. This parking space indicate that there is a high demand for parking denoting high dependency on private transport.

Floor-wise Landuse G+1

The Figure 4-42 shows the floor-wise land use map for G+1

- The first-floor land use is predominantly residential having 75% of the floor space.
- Commercial activity forms around 31% of the land use present along the main road corridors denotes that the commercial growth is still limited in the internal streets.
- Institutional and semi-public uses are limited and scattered and are mostly concentrated on the periphery or along the main road corridor.

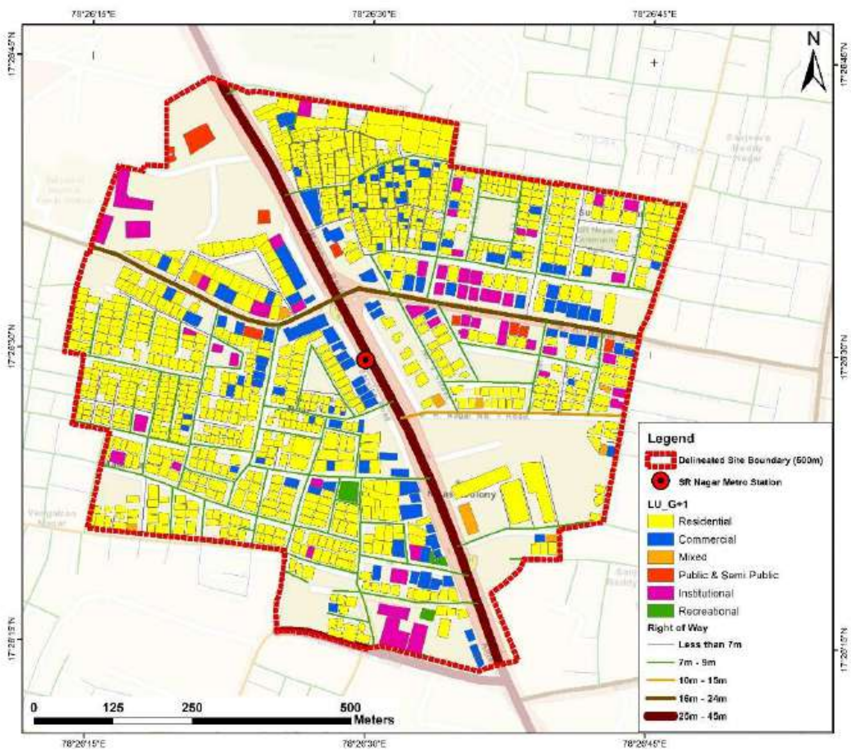


Figure 4-42 Floorwise landuse - G+1

Source: Output of the project team, SPAV

Floor-wise Land use G+2

The Figure 4-43 shows the floor-wise land use map for G+2

- In the second-floor land use is again dominated by the residential land use making around 77% of the total land use share.
- The vertical growth along the region is dominated by dense residential growth. Commercial use forms around 12% of the land use share mainly concentrated along the major roads and transit corridor.
- Mixed use and public semi-public space are observed along few locations but contributes negligible share to the overall land use percentage.

- Institutional zone makes around 10 % of the land use share denoting the presence of educational and public facilities.

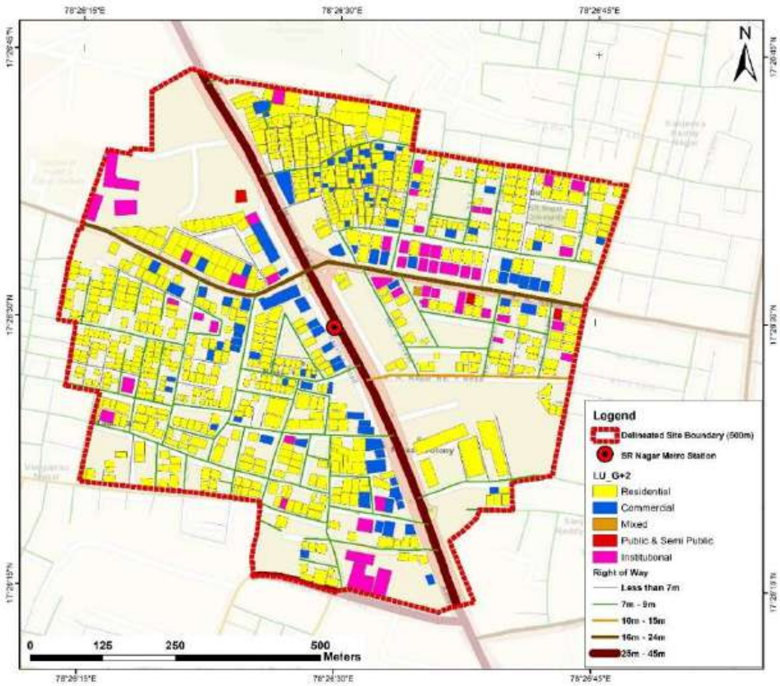


Figure 4-43 Floorwise landuse - G+2

Source: Output of the project team, SPAV

Floor-wise Landuse G+3

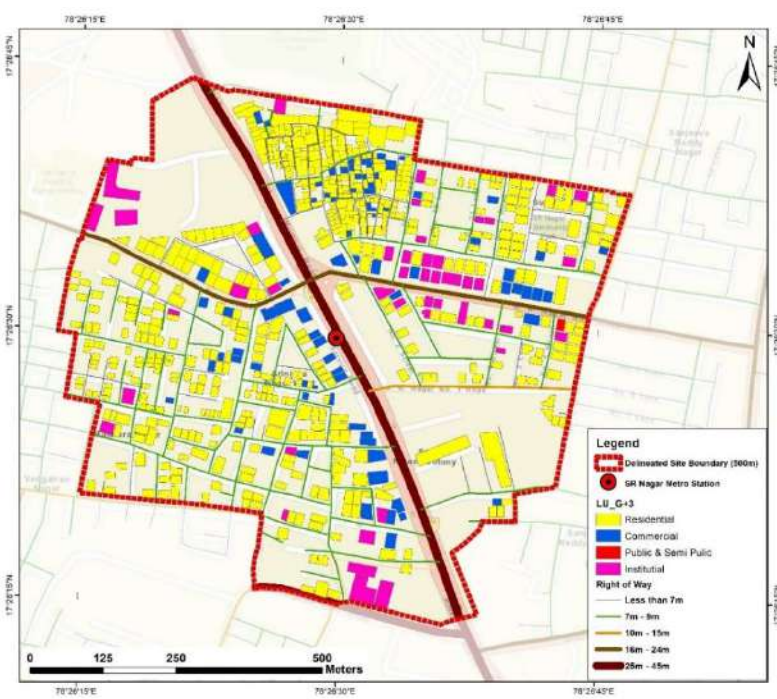


Figure 4-44 Floorwise landuse - G+3

Source: Output of the project team, SPAV

The Figure 4-44 shows the floor-wise land use map for G+3

- As the floor level increases the variation of land use gets narrowed to 4 categories.
- Similar to the previous floor-wise land use, the residential land use is predominant making 75% of the total land use share.
- Concentration of the residential zone is high in the northern region of the study area.
- Commercial and institutional land use is 13% which is concentrated along the Metro corridor and public and semipublic is negligible.

Floor-wise Landuse G+4

In case of G+4 Figure 4-45 land use, the percentage of the residential share is 73% the commercial reduces to 11% and the institutional zone has increased to 15%. There is an addition of mixed use which contributes to 1% of the land use.

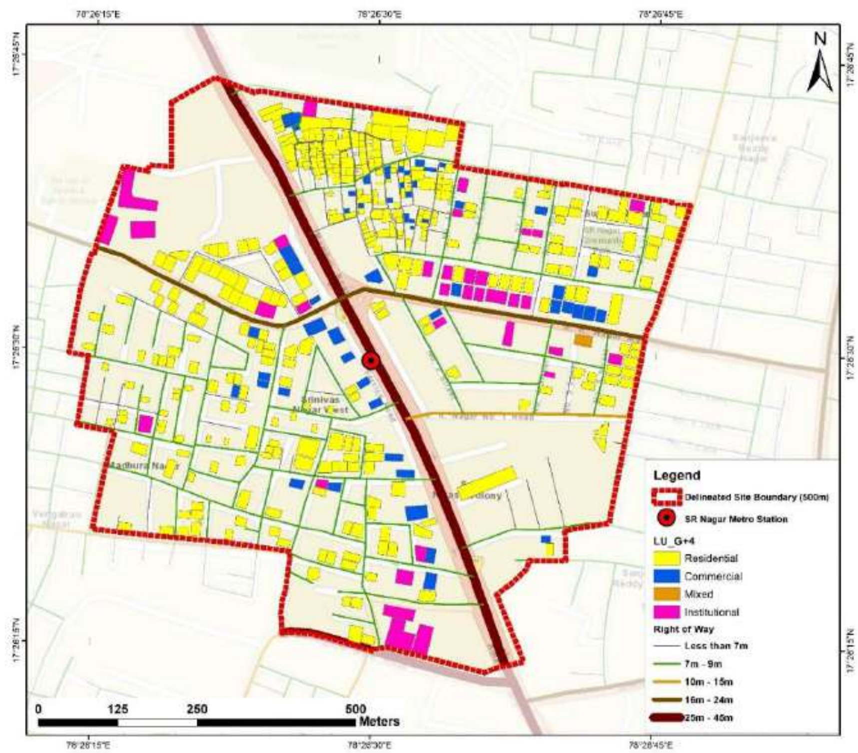


Figure 4-45 Floorwise landuse - G+4

Source: Output of the project team, SPAV

- In this condition the main concentration of the residential zones continues in the northern part and is also spread and scattered across the region.
- Commercial use is predominantly observed along the arterial road.
- This minimum commercial penetration denotes that the neighborhood-level services are lacking and the economic activity is relying wholly on the main arterial stretch.

Floor-wise Landuse G+5

- The G+5 land use (Figure 4-46) indicates a decrease in the residential land use when compared to the previous floor land use. Residential land use accounts for around 68 % of the overall land use followed by the institutional land use which accounts to 22% and commercial land use contributes to 10% of the overall land use.

- The residential concentration is still at the norther part of the study area indicating heavy residential density on the region.

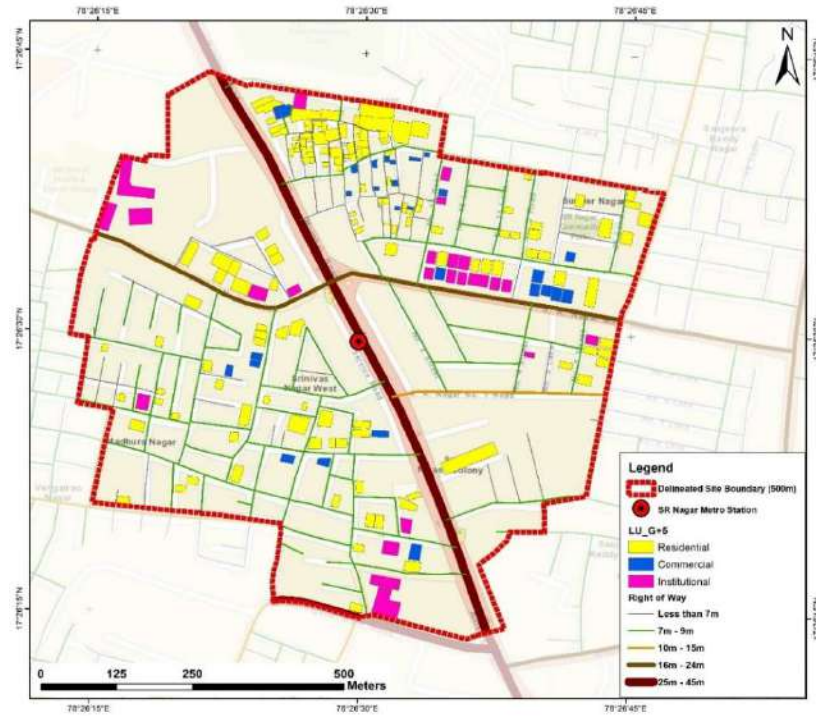


Figure 4-46 Floorwise landuse - G+5

Source: Output of the project team, SPAV

Floor-wise Land use Above G+5

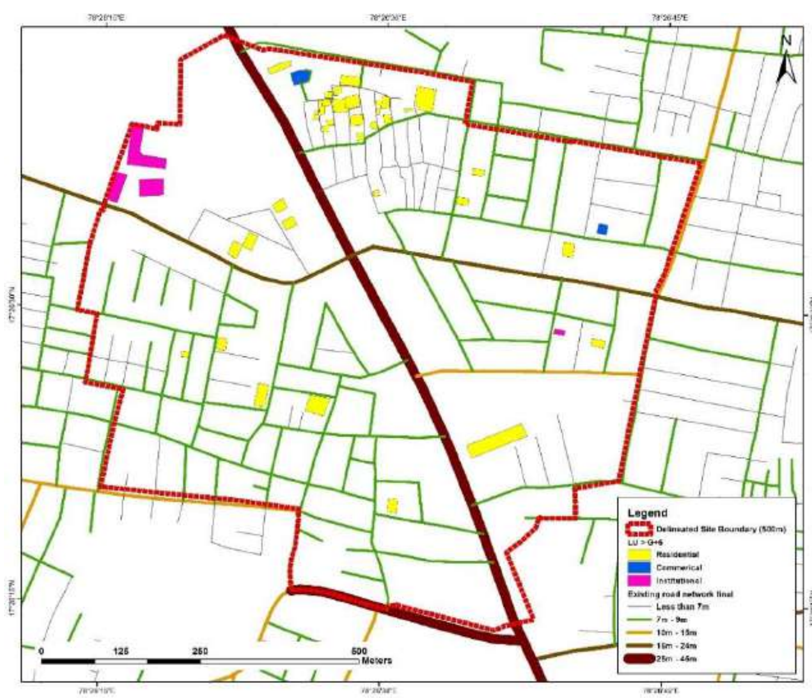


Figure 4-47 Floorwise landuse above G+5

Source: Output of the project team, SPAV

The Figure 4-47 shows the floor-wise land use map for above G+5. The Residential zone jumps back to 70% of the total land use share. The percentage of commercial land use is 5% and the institutional land use makes around 25%. The land use is scattered diversly across the study area.

4.1.2.3 Building Height

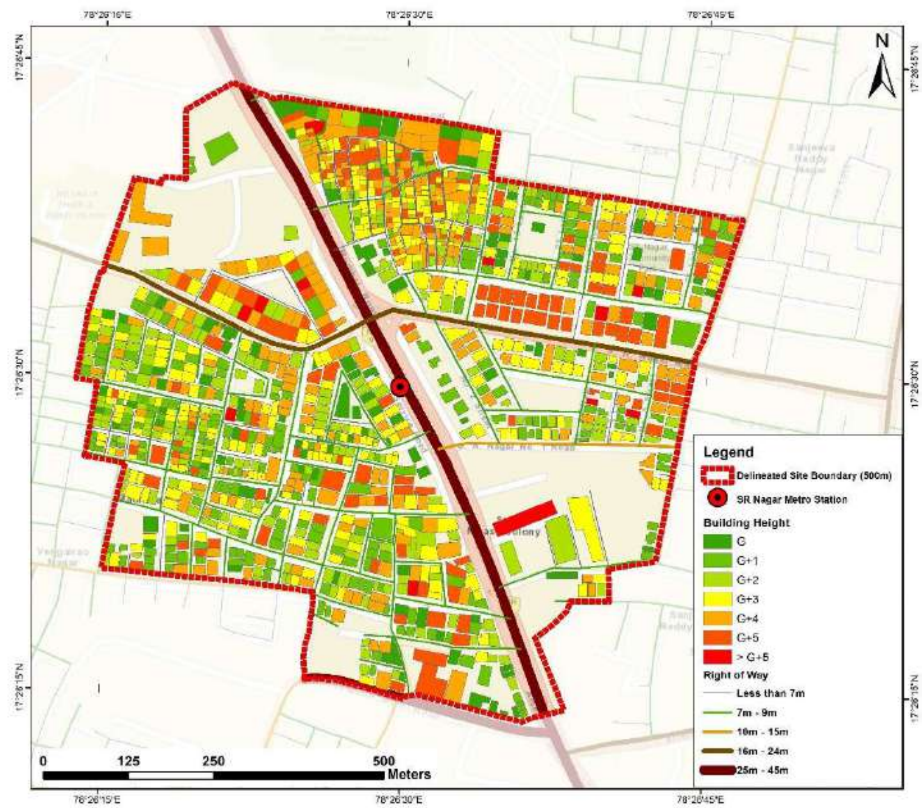


Figure 4-48 Building height distribution

Source: Output of the project team, SPAV

- The distribution of building height in SR Nagar (Figure 4-48) shows a varied urban environment with a dominance of mid-rise buildings.
- The majority of the buildings are within the range of G+2 (18%) to G+3 (19%). Clusters of buildings at G+4 (22%) and G+5 (19) are located along the main roads and transit corridors.
- The variation in building heights across the study area reflects the presence of high urban density. Around 12% of the building rise above G+5 reflecting its built-up and vertical growth pattern.
- Majority of the high rise are located at the northern part of the SR Nagar and the transit corridors.

4.1.3Density

4.1.3.1 Figure Ground Analysis

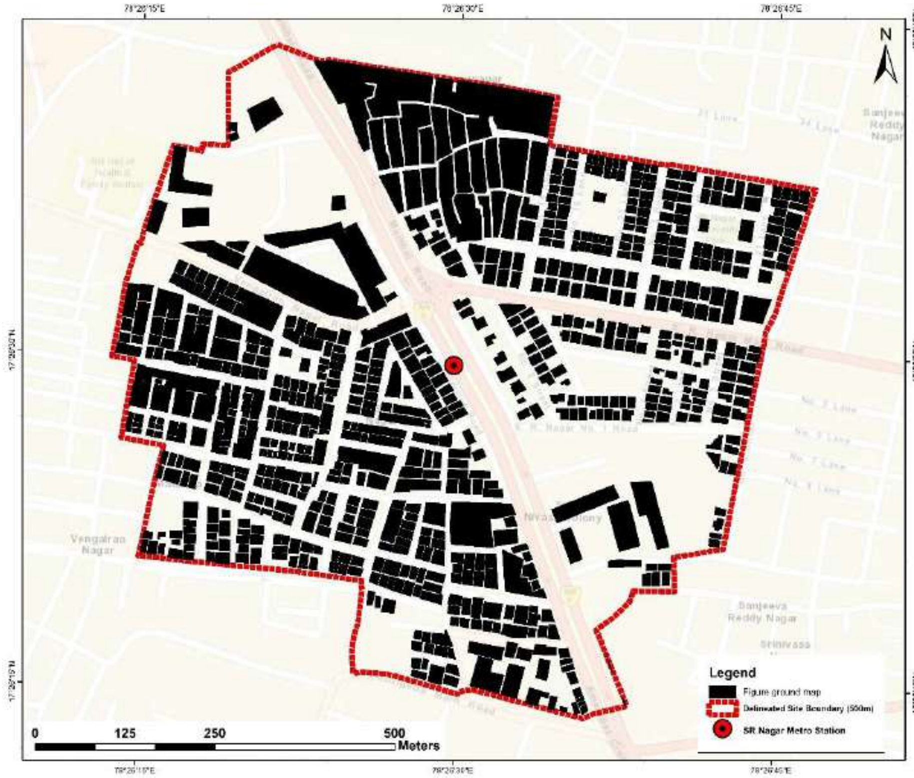


Figure 4-49 Figure ground map

Source: Output of the project team, SPAV

Table 4-5 solid void distribution

Solid & Voids	Area (Sqm)	Percentage (%)
Builtup Area	0.2786	45.4%
Road Network	0.1658	27.1%
Open Area	0.1686	27.5%

The Figure-Ground map (Figure 4-49) reveals a neighbourhood that is heavily fragmented rather than organically interconnected. The Table 4-5 shows the percentage of open space.

Built-up Mass Concentration: The solid mass is extremely dense and concentrated in the northern and western regions. This high building density confirms the over-utilized status identified in the potential plot utilization evaluation. The buildings are packed closely together, leaving very little room for private or semi-private open space.

Void Placement Issues: The voids (open areas) appear largely as residual spaces rather than planned urban parks or public squares. A major issue here is that the open spaces are either at the edges of the site or disconnected. They do not provide a continuous breathing room for the dense core. Absence of consolidated voids that could be used for major new public infrastructure.

Road Placement & Connectivity: The road network acts as a rigid grid that bisects the neighbourhood. While it provides access, the placement of these roads creates islands of dense built-up blocks. The secondary roads are as choked as primary corridors which affects the efficient movement.

4.1.3.2 Existing Land Utilization

The existing land utilization analysis for SR Nagar follows the frame work of GO MS No 168, under which building height and permissible plot area has be denoted. The two main governing factors are the width of the road abuting the plot and the plot size itself. This study examins the existing builtup development and compares with the maximum level of development allowed on each land parcel.

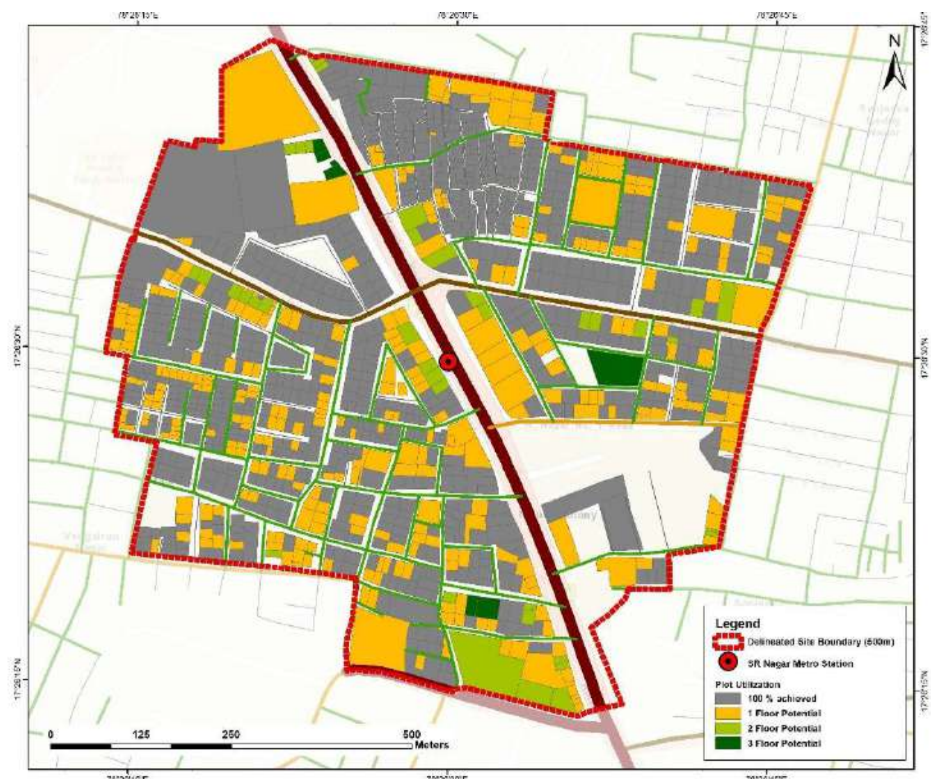


Figure 4-50 Potential land utilization map

Source: Output of the project team, SPAV

From the map Figure 4-50 we can observe that the over utilized plots dominate the region. It makes around 71.7% of the total plot area. This indicates that the neighborhood has reached its intended density under current planning norms.

Even though most plots are 100% utilized, there is still scope for expansion in certain areas. Approximately 9.5% of the plot has the potential for an additional floor. Large residential plots and a few institutional plots exhibit this potential scope.

Plots with potential for two floors makeup around 2.9% of the total plots. These plots are largely located along the metro corridor, commercial plots and along the collector roads.

Scope for 3 and more than 3 floor potential is comparatively less combined forming only 0.5 percent of the total plots.

This region has building which already have attained G+5 to G+7 heights leaving limited scope for vertical expansion.

4.1.4 Design

4.1.4.1 Loop and Pedestrian Permeability Analysis

Efficient pedestrian connectivity is a fundamental principle of Transit-Oriented Development (TOD), as it determines the ease with which residents and commuters can access transit infrastructure within the walking catchment area. To evaluate the performance of the street network around the metro station, an integrated analysis of pedestrian permeability and loop connectivity was conducted.

The analysis examines the structure of the street network, block lengths, intersection frequency, and route continuity to understand how effectively the urban fabric supports pedestrian movement within the TOD influence area.

4.1.4.1.1 Pedestrian Permeability of the Urban Fabric

Pedestrian permeability refers to the degree to which the urban street network allows multiple route choices and direct movement through the built environment. A highly permeable network typically consists of short block lengths, frequent intersections, and multiple internal connections, allowing pedestrians to move efficiently between destinations. The permeability analysis mapped the distance between intersections and available route segments throughout the study area (Figure 4-51).

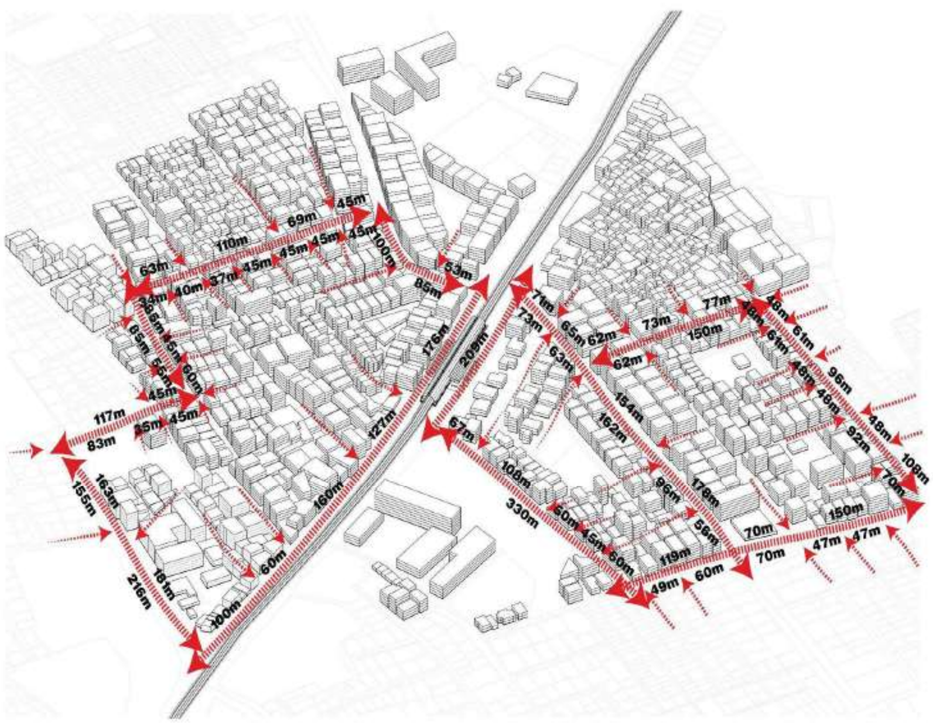


Figure 4-51 Pedestrian Permeability Map showing Block Lengths and Intersection Spacing

Source: Output of the project team, SPAV

High Permeability Zones

Several interior neighbourhood streets exhibit short block intervals between 40 m and 70 m, indicating a relatively fine-grain street structure.

These areas demonstrate:

- Frequent intersections
- Multiple route options
- Smaller walking segments
- Greater adaptability for pedestrian movement

Such fine-grain networks are typically more supportive of walkability and TOD principles, as pedestrians can easily choose alternative paths and adjust routes toward the metro station.

Moderate Permeability Zones

- Many streets fall within the 70 m to 120 m block length range, representing moderate permeability.
- These segments allow reasonable pedestrian circulation but provide fewer alternative route options, causing movement to concentrate along certain internal streets.

Low Permeability Zones and Barriers

Several areas within the study zone exhibit long block segments exceeding 150 m, with some reaching 200–330 m. These long blocks are primarily associated with:

- Large institutional parcels
- Consolidated building plots

Such long block lengths reduce pedestrian permeability by:

- Limiting route choice
- Increasing walking detours
- Concentrating movement along major streets

The metro corridor and the primary arterial road function as linear barriers, reducing cross-neighbourhood connectivity and restricting pedestrian movement to a limited number of junctions.

4.1.4.1.2 Loop Connectivity Analysis

To further understand the functional performance of the street network, a loop connectivity analysis was conducted. This analysis identifies continuous pedestrian circuits within the neighbourhood and evaluates how the street network supports circulation and route alternatives within the TOD catchment (Figure 4-52). Three representative loops were identified around the metro station based on the existing street hierarchy.

Loop 1 - Western Neighbourhood Network

Loop Length: 1.84 km

- Loop 1 covers the western neighbourhood block characterized by a dense fine-grain urban fabric with small plot divisions and numerous internal streets.
- Although the neighbourhood has several internal connections, the loop length is relatively long due to:
  - Irregular street alignments
  - Partial dead-end streets

- Lack of mid-block connections

- These conditions increase the actual walking distance compared to the straight-line distance to the metro station, indicating that pedestrians must follow indirect routes.

Figure 4-52 Pedestrian Loop Connectivity around the Metro Station

Source: Output of the project team, SPAV

Loop 2 – Transit Corridor Interface

Loop Length: 1.17 km

- Loop 2 runs along the central transit corridor surrounding the metro station.
- This loop is relatively shorter due to the presence of major arterial roads and direct street alignments. However, the corridor itself acts as a strong physical barrier, limiting lateral connectivity between the neighbourhoods located on either side.
- As a result, pedestrian movement is concentrated around the main junction near the metro station, where crossing opportunities are available.

Loop 3 – Eastern Residential Neighbourhood

Loop Length: 1.14 km

- Loop 3 encompasses the eastern residential block, which demonstrates moderately compact block structures and relatively efficient internal circulation.
- Block lengths within this area generally range between 60 m and 90 m, providing relatively frequent intersections and shorter walking segments.

- However, similar to the western neighbourhood, connectivity toward the metro corridor remains limited due to large edge blocks and restricted access points.

Integrated Inferences: Network Efficiency

- The combined permeability and loop analysis reveals several structural characteristics of the urban fabric surrounding the metro station.
- Fine-grain neighbourhood morphology exists internally, but permeability toward the transit corridor is limited.
- Large block edges and infrastructure corridors create movement barriers, forcing pedestrians to rely on a small number of access points.
- Several neighbourhood streets provide good internal connectivity, but the lack of cross-links increases walking distances to the metro station.
- Pedestrian movement is therefore channelled into a few dominant streets, leading to congestion at key junctions.

4.1.4.1.3 Implications for Transit-Oriented Development

For a TOD precinct to function effectively, the pedestrian network must enable short, direct, and comfortable walking routes to transit nodes. The analysis highlights the need to strengthen connectivity by:

- Introducing mid-block pedestrian connectors
- Increasing cross-corridor pedestrian crossings
- Improving secondary street connectivity
- Transforming impermeable compound walls into porous or active edges

These interventions can significantly reduce walking distances and distribute pedestrian movement more evenly, thereby improving last-mile accessibility and walkability within the TOD catchment area. Built-Use and Activity Pattern Analysis

Understanding the distribution of land uses within the TOD catchment area is essential for evaluating urban vitality, pedestrian activity, and transit-supportive development patterns. The analysis maps the spatial distribution of residential, commercial, mixed-use, institutional, public/semi-public, parks, and vacant lands along the primary pedestrian loops surrounding the metro station.

The objective of this analysis is to understand how land use patterns influence pedestrian movement and urban activity within the 500 m TOD catchment area.

4.1.4.2 Built-Use and Activity Pattern Analysis

Understanding the distribution of land uses within the TOD catchment area is essential for evaluating urban vitality, pedestrian activity, and transit-supportive development patterns. The analysis maps the spatial distribution of residential, commercial, mixed-use, institutional, public/semi-public, parks, and vacant lands along the primary pedestrian loops surrounding the metro station.

The objective of this analysis is to understand how land use patterns influence pedestrian movement and urban activity within the 500 m TOD catchment area. The Figure 4-54 depicts the urban growth along the metro corridor.

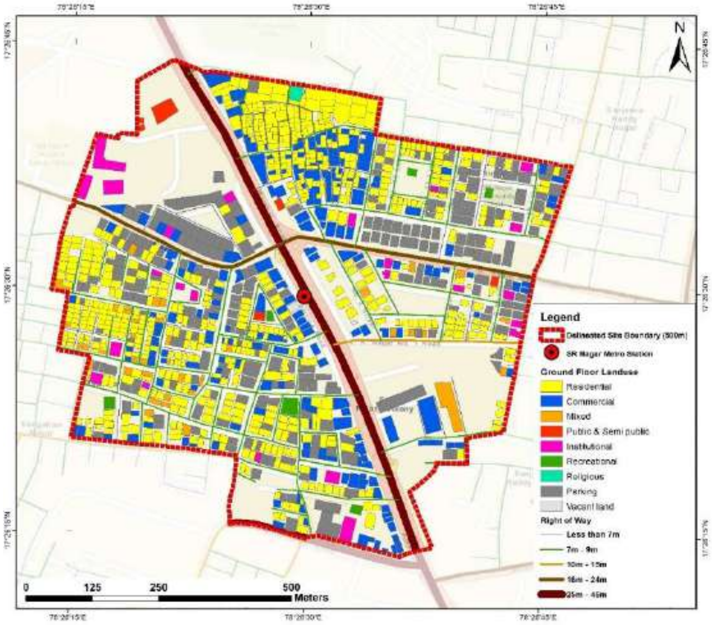


Figure 4-53 Existing Ground floor built-use map 2026

Source: Output of the project team, SPAV

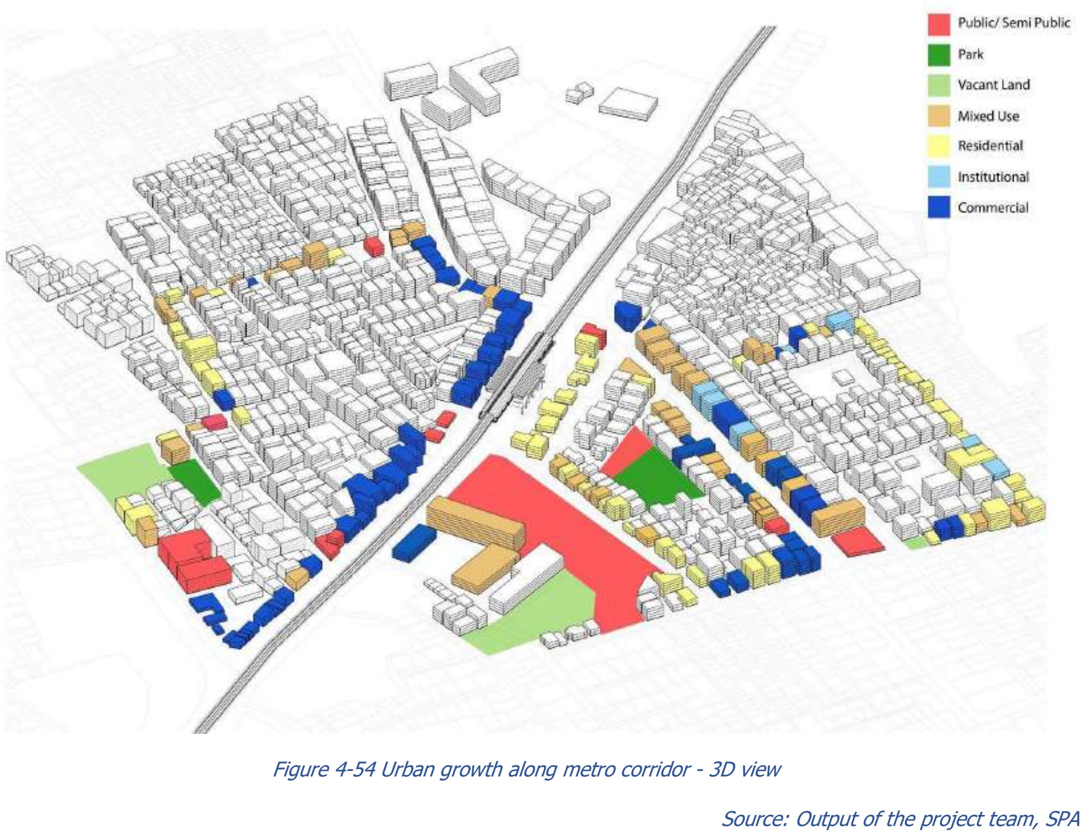


Figure 4-54 Urban growth along metro corridor - 3D view

Source: Output of the project team, SPAV

Residential Dominance in the Inner Neighbourhoods

- The study area is predominantly characterized by dense residential neighbourhoods, particularly within the internal street networks.
- These residential areas form the primary population base for the metro station, generating daily commuting demand. However, purely residential streets often exhibit lower levels of street activity, especially during non-peak hours.
- This condition indicates the need for greater functional diversity within the TOD catchment to support continuous urban activity.

Commercial Concentration along Major Corridors

- Commercial land uses are primarily concentrated along major arterial roads and transit-facing corridors, especially near the metro alignment and key intersections.
- These commercial edges create active street interfaces, supporting:
    - retail activity
    - pedestrian interaction
    - transit-oriented economic activity
- Such clustering is typical in transit corridors, where higher footfall and visibility encourage commercial development.
- However, the distribution appears linear rather than nodal, indicating that commercial activity is largely confined to the main roads rather than penetrating deeper into neighbourhood streets.

Emerging Mixed-Use Corridors

- Mixed-use development is particularly visible along the primary pedestrian corridors leading toward the metro station, indicating a gradual transition toward transit-supportive urban morphology.
- These areas present strong opportunities for TOD intensification, as mixed-use environments support both residential density and economic activity.

Institutional and Public Uses

- Institutional and public/semi-public land uses appear in larger consolidated parcels, especially toward the southern portion of the study area.
- While these uses contribute to the social infrastructure of the neighbourhood, large institutional parcels often create large impermeable edges, reducing street-level activity and pedestrian permeability.
- Such conditions highlight the need to activate institutional edges with publicly accessible frontages or shared open spaces.

Open Spaces and Vacant Parcels

- The analysis identifies a limited number of parks and vacant parcels within the study area.

- Vacant land parcels, particularly those located close to the transit corridor, represent significant opportunities for future TOD-oriented development, including:
    - mixed-use redevelopment
    - transit-supportive commercial spaces
    - public plazas or mobility hubs
- Strategically integrating these parcels into the TOD framework can significantly improve urban vibrancy and public realm quality.

4.1.4.3 Street Activity Mapping

SR Nagar Main Road
Right of Way of – 18m | Road Type – Two Way Four Lane Divided

SR Nagar Main Road (Figure 4-55) is already a vibrant blend of residential apartments, educational institutions (hosting over 500 schools and colleges), retail shops, banking offices, restaurants, hostels, and healthcare centres.

The field survey indicates a mixed urban activity pattern, where residential, commercial, institutional, and informal uses coexist along the primary corridors.

Several important observations emerge:

- Institutional clusters such as educational institutes and healthcare facilities generate large pedestrian flows throughout the day.
- Mixed-use buildings with retail at ground level contribute to street vibrancy and economic activity.
- Street vendors and small retail activities create localized gathering points and informal nodes.
- These conditions reflect a transit-supportive urban environment, where multiple daily activities occur within walking distance of the metro station.

Figure 4-55 Map of SR Nagar Main Road stretch

Source: Output of the project team, SPAV

Temporal Activity Mapping

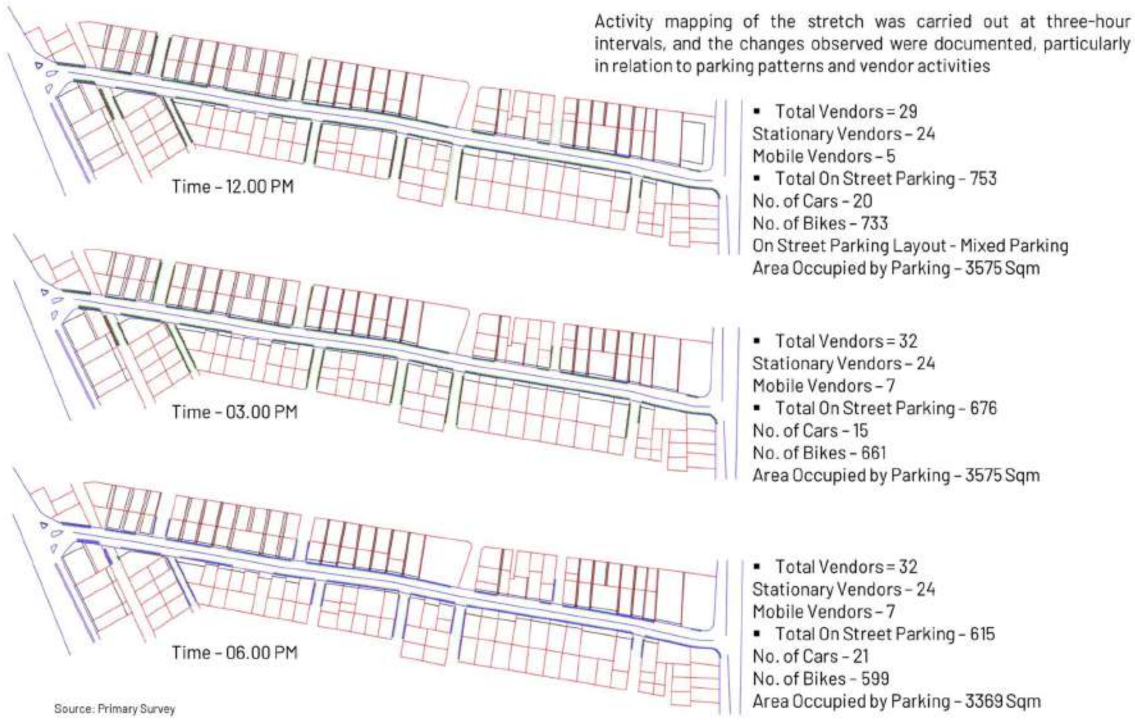


Figure 4-56 Temporal activity mapping of SR Nagar

Source: Output of the project team, SPAV

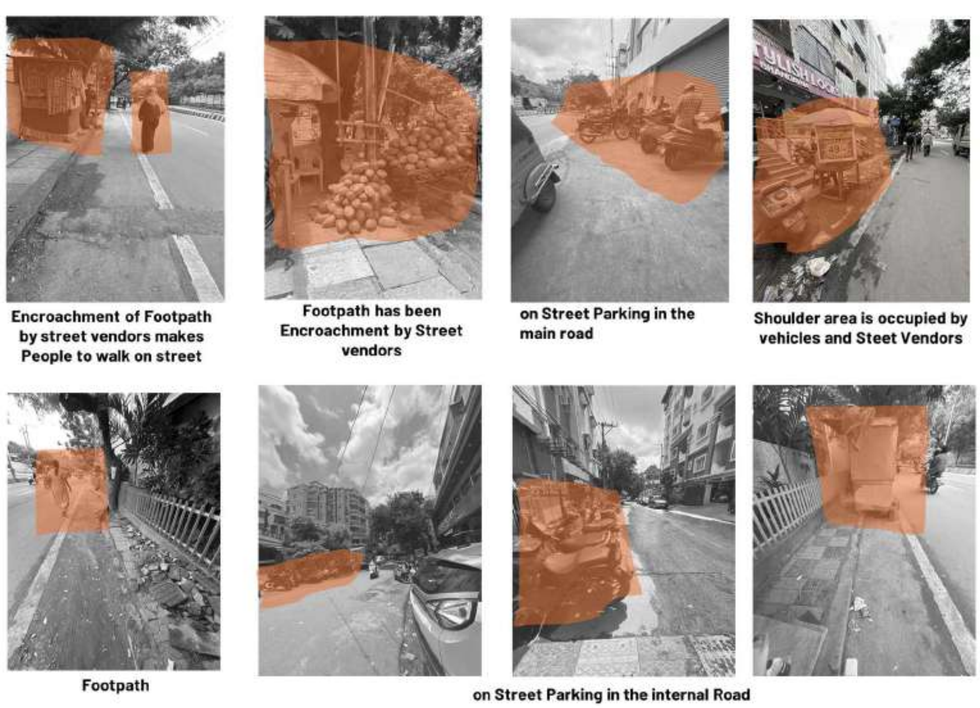


Figure 4-57 Issues in footpath

Source: Output of the project team, SPAV

- As illustrated in the Figure 4-56 the activity survey conducted at three-hour intervals revealed variations in street usage throughout the day.
- Midday hours show higher vendor activity and parking demand.
- Evening hours show increased pedestrian movement and retail activity.
- Parking demand slightly decreases during evening periods as commercial turnover increases.
- These temporal variations indicate that the corridor functions as a dynamic urban street supporting multiple daily activities.

Issue Mapping

The activity mapping highlights several public realm deficiencies affecting pedestrian comfort and safety as shown in Figure 4-58.

Key issues identified include:

- Discontinuous or absent footpaths
- Utility poles and trees obstructing pedestrian movement
- Footpath encroachment by vendors and parked vehicles
- Poor condition of sidewalks
- Inadequate signage and street furniture
- Localized waterlogging issues

These conditions significantly affect walkability within the TOD catchment area, despite the presence of high pedestrian activity.

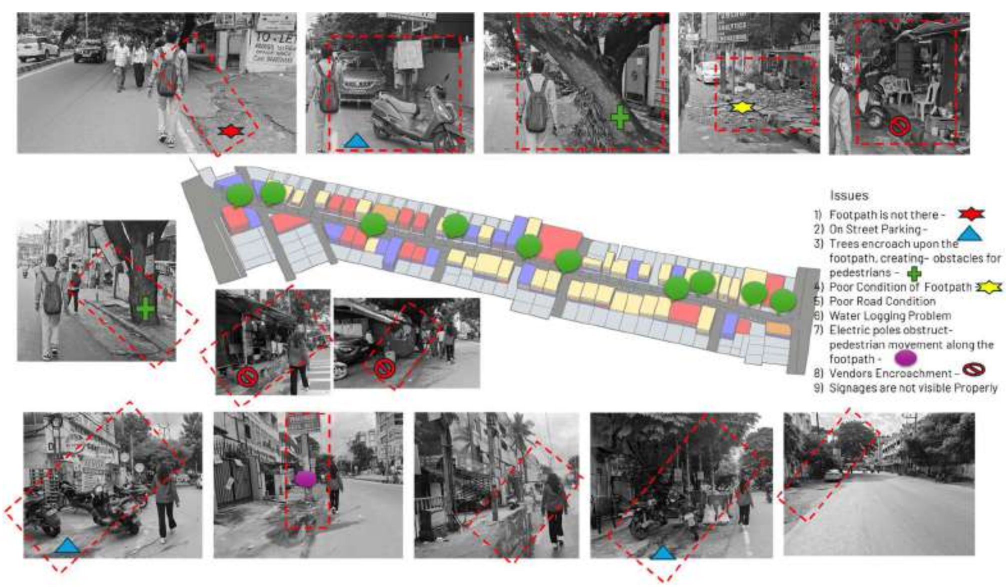


Figure 4-58 Issues identified along the SR Nagar Main Road stretch

Source: Output of the project team, SPAV

4.1.4.4 Hierarchy of Junction

Hierarchy of junction helps to prioritize and evaluate the functional important of junctions. Figure 4-59 illustrates hierarchy of junction in the study area. The Table 4-6 show the junction analysis.

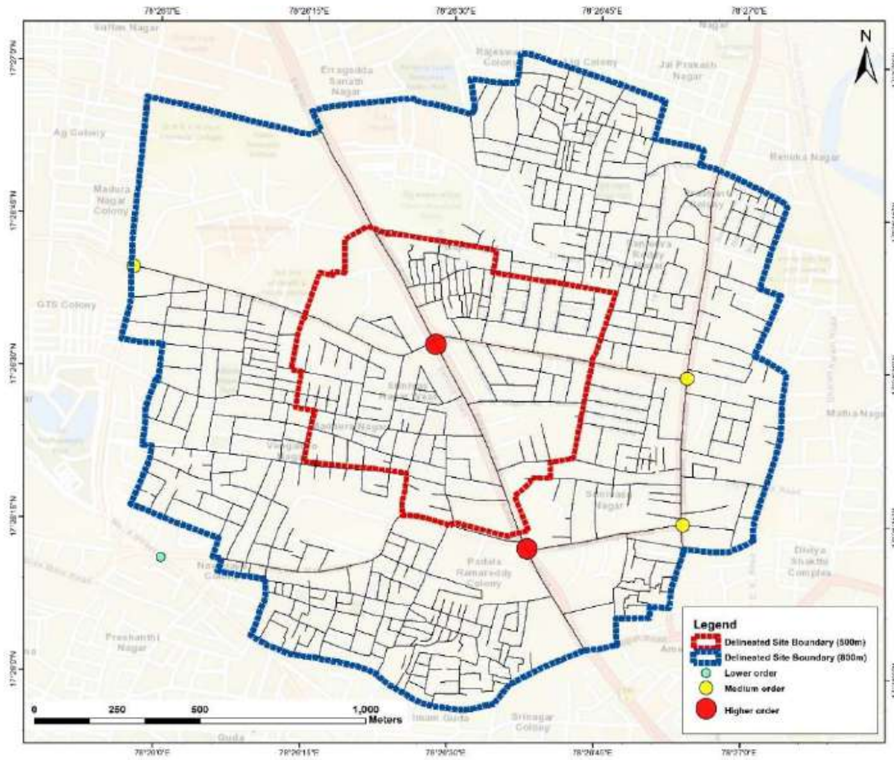


Figure 4-59 Hierarchy of junctions

Source: Output of the project team, SPAV

Ameerpet Junction: Ameerpet junction functions as the primary node within the network and serves as a major urban intersection. Due to intense commercial activity and heavy transit movement this junction experience significant pressure. The intersection currently operates at **LOS F for both vehicles and pedestrians,** indicating severe congestion and inadequate pedestrian infrastructure.

SR Nagar Junction: This is an important corridor linkage supporting a high intensity of mixed residential and commercial activity. This junction experience heavy vehicular congestion (LOS F) but it maintains a more functional pedestrian environment (LOS c).

Vengal Rao Nagar Junction: This junction exhibits moderate connectivity within the network but lacks active street features such as pedestrian friendly infrastructure0. Vehicular flow remains critical with LOS F, pedestrian movement is relatively manageable indicating scope for mobility improvements.

Satyam Theatre Road Junction: Despite the absence of signalization, it has managed to function as an important artery of high levels of commercial traffic. The presence of poor LOS ratings for vehicles (LOS F) and pedestrians (LOS E) denotes a heavily burdened area due to unplanned commercialization.

Balkampet Junction: This is the only junction with an excellent LOS rating for vehicles (LOS A), likely because it is a 3-arm unsignalized junction. The pedestrian infrastructures are completely absent (LOS D) indicating a prioritization for vehicles and exclusion of pedestrians.

Madhura Nagar Junction: This is a lower order junction. This junction experiences moderate mixed-use traffic. Poor pedestrian infrastructure (LOS E) and congestion of vehicles (LOS F) leads to critical deficit in the urban design measures.

Table 4-6 Hierarchy of junction analysis

Sl. No.	1	2	3	4	5	6
Junction	**Ameerpet Junction**	**SR Nagar Junction**	**Balkampet Junction**	**Vengal Rao Nagar Junction**	**Satyam Theatre Road Junction**	**Madhura Nagar Junction**
Road Hierarchy (Score)	NH + Sub-arterial + Collector **(5)**	NH-65 + Collector **(4)**	Collector **(3)**	Collector **(3)**	Collector road **(3)**	Sub-arterial + Local **(4)**
PT Proximity (Score)	50 m to Metro **(5)**	100 m to Metro **(5)**	900 m to Metro **(2)**	30 m Bus Stop & 1.5 km Metro **(3)**	900 m Metro **(2)**	600 m Metro **(3)**
Junction Type (Score)	4-arm signalised **(5)**	4-arm signalised **(3)**	3-arm unsignalised **(3)**	4-arm signalised **(5)**	4-arm un-signalised **(4)**	3-arm unsignalised **(3)**
Connectivity (Score)	Major city node **(5)**	Strong corridor linkage **(5)**	Medium neighbourhood linkage **(3)**	Medium connectivity **(3)**	Med-high linkage **(4)**	Medium internal linkage **(3)**
Land Use Activity (Score)	High intensity commercial **(5)**	High commercial/residential mix **(4)**	Moderate residential/commercial **(3)**	Medium activity area **(3)**	High commercial activity **(4)**	Moderate mixed use **(3)**
PLOS (Grade – Value)	F – 1	C – 4	D – 3	C – 4	E – 2	E – 2
Vehicle LOS (Grade – Value)	F – 1	F – 1	A – 6	F – 1	F – 1	F – 1
Urban Design (Score)	Signalled, Walkways, Highly active	Signage, Walkways, Medium activity	No Signage, No walkway, Low activity	Signalled, walkway, low active	Signage, walkway, high activity	No signal, walkway, medium activity
	5	3.5	1	3	4.5	3
Final Score (/42)	32	29.5	24	25	24.5	22
Hierarchy Category	High-Order Junction	High Order Junction	Medium-Order Junction	Medium-Order Junction	Medium-Order	Low-Order Junction

4.1.4.5 Nodal Hierarchy and Activity Structure

Urban nodes represent points of spatial convergence where movement, activity, and visibility intersect. Identifying these nodes is critical for understanding the functional structure of the urban environment and the distribution of pedestrian activity.

The node analysis categorizes locations within the study area into primary nodes, secondary nodes, and important intersections, based on factors such as:

- connectivity of streets
- proximity to transit
- presence of commercial activity
- pedestrian flow concentration

(i) Primary Nodes

- Primary nodes represent the most significant activity centres within the study area, typically located at major intersections or transit access points.
- The metro station junction forms the dominant primary node, where multiple movement corridors converge. This location functions as a major mobility interchange, accommodating pedestrian, vehicular, and transit-related flows.
- Additional primary nodes occur along major arterial streets where commercial activities and higher pedestrian densities are observed.
- These nodes play a critical role in shaping the public life and economic activity of the TOD precinct.

(i) Secondary Nodes

Secondary nodes occur at important neighbourhood intersections that connect local streets to primary corridors. These nodes often function as:

- Neighbourhood gathering points
- Small commercial clusters
- Local transit stops

Although smaller in scale, secondary nodes help distribute pedestrian activity throughout the urban fabric and reduce excessive concentration at the primary transit node.

(i) Intersection-Based Movement Concentration

Several intersections along the major streets function as movement convergence points, where pedestrian and vehicular flows intersect.

These intersections are particularly important for:

- pedestrian crossings
- transit access
- informal commercial activities

However, without proper urban design interventions, such intersections may become traffic-dominated spaces rather than pedestrian-friendly nodes.

Inferences

Key observations include:

- Pedestrian movement is structured along a few dominant corridors leading toward the metro station.

- Commercial and mixed-use activities tend to cluster along these movement corridors, reinforcing their importance.
- Several secondary nodes have the potential to evolve into neighbourhood activity centres through targeted urban design interventions.
- Vacant land and institutional parcels near the transit corridor offer opportunities for TOD-oriented redevelopment.

4.1.5 Parking Management

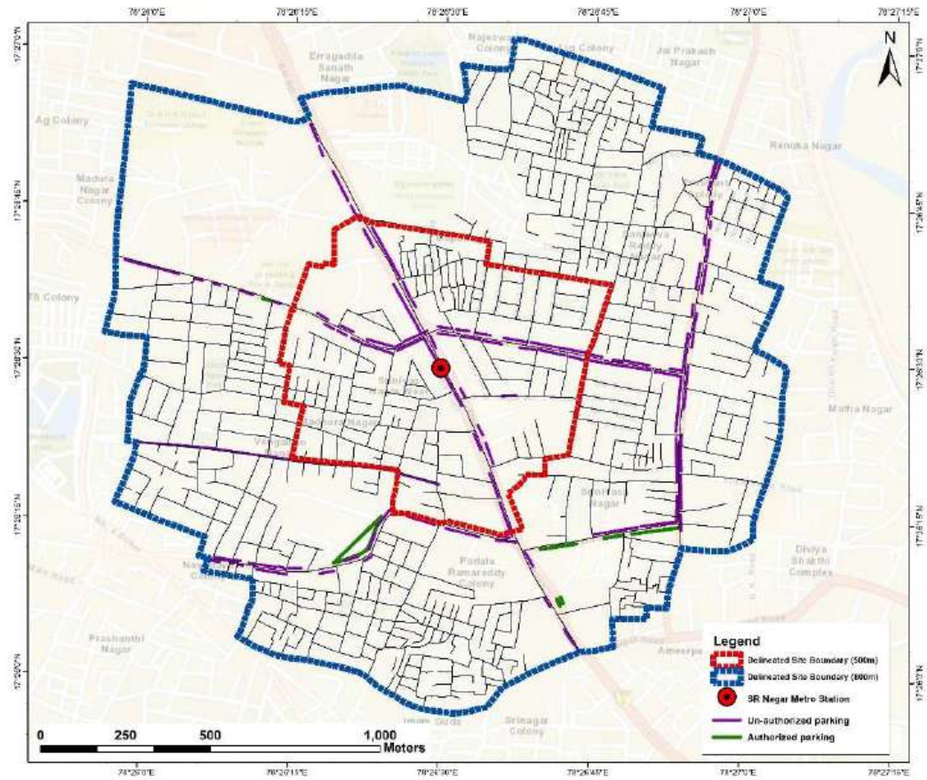


Figure 4-60 Authorized and Un-authorized parking

This table Table 4-7 presents the overall demand–supply analysis for all stretches. For each commercial stretch, different types of parking provisions were observed. Some large shops have dedicated basement parking, while others provide parking spaces in front of their establishments. Certain institutional buildings also maintain their own separate parking areas. The Figure 4-60 shows the locations of authorized and unauthorized parking. In the mixed-use stretches with offices and shops, common parking spaces were available, often free of charge.

Table 4-7 Parking demand and Supply in SR Nagar

Location	Total Length of Stretch (m)	Occupied by Parking (%)	Demand (ECS)	Supply (ECS)	Gap (ECS)
Sr Nagar	1500	30.0%	307	144	163
Vengal Rao Nagar	1900	20.7%	138	55	83
Madhura Nagar	2200	18.7%	156	250	0

Satyam Theatre Road	940	40.1%	153	110	43
Ameerpet to Balkampet Junction	1030	35.2%	148	110	38
Balkampet Junction to Temple	1250	32.4%	179	75	104
Ameerpet to SR Nagar Metro	2080	17.2%	134	425	0
SR Nagar Metro to ESI Metro	1600	25.5%	123	80	43
Madhura Nagar Stretch	2000	37.6%	222	20	202
Total	—	—	**1560**	**1245**	**315**

Madhura Nagar Stretch (Figure 4-62): Despite a 2000m stretch, the supply is only 20 ECS against a demand of 222 ECS. This massive shortfall (37.6% occupancy) likely forces vehicles into travel lanes hindering the carriageway.

SR Nagar: Being a commercial stretch (Figure 4-61) with a 1500m length (5250 on both sides) and a 30% occupancy rate, this area is failing to provide adequate parking, leading to the unauthorized on-street parking. The parking demand is dominated by Bikes (75%), followed by Cars (20%) and others (5%). This indicates that the parking pressure is primarily driven by two-wheelers.

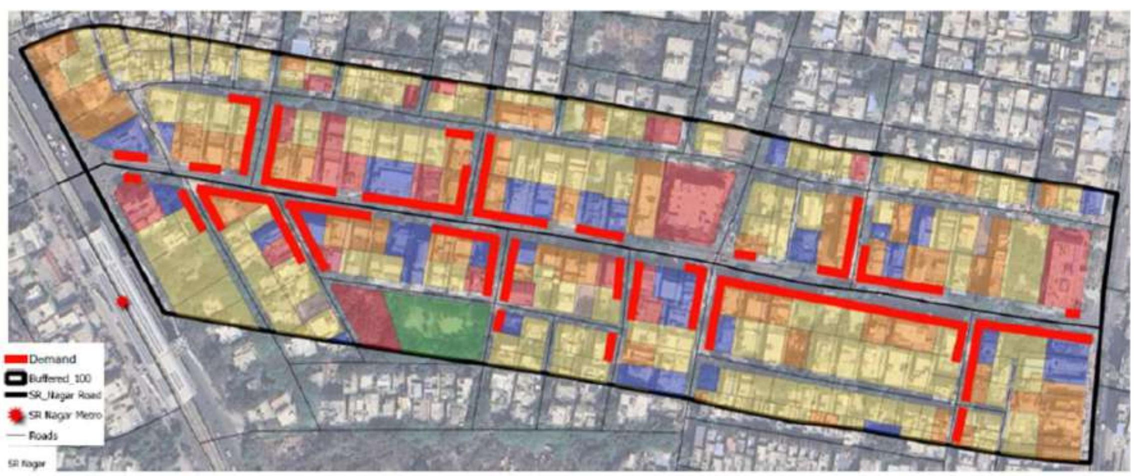


Figure 4-61 SR Nagar parking demand

Source: Output of the project team, SPAV

Figure 4-62 On-street parking at Madhura Nagar and Srinivasa W Nagar

Image credit: Project team, SPAV

Vengal Rao Nagar: Operating with a gap of 83 ECS, this 1900m stretch has an occupancy of 20.7%. While the gap is smaller than in other areas, the mismatch between demand (138 ECS) and supply (55 ECS) indicates that informal parking is still a persistent issue for commuters in this corridor.

Satyam Theatre Road: This 940m stretch is a critical pressure point, with a high occupancy rate of 40.1%. With a gap of 43 ECS (Demand 153 vs Supply 110), the high concentration of parking in such a short distance significantly reduces the road's effective capacity.

Ameerpet to Balkampet Junction: This 1030m corridor faces a gap of 38 ECS, with 35.2% of the stretch occupied by parking. The demand of 148 ECS against a supply of 110 ECS indicates that on-street parking is likely encroaching into the main traffic flow, disrupting throughput at this key junction.

Ameerpet to SR Nagar Metro: Similar to Madhura Nagar, this 2080m stretch shows a gap of 0. The demand of 134 ECS is overshadowed by a supply of 425 ECS. This indicates a high availability of space.

SR Nagar Metro to ESI Metro: This 1600m segment faces a gap of 43 ECS. With 25.5% occupancy and a supply of 80 ECS against a demand of 123 ECS, the limited space is struggling to accommodate the high volume of transit users moving between these two Metro hubs

4.2 LB NAGAR

4.2.1Access

The Access principle in Transit-Oriented Development focuses on ensuring safe, convenient, and efficient movement for pedestrians, cyclists, and public transport users within the transit influence area. In the LB Nagar study area, improving street connectivity, walkability, and last-mile accessibility is essential to strengthen access between surrounding neighborhoods and the Metro station.

4.2.1.1 Road Hierarchy

The road network in the study area around LB Nagar Metro Station shows a clear hierarchy (Figure 4-63) consisting of arterial, sub-arterial, collector, and local streets. Local streets form the largest share, followed by collector roads, while arterial and sub-arterial roads constitute a smaller proportion. This hierarchy influences overall movement, accessibility, and internal connectivity within the area.

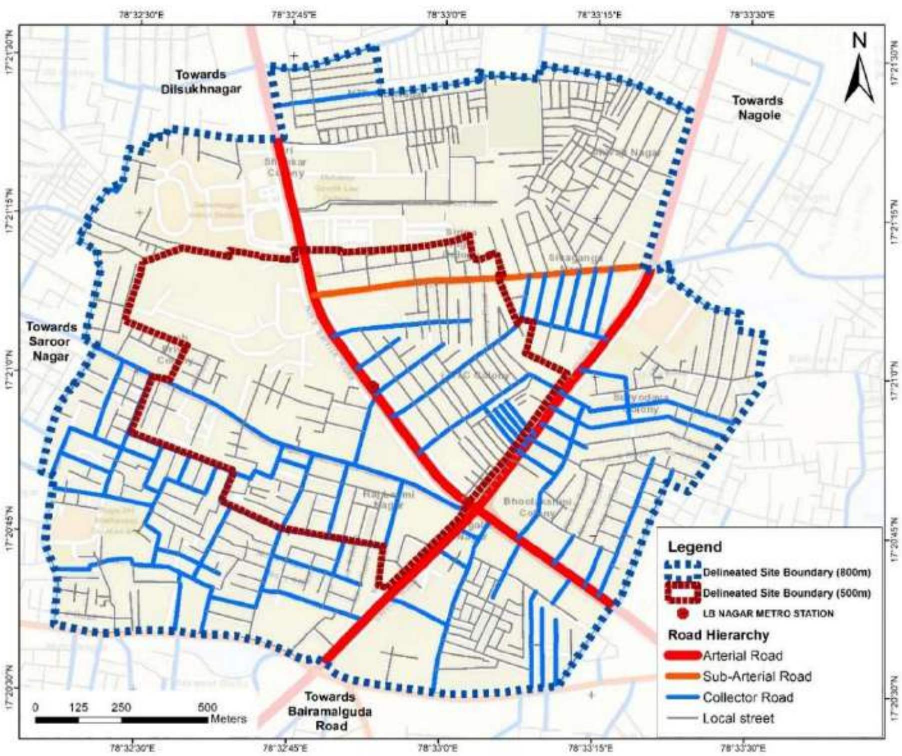
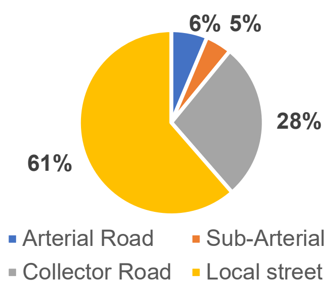


Figure 4-63 Map indicating the functional Road Hierarchy

Source: Output of the Project Team, SPAV

Table 4-8 Distribution of Road Network by Functional Hierarchy



Road Hierarchy	Length (Km)
Arterial Road	4.79
Sub-Arterial	3.47
Collector Road	20.10
Local street	46.62

The study area centered on the LB Nagar Metro Station demonstrates a defined, yet highly skewed road hierarchy. The hierarchy is categorized into four distinct levels:

Arterial Roads (6%): These serve as the primary regional corridors (e.g., the corridors toward Dilsukhnagar, Hayathnagar, Nagole, and Bairamalguda). While they provide high-volume vehicular access to the Metro station, they also act as significant "severance barriers" for pedestrians attempting to reach the station from the surrounding catchment areas.

Sub-Arterial Roads (5%): These act as the secondary corridors, distributing traffic from the main arterials into the neighborhood clusters.

Collector Roads (28%): Represented by the blue network, these roads play a crucial role in connecting the network in many TOD sites. In this specific area, they provide a transition from high-speed arterials to residential zones, offering significant potential for integrated public transport and cycling infrastructure.

Local Streets (61%): The vast majority of the network is composed of local streets. This high percentage indicates a predominantly residential character with a fine-grained internal mesh.

The dominance of local streets (61%) suggests that the "last-mile" experience for a transit user is almost entirely dependent on the quality of these narrow neighbourhood roads. For the LB Nagar Metro to be effectively utilized, the hierarchy must have smooth transition from being vehicular-centric (prioritizing arterials and sub-arterials) to pedestrian-centric (optimizing streets for walkability).

4.2.1.2 Existing ROW with Cross Sections

The Right of Way (ROW) (Figure 4-64) analysis reveals a network dominated by narrow corridors, with a significant disparity between arterials/regional corridors and neighbourhood access points. The network is quantified over a total length of approximately **75.88 km**.

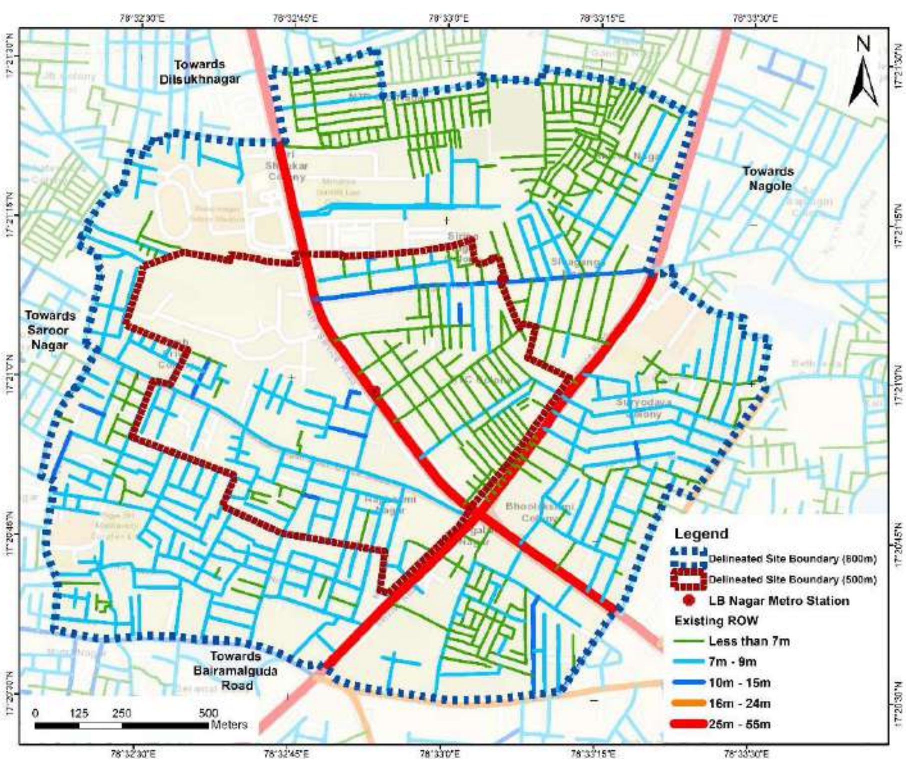
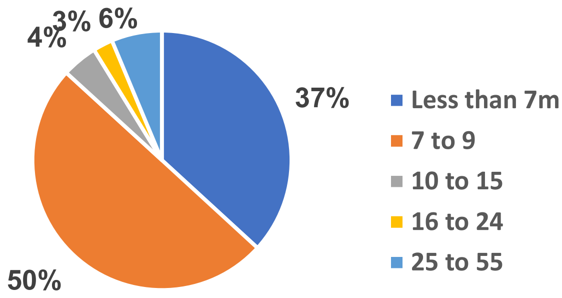


Figure 4-64 Map indicating the existing Right of Way (RoW)
Source: Output of the Project Team, SPAV

Table 4-9 Table showing Existing Right-of-Way Composition



Right of Way	Length (Km)
Less than 7m	27.92
7 to 9	37.93
10 to 15	3.37
16 to 24	1.87
25 to 55	4.79

Arterials/Regional Corridors (25m to 55m): Comprising only **6% (4.79 km)** of the network, these are the primary transit corridors (indiacted in red). While they accommodate the Metro infrastructure, their vast width often makes it difficult for pedestrians to navigate.

Intermediate Connectors (10m to 24m): These roads (indicated in yellow and grey) make up a combined **7%** of the network. This reflects a lack of "mid-sized" streets that usually facilitate smooth transitions between high-speed transit and residential areas.

Secondary/Neighborhood Roads (7m to 9m): Occupying **50% (37.93 km)** of the network, these are the primary feeders for the 500m and 800m catchments.

Local Roads (Less than 7m): The most striking feature of the LB Nagar site is that **37% (27.92 km)** of the roads (indicated in green) have a ROW of **less than 7 meters**.

Streets with a ROW below 7 m face significant spatial constraints, where pedestrians, cyclists, and vehicles share the same carriageway, creating safety concerns and slower pedestrian movement toward transit. These narrow lanes also restrict emergency access, municipal servicing, and the provision of street trees or pedestrian amenities, which affects overall accessibility and the walking environment. The Figure 4-65 shows the location of cross section

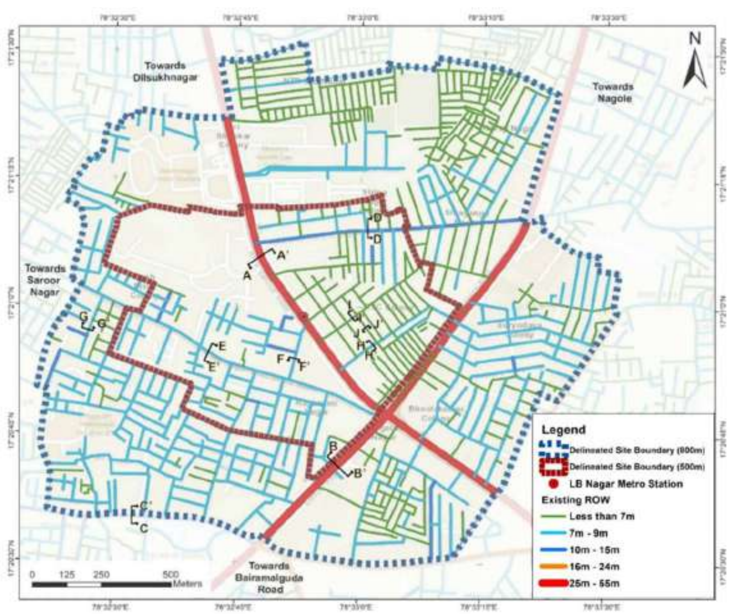


Figure 4-65 Map Showing the Location of Selected Cross-Sections along the Study Corridor.
Source: Output of the Project Team, SPAV

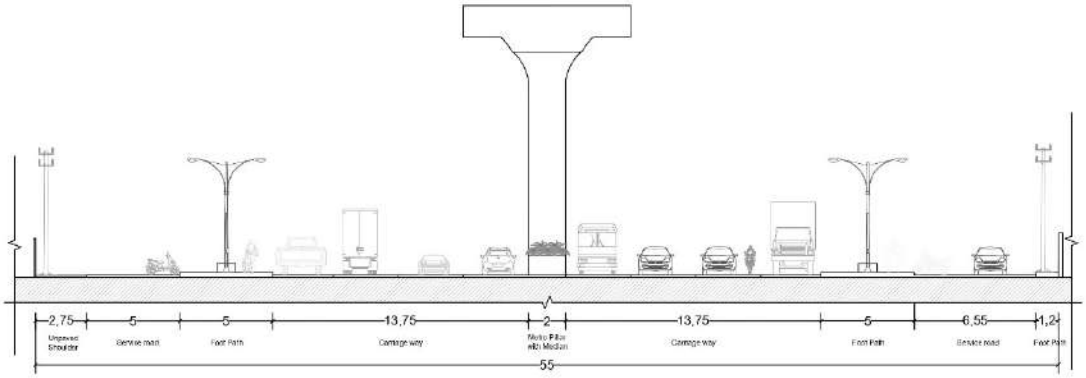


Figure 4-66 Road Cross Section: Metro Corridor near SIRIS Junction

Source: Output of the Project Team, SPAV

Figure 4-67 Site Photographs of Metro Corridor

Image Credit: Google Maps

The 55m Arterial Road (NH 65) serves as a high-capacity regional lifeline(Figure 4-66), yet it faces a significant "urban-utility" conflict. While the central carriage ways and Metro infrastructure are well-maintained, the edges struggle with informal activities. Despite an active commercial frontage, the lack of off-street parking forces vehicles onto the service lanes, obstructing the intended NMT flow. Poorly managed overhead cables and sparse greenery further reduce environmental quality, turning a vital transit corridor into a cluttered space for pedestrians (Figure 4-7)

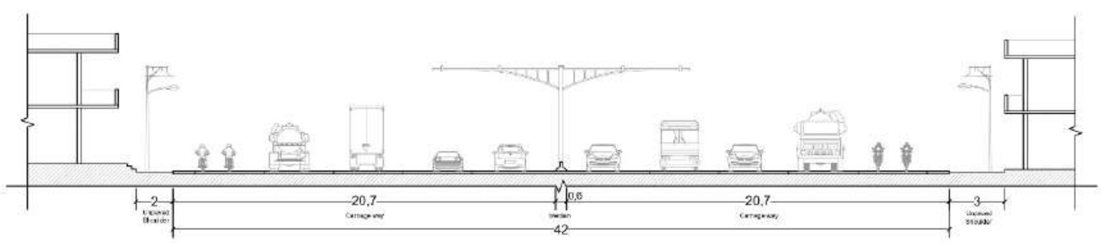


Figure 4-68 Road Cross Section: Inner Ring Road near Sri Sri Sri Nalla Pochamma Sevalaymu temple

Source: Output of the Project Team, SPAV

Figure 4-69 Site Photographs of Inner Ring Road

Image Credit: Google Maps

The 42m Inner Ring Road (LB Nagar to Uppal) serves as a significant corridor (Figure 4-68), characterized by its five lanes in each direction. The cross-section reveals a stark unbalanced mode mix staggering 41.4m of paved surface. The most pressing concern is the near-total exclusion of vulnerable road users, with only 2m to 3m of unpaved shoulders and no dedicated footpaths or cycle tracks, pedestrians and cyclists are pushed to the extreme, hazardous edges. This design creates a hostile environment for transit-oriented living, prioritizing regional connectivity over local accessibility and safety (Figure 4-69).

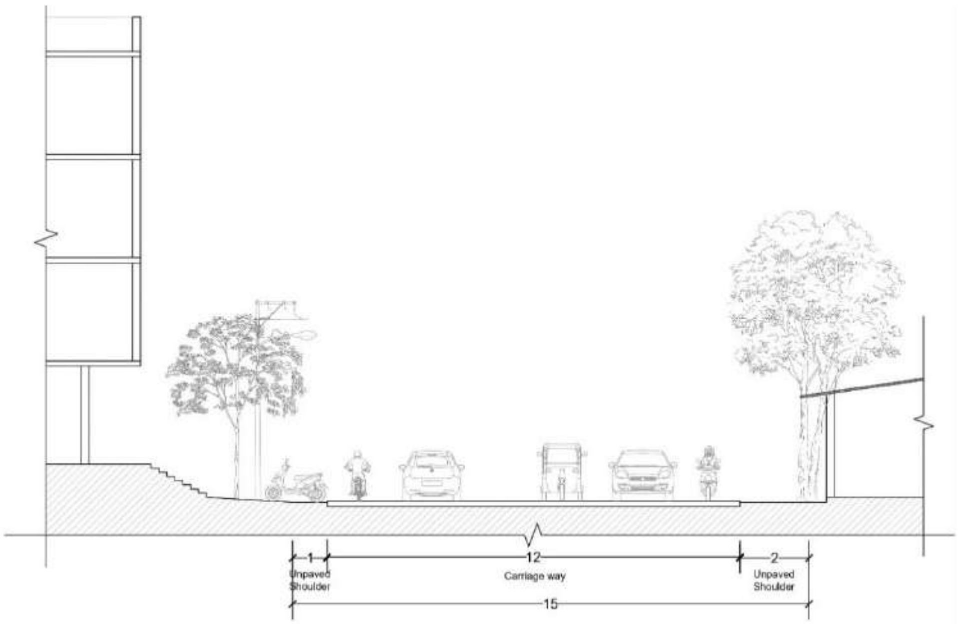


Figure 4-70 Road Cross Section: Bairamalguda Road near Krishna Prasad petrol bunk

Source: Output of the Project Team, SPAV

Figure 4-71 Site Photograph of Bairamalguda Road

Image Credit: Google Maps

The 15m Biravaguda Road (Figure 4-70) functions as a vital collector road, yet its design remains secondary to vehicular needs. The 12m undivided carriage way serves a chaotic mode mix, where private cars, auto-rickshaws, and two-wheelers compete for space. With an active commercial frontage and a lack of building-integrated parking, the road edges are perpetually choked by on-street parking. This creates a significant "blind spot" for safety; since there is no formal NMT infrastructure, pedestrians are forced into the flow of traffic or onto narrow, unpaved shoulders. While street lighting and sparse greenery provide some relief, the absence of dedicated footpaths prevents this corridor from becoming a truly walkable link connected to the Metro (Figure 4-71).

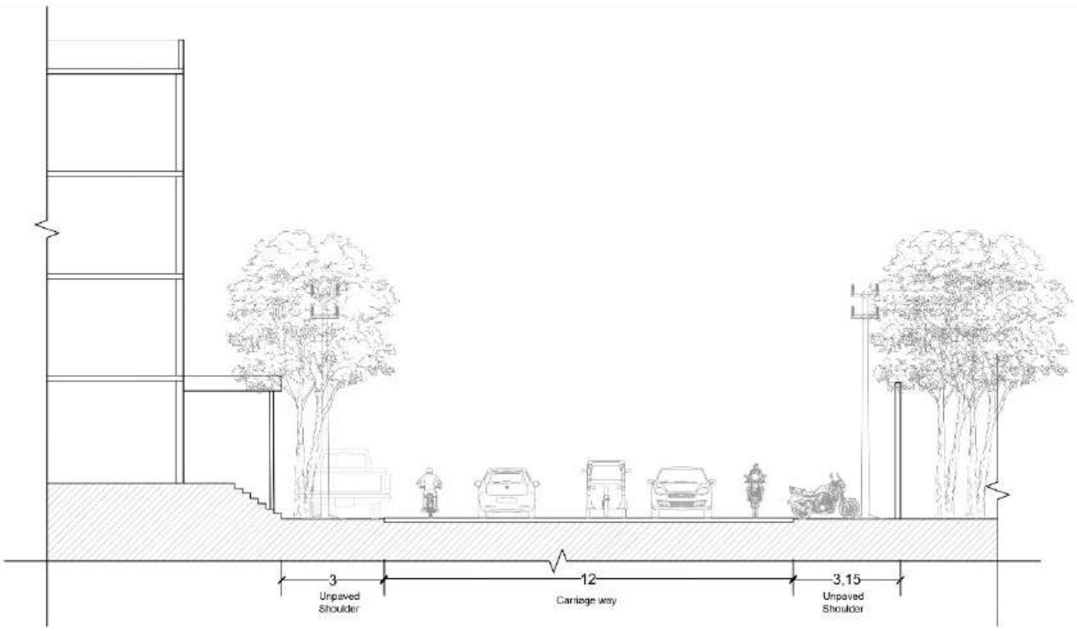


Figure 4-72 Road Cross Section: SIRIS Road near GVK Hospital

Source: Output of the Project Team, SPAV

Figure 4-73 Site Photograph of SIRIS Road

Image Credit: Google Maps

The 18m SIRIS Road serves as a vital collector corridor (Figure 4-72), yet its current configuration prioritizes vehicular movement over safe access. The 12m undivided carriage way carries a dense mode mix, ranging from heavy institutional traffic and private cars to nimble auto-rickshaws and two-wheelers. Despite the highly active commercial and institutional frontages, the lack of dedicated building parking forces significant on-street parking, which further constricts the flow. The total absence of formal NMT infrastructure leaves pedestrians to navigate unpaved, 3m-wide shoulders cluttered by poorly managed overhead cables and informal vendors. While street lighting is consistent, the environment remains fragmented, failing to provide a seamless, walkable connection for the community (Figure 4-73)

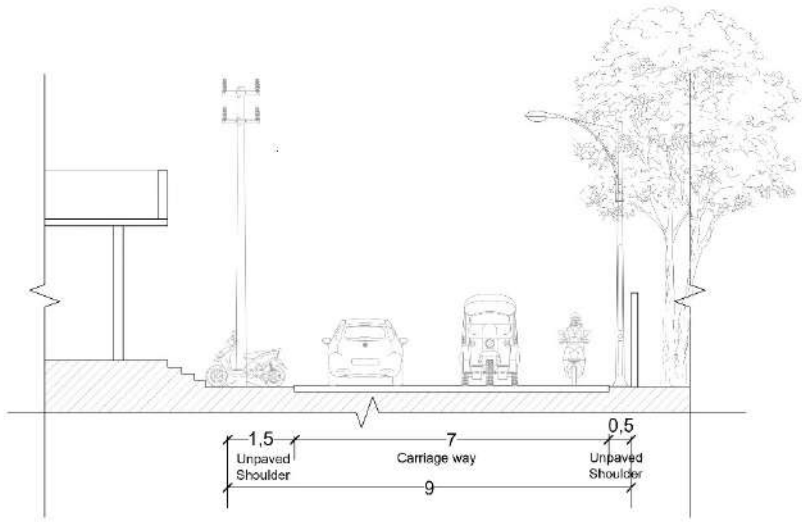


Figure 4-74 Road Cross Section: Brindavan Road near Sri Chaitanya Academy

Source: Output of the Project Team, SPAV

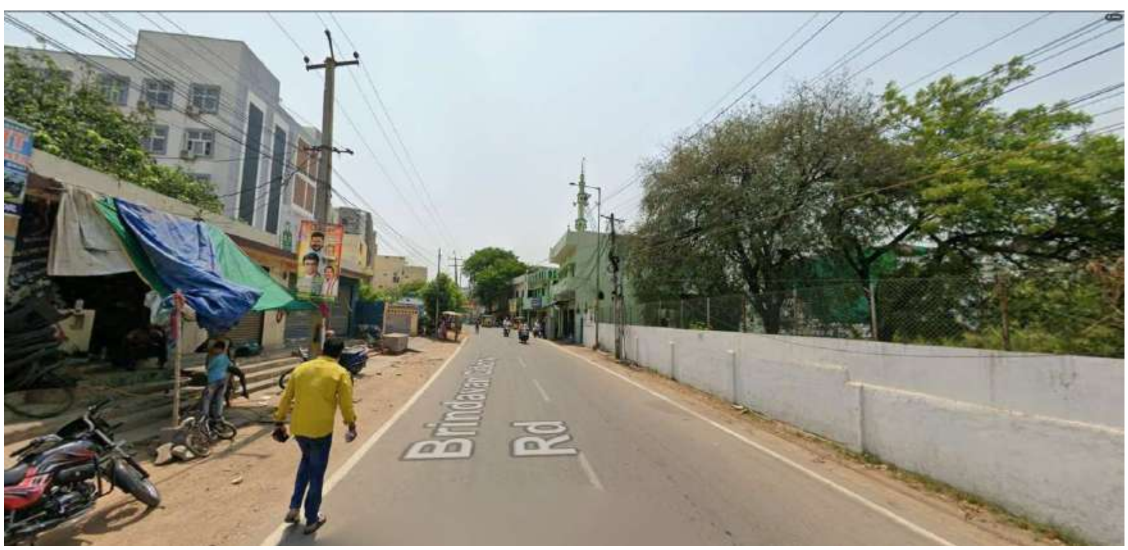


Figure 4-75 Site Photograph of Brindavan Road

Image Credit: Google Maps

The 9m Brindavan Road (Figure 4-74) functions as a high-intensity collector street, yet its physical constraints significantly impact transit efficiency. The 7m undivided carriage way struggles to accommodate a dense mode mix of private cars, auto-rickshaws, and two-wheelers. Because the commercial frontages are highly active and lack integrated parking, on-street parking frequently spills into the travel lanes, causing bottlenecks. The total absence of formal NMT infrastructure forces pedestrians onto unpaved shoulders as narrow as 0.5m, often obstructed by poorly managed overhead cables and informal vendors. While street lighting remains consistent, the road's current design prioritizes vehicular movement over a safe, walkable experience for the local community(Figure 4-74)

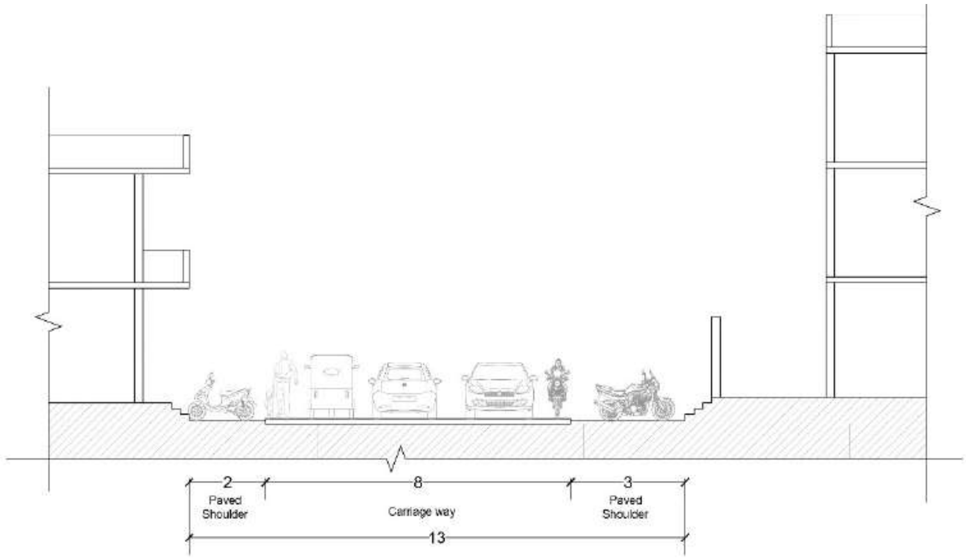


Figure 4-76 Road Cross Section: SBH Road near Telangana State Co-Operative Apex Bank

Source: Output of the Project Team, SPAV

Figure 4-77 Site Photograph of SBH Road

Image Credit: Google Maps

The 13m SBH Road functions (Figure 4-76) as a high-intensity collector street where the design fails to match the complexity of its usage. The section reveals an 8m carriage way managing a diverse mode mix, featuring private cars, auto-rickshaws, and motorcycles that share a single undivided space. With an active commercial frontage and a lack of integrated building parking, the 2m to 3m paved shoulders are frequently utilized for on-street parking. This creates a hazardous environment for pedestrians; since there is no formal NMT infrastructure (Figure 4-77), those on foot must negotiate a cluttered landscape of poorly managed cables and informal vendors. While consistent street lighting is present, the absence of dedicated footpaths prevents this road from becoming a safe, walkable corridor for the community.

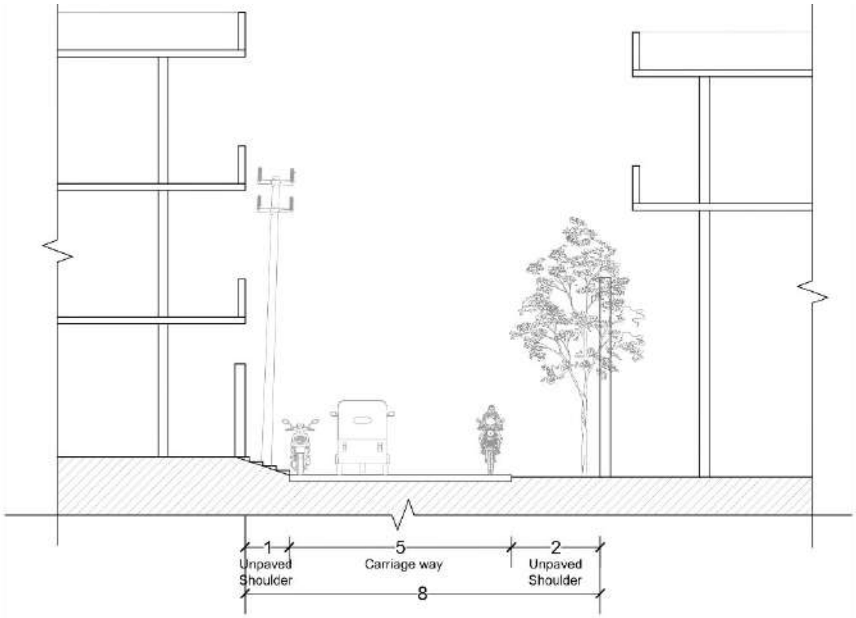


Figure 4-78 Road Cross Section: Vijayapuri Colony Road

Source: Output of the Project Team, SPAV

Figure 4-79 Site Photograph of Vijayapuri Colony Road

Image Credit: Google Maps

The 8m Vijayapuri Colony Road (Figure 4-78) serves as a feeder road, yet its current state highlights the friction between residential areas and transit access. The narrow 5m carriage way manages a mode mix heavily dominated by two-wheelers, auto-rickshaws and cars appearing less frequently. The environment is constrained by continuous residential compound walls and informal on-street parking, which effectively shrinks the usable road width. With no formal NMT infrastructure or footpaths, pedestrians must share the space with moving traffic. The presence of poorly managed overhead cables and encroaching vendors further complicates movement, making this a challenging "last-mile" link despite the consistent street lighting (Figure 4-79).

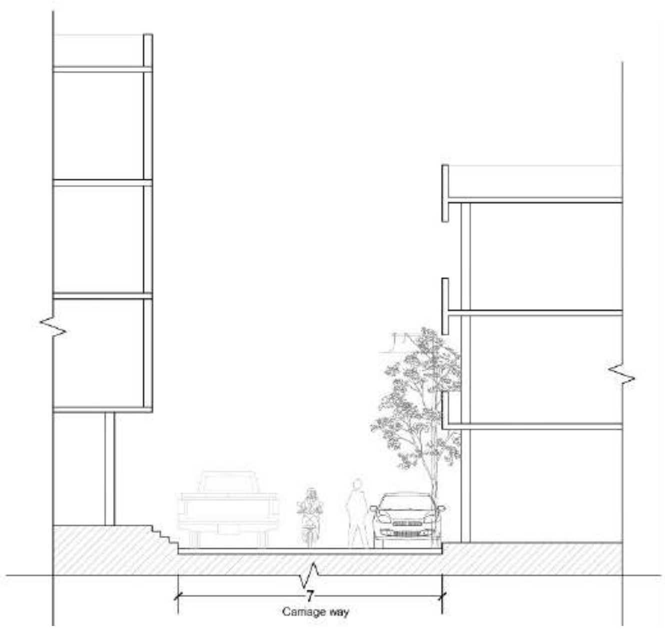


Figure 4-80 Road Cross Section: Majid Road

Source: Output of the Project Team, SPAV

Figure 4-81 Site Photograph of Majid Road

Image Credit: Google Maps

The 7m Masjid Road (Figure 4-80) exemplifies the "last-mile" challenge in a dense TOD environment, where the street functions more as a shared alley than a formal collector road. The narrow 7m cross-section manages a mode mix heavily dominated by two-wheelers, with larger vehicles like cars, auto-rickshaws and Light commercial vehicles. The road's efficiency is severely compromised by highly active commercial frontages that lack off-street facilities, leading to on-street parking. This encroachment, combined with poorly managed overhead cables and street vendors, effectively narrows the Right of Way (ROW) even further. With no formal NMT infrastructure, pedestrians are forced to negotiate the central carriage way alongside moving traffic, making safety a significant concern despite the presence of regular street lighting (Figure 4-81).

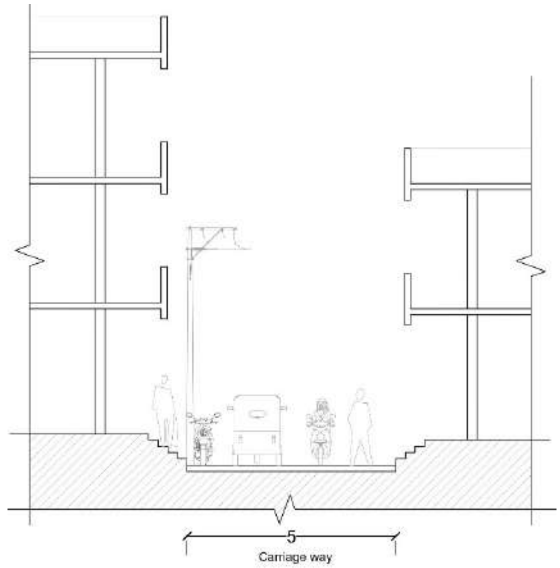


Figure 4-82 Road Cross Section: RTC Road

Source: Output of the Project Team, SPAV

Figure 4-83 Site Photograph of RTC Road

Image Credit: Google Maps

The 5m RTC Road (Figure 4-82) functions as a high-density commercial feeder directly connecting to the NH 65 Arterial Road. It's extremely constrained 5m width creates a high-friction environment where the mode mix is dominated by two-wheelers and Light Commercial Vehicles (LCVs). The presence of cars and auto-rickshaws often leads to total gridlock due to the lack of maneuvering space. Because the road serves as a vibrant commercial link, the encroachment of formal vendors and persistent on-street parking effectively dissolves the distinction between the carriage way and the pedestrian realm (Figure 4-83).

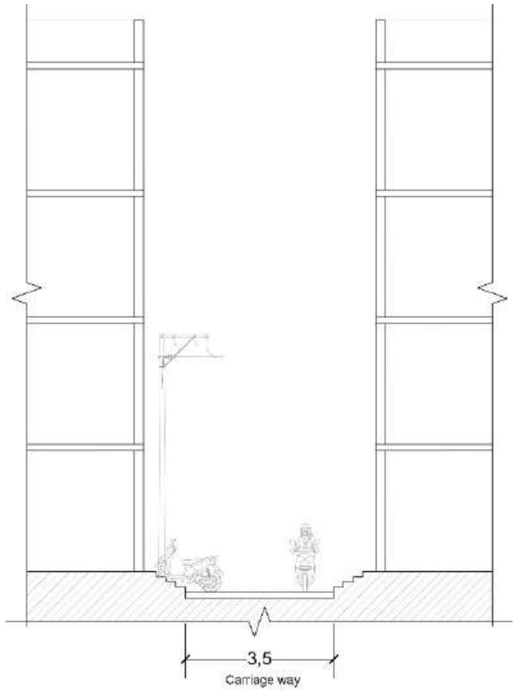


Figure 4-84 Road Cross Section: Local Road

Source: Output of the Project Team, SPAV

Figure 4-85 Site Photograph of RTC Colony Lane 3 road

Image Credit: Google Maps

The 3.5m LB Nagar Lane 3 (Figure 4-84) represents the most granular level of the neighborhood's road network, acting as a direct residential feeder. Its narrow profile creates a naturally slow-speed environment where the mode mix is overwhelmingly dominated by two-wheelers. While larger vehicles like cars or auto-rickshaws occasionally enter, the tight 3.5m width makes passing nearly impossible, especially with prevalent on-street parking along the residential compound walls. The street lacks any formal NMT infrastructure, forcing residents to walk directly on the shared carriage way. This creates a high-friction environment where pedestrians must navigate around parked vehicles and poorly managed overhead cables. Despite these constraints, the presence of regular street lighting ensures a baseline of safety for the final steps of a commuter's journey home from the Metro (Figure 4-84).

4.2.1.3 Existing Block Size

The morphology of the LB Nagar study area is characterized by an irregular grid with significantly large block sizes, particularly in the northern and southeastern quadrants. As the area transitions from traditional low-density residential pockets to high-intensity mixed-use and commercial developments, these expansive block perimeters have become a major deterrent to Walkability. The Figure 4-86 shows the existing blocks in LB Nagar.

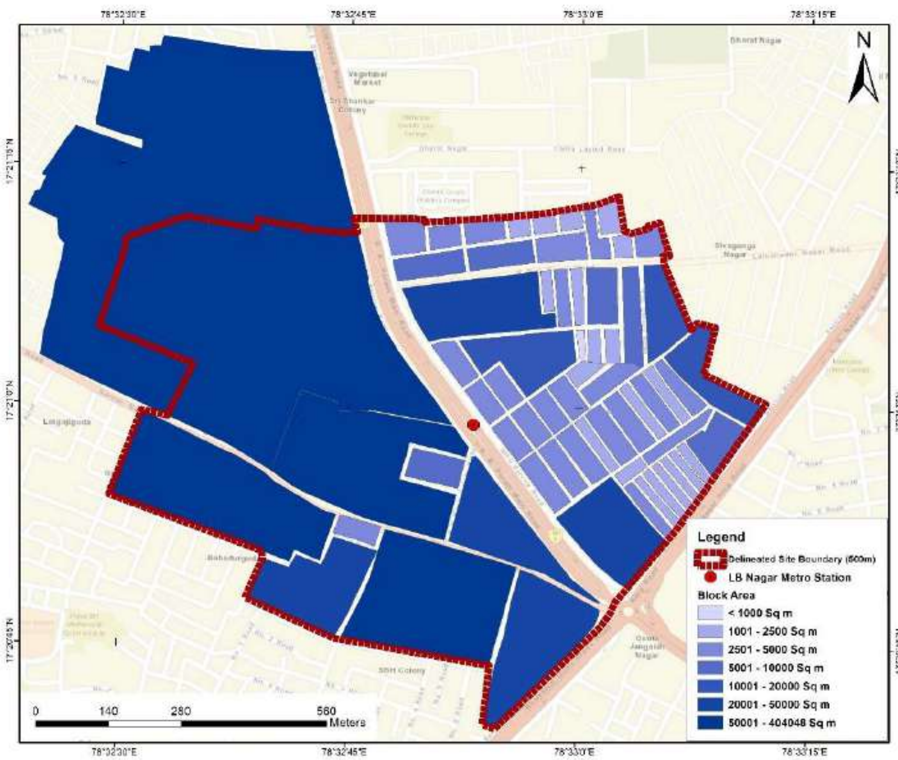


Figure 4-86 The Map Indicating Existing Block Size

Source: Output of the Project Team, SPAV

Currently, the lack of internal through-access means pedestrians often face a 15 – 20 minute walk just to navigate half a block perimeter to reach a primary arterial road. This lack of "porosity" reduces walkability and forces commuters into longer, circuitous routes toward the Metro station. To support the densification of the 500m TOD zone, the redevelopment strategy must prioritize breaking down these "mega-blocks" by introducing dedicated lanes to shortcuts and mid-block crossings. Enhancing the permeability of the local street network (which already constitutes 61% of the area) will be essential to reducing detour factors and making the Metro truly accessible.

4.2.1.4 Intersection Density

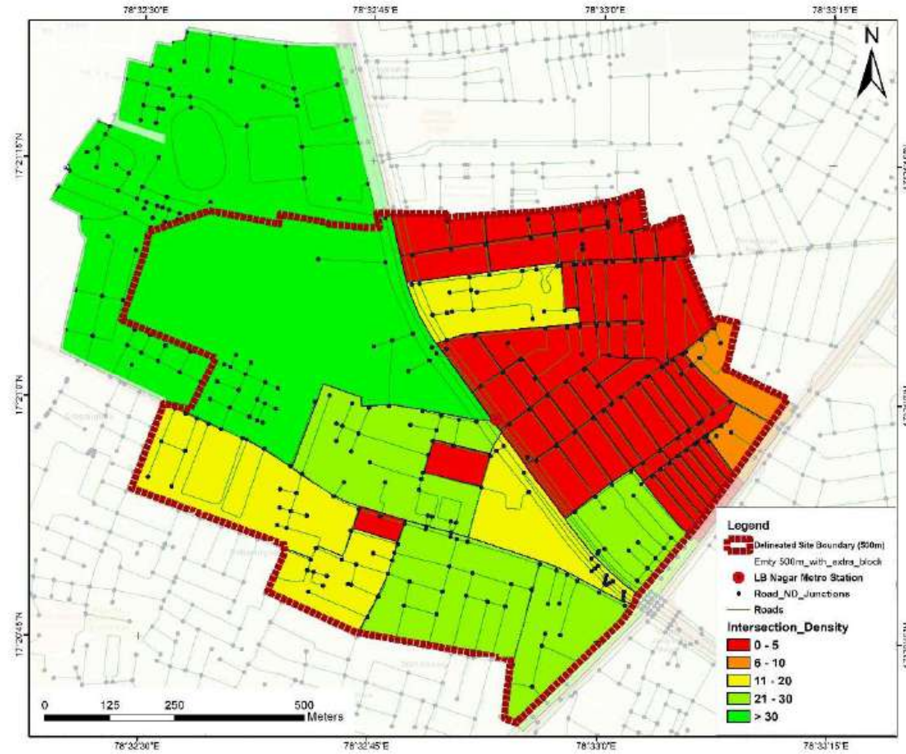


Figure 4-87 The Map showing the existing block wise Intersection Density

Source: Output of the Project Team, SPAV

Intersection density is fundamentally linked to block sizes and street connectivity; generally, smaller average block sizes correlate with a higher density of intersections. Within the LB Nagar study area, the intersection density is calculated at 67 intersections/sq. km (Figure 4-87).

- **Walkability Benchmark:** While an intersection density of approximately **80/sq. km** is considered ideal for a highly walkable urban environment, the current value of 67 indicates a moderate level of connectivity.
- **Route Choice:** The existing density suggests that while the internal residential mesh (constituting 61% of the network) is somewhat porous, there are still significant "dead links" where large block perimeters limit a pedestrian's ability to change direction or find shorter routes to the Metro station.
- **Catchment Performance:** Within the critical 500m TOD influence zone, the moderate intersection density forces commuters onto fewer, more congested secondary roads rather than distributing foot traffic across a finer grid.

To reach the ideal walkability threshold, the area requires tactical interventions that create new "virtual" intersections such as pedestrian pathways effectively breaking down large blocks to improve the overall network permeability and decrease the average detour factor for transit users.

4.2.1.5 Network Connectivity

Network connectivity analysis evaluates how effectively roads and intersections are interconnected within the study area. It measures the degree to which different parts of the transport network are accessible and integrated. A well-connected network improves mobility, distributes traffic efficiently, and enhances accessibility to key destinations such as the LB Nagar Metro Station.

4.2.1.5.1 Alpha Index

The Alpha Index measures the ratio of actual circuits (loops) present in a transport network to the maximum possible circuits. It reflects the redundancy and alternative route availability within the network. Higher Alpha values indicate better connectivity, greater route choice, and improved resilience of the road network during congestion or disruptions.

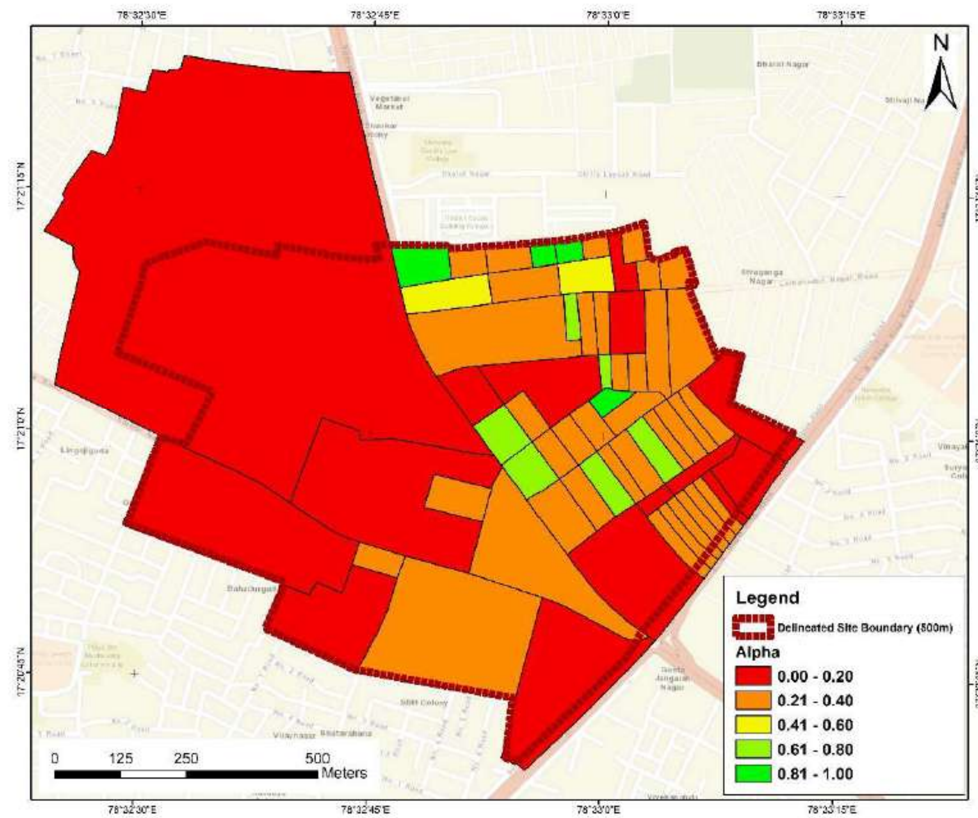


Figure 4-88 The Map Indicating the Alpha Index

Source: Output of the Project Team, SPAV

The **Alpha Index** is a measure of the connectivity of a network, specifically looking at the number of cycles (loops) in the graph relative to the maximum possible number of cycles. In the context of the LB Nagar study area, this explains the **circuitry** of the street network the ability of a pedestrian or vehicle to choose alternative paths to reach a destination without backtracking.

- **Study Area Value:** The calculated Alpha Index for the site is **0.25**.
- **Ideal Benchmark:** An index of **1.0** represents a completely interconnected grid, while **0** represents a simple tree-like structure with no loops.
- **Assessment:** A value of 0.25 indicates **low to moderate circuitry**. This means that while some loops exist, a significant portion of the network is leading to many dead ends (Figure 4-88).

For effective TOD, a higher Alpha Index is preferred because it disperses foot traffic and reduces the "bottleneck" effect. The current value of 0.25 suggests that a pedestrian's journey is often restricted to a single path; if that path is obstructed or unpleasant (e.g., narrow, no footpath), it significantly discourages walking to the station.

4.2.1.5.2 Beta Index

The Beta Index represents the ratio of the number of links (roads) to the number of nodes (intersections) in a network. It indicates the average connectivity between nodes and helps understand the structural complexity of the road network. Higher values signify stronger interconnections and improved accessibility within the transportation system.

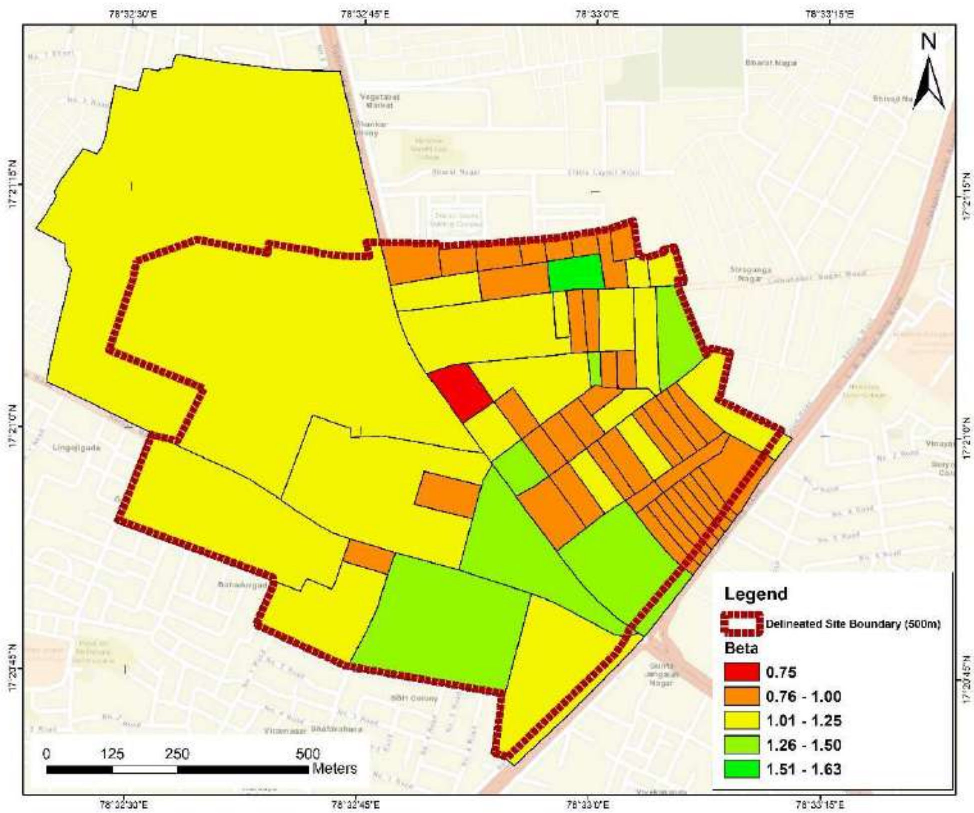


Figure 4-89 The Map Indicating the Beta Index

Source: Output of the Project Team, SPAV

The **Beta Index** measures the complexity and connectivity of a network by calculating the ratio of the number of links (edges) to the number of nodes (intersections). It provides a direct indication of how well-connected the study area is for both vehicular and pedestrian movement.

- **Study Area Value:** The calculated Beta Index for the LB Nagar site is 1.35.
- **Analysis:** In graph theory, a Beta Index of less than 1.0 indicates a tree-like (dendritic) structure. A value between 1.0 and 2.0 represents a connected network with at least one circuit.
- **Assessment:** A value of 1.35 signifies a moderately complex network. While it is superior to a simple branching system, it falls short of a highly interconnected "grid-iron" system (which typically sees values closer to 2.0 or 3.0) (Figure 4-89).

4.2.1.5.3 Gamma Index

The Gamma Index compares the number of existing links in the road network to the maximum possible links between nodes. It indicates the completeness of the network. Values closer to one represent highly connected networks, while lower values suggest limited connectivity and fewer route alternatives for traffic movement.

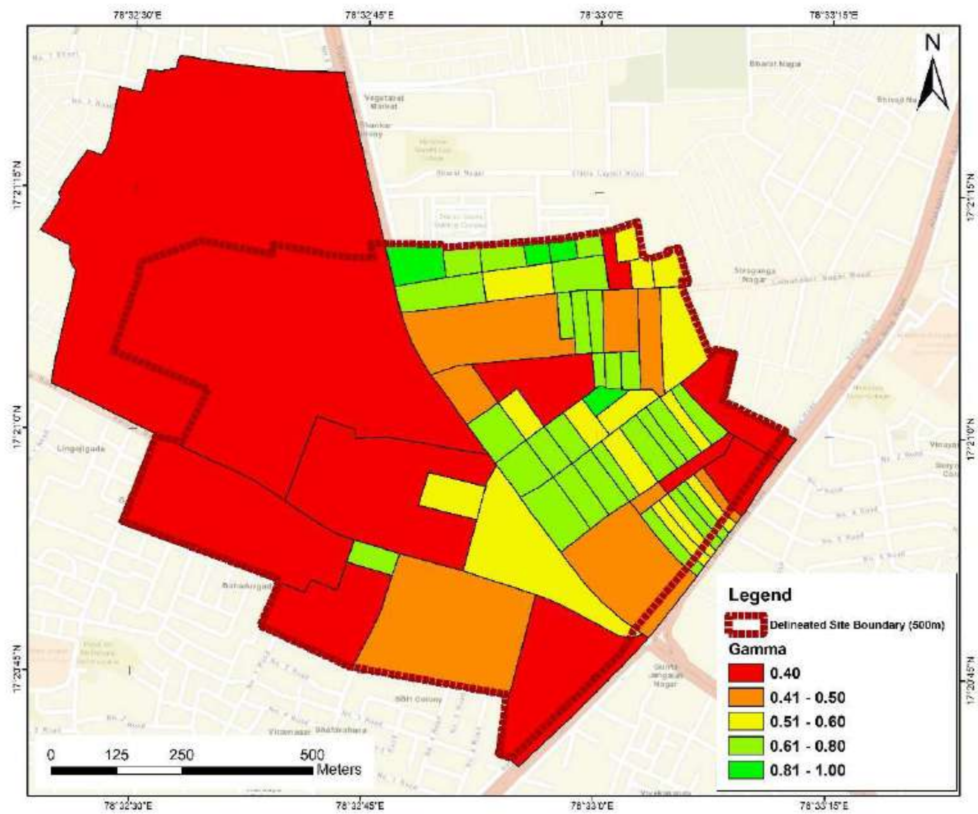


Figure 4-90 The Map Indicating the Gamma Index

Source: Output of the Project Team, SPAV

The **Gamma Index** is a measure of network connectivity that calculates the ratio of the actual number of links to the maximum possible number of links in a network. It essentially explains the **completeness** of the grid, where a higher value signifies a more "mature" or saturated network with fewer missing connections.

- **Study Area Value:** The calculated Gamma Index for the LB Nagar TOD area is 0.55.
- **Analysis:** On a scale from 0 to 1.0, a value of 0.46 indicates that the network is approximately 55% complete.
- **Assessment:** This represents a moderately connected network. While the area is far from being a simple tree structure, it still lacks over half of the potential links that would create a perfectly resilient and efficient grid (Figure 4-90).

4.2.1.5.4 ETA Index

The Eta Index measures the average length of links within a transport network. It is calculated as the ratio of total network length to the number of links. This index helps assess the spacing of intersections and road segments, which influences travel efficiency, accessibility, and overall network structure.

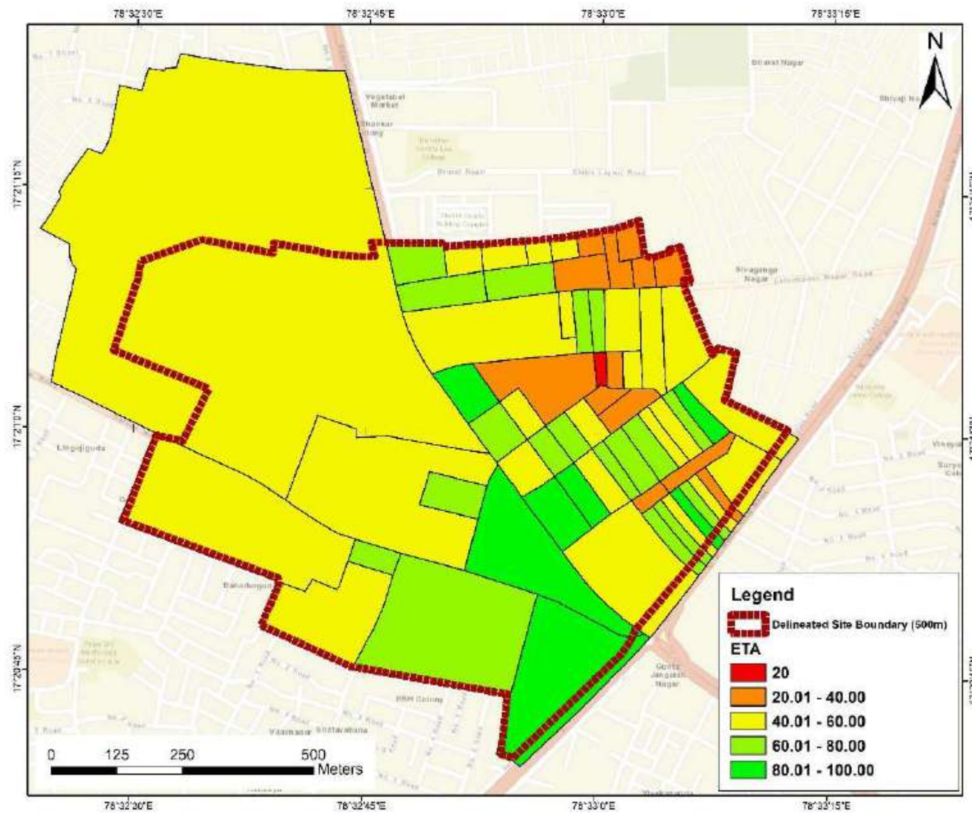


Figure 4-91 The Map Indicating the ETA Index

Source: Output of the Project Team, SPAV

The **Eta Index** represents the average length per link (the distance between two intersections). In the context of the LB Nagar TOD area, this value reflects the "utility" and scale of the street grid.

- **Map Value:** The legend indicates a range from 20 to 100. This scale measures the average segment length in meters.
- **Analysis:** A value on the lower end of this scale (closer to 20) indicates a very fine-grained urban fabric with very frequent intersections. Conversely, values closer to 100 indicate longer blocks with fewer opportunities for pedestrians to change direction.
- **Assessment:** With the study area falling within this 20–100 range, it reveals a network that varies significantly (Figure 4-91). The core residential blocks lean toward the lower end of the scale, providing high utility for walking. However, the commercial and arterial edges lean toward the higher end (100), where long, uninterrupted stretches reduce the utility of the network for those trying to reach the Metro station on foot.

4.2.1.5.5 Cyclomatic Index

The Cyclomatic Index measures the number of independent cycles or closed loops in a network. It indicates the extent to which alternative routes exist between nodes. Higher cyclomatic values suggest greater route flexibility, allowing traffic to redistribute during congestion or blockages within the road network.

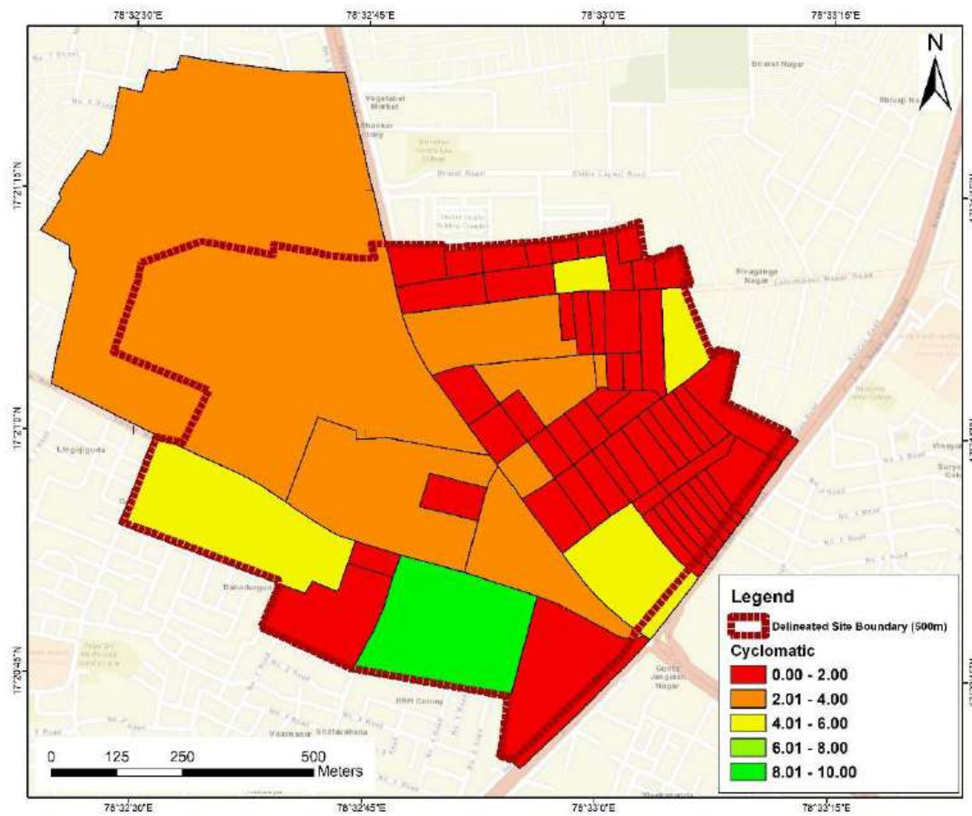


Figure 4-92 The Map Indicating the Cyclomatic Index

Source: Output of the Project Team, SPAV

The Cyclomatic Number quantifies the number of independent closed loops within the network. It is a key indicator of redundancy; the higher the value, the more path options a pedestrian has, ensuring they aren't trapped in a "tree" network with only one way in or out.

- **Map Value:** The legend indicates a normalized scale from 0 to 10.
- **Analysis:** A value of 0 represents a purely linear or branching network (dead ends), while a value of 10 represents a highly resilient, complex web of streets.
- **Assessment:** The majority of the study area falls into the mid-to-high range, indicating that the urban fabric is generally "closed" and connected. However, the distribution is not uniform (Figure 4-92).

4.2.1.5.6 Overall Network Connectivity

The Overall Connectivity Index provides a combined assessment of the road network structure using multiple connectivity indicators such as Alpha, Beta, Gamma, Eta, and Cyclomatic indices. It helps evaluate the efficiency, redundancy, and accessibility of the network, supporting planning decisions for improving urban mobility and infrastructure performance.

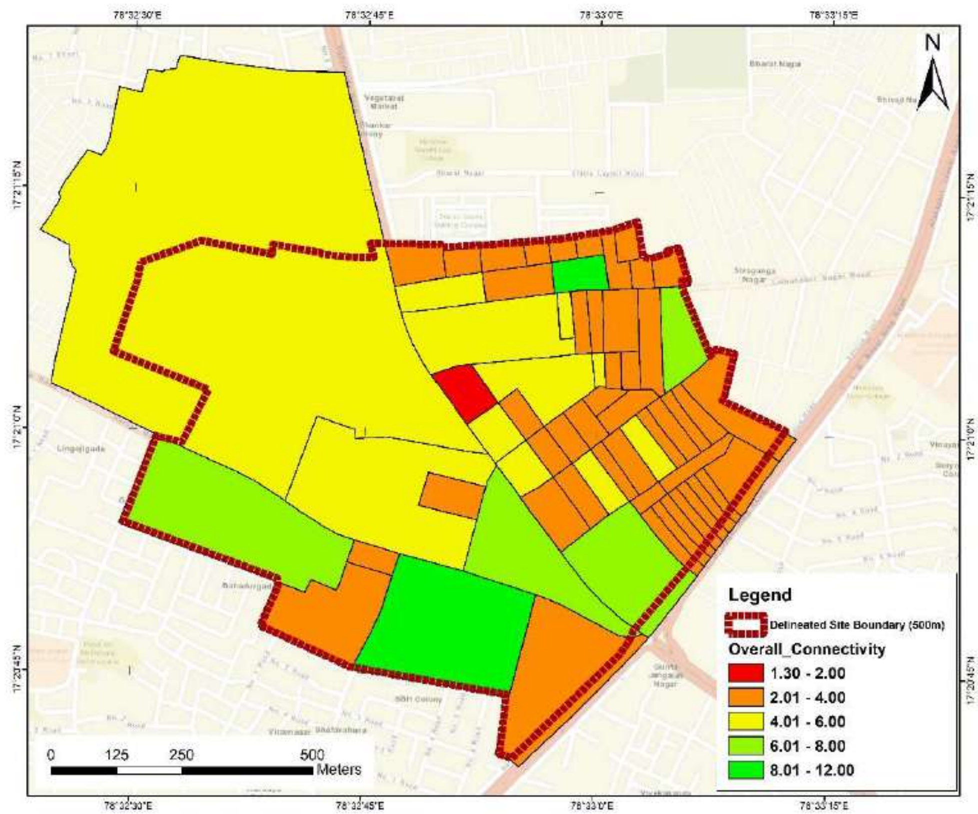


Figure 4-93 The Map Indicating the Overall Network Connectivity Index

Source: Output of the Project Team, SPAV

The **Overall Connectivity** is a composite metric that aggregates indices like Alpha, Beta, Gamma, and Cyclomatic numbers to provide a definitive assessment of the network's efficiency. It highlights how easily a user can move through the urban fabric to reach the transit station.

- **Map Value:** The analysis uses a scale ranging from a minimum of 1.3 to a maximum of 12.
- **Calculated Average:** The average connectivity score for the LB Nagar study area stands at approximately 6.65.
- **Analysis:** An average score of 6.65 indicates a moderate-to-high connectivity level. While the network is far from being fragmented or "broken," it hasn't yet reached the peak efficiency (10+) required for a seamless, world-class TOD environment (Figure 4-93).

4.2.1.1 Existing NMT Infrastructure

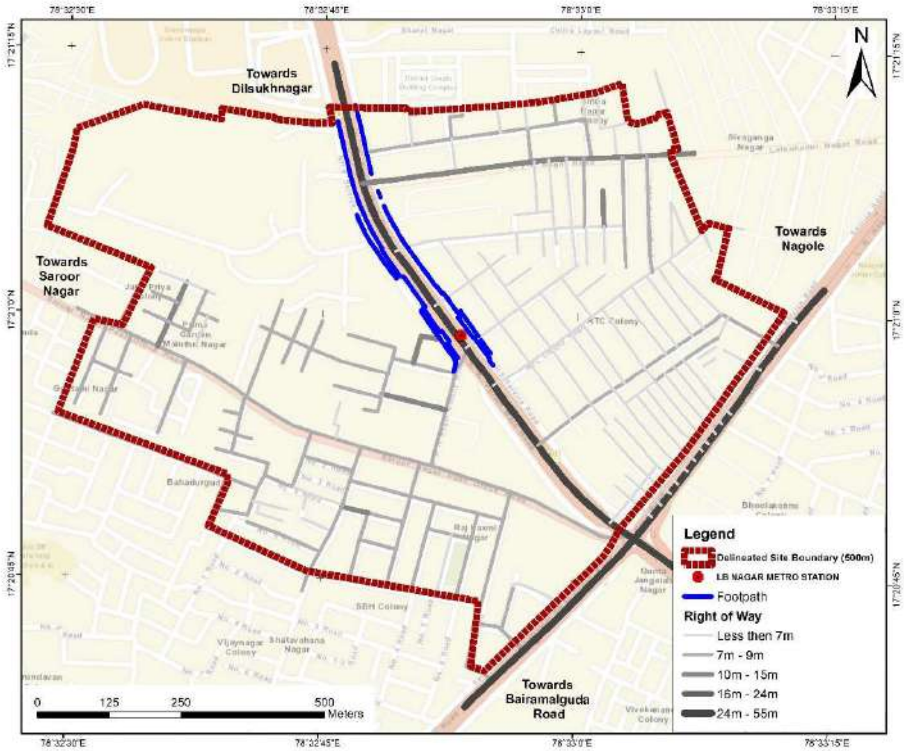


Figure 4-94 The Map showing the existing NMT infrastructure

Source: Output of the Project Team, SPAV

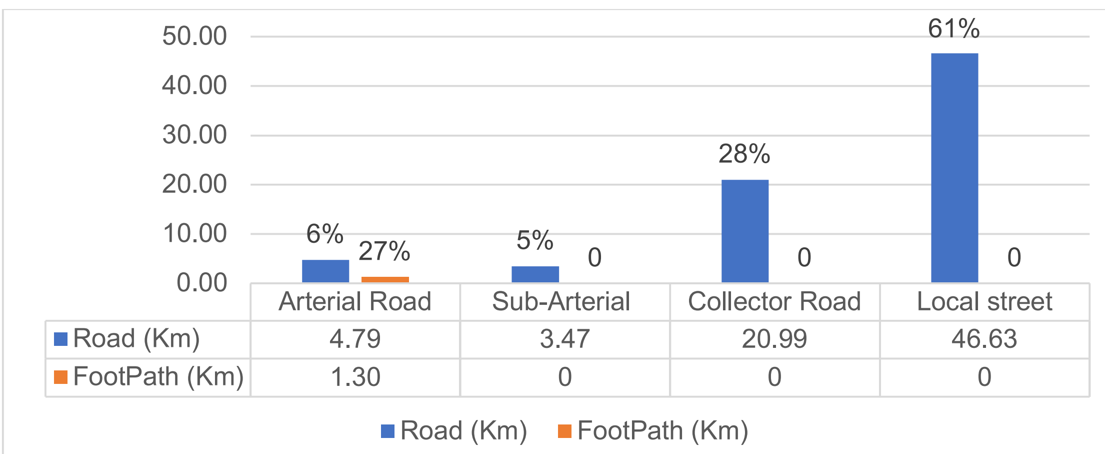


Figure 4-95 The Composition of Road Hierarchy with Footpath

Source: Output of the Project Team, SPAV

The assessment of the Non-Motorized Transport (NMT) (Figure 4-94)network in the study area indicates a significant shortage of dedicated pedestrian infrastructure (Figure 4-95). Although the total road network extends over approximately 75 km, the availability of footpaths is extremely limited. Only about 1.30 km of footpath exists, and this infrastructure is primarily located along the arterial corridor (NH-65).

A major gap is observed across the rest of the street network. Local streets (46.63 km) and collector roads (20.99 km) constitute the majority of the road network, yet these streets lack formal NMT facilities. As a result, pedestrians are required to share the carriageway with mixed traffic such as two-wheelers, cars, and light commercial vehicles, increasing exposure to safety risks.

This condition reflects a mobility pattern where the street environment is largely vehicle-oriented rather than pedestrian-friendly. The absence of continuous pedestrian infrastructure across the streets affects the ease and comfort of walking within the neighborhood, particularly for those accessing the Metro station from nearby residential areas.

4.2.1.2 Pedestrian Catchment Area

Pedestrian Catchment Areas (PCA) represent the walkable zones that can be accessed through the existing street and pathway network from a specific point of interest. In this study, PCA analysis is conducted for the Metro station and nearby Public Transport (PT) stops to understand the actual walking accessibility within the study area and the extent of areas that can be reached on foot through the available network.

4.2.1.2.1 Metro Accessibility

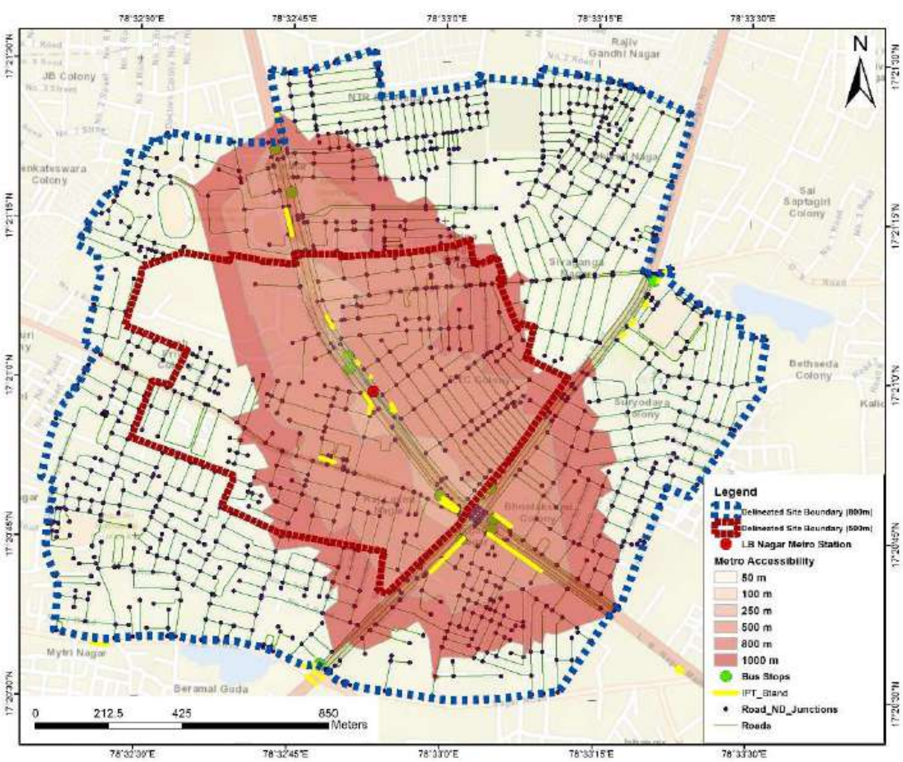


Figure 4-96 The Map Indicating the Metro Accessibility

Source: Output of the Project Team, SPAV

The Pedestrian Catchment Area (PCA) analysis (Figure 4-96) for LB Nagar Metro Station was conducted using network-based accessibility to understand the walkable coverage within different distance thresholds. The analysis indicates that within a 1000 m catchment, the accessible area covers 1,236,500 sq m, representing the maximum walkable coverage from the station. The 800 m catchment, which is generally considered the comfortable walking distance to transit, covers 729,344 sq m, accounting for approximately 59% of the 1000 m accessible area.

Further, the 500 m catchment area covers 88,397 sq m, representing about 7.1% of the 1000 m coverage, indicating that only a limited portion of the immediate surroundings falls within a short walking distance of the station. The accessibility further decreases within shorter distances, with 250 m covering 6,664 sq m (0.54%), 100 m covering 742 sq m (0.06%), and 50 m covering 190 sq m (0.02%) of the total 1000 m accessible area.

These values indicate that while the broader 1 km catchment provides considerable network reach, the proportion of area accessible within closer walking distances is relatively small. The map illustrates the network-based PCA coverage along with the location of Public Transport (PT) and Intermediate Public Transport (IPT) stops, highlighting the spatial relationship between the Metro station and surrounding transit facilities within the study area.

4.2.1.2.2 PT Accessibility

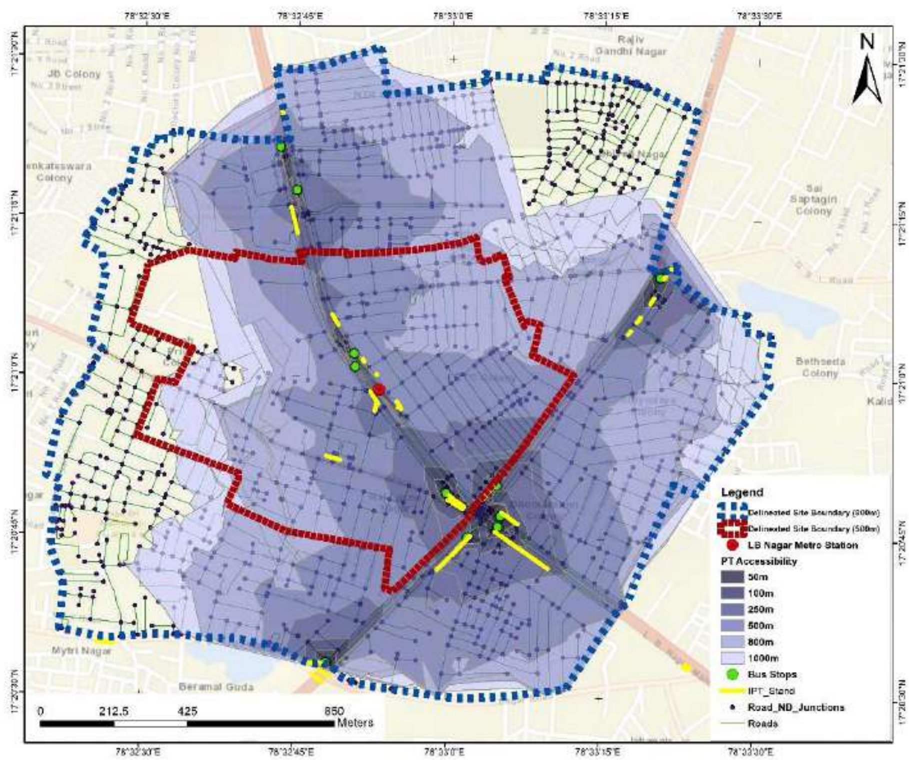


Figure 4-97 The Map Indicating the PT Accessibility

Source: Output of the Project Team, SPAV

The Pedestrian Catchment Area (PCA) analysis for existing bus stops (Figure 4-97) was carried out using network-based accessibility to understand the extent of walkable coverage from Public Transport (PT) locations within the study area. The analysis shows that within a 1000 m catchment, the accessible area reaches 13,597,697 sq m, representing the maximum service coverage of the bus stop network.

Within shorter walking distances, the 800 m catchment covers 9,236,882 sq m, accounting for approximately 67.9% of the total 1000 m coverage. The 500 m catchment covers 3,436,515 sq m, which represents about 25.3% of the total coverage, indicating that a considerable portion of the area lies within a moderate walking distance to bus stops. Similarly, the 250 m catchment covers 662,801 sq m (4.9%), while the 100 m catchment covers 90,464 sq m (0.66%) and the 50 m catchment covers 21,055 sq m (0.15%) of the total accessible area.

The results indicate that bus stops provide relatively wider spatial accessibility across the study area, particularly within the 800 m and 1000 m walking thresholds. The map shows the network-based PCA coverage along with the location of PT and IPT stops, illustrating the spatial distribution of bus accessibility and its relationship with the surrounding street network.

4.2.1.3 Walkability

4.2.1.3.1 Road Connectedness

Road connectedness in the study area was evaluated using Space Syntax analysis, which measures how easily a street segment can be reached from all other streets within the network. Higher connectivity values indicate streets that are more centrally located within the network and provide better accessibility for pedestrian movement.

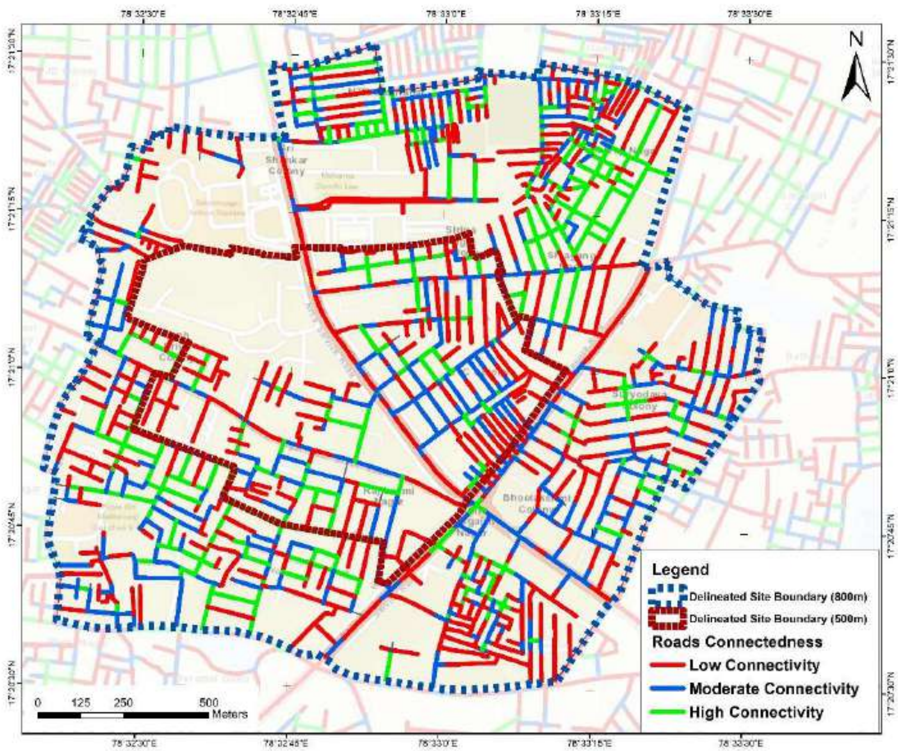


Figure 4-98 The Map Indicating the Road Connectedness

Source: Output of the Project Team, SPAV

The results as depicted in the Figure 4-98 show that moderate accessibility streets (Class 2) form the largest share of the network, covering 78.10 km, which represents approximately 33.8% of the total road length. These streets function as secondary connectors, linking different parts of the neighborhood and supporting movement between local streets and major corridors. High accessibility streets (Class 3) extend over 76.30 km, accounting for about 33.1% of the network, and represent well-integrated routes that act as important pedestrian movement corridors within the study area. Meanwhile, low accessibility streets (Class 1) cover 76.44 km, representing approximately 33.1% of the network, indicating segments that are relatively segregated and less directly connected to the overall street system.

From a walkability perspective, the relatively balanced distribution of connectivity levels suggests that while a significant portion of the network provides moderate to high accessibility for movement, there are still several segregated street segments that may limit direct pedestrian routes. Highly integrated streets play an important role in facilitating efficient pedestrian circulation, while moderate connectivity streets help distribute movement across the network and support neighborhood-level accessibility.

4.2.1.3.2 Network Connectivity

Network connectivity within the study area was assessed using Space Syntax analysis, which categorizes street segments based on their level of connectivity within the network. The results show three levels of connectivity: low, moderate, and high connectivity.

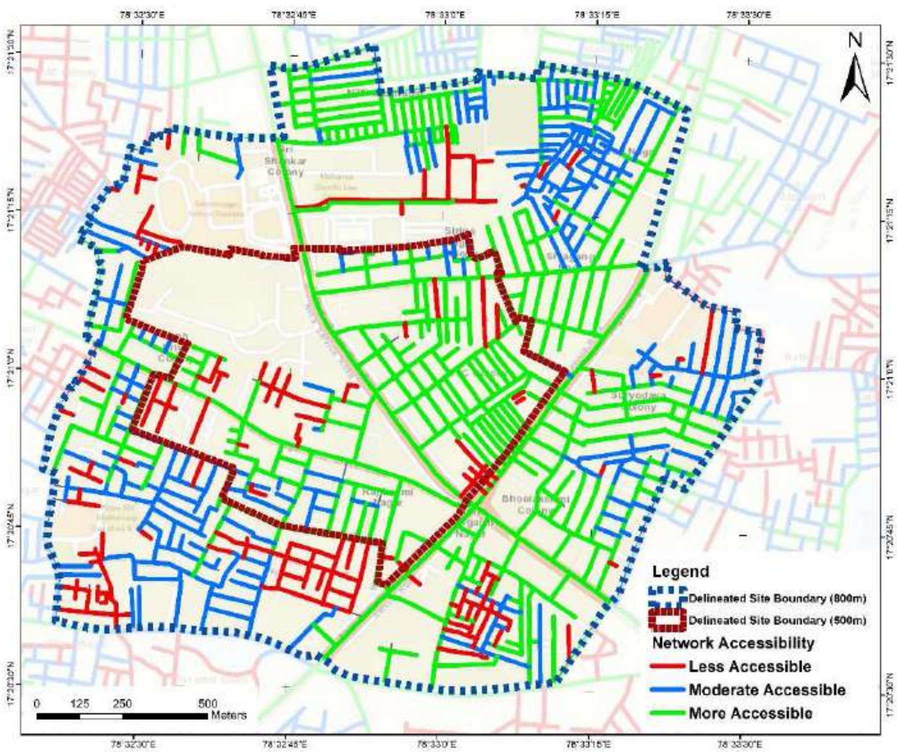


Figure 4-99 The Map Indicating the Network Connectivity

Source: Output of the Project Team, SPAV

The analysis (Figure 4-99) indicates that low connectivity streets account for 116 km, representing approximately 50.8% of the total network length. These streets are primarily internal residential roads and cul-de-sac type segments, which limit direct route options for pedestrians and reduce overall network permeability. Moderate connectivity streets cover 67.35 km, forming about 29.3% of the total network, and act as intermediate links connecting local streets to larger road corridors. High connectivity streets extend over 46.61 km, representing around 19.9% of the total network, and generally function as important movement corridors that provide multiple route choices and better network integration (Figure 4-99).

The map illustrates the spatial distribution of connectivity levels, where highly connected segments (green) form key movement corridors, moderate connectivity streets (blue) provide secondary links, and low connectivity streets (red) dominate the internal street network. From a walkability perspective, the presence of a large proportion of low connectivity streets indicates limited route choices and longer walking paths in certain areas. However, the moderate and highly connected streets play a crucial role in supporting pedestrian movement by linking different parts of the neighborhood and improving access across the study area.

4.2.1.3.3 Pedestrian Movement Potential

Pedestrian movement potential in the study area indicates the likelihood of a street segment being used as a route between different locations within the network. Higher values represent streets that function as important movement corridors for pedestrian flow.

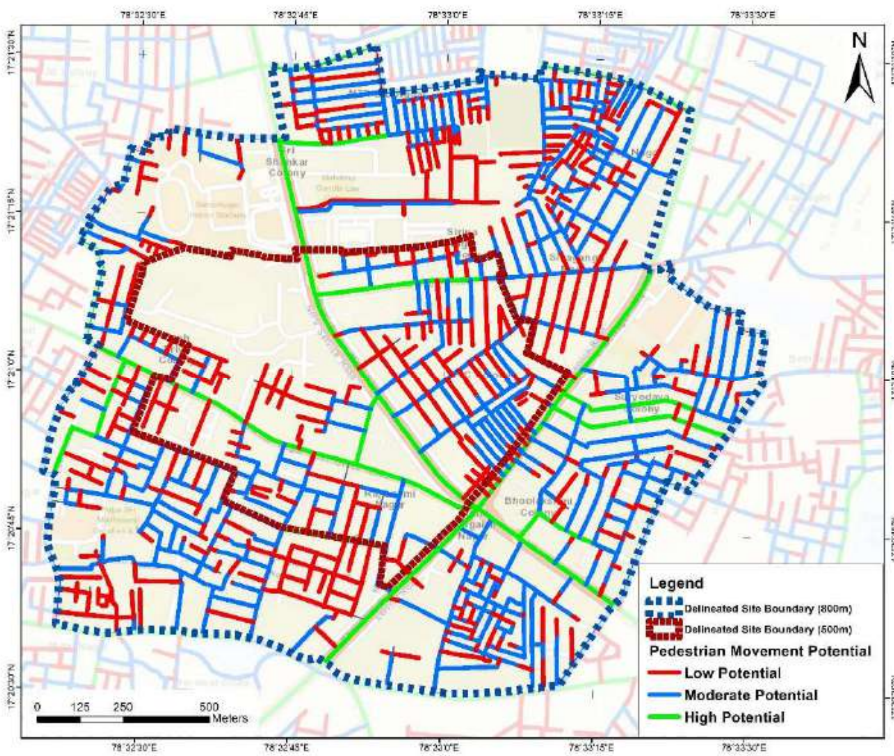


Figure 4-100 The Map Indicating the Pedestrian movement potential

Source: Output of the Project Team, SPAV

The Figure 4-100 illustrates Pedestrian movement potential mapping. The results show that moderate movement potential streets (Class 2) account for the largest share, with a total length of 113.02 km, representing approximately 49% of the network. These streets function as supporting movement corridors, connecting different parts of the neighborhood and facilitating pedestrian circulation. Low movement potential streets (Class 1) extend over 93.18 km, accounting for about 40.4% of the network, and generally represent local access streets with limited through movement. In contrast, high movement potential streets (Class 3) cover 24.64 km, representing approximately 10.7% of the total network, and act as primary pedestrian routes or major through-movement corridors.

From a walkability perspective, the dominance of moderate movement potential streets suggests that a large portion of the network supports pedestrian circulation at the neighborhood level. However, the relatively smaller share of high movement potential streets indicates that only a limited number of corridors function as strong pedestrian movement routes across the study area. These highly integrated corridors play an important role in facilitating efficient pedestrian connectivity and linking different parts of the neighborhood.

4.2.1.4 Speed and Delay

Speed and delay analysis helps in understanding the operational performance of the road network by examining the movement efficiency of vehicles along different road segments. For the LB Nagar Metro Station study area, this analysis was conducted to evaluate the average travel speed and delays experienced on key roads within the network. The results provide insights into traffic flow conditions, congestion levels, and the overall efficiency of road connectivity in the study area.

4.2.1.4.1 BAIRAMALGUDA ROAD

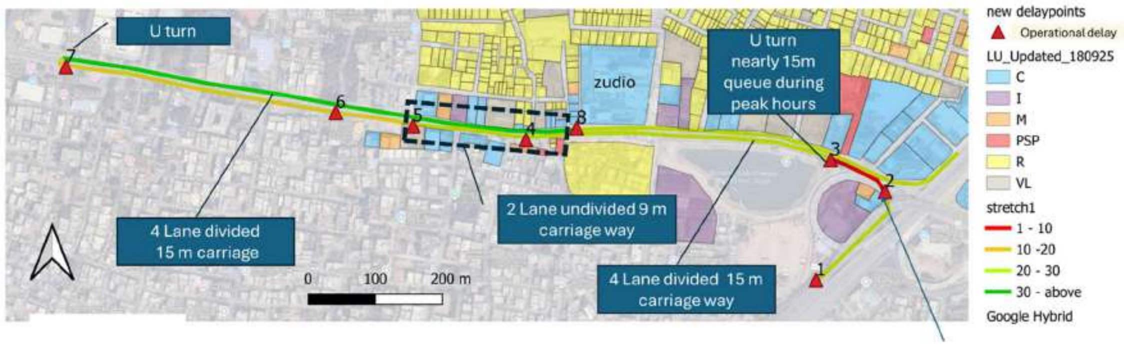


Figure 4-101 The Keymap Showing the Bairamalguda Road

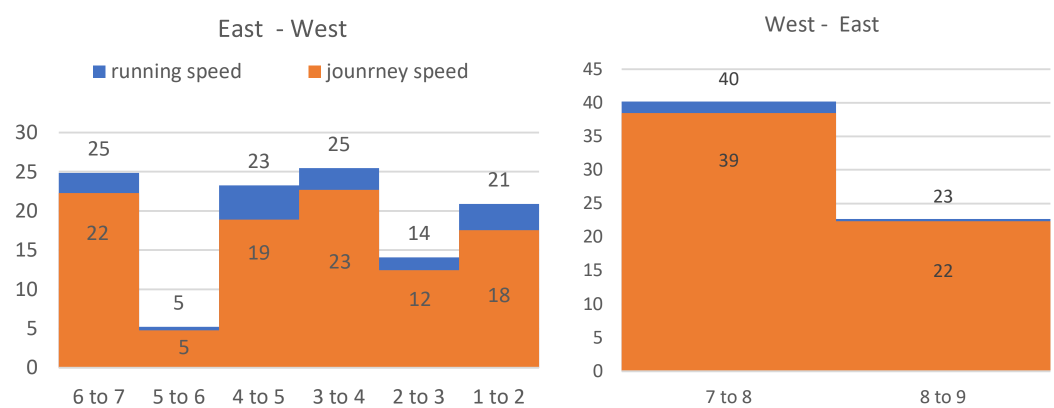


Figure 4-102 The graph showing the Speed & Delay for Bairamalguda Road

Source: Output of the Project Team, SPAV

The analysis for Bairamalguda Road (Figure 4-101 & Figure 4-102) highlights the operational inefficiency of a critical transit feeder. Despite being an arterial link, the road suffers from localized bottlenecks that impede smooth movement toward the LB Nagar Metro hub.

Average Journey Speed: The recorded speed is 20 km/h. This is significantly below the optimal urban arterial speed, indicating a high-friction environment.

Congestion Index (0.08): This index reveals that travel during peak periods takes 8% longer than the free-flow travel time. While seemingly low, in a high-density TOD zone, this overhead adds up to significant cumulative delays for daily commuters.

Primary Bottleneck: A major source of delay is identified as bus stops located near junctions. The lack of dedicated bus bays causes transit vehicles to stop in the active carriage way, leading to congestion that blocks the entire intersection.

Mode Mix and Friction Factors

The mode mixes on Bairamalguda Road comprising heavy buses, private cars, and a high volume of two-wheelers struggles to coexist within the existing cross-section. When a bus stops near the junction, it forces the entire stream of smaller, faster vehicles to merge or wait, exacerbating the 8% delay factor.

4.2.1.4.2 SAROORNAGAR ROAD

The analysis of Saroornagar Road reveals a significant collapse in vehicular efficiency due to the dynamic shifting of land use throughout the day(Figure 4-103). While the Right of Way (ROW) varies between 15m to 20m, the functional space for transit is severely restricted.

Figure 4-103 The Keymap Showing the Saroornagar Road

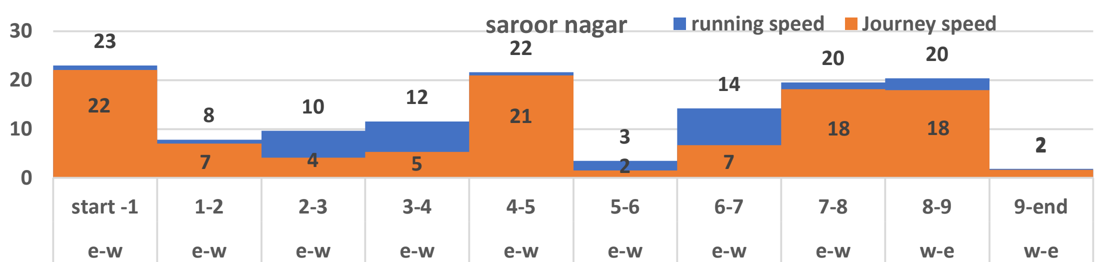


Figure 4-104 The graph showing the Speed & Delay for Saroornagar Road

Source: Output of the Project Team, SPAV

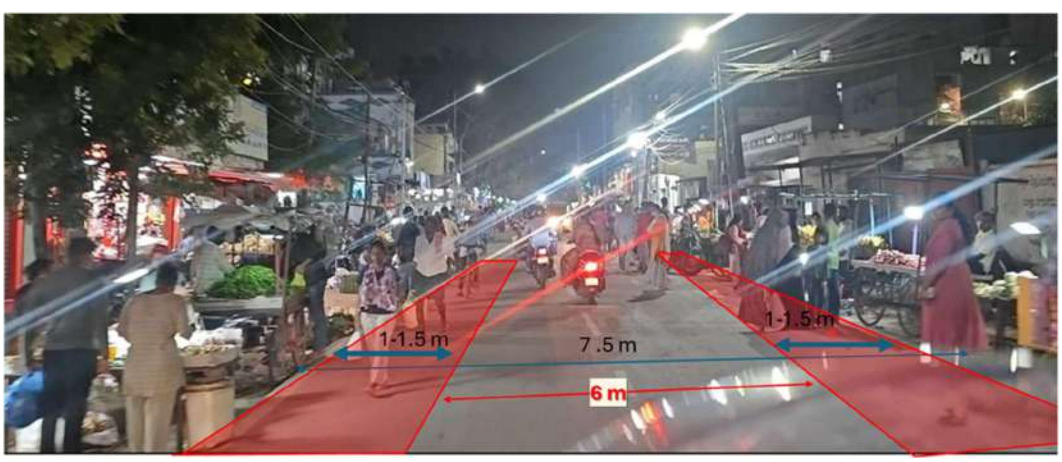


Figure 4-105 Street vending activity was observed on both sides of the road.

Image credit: Project Team, SPAV

Average Journey Speed: The recorded speed is a mere 11 km/h, indicating a near-total breakdown of traffic flow during peak hours (Figure 4-104).

Congestion Index (0.15): A value of 0.15 indicates that commuters face a 15% time penalty compared to free-flow conditions. This is nearly double the congestion observed on Bairamalguda Road.
Primary Bottleneck: The evening markets act as the primary catalyst for delay. During these hours, the 7.5m carriage way is effectively "invaded" by pedestrians and informal vendors due to the lack of formal NMT infrastructure.

4.2.1.4.3 SIRIS ROAD

The analysis of Siris Road highlights a significant discrepancy between planned infrastructure and current operational reality. As a key connector within the TOD zone, the road's efficiency is compromised by a mismatch in Right of Way (ROW) and high local activity.

Figure 4-106 The Keymap Showing the SIRIS Road

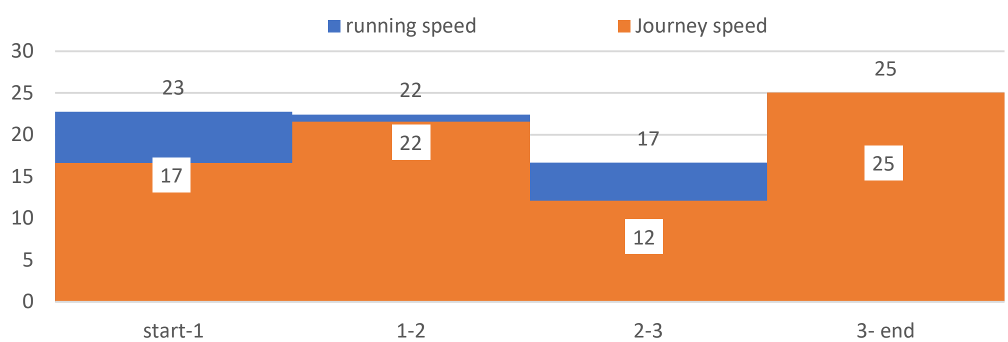


Figure 4-107 The graph showing the Speed & Delay for SIRIS Road

Source: Output of the Project Team, SPAV

ROW Discrepancy: While the master plan specifies a 30m ROW, the existing physical ROW is constrained between 20m and 24m. This "lost" space limits the ability to provide dedicated lanes for transit or NMT (Figure 4-106).
Average Journey Speed: The recorded speed is 19 km/h. This indicates a sluggish traffic flow that fails to meet the expectations of an efficient arterial/sub-arterial feeder (Figure 4-107).
Congestion Index (0.13): A score of 0.13 indicates that travel times on Siris Road are 13% longer than they would be under free-flow conditions.
Friction Factors: The delay is largely attributed to the road's high permeability; numerous local streets intersect this stretch, creating frequent merging conflicts. Additionally, the presence of multiple Public and Semi-Public (PSP) buildings generates high "turn-in/turn-out" traffic and localized pedestrian crossings.

4.2.1.4.4 METRO CORRIDOR

The analysis of the NH 65 stretch, the primary arterial backbone of the study area reveals significant operational inefficiencies for a road of its hierarchy (Figure 4-108). As the main corridor housing the LB Nagar Metro station, its performance dictates the accessibility of the entire TOD zone.

Figure 4-108 The Keymap Showing the Metro Corridor Road

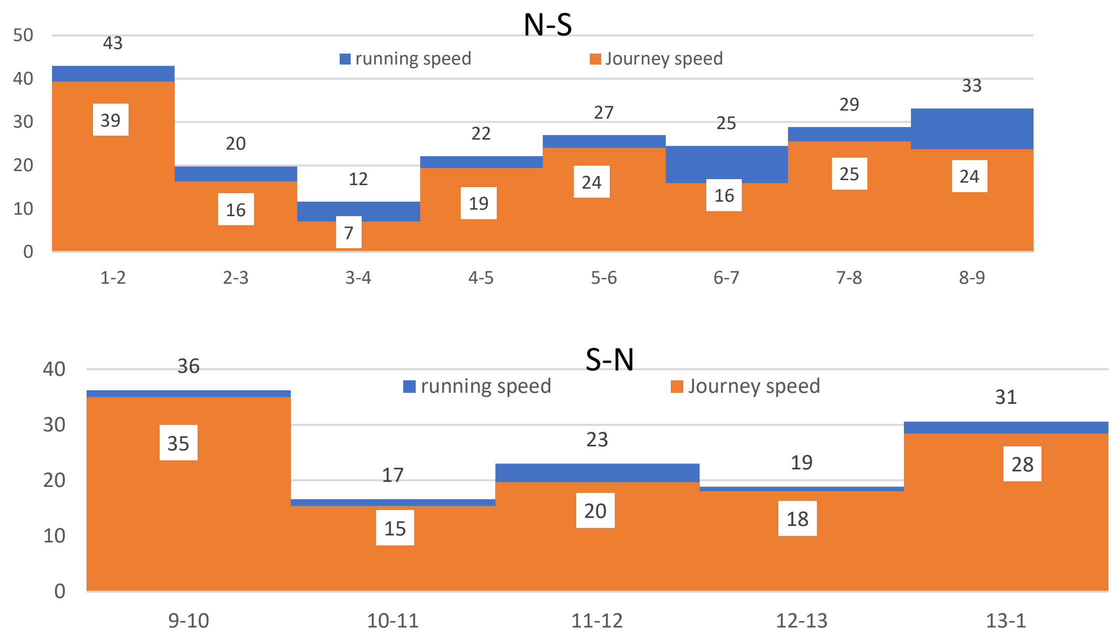


Figure 4-109 The graph showing the Speed & Delay for Metro Corridor Road

Source: Output of the Project Team, SPAV

Average Journey Speed: The recorded speed is 22 km/h. For a major national highway/arterial road, this is exceptionally low, indicating that the high-capacity design is being undermined by intense urban friction (Figure 4-109).

Congestion Index (0.15): The data shows that the time taken to travel this stretch is 15% more than under free-flow conditions.

Running vs. Journey Speed: While the running speed is higher, the journey speed drops to 22 km/h due to frequent “delay points” such as signalized intersections, U-turns, and merging traffic from service roads.

Friction Factors and Bottlenecks

Metro Station Activity: The concentration of commuters, paratransit and feeder buses near the Metro entrance creates a “crawling” effect.

Service Road Conflicts: The constant merging and diverging of traffic between the main carriage way and service roads create "turbulence," slowing down through-traffic.

U-Turn Queuing: U-turns create queues of up to 15m during peak hours, effectively "choking" one or more lanes of the 15m divided carriage way.

4.2.1.4.5 INNER RING ROAD

The analysis of the Inner Ring Road segment reveals a corridor that, while vital for regional connectivity, operates significantly below its potential efficiency due to urban friction and intersection delays (Figure 4-110).

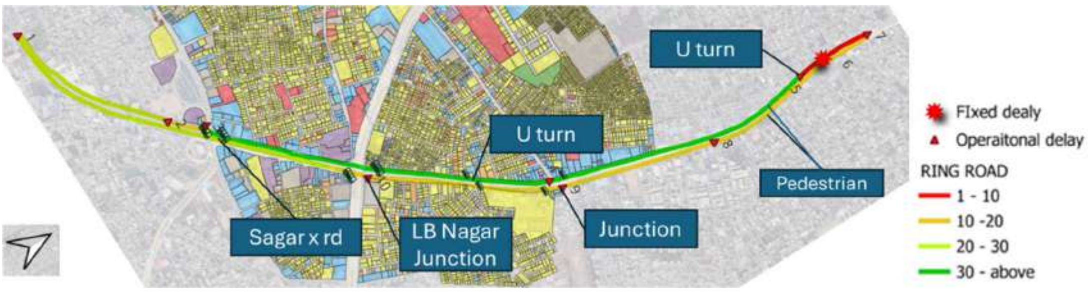


Figure 4-110 The Keymap Showing the Inner Ring Road

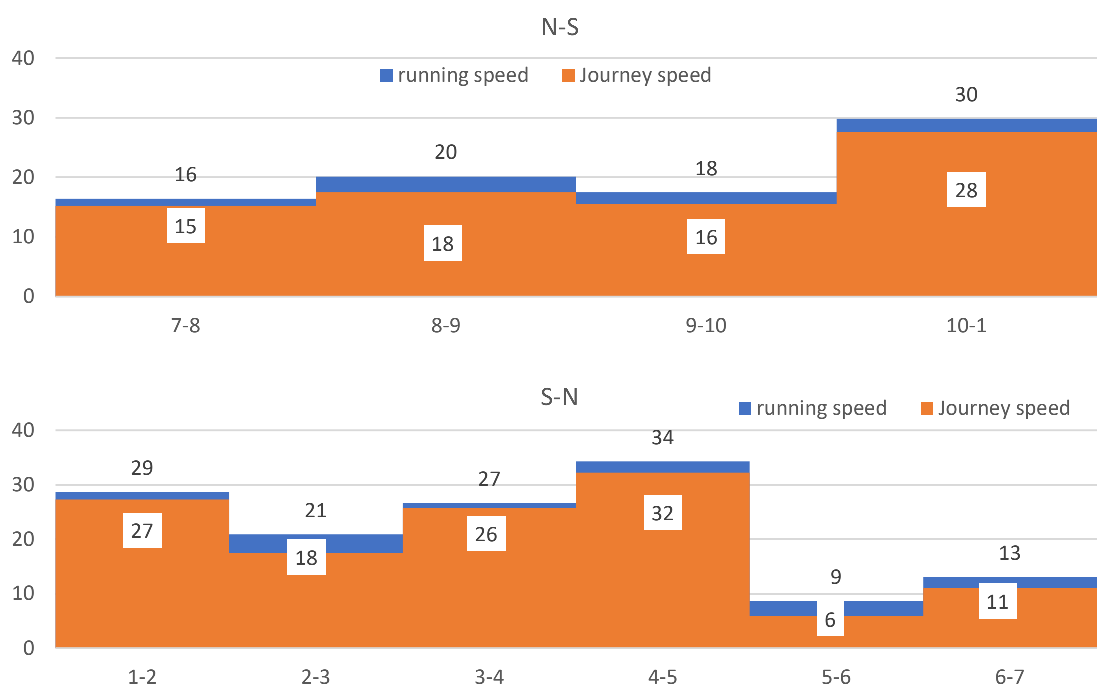


Figure 4-111 The graph showing the Speed & Delay for Inner Ring Road

Source: Output of the Project Team, SPAV

Average Journey Speed: The recorded average speed is 20 km/h. Similar to NH 65, this is remarkably slow for a high-order "Ring Road" facility, indicating that the road is behaving more like a congested local arterial during peak periods (Figure 4-111).

Congestion Index (0.09): The time taken to travel this stretch is 9% more than the free-flow speed. While this is lower than the 15% delay observed on NH 65, it still represents a tangible loss in productivity for commuters.

Speed Reduction (12%): There is a 12% reduction in journey speed relative to running speed. This specific metric quantifies the impact of "stopped time" (delays at signals, junctions, or due to queuing) versus the time spent actually moving.

Friction Factors and Bottlenecks

The mapping and data suggest that the Inner Ring Road suffers from a "stuttering" flow. The 12% reduction in journey speed is likely caused by:

Junction Overload: Large volumes of traffic merging from the residential blocks (identified in the connectivity analysis) create significant wait times at major entry points.

Signalized Impedance: The frequency of stops prevents vehicles from maintaining a steady running speed, effectively capping the journey speed at 20 km/h.

Commercial Encroachment: Much like the other surveyed roads, informal activities near the edges of the carriage.

4.2.1.4.6 COMPREHENSIVE SPEED AND DELAY

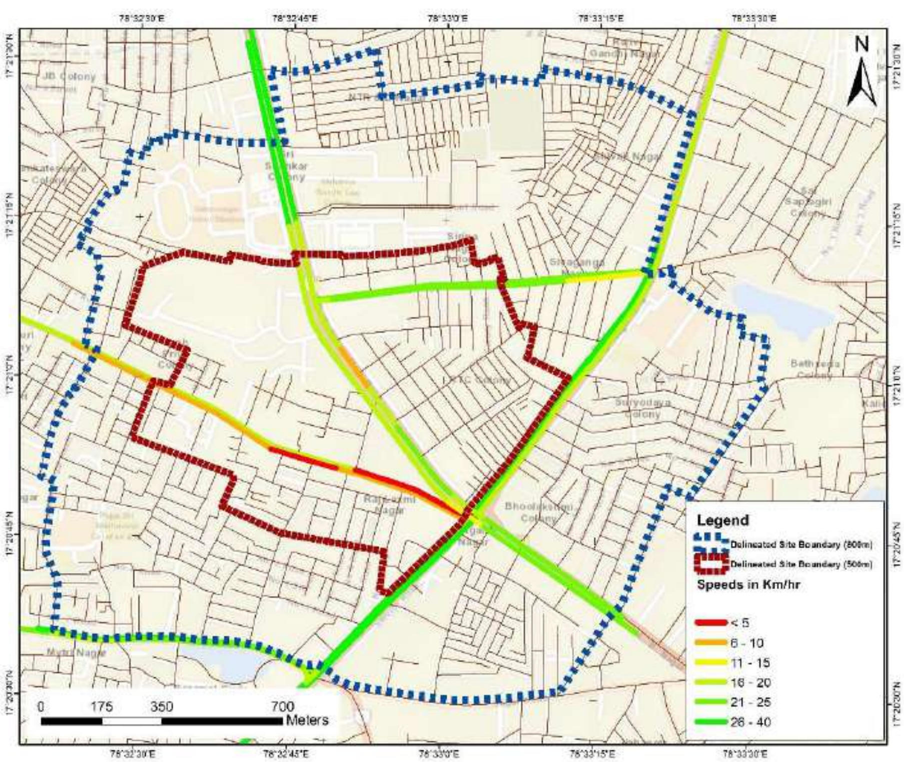


Figure 4-112 Comprehensive speed and delay map for the LB Nagar study area

Source: Output of the Project Team, SPAV

The speed and delay analysis of the LB Nagar study area (Figure 4-112) indicates significant pressure on the road network. Average travel speeds range between 11 km/h and 22 km/h, showing that even major corridors operate at relatively low speeds. The congestion index varies from 0.08 to 0.15, suggesting that commuters lose approximately 8-15% of travel time due to delays. A noticeable gap between running speed and journey speed reflects frequent stop-start traffic conditions, often caused by intersections, U-turn movements, and roadside activities. Certain locations, such as Saroornagar Road, NH 65, and the Bairamalguda, Siris junction, experience higher delays due to narrow carriageways, traffic merging, and junction-related bottlenecks, affecting overall movement efficiency within the study area.

4.2.1.5 Network Level of Services

Level of Service (LOS) is a widely used measure to evaluate the operational performance and quality of traffic flow on road networks. It indicates the degree of congestion, travel speed, and delay experienced by road users. For the LB Nagar Metro Station study area, LOS analysis was carried out for key road corridors (Figure 4-113) to understand the existing traffic conditions and overall efficiency of the road network.

Table 4-10 The Selection of Junction and Justification

Junction	Analysis	Justification
Kamineni Junction	TMC (Turning Movement Count)	• Major traffic node in located along the Inner Ring Road near Kamineni Hospital. • It experiences heavy traffic flow due to the convergence of residential, commercial, and institutional areas. A flyover has been built to ease congestion at the junction.
LB Nagar Junction	TVC Mid-Block (Traffic Volume Count)	• LB Nagar Junction is a major intersection in the city of Hyderabad, Telangana. • It connects arterial roads like Inner Ring Road and NH-65 routes toward Vijayawada. • The junction is a busy transport node: heavy vehicular traffic, metro access nearby (via LB Nagar Metro Station) and considerable commuter flows.
Bairamguda Junction	TVC Mid-Block (Traffic Volume Count)	• Lies along the Inner Ring Road (IRR) and serves as a key connecting point between Sagar Road, Srisailam Road, and other arterial routes leading toward LB Nagar, Karmanghat, and BN Reddy Nagar. • The junction experiences very high traffic volumes and has been developed under the Strategic Road Development Plan (SRDP) initiated by the Greater Hyderabad Municipal Corporation (GHMC) to improve mobility and reduce congestion across the city.
Saroornagar Road	TVC Mid-Block (Traffic Volume Count)	• Low to medium-rise development is observed along the Saroornagar road, along with a few industries. The area is predominantly characterized by commercial and mixed-use development, and there are also some institutional buildings.

Figure 4-113 The Keymap Showing the Location and Arm numberi

Table 4-11 The Network Level of Services for different location

Arm	Time	Vehicles/ hr	IHCM PCU/hr	Peak Hour Factor	Base Capacity (Indo HCM)	Adjusted Capacity Indo HCM	Adjusted V/C (IHCM	LOS	IRC PCU /Hr	Capacity (IRC)	V/C (IRC)	LOS
Siris Road												
Siris Road	5:00 PM-6.00 PM	1026	752	0.84	2400	1014	0.74	C	1049	2400	0.42	**B**
LB Nagar Junction												
1	9:00 AM-10 AM	4418	3525	0.99	8400	3549	0.99	E	4033	5400	0.75	**E**
2		5247	4012	0.98	8400	3549	1.13	F	5562	5400	1.03	**F**
3		4913	3537	0.98	8400	3549	1	F	4334	5400	0.80	**E**
Saroornagar Road												
1	5:00 PM-6.00 PM	2477	1450	0.95	2400	1014	1.43	F	1895	1200	1.58	**F**
2		1625	1083	0.93	2400	1014	1.07	F	1487	1200	1.24	**F**
3		3465	1983	0.90	2400	1014	1.96	F	2804	1200	2.34	**F**
Bairamguda Junction												
1	5:00 PM-6.00 PM	5347	3933	0.99	5400	2282	1.72	F	5245	2400	2.18	**F**
2		11215	9664	0.94	5400	2282	4.24	F	11329	2400	4.72	**F**
3		3773	2587	0.97	5400	2282	1.13	F	3084	2400	1.28	**F**
4		8239	6836	0.89	5400	2282	3.00	F	7741	2400	3.22	**F**
5		6852	5523	0.98	5400	2282	2.42	F	7416	2400	3.09	**F**

The Level of Service (LOS) analysis for the LB Nagar study area (Figure 4-114) indicates that several key road segments and junctions operate under congested conditions, particularly during peak hours. The analysis was carried out using both Indo HCM and IRC standards to understand the traffic performance of major corridors and intersections within the study area.

At Siris Road, the traffic condition is relatively moderate, with a V/C ratio of 0.74 under Indo HCM resulting in LOS C, while the IRC method indicates LOS B with a V/C ratio of 0.42. This suggests that traffic flow on this corridor is comparatively stable with manageable levels of congestion.

In contrast, the LB Nagar Junction experiences higher traffic pressure during the morning peak hours. The analysis shows LOS E and F conditions, with V/C ratios reaching 0.99 and above under Indo HCM, indicating traffic operating close to or exceeding the designed capacity. Similar conditions are reflected in the IRC analysis where V/C ratios range from 0.75 to 1.03, indicating heavy congestion and reduced operational efficiency at the junction.

The situation is more critical on Saroornagar Road, where multiple arms show LOS F conditions with V/C ratios ranging between 1.07 and 1.96 (Indo HCM) and 1.24 to 2.34 (IRC). These values indicate that traffic demand significantly exceeds the available road capacity, leading to severe congestion and delays.

A similar pattern is observed at the Bairamguda Junction, where all arms operate under LOS F conditions. The V/C ratios are particularly high, ranging from 1.13 to 4.24 under Indo HCM and 1.28 to 4.72 under IRC, indicating extremely congested traffic conditions where the volume of vehicles is far greater than the designed capacity of the junction.

Comprehensively, the LOS analysis suggests that while certain corridors such as Siris Road maintain moderate traffic flow, major junctions including LB Nagar Junction, Saroornagar Road, and Bairamguda Junction experience severe congestion during peak periods. The high V/C ratios highlight the pressure on the road network and indicate limited capacity to accommodate additional traffic demand within the study area.

Figure 4-114 The map showing Comprehensive Level of Service for the LB Nagar study area

Source: Output of the Project Team, SPAV

4.2.2 Diversity

Diversity refers to the mix of land uses and activities within the study area, which is a key principle of Transit-Oriented Development (TOD). A balanced mix of residential, commercial, institutional, and recreational uses encourages shorter travel distances, promotes walkability, supports public transit usage, and enhances the overall vibrancy and functionality of urban spaces.

4.2.2.1 Existing Landuse 2026

The Existing Land Use 2026 (Figure 4-115) within the 800 m influence zone of the LB Nagar Metro Station reflects a well-established urban fabric shaped by residential development and supporting commercial activities. The land use classification has been prepared based on primary field surveys, providing an accurate representation of the current spatial distribution of activities within the study area. The composition of landuse is represented in Table 4-12

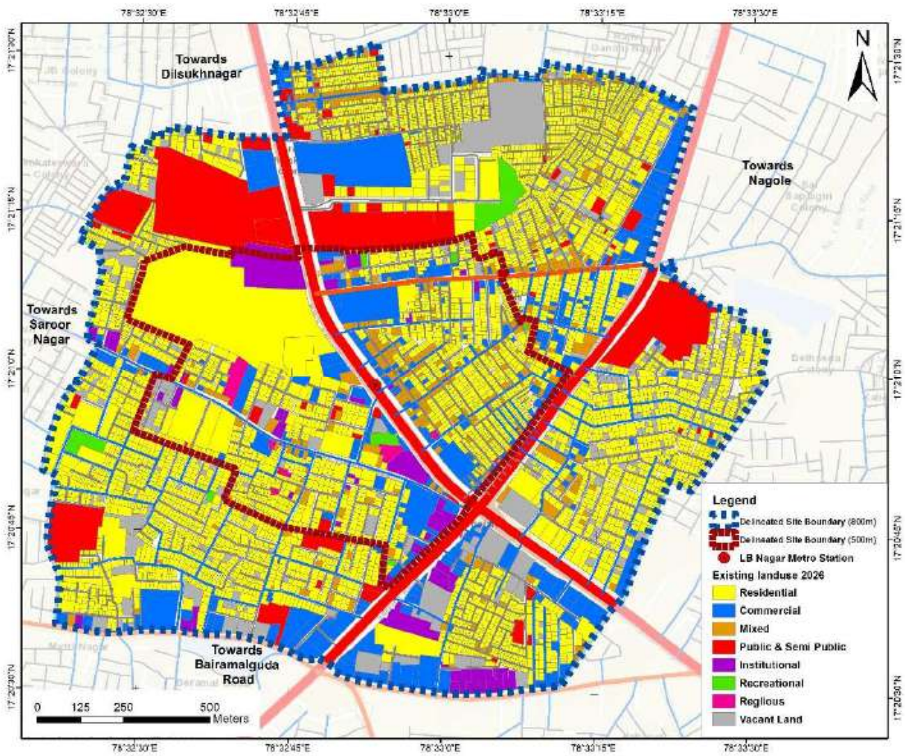


Figure 4-115 The map indicating the Existing Land Use 2026

Source: Output of the Project Team, SPAV

Table 4-12 Existing Land Use Composition of the Study Area.

Exsiting Landuse	Area (Ha)	Percentage (%)
Commercial	31.40	13.86%
Institutional	7.98	3.52%
Mixed	11.47	5.07%
Public & Semi Public	25.31	11.18%
Recreational	2.38	1.05%
Reglious	1.01	0.45%
Residential	127.21	56.16%
Vacant Land	19.73	8.71%
Total	**226.51**	**100.00%**

The mapping reveals a "Ribbon and Patch" development pattern:

Commercial Ribbon Development: High-intensity commercial activity (13.86%) is strictly concentrated along the NH-65 and the Inner Ring Road. This creates a "commercial wall" that shields the inner residential colonies from highway noise and provides high visibility for retail.

Residential Core: Dominating over half the study area (56.16%), residential use indicates dense, fine-grained blocks in the southwest and northeast quadrants, primarily consisting of established colonies like RTC Colony and Bahadurguda.

Public & Semi-Public Anchors: Covering 11.18%, these large parcels (including government offices and utilities) are situated as major blocks, often acting as "buffer zones" between the high-speed transit corridors and the residential interiors.

Vacant Land: Despite the proximity to the Metro, 8.71% of the land remains vacant. These patches are largely found toward the northern and eastern peripheries of the 800m boundary, representing significant "Infill Development" potential for future Transit-Oriented Development (TOD).

Limited Integration: Mixed-use development is relatively low at 5.07%. This suggests a "Siloed" planning approach where living and working spaces are horizontally separated rather than vertically integrated a pattern typical of traditional Hyderabad suburbs but one that TOD aims to evolve.

4.2.2.2 Floor wise Landuse

4.2.2.2.1 Ground Floor Landuse

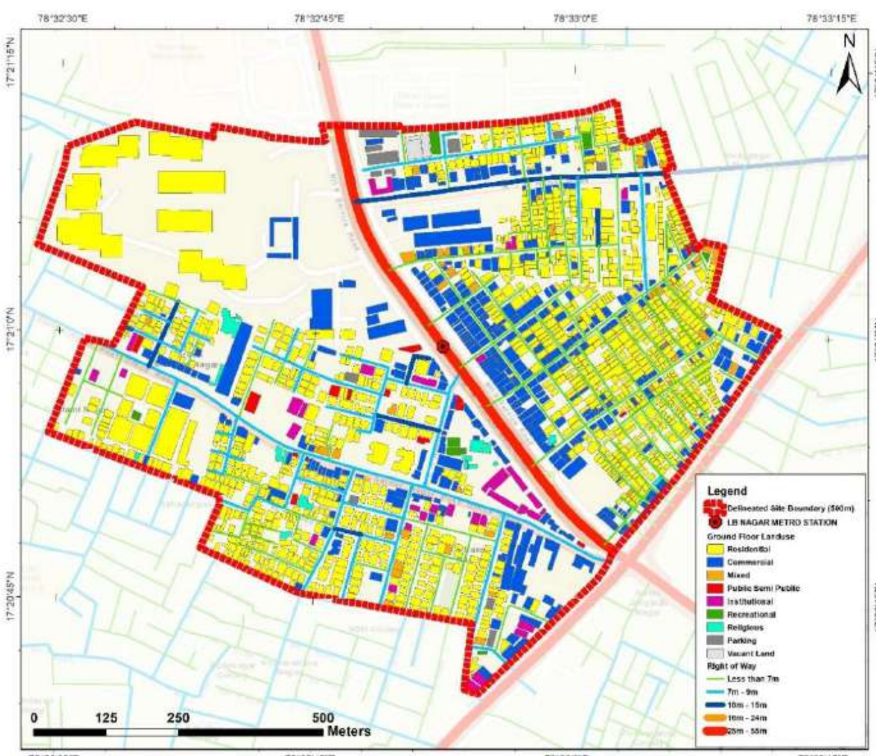


Figure 4-116 The map showing the Ground floor Landuse

Source: Output of the Project Team, SPAV

The analysis of the land use map reveals a distinct "Linear Commercialization" pattern:

Arterial Commercial Ribbon: The 27% commercial share is almost entirely concentrated along NH 65 and the Inner Ring Road (Figure 4-116). This creates a high-intensity commercial "buffer" or ribbon that shields the inner residential pockets. These ground floor commercial spaces primarily consist of retail outlets, showrooms, and service centers that leverage high visibility.

Residential Core: The 63% residential dominance is located within the internal blocks. The "fine-grain" network identified in previous connectivity studies supports these quiet residential zones. However, the ground floor in these areas remains largely mono-functional, contributing to lower activity levels outside of peak commuting hours.

Institutional & PSP: The Public and Semi-Public (1%) and Institutional (3%) uses are scattered strategically, often acting as landmark nodes at major intersections or along Siris Road.

Mixed-Use: Mixed-use accounts for only 2% of the ground floor. In a TOD zone, this figure is typically higher. The current pattern suggests a rigid separation where buildings are either purely residential or purely commercial, rather than the integrated "live-work-play" vertical mix ideal for transit hubs.

While the high commercial percentage (27%) along the main roads supports transit ridership by providing destinations near the Metro, the residential dominance (63%) in the interior indicates a "dormitory" character for much of the catchment area. To truly optimize the TOD, there is significant potential to convert purely residential ground floors into mixed-use or "active fronts" along identified collector roads, which would enhance natural surveillance and improve the pedestrian experience throughout the day.

4.2.2.2.2 G+1 Floor Landuse

The G+1 floor land use acts as a transitional layer in the LB Nagar TOD area (Figure 4-117). It marks the shift from the high-intensity retail environment of the ground floor to the private, residential the upper floors.

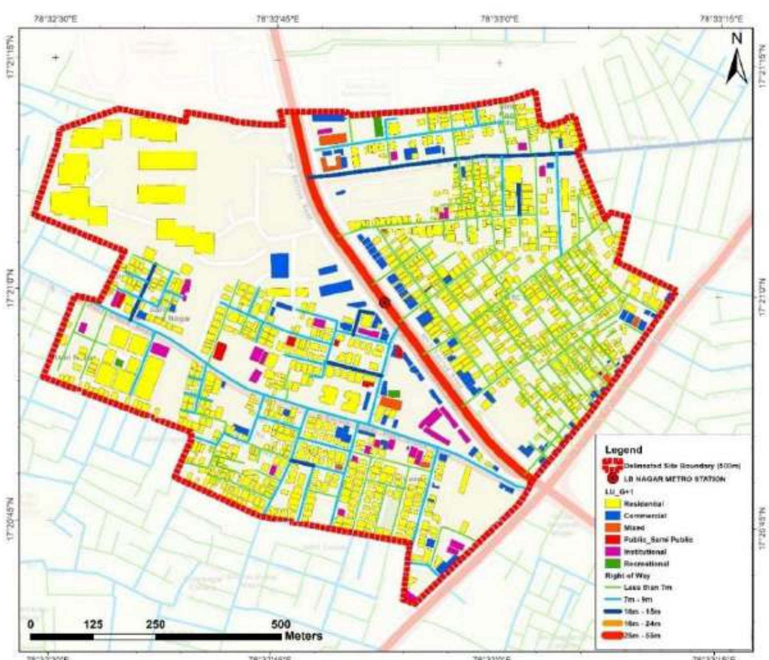


Figure 4-117 The map showing the G+1 Floor Landuse
Source: Output of the Project Team, SPAV

Spatial Pattern and Distribution: the mapping reveals a "Vertical Transition" where the commercial influence begins to fade in favor of residential dominance:

Residential: At the G+1 level, residential use Increases to 82.55% (compared to 63% on the ground floor). This indicates that even along the busier collector roads, the first floor is often the point where private living begins.

Commercial: Commercial activity drops significantly from 27% (Ground) to 9.80%. The commercial entities that remain at this level are typically "Service-Oriented" rather than "Product-Oriented" (clinics, small offices, banks, or gyms that don't require high-visibility storefronts but benefit from transit proximity).

Institutional Stability: At 4.30%, institutional uses (schools, training centers) remain consistent. These uses often occupy both the ground and first floors to accommodate larger footprints within the narrow urban plots.

Mixed-Use: While still low at 1.43%, the mixed-use category at G+1 often represents buildings where the owner lives on the first floor and operates a business below, or where office and residential units share the same level.

The G+1 data reveals a moderate vertical mix. While the area is overwhelmingly residential at this height, the nearly 10% commercial presence suggests a "podium" effect along major streets. For a TOD, this is a healthy sign of density, as it places a significant population directly above or adjacent to economic activity. However, the lack of dedicated "Mixed Use" zoning means that these functions are likely operating in silos rather than as integrated transit-supporting services.

4.2.2.2.3 G+2 Floor Landuse

The land use at the G+2 level provides a clear picture of the vertical character of the LB Nagar study area. Unlike the ground floor, which is heavily influenced by commercial development, the second floor reflects the area's primary identity as a high-density residential neighborhood.

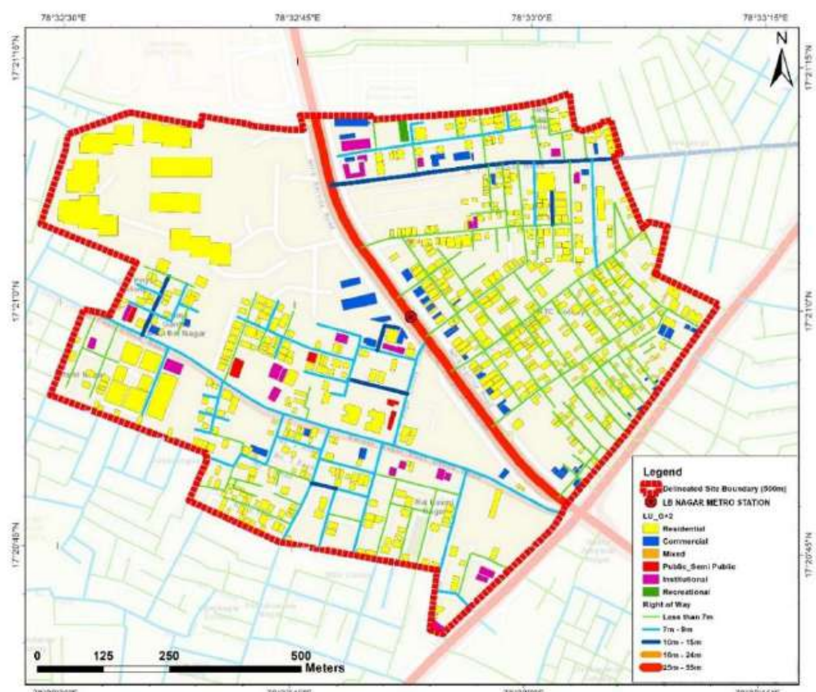


Figure 4-118 The map showing the G+2 Floor Landuse
Source: Output of the Project Team, SPAV

The analysis reveals a "Vertical Homogeneity" pattern (Figure 4-118)within the inner blocks and a "Tapering Commercial" pattern along the arterials:

Residential Solidification: Residential use jumps significantly from 63% on the ground floor to over 85% at the G+2 level. This indicates that the vast majority of buildings in the catchment are walk-up apartments or independent houses where the upper floors are strictly reserved for living.

Commercial Recession: Commercial activity drops from 27% (ground floor) to only 7.29%. This suggests that commercial use in LB Nagar is primarily "street-facing" and retail-oriented. Only a small fraction of buildings—likely along NH 65—maintain commercial functions (such as offices or private clinics) up to the second floor.

Institutional Presence: At 5.27%, institutional use is actually higher on the upper floors than on the ground floor. This pattern is common in Indian TODs where schools, coaching centers, and small hospitals utilize upper floors for quieter environments while keeping the ground floor for parking or reception.

Lack of Vertical Mix: The negligible 0.04% mixed-use value at this level confirms that vertical integration is nearly non-existent. Buildings are segmented by floor rather than having a truly integrated mix.

The G+2 data highlights a vertical disconnect. While the ground floor is active and commercial (supporting transit), the floors above are almost exclusively residential. For a TOD to be vibrant 24/7, a greater percentage of "Active Upper Floors" (offices, gyms, or coworking spaces) is usually encouraged. The current 85% residential dominance at the G+2 level suggests that after business hours, the commercial corridors might experience a "deadening" effect as the activity retreats to the inner residential streets.

4.2.2.2.4 G+3 FLOOR LANDUSE

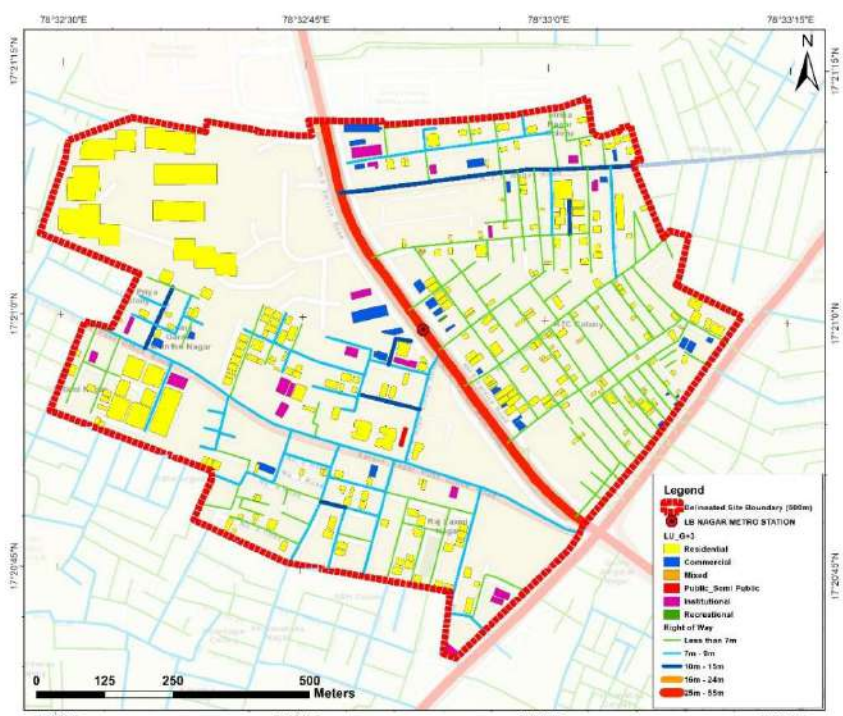


Figure 4-119 The map showing the G+3 Floor Landuse
Source: Output of the Project Team, SPAV

The G+3 floor land use data (Figure 4-119) for the LB Nagar study area illustrates the final stages of vertical residential consolidation. At this height, the urban fabric moves away from the multi-functional street level and becomes almost entirely dedicated to housing and institutional anchors.

Residential Dominance: At 84.17%, residential use remains the overwhelming primary function. This indicates that buildings reaching four stories (G+3) in this catchment are predominantly apartment complexes or larger multi-family dwellings. The inner residential colonies show a very high degree of homogeneity at this level.

Commercial: Commercial use stands at 7.94%. Interestingly, this is a slight increase compared to the G+2 level (7.29%), suggesting that newer, taller commercial buildings along NH 65 or the Inner Ring Road are utilizing their upper floors for corporate offices, diagnostic centers, or specialized services that require larger contiguous floor plates.

Institutional Concentration: Institutional use reaches its highest vertical share here at 7.26%. This pattern suggests that educational institutions or hospitals within the study area are "verticalized," occupying significant portions of taller buildings to maximize floor area on limited plot sizes.

Mixed-Use: At 0.06%, mixed-use is statistically negligible. This confirms that the higher the building goes, the more mono-functional the floors become.

4.2.2.2.5 G+4 FLOOR LANDUSE

The G+4 floor land use analysis represents the highest vertical tier for the majority of the building stock in the LB Nagar study area. At this level, we see the culmination of institutional growth and the continued dominance of high-density residential apartments.

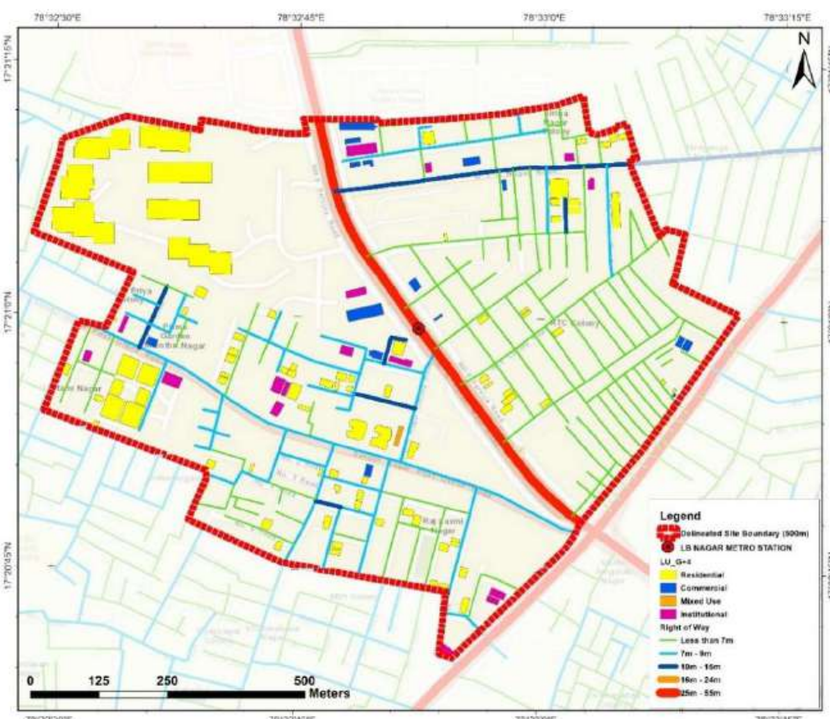


Figure 4-120 The map showing the G+4 Floor Landuse
Source: Output of the Project Team, SPAV

The analysis of the G+4 layer (Figure 4-120) reveals a "Vertical Specialization" pattern:

Residential Consolidation: While still the dominant category at 81.62%, residential use shows a slight percentage drop compared to G+3. This is not due to a decrease in housing, but rather an increase in the proportion of taller buildings being used for institutional or commercial purposes at this height.

Stable Commercial Presence: Commercial use remains steady at 8.05%. These are no longer "shops" but represent professional services, corporate regional offices, or diagnostic centers. Spatially, these are clustered along the NH 65 and Inner Ring Road, where higher FSI (Floor Space Index) allows for taller commercial structures.

Institutional Peak: At 9.85%, institutional use reaches its highest percentage across all floor levels. This indicates that buildings reaching G+4 are frequently dedicated to large-scale functions like hospitals, private colleges, or administrative offices. These institutions act as "vertical anchors" in the TOD zone, drawing significant footfall that likely utilizes the Metro.

Vertical Mix: While still low, Mixed Use rises to 0.48%. This suggests that as buildings get taller (G+4 and above), there is a slightly higher tendency to mix different functions (like an office floor within a residential-led building) compared to the mid-level floors.

4.2.2.2.6 G+5 FLOOR LANDUSE

The G+5 floor land use analysis (Figure 4-121)represents the high-rise stratum of the LB Nagar study area. At this vertical level, the network of buildings begins to filter out smaller commercial enterprises, leaving behind large-scale residential complexes and established institutional anchors.

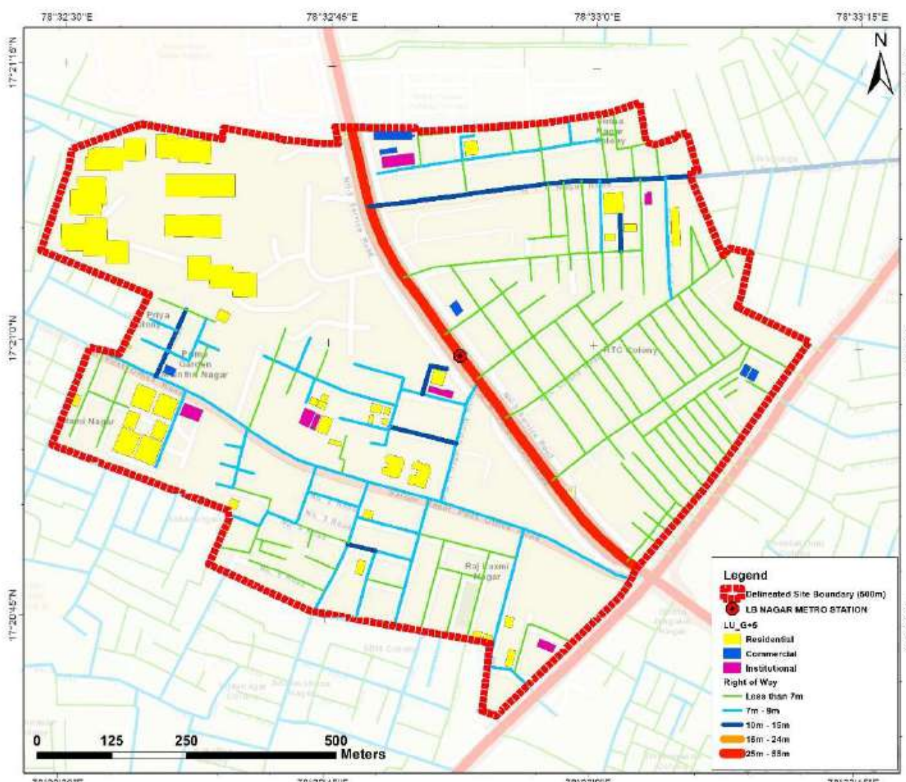


Figure 4-121 The map showing the G+5 Floor Landuse
Source: Output of the Project Team, SPAV

Residential Dominance (88.47%): This is the highest percentage of residential use observed across all floor levels (surpassing even G+2 and G+3). It indicates that most buildings reaching this height are modern apartment complexes or gated high-rises. These structures are primarily located in the deeper residential pockets where consolidated plots allow for greater vertical clearance.

Institutional Persistence (7.07%): Institutional use remains a significant player at this height. These typically represent large hospitals or educational blocks that require significant vertical volume to accommodate their specialized departments.

Commercial Contraction (4.47%): Commercial use drops to its lowest percentage in the vertical study. This suggests that very few buildings in LB Nagar are dedicated purely to high-rise commercial offices. The commercial activity at this level is likely restricted to "A-Grade" office spaces or hotels along the primary arterials.

Above G+5 Floor Landuse

The analysis of buildings exceeding five stories (> G+5) represents the pinnacle of vertical development in the LB Nagar study area (Figure 4-122). At this height, the urban fabric reaches its most specialized and least diverse state, becoming an almost exclusive residential enclave.

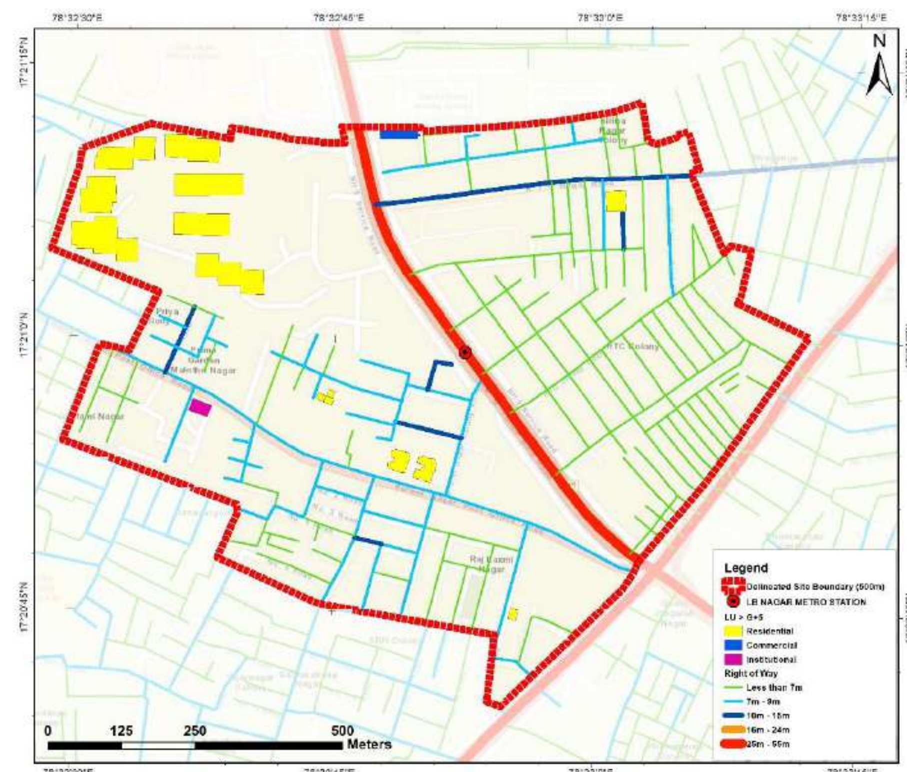


Figure 4-122 The map showing the G+5 Floor Landuse

Source: Output of the Project Team, SPAV

Extreme Residential Concentration (95.13%): This is the highest residential percentage across all vertical levels. It indicates that high-rise development in LB Nagar is almost entirely synonymous with modern, multi-story apartment complexes. These are typically gated communities or standalone high-rise blocks that have emerged recently to capitalize on the proximity to the Metro.

Minimal Commercial & Institutional Footprint: Both Commercial (2.75%) and Institutional (2.12%) uses shrink to their lowest levels. This suggests that the study area lacks "Skyscraper" office culture or large-scale vertical hospitals/universities. The few tall buildings that aren't residential are likely flagship corporate offices or specialized medical wings along the primary transit corridors.

4.2.2.3 Building Height

The building height profile of the LB Nagar study area (Figure 4-123)presents a diverse urban grain, ranging from traditional low-rise structures to modern high-rise developments. The distribution shows a significant skew toward low-to-mid-rise buildings, though a notable high-rise cluster is emerging.

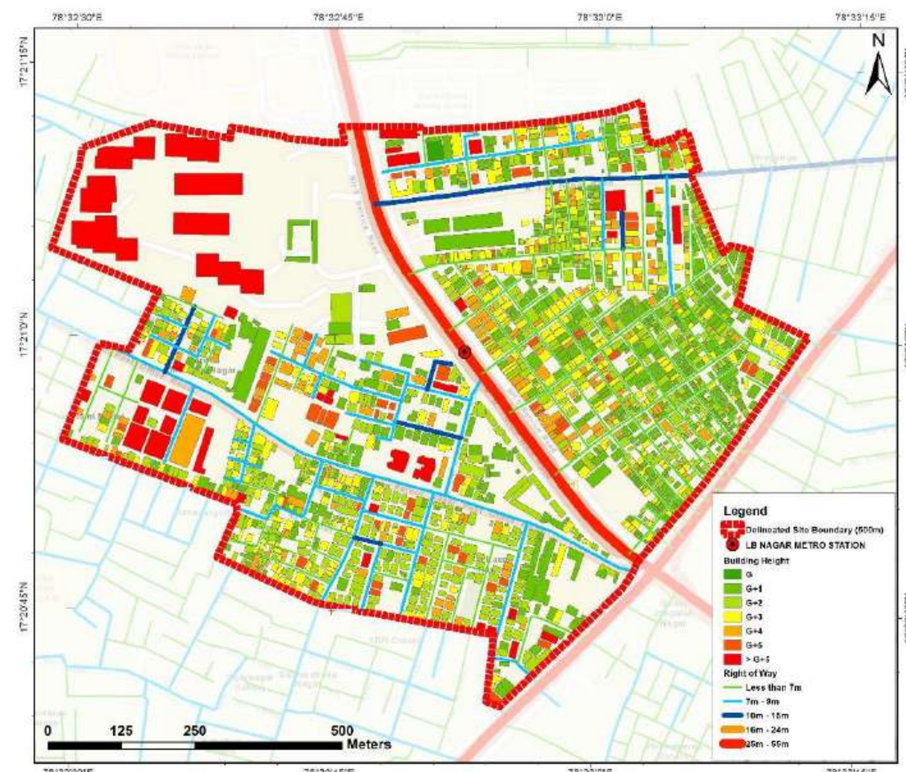


Figure 4-123 The map showing the above G+5 Floor Landuse

Source: Output of the Project Team, SPAV

The analysis of the map reveals a "Horizontal Core with Vertical Spikes" pattern:

Low-Rise Dominance (G to G+1): Over 54% of the building stock consists of Ground or G+1 structures. These are primarily located in the older, organic residential colonies. This horizontal spread indicates an older development fabric that hasn't yet undergone significant redevelopment despite the proximity to the Metro.

Mid-Rise: There is a steady decline in the share of buildings from G+2 at 15% down to G+5 at 4%. These are typically individual developments or small-scale apartment conversions of older plots.

High-Rise (> G+5): Interestingly, 10.92% of buildings exceed five stories. This is a significant jump compared to the G+4 and G+5 categories. Spatially, these are concentrated in specific pockets where large land parcels have been consolidated for high-density residential towers or major commercial/institutional complexes along the NH 65 and Inner Ring Road.

4.2.3 Density

Density analysis examines the concentration of population, built-up area, and development intensity within a defined area. It helps understand how land is utilized and the level of urban compactness. Higher densities near transit nodes support efficient public transport use, improve accessibility, and promote sustainable urban development within the study area.

4.2.3.1 Figure Ground Analysis

The figure-ground map (Figure 4-124) provides a morphological aspect of the LB Nagar study area, illustrating the relationship between "solid" mass (buildings) and "void" spaces (roads and open land). This spatial arrangement defines the texture and permeability of the urban fabric.

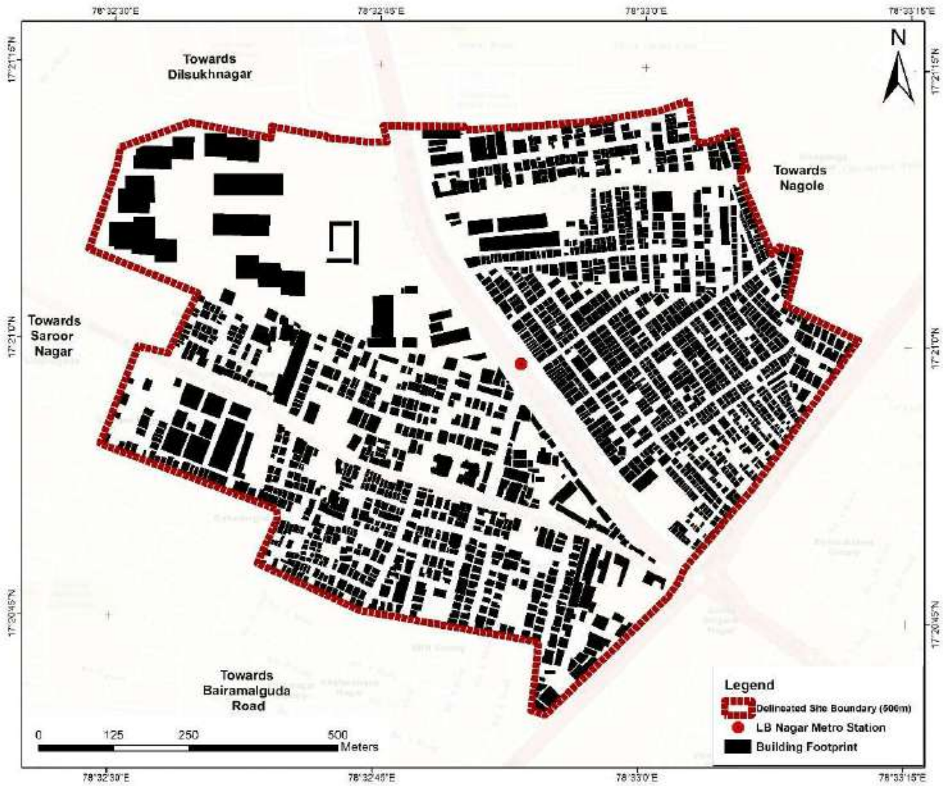


Figure 4-124 The map showing Figure Ground for the LB Nagar study area

Source: Output of the Project Team, SPAV

Table 4-13 The Solids and Voids distribution within the Study Area

Solids & Voids	Area (Ha)	Percentage (%)
Builtup Area	31.47683	38.18%
Road	15.86721	19.25%
Open Area	35.0922	42.57%

The Table 4-13 represented the solids and voids distribution.

Pockets of Fragmentation: Despite being a transit hub, the 42.57% open area indicates significant fragmentation. These are not necessarily formal "green spaces" but include vacant plots, setbacks, and undeveloped land. This suggests that the urban core is not yet fully consolidated into a continuous urban wall.

Solid Mass Concentration: The 38.18% built-up area is densest along the inner residential blocks and the primary commercial corridors. The "solids" appear as tight, clustered grains in the older colonies, contrasting with the larger, standalone footprints of modern high-rises and commercial complexes.

Road Area: The 19.25% road share is relatively healthy for an urban area, but as noted in previous connectivity studies, much of this is comprised of narrow local streets rather than a hierarchy of wide, walkable boulevards.

Low Compactness: In a high-performing TOD, the "voids" should be strategically placed as public plazas or active streets. Currently, the high percentage of open area (42.57%) suggests an "under-built" environment relative to its transit capacity.

Infill Potential: The large amount of non-road open area represents prime opportunities for infill development. Consolidating these voids into planned built-up mass could increase the residential and commercial density within the 500m station radius.

Permeability Issues: The map shows that while roads exist, the "solids" (buildings) often form long, impenetrable blocks. This forces pedestrians to take circuitous routes, reducing the effective accessibility of the Metro station.

4.2.3.2 Existing Land Utilization

The existing land utilization analysis for the LB Nagar study area (Figure 4-125) evaluates the relationship between the current built-up development and the permissible development potential of land parcels. This assessment follows the provisions of G.O.Ms.No.168, where building height and development potential are regulated through two parameters abutting road width and plot area. The final plot utilization values are derived by integrating the permissible limits under both scenarios to understand the overall development capacity of the area.

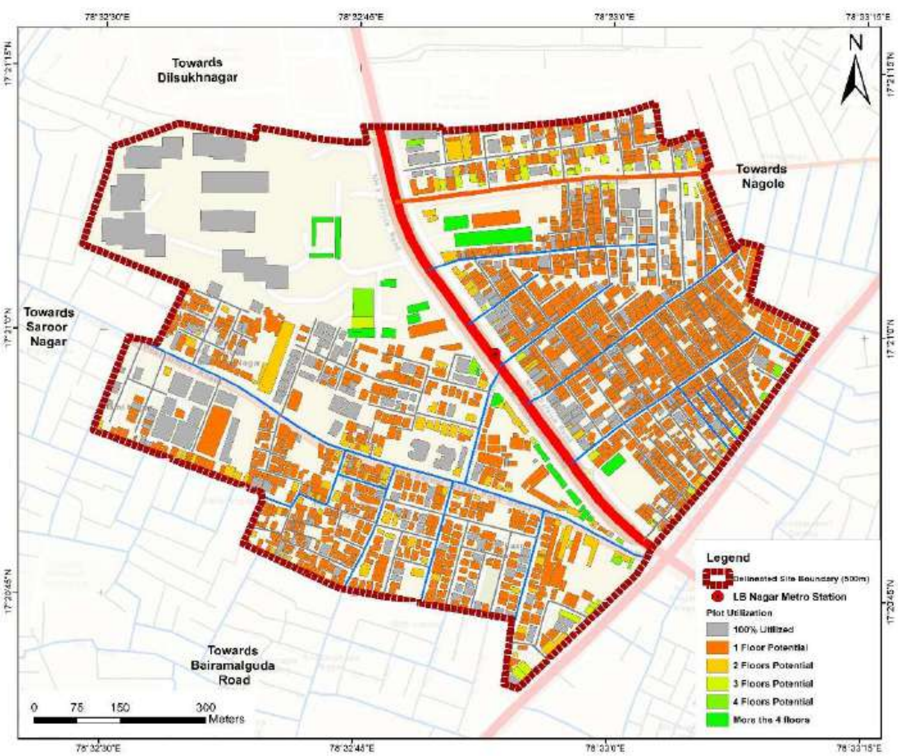


Figure 4-125 The map showing existing Land Utilization for the LB Nagar study area
Source: Output of the Project Team, SPAV

The "Under-Built" Dominance (73%): Nearly three-quarters of the study area has the potential to add at least one more floor. This aligns with the previous Building Height Analysis, which showed a high concentration of Ground and G+1 structures. It confirms that the area is horizontally spread rather than vertically optimized.

100%-Utilized (15%): This segment represents 100% Utilized plots. These are likely older commercial buildings along the NH 65 or dense residential clusters where the built-up area has expanded to the very edge of the property line, leaving zero setbacks. This pattern is common in areas where informal expansion occurred before strict TOD regulations were in place.

Redevelopment Pockets (11% Combined): The plots with 2-floor to 4+ floor potential represents the "Low Hanging Fruit" for urban renewal. These are often larger residential plots or institutional lands that are currently under-utilized. In a TOD context, these are the primary targets for Infill Development.

Vertical Resistance: The sharp drop-off from "1 Floor Potential" (73%) to "2 Floor Potential" (8%) suggests that the current plot sizes in LB Nagar are relatively small. Most plots can accommodate a small vertical extension, but very few have the structural or land-area capacity for massive vertical growth without Plot Amalgamation (joining adjacent plots).

The data highlights a significant mismatch between transit infrastructure and land use. While the Metro provides high-capacity transport, 73% of the land is "under-performing" by at least one floor.

4.2.4 Design

Urban design analysis evaluates the spatial structure, movement patterns, and activity distribution within the study area. It focuses on the relationship between built form and public spaces to understand how effectively the environment supports pedestrian movement, connectivity, and place-making, particularly in enhancing accessibility and livability within the transit influence zone.

4.2.4.1 Pedestrian Permeability of the Urban Fabric

In LB Nagar, the three-dimensional map (Figure 4-126) indicates a mixed condition: while several inner residential streets display a fine-grain structure, the metro corridor and a few larger edge parcels act as strong linear barriers that limit cross-connectivity.

The mapped block lengths suggest that a substantial portion of the internal neighbourhood fabric consists of short to moderate segments in the range of approximately 40-90 m, especially within the eastern residential grid. These shorter intervals generate frequent intersections and improve route choice for pedestrians moving toward the station. At the same time, a second set of segments falls in the 90-150 m range along the principal east-west streets, which continues to support walkability but begins to concentrate movement along fewer corridors.

Low permeability conditions are most visible along the metro edge and around larger consolidated plots, where certain block faces extend well beyond 150 m and in some cases exceed 300 m. These long edges reduce route flexibility, increase detours, and channel pedestrian movement into a small number of entry points and crossings. As a result, the urban fabric is internally permeable in parts, but its connection to the transit corridor is uneven and highly dependent on a few dominant streets.

Figure 4-126 Pedestrian permeability structure of LB Nagar showing principal walking loops and access corridors around the metro station.

Source: Output of the Project Team, SPAV

High Permeability Zones

The eastern neighbourhood block demonstrates the highest degree of permeability because of its compact residential grain, multiple internal cross-streets, and relatively frequent intersections. These areas are more supportive of TOD principles because pedestrians can choose alternate routes and distribute movement across the network rather than relying on a single spine.

- Frequent intersections and shorter block lengths
- Multiple internal route choices within the neighbourhood fabric
- Better adaptability for walking access to the metro station
- Potential for strengthening pedestrian priority streets and shaded local connectors

Moderate Permeability Zones

The central and southern parts of the study area exhibit moderate permeability. Here, block lengths are longer and movement tends to be drawn toward a few structurally important east–west streets that connect back to the station and the arterial network. These streets can accommodate significant pedestrian movement but require public-realm improvement to function as comfortable TOD corridors.

Low Permeability Zones and Barriers

The lowest permeability conditions occur along the metro corridor, around large institutional or consolidated plots, and at edge conditions where the street network does not fully connect across neighbourhoods. These areas create long frontages, reduce crossing opportunities, and interrupt desire lines between the station and surrounding blocks.

- Long block edges along the transit corridor and major parcels
- Limited lateral connections across the metro edge
- Concentration of pedestrian movement at a few strategic access points
- Need for mid-block links, crossing enhancements, and more porous street edges

4.2.4.2 Loop Connectivity Analysis

To understand the functional logic of movement within the station area, loop connectivity was assessed through three representative pedestrian circuits identified on the map (Figure 4-127). These loops reveal how the existing street hierarchy organizes access to the station and how walking distances vary across the catchment.

Figure 4-127 Loop connectivity pattern in LB Nagar showing three principal walking circuits around the metro station.

Source: Output of the Project Team, SPAV

Loop 1 - Western Interface Loop

Loop 1 measures approximately 0.92 km and forms the shortest of the identified circuits. It primarily captures the western interface between the metro corridor and the institutional/commercial edge. Despite its relatively short distance, this loop is influenced by the barrier effect of the transit alignment and relies heavily on a limited set of access points near the station junction.

- Shortest loop, but strongly dependent on station-adjacent crossings
- Connects larger plots and western frontage development to the metro
- Needs safer crossings, clearer pedestrian priority, and active edge treatment

Loop 2 - Central Neighbourhood Loop

Loop 2 is approximately 1.40 km in length and represents the most extensive circuit within the study area. It traverses the inner neighbourhood block to the east of the metro line and reveals how several east–west internal streets collectively provide access back to the central station spine. The greater length of this loop suggests that internal permeability exists, yet directness to transit remains uneven due to long edge conditions and the limited number of strong north–south connectors.

- Largest loop and most representative of the inner residential fabric
- Supported by multiple local streets but constrained by indirect access geometry
- Offers the strongest potential for TOD-oriented street redesign and shaded pedestrian corridors

Loop 3- Eastern Edge Loop

Loop 3 measures approximately 1.08 km and covers the eastern residential edge. This loop performs better than Loop 2 in terms of compactness, as many of the internal block lengths are relatively short. However, it still depends on a small number of key streets for connection to the metro corridor, which means that activity and movement are concentrated along selected junctions rather than evenly spread across the network.

- Moderately efficient residential loop with relatively fine grain blocks
- Good internal circulation but limited direct interface with the transit edge
- Requires targeted node improvement at key approach streets

Integrated Inferences: Network Efficiency

The combined permeability and loop analysis reveals that LB Nagar contains a reasonably walkable internal morphology, particularly within the eastern residential grid, but the overall station-area network remains structurally uneven. The metro corridor serves as the dominant north-south spine but also functions as a physical divider. Consequently, pedestrian movement converges on a limited number of east-west connectors and station-adjacent junctions.

- Fine-grain internal morphology exists, especially within the eastern neighbourhood block
- Permeability toward the metro corridor is weaker than permeability within the neighbourhood itself
- Large edge blocks and infrastructure corridors create detours and concentrate movement
- The future TOD framework should prioritize direct station access, stronger secondary connectors, and a more legible pedestrian network

4.2.4.3 Built-Use and Activity Pattern Analysis

Understanding the distribution of built use within the TOD catchment is essential for evaluating urban vitality, movement demand, and redevelopment potential. The three-dimensional built-use map (Figure 4-128) for LB Nagar reveals a distinct spatial pattern in which the metro corridor and major streets accommodate commercial and mixed-use activity, while the interior fabric remains predominantly residential.

Figure 4-128 Built-use structure of LB Nagar showing residential, commercial, mixed-use, institutional, vacant, and public/semi-public parcels.

Source: Output of the Project Team, SPAV

Residential Dominance in the Inner Neighbourhoods:

The internal block structure is predominantly residential, particularly within the eastern and south-eastern portions of the study area. These neighbourhoods form the everyday commuter base for the metro station and generate recurring walking trips. However, where residential streets lack active frontage or mixed use, street life may become discontinuous outside peak commuting hours, indicating the need for carefully distributed local activity anchors.

Commercial Concentration along Major Corridors:

Commercial activity is concentrated primarily along the metro-facing edge, at key road frontages, and near important intersections. This produces a linear band of high-visibility uses that reinforce the transit spine as the most active urban frontage within the precinct. Such a pattern is typical of emerging TOD environments, where higher footfall and accessibility attract retail, services, and small business uses.

Emerging Mixed-Use Corridors:

Mixed-use parcels appear along selected east–west approach streets and around station-proximate blocks, indicating early signs of transit-supportive transformation. These corridors are particularly important because they can evolve into active pedestrian connectors that combine residential density, small-scale commerce, and ground-floor engagement.

Institutional, Industrial, and Public Uses:

The map also identifies a set of larger institutional/public and industrial parcels, especially near the station-side edge and in a few upper and lower precinct locations. These plots are significant urban structuring elements because they interrupt the finer grain of the surrounding fabric and often create longer blank edges. From an urban design perspective, such sites should be treated as opportunities for edge activation, internal permeability, and future land-use transition where appropriate.

Open Spaces and Vacant Parcels:

Open space within the immediate catchment appears limited and fragmented. A small number of vacant parcels and residual open lands are visible within the eastern side of the study area. These locations are important because they offer opportunities for future TOD-supportive infill, local green pockets, public plazas, or community facilities that can enhance both walkability and place quality.

4.2.4.4 Building Condition

The building condition assessment of the LB Nagar study area (Figure 4-129) provides a critical baseline for urban renewal and intensification. The data reveals a fabric that is largely aging but stable, with a significant surge in new development.

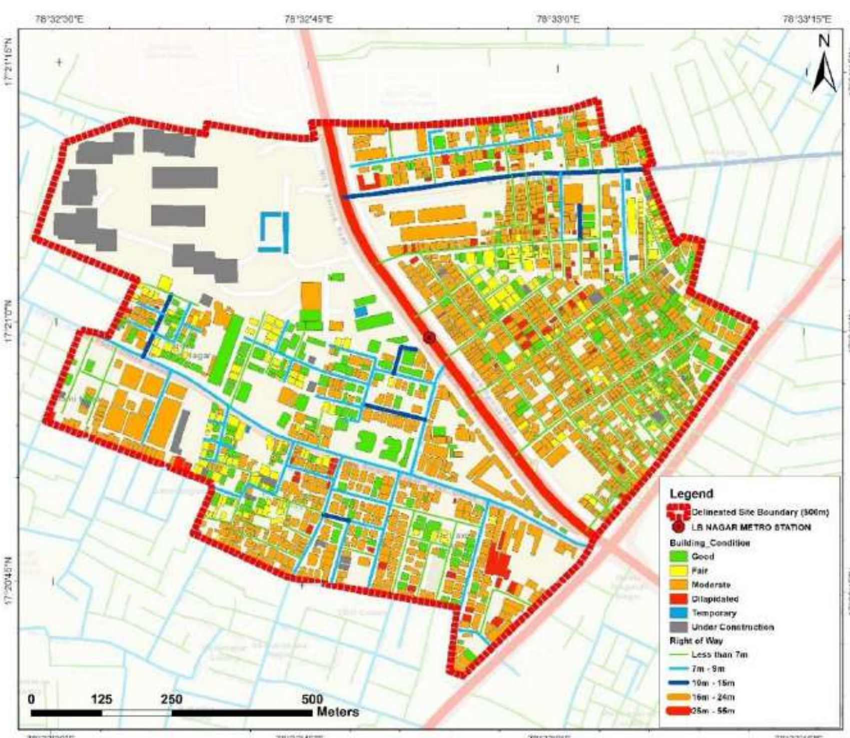


Figure 4-129 The map showing the building condition
Source: Output of the Project Team, SPAV

The analysis of the condition map reveals a "Core-Periphery Transition" pattern:

Dominance of "Moderate" Stock: Nearly 59% of the buildings are classified as "Moderate." These are typically older R.C.C. structures (15–30 years old) that form the bulk of the residential colonies. While functional, they represent the segment most likely to undergo redevelopment as land values rise due to Metro proximity.

The "Good" & "Under Construction": Combined, these account for over 28% of the area. Spatially, these are concentrated along the NH 65 and Inner Ring Road arterials. This pattern highlights a clear "TOD effect," where the presence of the Metro is triggering the replacement of older structures with high-quality, modern commercial and residential blocks.

Decay and Temporary Structures: Only a small fraction (~4.2%) is dilapidated or temporary. These are scattered in organic clusters, often in the oldest parts of the settlement where narrow road widths make redevelopment logistically challenging.

4.2.4.5 Hierarchy of Junction

The junction hierarchy analysis categorizes key intersections based on their strategic importance and operational performance. The scoring system evaluates factors such as road hierarchy, Metro proximity, connectivity, and urban design.

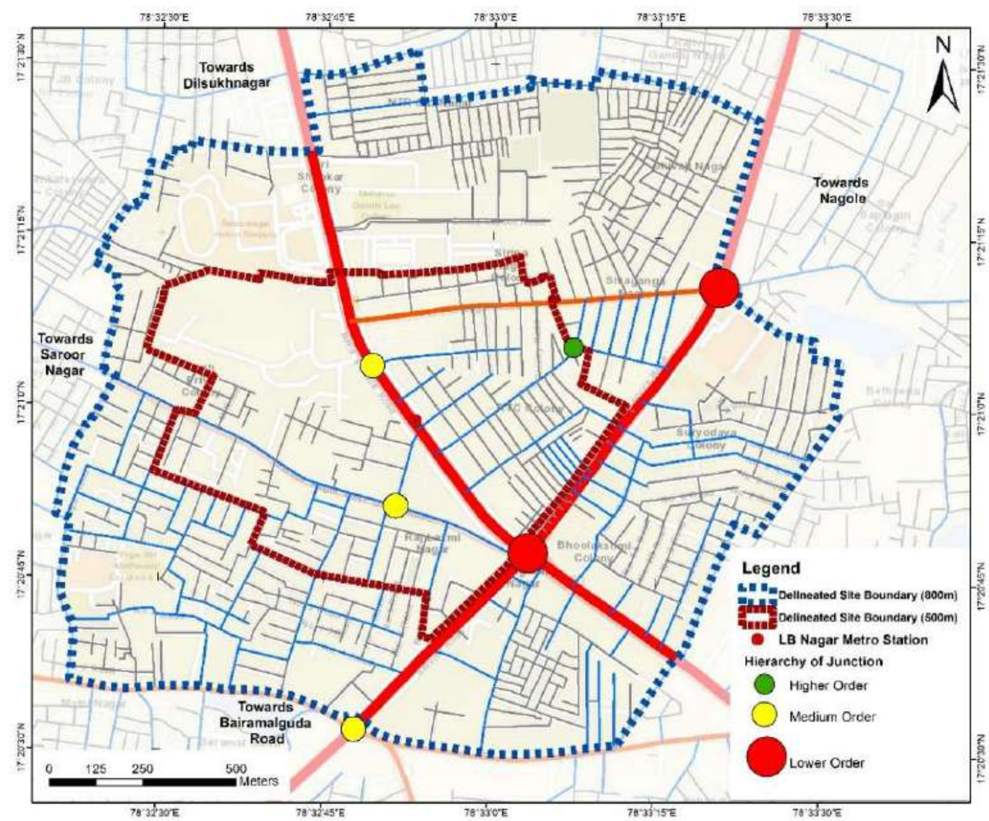


Figure 4-130 The map showing Hierarchy of Junction for the LB Nagar study area

Source: Output of the Project Team, SPAV

The Figure 4-130 represents the junction hierarchy and the Table 4-14 illustrates the analysis carried out.

Table 4-14 Hierarchy of Junction for the LB Nagar study area

Junction	LB Nagar Junction		Bairamguda Junction		Kamineni Junction		Metro Junction		Saroor Nagar Junction		RTC colony junction	
Road Hierarchy (Score)	NH+Arterial road	5	Arterial roads + sub-arterial roads	4	Arterial roads + sub-arterial roads	4	NH+Collector	4	Collector + Collector road	3	Collector + Collector road	3
PT Proximity (Score)	500m to Metro	3	1km to Metro	2	1km to Metro	2	200m to Metro	3	250m to Metro	3	500m to Metro	3
Junction Type (Score)	4-arm unsignalised	5	4-arm unsignalised	4	4-arm signalised	5	3-arm unsignalised	3	4-arm unsignalised	4	5-arm unsignalised	3
Connectivity (Score)	Major City Node	5	Major City Node	5	Major City Node	5	Medium Corridor linkage	4	Medium Neighbourhood linkage	3	Medium internal linkage	3
Land Use Activity (Score)	High intensity commercial	5	High intensity commercial	5	High intensity commercial	5	Moderate commercial	3	Moderate mixed use	3	High residential	2
Vehicle LOS (Grade – Value)	E	2	F	1	B	5			F	1		
Urban Design (Score)	No signals no walkways Highly active	3	No signals no walkways medium active	2	Signaled no walkways Highly active	4	No signals No walkways Low active	1	No signals No walkways Medium active	2	No signals No walkways No activity	0
Final Score	**28**		**23**		**30**		**18**		**19**		**14**	
Hierarchy Category	Higher order junction		Higher order junction		Higher order junction		Medium order junction		Medium order junction		Lower order junction	

The Signalization Advantage: Kamineni Junction is the only signalized intersection in the study. Despite its 1km distance from the Metro, it achieves the highest score (30) and the best Vehicle LOS (Grade B). This underscores that signalization is the primary driver of junction efficiency in the area, regardless of road hierarchy.

The "Core" Bottleneck (LB Nagar Junction): As the primary node connecting the National Highway and the Metro (500m), LB Nagar Junction is functionally "overloaded." With an un-signalized 4-arm configuration, it operates at LOS E. This creates a chaotic environment where high-intensity commercial activity competes with heavy transit volumes.

Severe Local Congestion: Bairamguda and Saroor Nagar junctions both suffer from LOS F. Bairamguda is a victim of its "Major City Node" status without having the controlled infrastructure (signals/walkways) to manage its volume. Saroor Nagar, being a neighborhood linkage, lacks the capacity to handle merging traffic from collector roads.

The Urban Design Deficit: There is a recurring pattern of "No signals, no walkways" across almost all junctions. Urban Design scores are remarkably low (0–4), indicating that these nodes are treated strictly as vehicular conduits rather than pedestrian-friendly urban spaces.

The 5-Arm Complexity: RTC Colony Junction is geometrically complex (5-arm) but scores the lowest (14). Because it is located in a residential zone with low activity, it has been neglected in terms of urban design (Score 0), which can lead to safety risks for local commuters.

4.2.4.6 Node Hierarchy and Activity Structure

Urban nodes represent points of convergence where movement, visibility, access, and activity overlap. In LB Nagar, the node hierarchy is strongly shaped by the metro station spine, the principal east–west connectors, and the distribution of commercial frontages. Based on the combined map, the study area may be interpreted as comprising a hierarchy of primary and secondary nodes that structure everyday pedestrian movement and urban intensity (Figure 4-131).

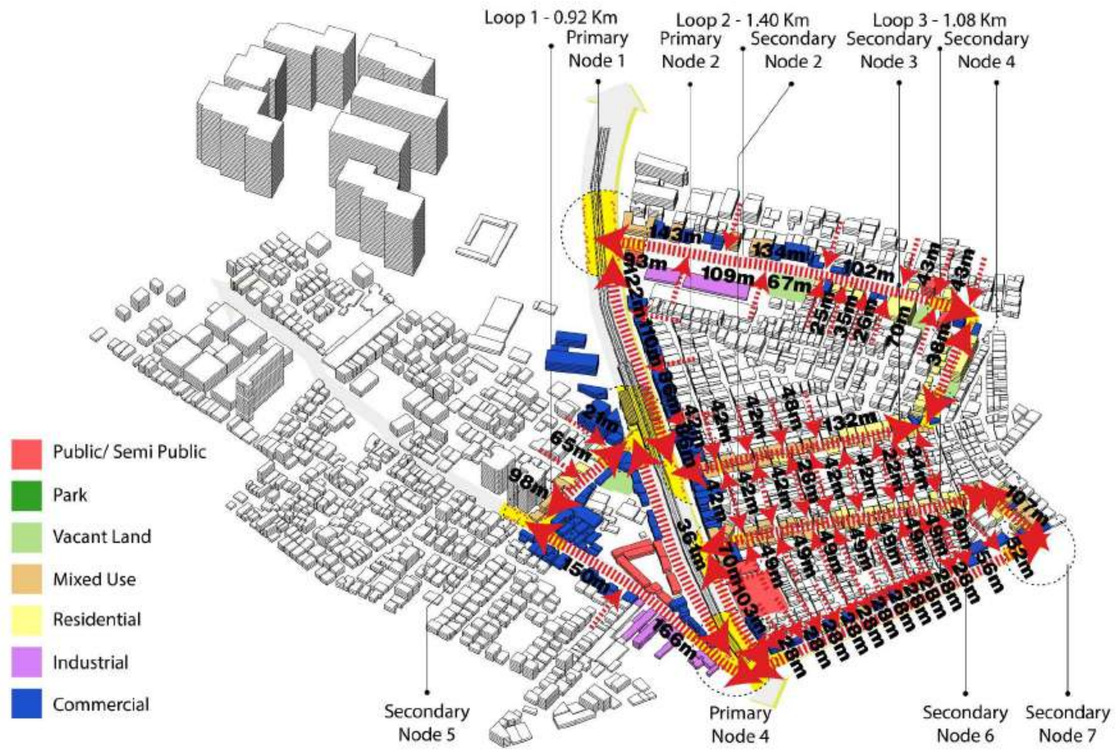


Figure 4-131 Combined movement and node structure of LB Nagar indicating block lengths, major loops, and primary and secondary nodes.

Source: Output of the Project Team, SPAV

Primary Nodes:

The principal metro station junction functions as the dominant primary node because it concentrates interchange activity, pedestrian crossings, and access from multiple directions. In addition, the map suggests two other primary nodes associated with major approach streets and high-visibility commercial frontages, one toward the northern edge and another toward the southern station approach. These locations operate as the strongest urban anchors within the precinct.

- Primary Node 1: metro-station-side convergence point and main interchange focus
- Primary Node 2: northern approach node linked to a major east–west connector
- Primary Node 4: southern approach node associated with station access and corridor transition

Secondary Nodes:

A finer network of secondary nodes is distributed across the eastern neighbourhood and peripheral edges. These nodes typically occur where local streets intersect the main movement corridors or where commercial and mixed-use activity begins to cluster. Although smaller in scale, they are essential for diffusing activity away from the principal junction and for supporting neighbourhood-level wayfinding, vending, and everyday gathering.

- Secondary nodes emerge along the upper east–west corridor and eastern edge streets
- Additional nodes occur near western and south-eastern approach points
- These locations have potential to evolve into micro-centres through junction redesign, frontage activation, and shaded public-realm interventions

Intersection-Based Movement Concentration

The node map confirms that pedestrian movement is not evenly distributed across the whole precinct. Instead, it is channelled into a sequence of high-intensity intersections located along the principal connectors leading to the station. These intersections are especially important because they combine crossing demand, local commerce, transit access, and informal activity. Without design intervention, however, they risk becoming traffic-dominated rather than people-oriented urban places.

Inferences

- LB Nagar exhibits a strong linear transit spine with a secondary network of east–west access streets
- Commercial and mixed-use activities reinforce the importance of major connectors and nodal intersections
- The eastern residential grid has the capacity to support a highly walkable TOD neighbourhood if strengthened with safer crossings and better public realm
- Large edge parcels, long frontages, and limited open spaces should be strategically addressed through redevelopment controls and green-network planning
- The identified hierarchy of primary and secondary nodes provides a clear framework for future street redesign, junction improvement, and place-making interventions
- Street Structure and Urban Design Implications

From an urban design perspective, the street structure of LB Nagar can be understood as a three-part system: a dominant north south transit spine, a set of critical east–west connectors linking the neighbourhood to the metro, and a finer internal residential grid that distributes movement within the catchment. This layered structure is fundamentally supportive of TOD, but it requires rebalancing in favour of pedestrians.

- The transit spine should function as a highly legible multimodal corridor with safe crossings and active frontages
- The east–west connectors should be redesigned as shaded access streets that prioritize walking, cycling, and local commerce
- The internal residential grid should be retained and strengthened through traffic calming, improved footpaths, and better node definition
- Future proposals should use the node hierarchy to guide junction upgrading, frontage activation, green-network insertion, and selective redevelopment

4.2.5 Parking Management

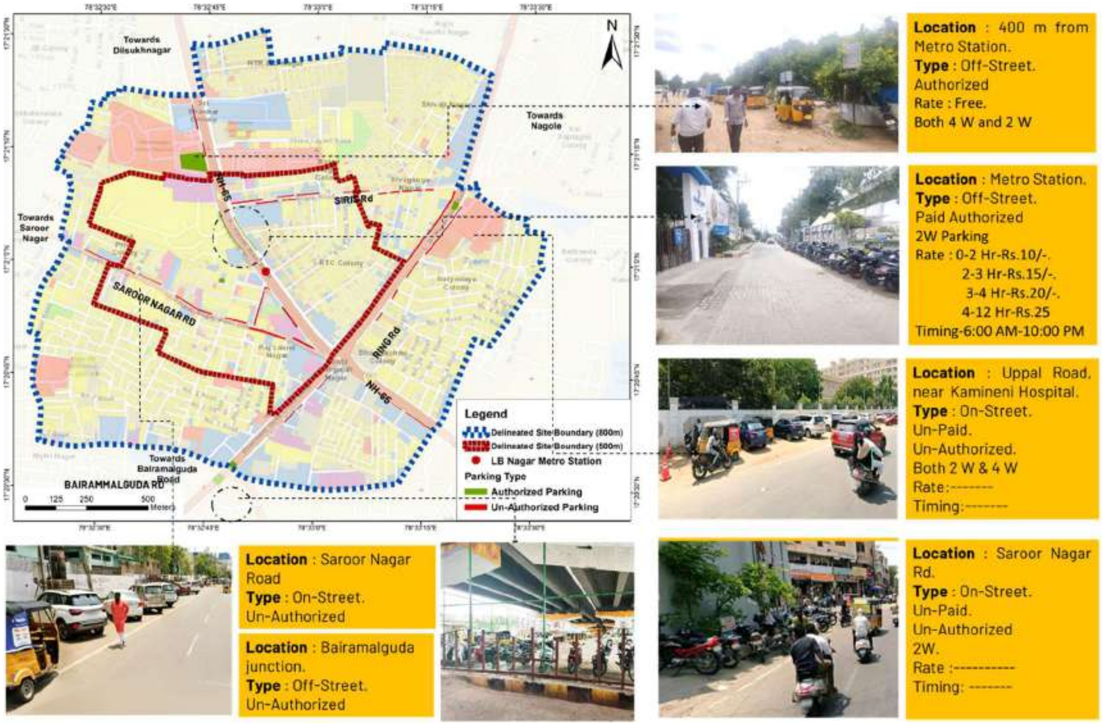


Figure 4-132 The Keymap Showing the existing Parking Management

Source: Output of the Project Team, SPAV

4.2.5.1.1 SIRIS Road

Figure 4-133 The Keymap Showing the SIRIS Road Parking condition

Image Credit: Project Team, SPAV

The parking demand assessment for Siris Road was conducted using a 100 m buffer from the center of the carriageway to understand the intensity of on-street parking along the corridor (Figure 4-133). The analysis indicates a total parking demand of approximately 504 ECS, which reflects a relatively high requirement for parking space within the corridor. However, the corridor currently has no designated parking supply, resulting in vehicles occupying the carriageway edges and reducing the effective road width available for traffic movement

Table 4-15 SIRIS Road Parking Status

Vehicle Type	Numbers	Demand ECS
Two-wheeler	1094	262.2
Auto-rickshaw	85	42.6
Car (4-wheeler)	199	199.2
LCV	48	72
HCV	8	25.2
Bus / Truck	1	2.4
Total	1391	**504** (2W,3W, 4W)

In terms of vehicle composition (Table 4-15), two-wheelers form the largest share, with 1,094 vehicles accounting for 262.2 ECS, followed by cars (199 vehicles) contributing 199.2 ECS. Other vehicle types include auto-rickshaws (42.6 ECS), light commercial vehicles (72 ECS), heavy commercial vehicles (25.2 ECS), and buses or trucks (2.4 ECS). Overall, a total of 1,391 vehicles were observed within the buffer area. The absence of formal parking facilities combined with the high parking demand contributes to roadside encroachment, which affects the available carriageway space and overall traffic movement along Siris Road.

4.2.5.1.2 Saroornagar Road

On-Street Parking:

- Un-Authorized.
- 2 W Parking.
- Commercial & Mixed Use.

Figure 4-134 The Keymap Showing the Saroornagar Road Parking condition

Image Credit: Project Team, SPAV

The parking demand assessment for Saroornagar Road was carried out using a 100 m buffer from the center of the carriageway to evaluate the extent of on-street parking along the corridor (Figure 4-134). The analysis shows a total parking demand of approximately 199 ECS, indicating a considerable requirement for parking within the stretch. However, the corridor currently has no designated parking supply, which results in vehicles occupying the road edges and reducing the effective carriageway width.

Table 4-16 Saroornagar Road Parking Status

Vehicle Type	Numbers	Demand ECS
Two-wheeler	226	56
Auto-rickshaw	121	61
Car (4-wheeler)	82	82
LCV	79	199
HCV	5	14
Bus / Truck	1	2
Total	514	**199** (2W,3W,4W)

In terms of vehicle composition (Table 4-16), cars contribute the largest share with 82 ECS, followed by light commercial vehicles (LCVs) contributing around 199 ECS, while two-wheelers account for 56 ECS and auto-rickshaws for 61 ECS. Smaller shares are contributed by heavy commercial vehicles and buses/trucks. In total, 514 vehicles were observed within the buffer area. The absence of organized parking facilities, combined with the presence of roadside vendors particularly during the evening hours further intensifies parking pressure and reduces the effective capacity of the carriageway.

4.2.5.1.3 Metro Corridor NH65

Figure 4-135 The Keymap Showing the Metro Corridor Road Parking condition

Image Credit: Project Team, SPAV

The parking assessment for the Metro Corridor (NH 65), conducted within a 100m buffer from the center of the carriageway, reveals a critical shortfall in infrastructure (Figure 4-135). This deficit directly impacts the corridor's flow, as insufficient supply often leads to spillover and informal parking on the main travel lanes.

Parking Demand vs. Supply Analysis

The study quantifies the gap using Equivalent Car Space (ECS) to standardize different vehicle types which is tabulated in the Table 4-17:

Table 4-17 Metro Corridor Road Parking Demand and Supply Results

Vehicle Types	Numbers	Demand (ECS)	Supply (ECS)	Gap
Two-wheeler	1670	417.3	348 of On-Street Parking	69.4
Auto-rickshaw	241	120.6		
Car (4-wheeler)	197	197		
LCV	112	211	312 of Off-Street Parking	5.6
HCV	9	32.6		
Bus / Truck	0	0		
Total	**2229**	**735 (2W,3W,4W)**	**660**	**75**

Source: Output of the Project Team, SPAV

The Two-Wheeler Crisis: With 1,670 units, two-wheelers represent the highest volume of parking demand. The current on-street supply (348 ECS) is significantly inadequate, leaving a gap of 69.4 ECS. This suggests that nearly 17% of two-wheeler users are likely parking in unauthorized areas, hindering pedestrian movement.

Service and Freight Friction: The demand from LCVs and HCVs (243.6 ECS) is nearly met by the off-street supply (312 ECS). However, the small gap of 5.6 ECS indicates that during peak hours, commercial loading/unloading likely overflows onto the service roads.

Auto-Rickshaw Integration: There is a specific demand of 120.6 ECS for auto-rickshaws. Given their role as a primary "last-mile" feeder for the Metro, the lack of dedicated, regulated "Auto-Stands" within the supply mix is a major contributor to the chaos observed at junction points.

On-Street Dependency: The corridor relies heavily on on-street parking for smaller vehicles. This reduces the effective width of the service roads and contributes to the low average speeds (22 kmph) previously noted in the speed and delay analysis.

Station Pressure: The 735 ECS demand is concentrated around the Metro station entrances and major commercial showrooms. The "Supply Gap" of 75 ECS is most acute at these "high-pressure" nodes.

4.2.5.1.4 Inner Ring Road

Figure 4-136 The Keymap Showing the Inner Ring Road

Source: Output of the Project Team, SPAV

Off-Street Parking:
*Authorized.
*4W Parking.
*Free Parking.

On-Street Parking:
*Un-Authorized.
*4W Parking.
*Free Parking.

Figure 4-137 The Keymap Showing the Inner Ring Road Parking condition

Image Credit: Project Team, SPAV

The parking analysis for the Inner Ring Road segment (within a 100m buffer) reveals a critical infrastructure failure (Figure 4-136). Unlike other corridors where some supply exists, this stretch operates with zero formal parking supply, creating a high-stress environment for both through-traffic and local visitors.

Parking Demand Analysis

Table 4-18 The demand is calculated based on vehicle volume converted to Equivalent Car Space (ECS):

Vehicle Type	Numbers	Demand (ECS)
Two-wheeler	800	200
Auto-rickshaw	301	186
Car (4-wheeler)	590	590
LCV	46	69
HCV	2	5
Bus / Truck	7	22
Total	1746	977 (2W,3W,4W)

The Zero-Supply Crisis: With a Supply = 0, 100% of the parking demand (977–1,072 ECS) as illustrated in the Table 4-18 is forced onto the existing carriageway or onto the unpaved shoulders. This effectively "steals" at least one full lane of traffic, explaining the significant delays noted in the speed analysis.

Institutional Pressure (Kamineni Hospital): A primary driver of this demand is the proximity to Kamineni Hospital. Medical facilities generate high "short-stay" parking demand (ambulances, visitors, and staff). Without an off-street facility, these vehicles choke the hospital approach and the main junction.

Commercial Overspill: The high number of Cars (590) and Two-wheelers (800) indicates that customers of the commercial establishments along the Inner Ring Road have no choice but to park on the street, creating a "constricted throat" effect near the Kamineni Junction.

High IPT (Auto) Volume: 301 auto-rickshaws (186 ECS) are competing for space. These vehicles often cluster near the hospital entrance and the junction to pick up passengers, further reducing the road's effective width.

5. FINDINGS AND DISCUSSION

5.1 SR Nagar

The analysis of SR Nagar reveals it is a dense and predominantly residential urban fabric with significant pressure on its transportation network and land utilization patterns. With 89% of the road network classifies as local roads and 81% of the total network consisting of ROW less than 9m, the area lacks an efficient arterial/ sub arterial road force the internal streets to handle traffic and highlights an imbalanced road hierarchy and a shortage of secondary corridors necessary for effective traffic distribution. As a result, major corridors such as NH-65 and SR Nagar Main Road experience significant traffic pressure, further aggravated by fluctuating traffic speeds, bottlenecks, and on-street parking despite the presence of some off-street parking facilities.

Connectivity analysis further indicates that despite the presence of a dense local street network, the area demonstrates low connectivity indices indicating a lack of alternative routes. Large urban blocks with low intersection density and the presence of dead-end streets reduce permeability and accessibility, especially within the internal residential areas. This condition is further reflected in the uneven pedestrian infrastructure, where continuous and adequate footpaths are mainly restricted to the arterial corridor and institutional zones, while most collector and local roads lack proper pedestrian facilities. This forces pedestrians to share carriageways with vehicles, creating safety concerns and disrupting traffic flow.

The land use pattern shows a strong dominance of residential use (48%) supported by institutional (31%) and limited commercial (8%) and mixed-use (9%) development, with economic activities largely concentrated along major road corridors and near the metro station. This linear pattern of commercial growth indicates transit influence but also reflects weak integration of mixed-use development within interior residential areas. The figure-ground analysis reinforces this observation by showing highly compact built-up areas with minimal open spaces (2%) and fragmented voids that function more as residual spaces rather than planned public areas, highlighting a lack of recreational infrastructure and community spaces. The building typology shows a predominance of mid-rise structures (G+2 to G+5) with increasing vertical growth along transit corridors, indicating high land value and development pressure. SR Nagar is likely to have a higher proportion of stressed plots due to commercial conversions and rental demand. At the same time, small and irregular plot sizes create vertical expansion constraints due to regulatory requirements, limiting redevelopment potential despite high demand.

The arterial NH-65 and the metro corridor act as the primary mobility spine, but they suffer from severe speed and delay fluctuations and bottleneck zones, confirming that transit infrastructure is currently overwhelmed by private vehicle demand. The hierarchy of junctions further becomes critical in this context because high plot utilization combined with limited road capacity can increase pressure on key intersections.

The neighbourhood has reached a critical stage of densification where almost all plots are built to their maximum potential. There is a visible concentration of high-density activity and parking demand. While transit is meant to reduce car use, the current lack of last-mile connectivity forces residents to use private vehicles to reach the station, effectively turning the transit hubs into congestion magnets

5.2 LB Nagar

The comprehensive analysis of the LB Nagar Metro station influence area reveals several critical insights related to mobility performance, land utilization patterns, urban form, and parking management. The findings collectively indicate that although the area functions as a major transit node within the metropolitan road network, the surrounding urban structure has not yet fully evolved to support efficient Transit-Oriented Development (TOD).

One of the key findings from the road hierarchy analysis is the dominance of local streets within the network. Approximately 61% of the road network consists of local streets, while arterial and sub-arterial roads account for a relatively smaller share. While this indicates a fine-grained residential street network, it also implies that the last-mile accessibility to the metro station largely depends on narrow neighborhood roads which often lack adequate pedestrian infrastructure. The Right of Way analysis further reinforces this condition, showing that a significant portion of the road network has widths below 9 meters, which limits the capacity to accommodate multimodal infrastructure such as pedestrian pathways, cycle tracks, and organized parking.

The Level of Service (LOS) analysis highlights significant congestion issues within the study area. While Siris Road performs relatively better with LOS C (Indo-HCM) and LOS B (IRC), indicating moderate traffic conditions, major intersections such as LB Nagar Junction, Saroornagar Road, and Bairamguda Junction experience severe congestion during peak hours. The volume-to-capacity (V/C) ratios in these locations frequently exceed 1.0, indicating that traffic demand surpasses the designed road capacity. In particular, Bairamguda Junction exhibits extremely high congestion levels, with V/C ratios reaching up to 4.24 under Indo-HCM and 4.72 under IRC standards, reflecting severe operational inefficiencies. These conditions indicate that key intersections are functioning beyond their carrying capacity, resulting in longer delays, reduced travel speeds, and unstable traffic flow conditions.

The speed and delay analysis further confirms the operational stress on the road network. Average travel speeds within the study area range between 11 km/h and 22 km/h, which is significantly lower than desirable urban travel speeds. The congestion index ranges from 0.08 to 0.15, indicating that commuters experience travel time losses of approximately 8–15% due to delays caused by intersection conflicts, roadside activities, and irregular traffic flow. These conditions highlight the need for improved junction management, traffic regulation, and street design improvements.

From a spatial development perspective, the figure–ground analysis reveals that only about 38.18% of the area is built-up, while 42.57% consists of open or underutilized spaces and 19.25% is occupied by roads. This pattern indicates a relatively low level of urban compactness despite the presence of high-capacity metro infrastructure. In TOD planning principles, areas surrounding transit stations are expected to exhibit higher densities and compact urban form. However, the LB Nagar station area currently demonstrates fragmented development patterns with large vacant parcels and discontinuous building clusters. This suggests significant potential for infill development and land consolidation in the future.

The analysis of existing land utilization further strengthens this observation. Nearly 73% of the plots within the study area are identified as under-built, meaning they have the potential to add at least one additional floor within the permissible development regulations. This indicates that the current built-up intensity does not fully utilize the development potential permitted under planning regulations such as G.O.Ms.No.168. Only about 15% of plots are considered over-utilized, primarily located along major commercial corridors where development has reached the maximum permissible limits. The presence of approximately 11% redevelopment potential plots also suggests opportunities for strategic densification and redevelopment in the future.

The building height analysis also reflects a predominantly low-rise development pattern, where more than half of the building stock consists of ground or G+1 structures. Although high-rise buildings exceeding five floors account for approximately 10.92% of the built form, these are generally concentrated along major corridors such as NH-65 and the Inner Ring Road. This spatial distribution indicates a gradual vertical transition from low-density residential colonies to high-density transit corridors. However, the current pattern still reflects a horizontally spread urban form rather than a vertically optimized TOD environment.

The existing land use pattern also reveals a residential dominance within the station influence area, with residential use accounting for more than half of the land. Commercial activities are primarily concentrated along major transportation corridors such as NH-65 and the Inner Ring Road, forming linear ribbon development patterns. Public and semi-public uses act as institutional anchors within the urban fabric, while approximately 8.71% of the land remains vacant. These vacant parcels represent a significant opportunity for future transit-supportive development, particularly mixed-use and higher-density residential projects within walking distance of the metro station.

Another critical issue identified in the study area is the significant parking imbalance within the metro influence zone. The parking demand analysis conducted for the 0–800 m influence area indicates a total parking demand of approximately 2415 ECS, while the available supply remains extremely limited. Within the Core Zone (0–300 m), the parking supply covers only 14.40% of the total demand, while the Intermediate Zone (300–500 m) meets only 13% of the required parking demand. The Outer Zone (500–800 m) shows negligible organized parking supply (Table 5-1). This severe mismatch between parking demand and supply results in widespread on-street parking, which reduces the effective carriageway width and contributes to traffic congestion along key corridors. The findings highlight the urgent need for structured parking management strategies within the station influence area. Interventions such as multilevel off-street parking facilities, stricter enforcement of on-street parking regulations, and shared parking strategies across commercial and institutional uses can help address the current parking deficit while improving overall traffic circulation and street functionality.

Table 5-1 Overall Influential zone Parking Demand and Supply

Zones	Total Demand (ECS)	Supply (ECS)	Coverage (Supply)
Core Zone (0-300 m)	2415	348	14.40 %
Intermediate (300-500 m)		312	13 %
Outer Zone: 500-800 m		-	--

Another important finding relates to the urban design quality of junctions and streets. The analysis highlights that most junctions lack proper signalization, pedestrian crossings, and walkable infrastructure. Urban design scores across the junction hierarchy remain very low, often ranging between 0 and 4. This indicates that the street environment is primarily designed for vehicular movement rather than pedestrian accessibility. Given the proximity to the metro station, the lack of pedestrian-friendly infrastructure significantly affects last-mile connectivity and discourages transit-oriented mobility behavior.

Overall, the findings (Table 5-2) reveal a strong contrast between the presence of high-capacity transit infrastructure and the relatively under-optimized urban structure surrounding the LB Nagar Metro station. While the area functions as an important mobility hub within the city, the current land utilization patterns, low-density development, limited pedestrian infrastructure, and inadequate parking management prevent the area from fully realizing the benefits of Transit-Oriented Development. Addressing these structural gaps will be essential to transform the station influence area into a more compact, accessible, and transit-supportive urban environment.

Table 5-2 Station-wise Key Findings

TOD Principle	SR Nagar	LB Nagar
Access	High metro accessibility within 0–500 m zone; majority of trips are walk-based. Street connectivity indices indicate relatively better access (higher node-link ratio). However, last-mile gaps exist beyond 500 m.	Strong corridor-level access but weak internal accessibility. Outer zone (500–800 m) shows reduced connectivity. Heavy dependence on arterial roads reduces effective access coverage.
Diversity	Approx. 60–70% residential dominance, with commercial uses concentrated along main roads. Limited mixed-use penetration inside blocks reduces TOD efficiency.	Higher commercial concentration along metro corridor (~30–40% corridor activity mix), but interior areas remain mono-functional (~70% residential), indicating poor land-use integration.
Density	Moderately high and compact density supports transit usage; relatively uniform distribution across buffer. Scope for vertical densification remains underutilized.	High density in core (0–300 m), but sharp decline toward outer zone. Uneven density distribution leads to inefficient TOD utilization despite high demand potential.
Design	Smaller block sizes and relatively permeable street network improve walkability. However, irregular layouts and lack of planned pedestrian infrastructure reduce design efficiency.	Larger blocks and discontinuous street patterns reduce permeability. Poor pedestrian infrastructure (missing footpaths, unsafe crossings) significantly impacts TOD-supportive design.
Parking Management	Moderate parking stress; on-street parking is observed but manageable due to smaller blocks and distributed activity.	Severe parking imbalance: Total Demand = 2415 ECS, but very low coverage (Core: 14.40%, Intermediate: 13%). Overall supply (660 ECS earlier estimate) is far below demand, indicating critical shortage and need for structured parking solutions.

6. WAY FORWARD

In both study areas, the evidence indicates that the metro station has already generated significant movement intensity and development pressure; however, this potential is presently constrained by discontinuous pedestrian infrastructure, unmanaged junction conditions, on-street parking, informal encroachments, and fragmented public-space systems. The next stage should move from diagnostic analysis toward a more clearly articulated **planning and design framework**. The proposed direction should not be understood merely as a set of isolated transport or engineering interventions, but as an integrated strategy for restructuring the station influence area through improvements in public realm quality, multimodal accessibility, street hierarchy, and development form.

Street redesign as the primary structuring strategy:

The principal way forward should therefore be a **street-led urban design approach**, wherein streets are treated not only as movement corridors but also as the primary public spaces through which TOD objectives are spatially realized. In SR Nagar, the urban structure demonstrates relatively smaller block sizes and a finer grain, which inherently support walkability, route choice, and local accessibility. The study further indicates that nearly **45% of roads have a right-of-way below 6 m**, while approximately **42% fall within the 7–10 m category**, suggesting a predominantly local-street network but also revealing a substantial proportion of streets that may be redesigned to accommodate improved pedestrian and cycle movement. At the same time, the road hierarchy is dominated by local roads, and the footpath system remains incomplete, indicating that mobility improvement must focus on continuity, safety, and legibility rather than road widening alone.

In this context, the SR Nagar proposal should emphasize the formation of a **continuous pedestrian and cycle-supportive street network** that links the metro station with educational institutions, healthcare facilities, neighbourhood clusters, and key junctions such as Balkampet, Vengal Rao Nagar, Madhura Nagar, and Satyam Theatre Road. The proposed redesign of major corridors such as SR Nagar Main Road, Balkampet Road, and Madhura Nagar Road can be positioned as demonstrative corridors where footpaths, cycle tracks, planted buffers, median treatments, safe crossings, and universal accessibility measures work together to create a safer and more climate-responsive public realm.

A similar but more corrective approach is required in LB Nagar. The study area is characterized by a dense residential and mixed-use fabric, but its internal circulation structure is weaker and more fragmented. The presentation identifies poor pedestrian infrastructure, low public-realm quality, and multiple conflicts involving transit access, informal activity, and vehicular movement. Siris Road, in particular, emerges as a strategic corridor because of its connection to NH-65 and LB Nagar Metro, its mixed-use development character, and its institutional frontage. With an existing ROW of approximately **22–24 m** and a proposed ROW of **30 m**, it presents a viable opportunity for integrated street redesign.

Junction improvement as a catalyst for TOD urbanity:

The second major direction should be **junction improvement**, not only from the perspective of traffic efficiency but also as a means of producing identifiable urban nodes within the TOD influence zone. Study has revealed that key intersections currently function as points of congestion, conflict, and spatial disorder. In SR Nagar, the proposed junction hierarchy already identifies high-order nodes such as Ameerpet Junction, SR Nagar Junction, Balkampet Junction, and Vengal Rao Nagar Junction, where relocation of bus stops, pedestrian safety upgrades, encroachment clearance, traffic management, and redesigned junction geometry are expected to improve both pedestrian LOS and vehicular LOS.

Public spaces remain essential to the vitality of the public realm, as there is increasing recognition that even though modern societies no longer depend on traditional town squares or piazzas for daily activities, well-designed public environments are still crucial for the social and psychological well-being of communities. The strategies and design-based solution will be given based on Public Space Index calculated for relevant junctions including key factors such as inclusiveness, enjoyment, activity, comfort, and safety providing a data-driven understanding of existing conditions and forming a foundation for proposing appropriate, context-sensitive improvements.

These junctions should be conceptualized as **mobility-and-place nodes**. This means that future proposals should demonstrate how the redesign of intersections can simultaneously resolve traffic conflicts and create stronger urban identity. Such nodes could then anchor public plazas, shaded waiting spaces, vending courts, and small urban forecourts, thereby strengthening both place value and investment attractiveness.

Urban greenery as a spatial and climatic framework:

A third critical direction concerns **urban greenery**, which should be framed not as an aesthetic supplement but as a functional and structural component of the LAP-TOD proposal. The future proposal should therefore establish a **green mobility framework** in which shaded pedestrian routes connect the metro station to bus stops, institutions, commercial streets, parks, and neighbourhood-level activity generators.

In SR Nagar, the proposed road-design slides already incorporate planted medians, green buffers, and landscaped edges within redesigned corridors and junction sections. These elements should be consolidated into a broader strategy of **green shaded pathways**, especially along the principal walking desire lines leading to the station and high-footfall institutional corridors. Such a strategy would complement the existing fine-grain block structure and improve the experiential quality of walking within the 800 m influence area.

In LB Nagar, where the public realm is under pressure from traffic, parking spill over, and informal encroachment, the integration of urban greenery becomes even more important. The proposal should identify opportunities to connect existing public open spaces, institutional edges, and transport corridors through continuous planting, shaded seating pockets, bioswale-compatible edges where feasible, and tree-based place-making nodes. Trees may also function as anchors for pause spaces, vending pockets, and wayfinding markers, thereby contributing simultaneously to climate adaptation and social use of the street.

Typological restructuring and redevelopment-based intensification:

The next stage of the In SR Nagar, the presence of smaller blocks and a mixed urban grain suggests that the station area can support **selective intensification** without erasing its existing walkable structure. Instead of proposing uniform redevelopment, the report should identify specific corridors and junction edges where higher-density, mixed-use typologies may be introduced through revised development control regulations, active frontage requirements, and consolidation of larger plot should also advance toward a more explicit discussion of **typological change**.

There is a clear parking imbalance within the metro influence zones at both SR Nagar and LB Nagar stations, caused by high demand and limited organized supply. This situation disrupts traffic flow and raises safety concerns for pedestrians. Informal and unregulated on-street parking further reduces efficiency and accessibility.

In SR Nagar, the Madhura Nagar road, SR Nagar Main Road, SR Nagar Metro Station Area, Yousufguda Road and in LB Nagar, Metro Corridor, Internal Ring Road, Siris Road, and Bairamalguda Road have heavy dependence on on-street parking has led to carriageway encroachment, reduced road width, frequent bottlenecks, and traffic disruptions. This highlights the need for comprehensive parking management measures like organized off-street facilities, regulated parking zones, and better last-mile connectivity.

A useful way forward would be to develop **two alternative scenarios** for selected junctions in both SR Nagar and LB Nagar. The first scenario may retain the existing plot grain and current permissible development controls, showing how significant improvements can still be achieved through better geometric design, crossing infrastructure, footpath continuity, refuge islands, street furniture, planting, and corner treatment. The second scenario may explore **plot**

amalgamation and redevelopment-based intensification, particularly at strategically located junctions where larger plot assembly could support higher floor-space utilization, more active frontages, and landmark mixed-use development.

Strategic Development goals:

While both SR Nagar and LB Nagar are pilot areas for Transit-Oriented Development (TOD) in Hyderabad, their development goals (Table 6-1) differ based on their existing urban maturity and spatial context. SR Nagar is treated as a well-established mid-urban center requiring restructuring and enhancement, whereas LB Nagar is viewed as a transitioning outer-urban corridor requiring vertical optimization and infill development.

SR Nagar: Restructuring an Established Fabric:

The redevelopment goals for SR Nagar focus on refining a highly dense and stable urban environment where most land is already over-utilized.

- **Restructuring for Walkability:** A primary goal is to restructure the local road network which currently handles 89% of the traffic into smaller, more walkable blocks to improve pedestrian permeability.
- **Balancing Road Hierarchy:** The plan aims to develop secondary corridors and widen collector roads to alleviate pressure on the primary Mumbai Highway (NH-65) spine.
- **Creating "Breathing Room":** Because the area lacks recreational infrastructure (only 2% open space), a key goal is creating planned public squares and community spaces to break up the compact, high-density residential blocks.
- **Strategic Consolidation:** To meet high demand despite small and irregular plot sizes, the strategy encourages **plot consolidation** to enable vertical growth in suitable areas that are currently restricted by regulatory constraints.

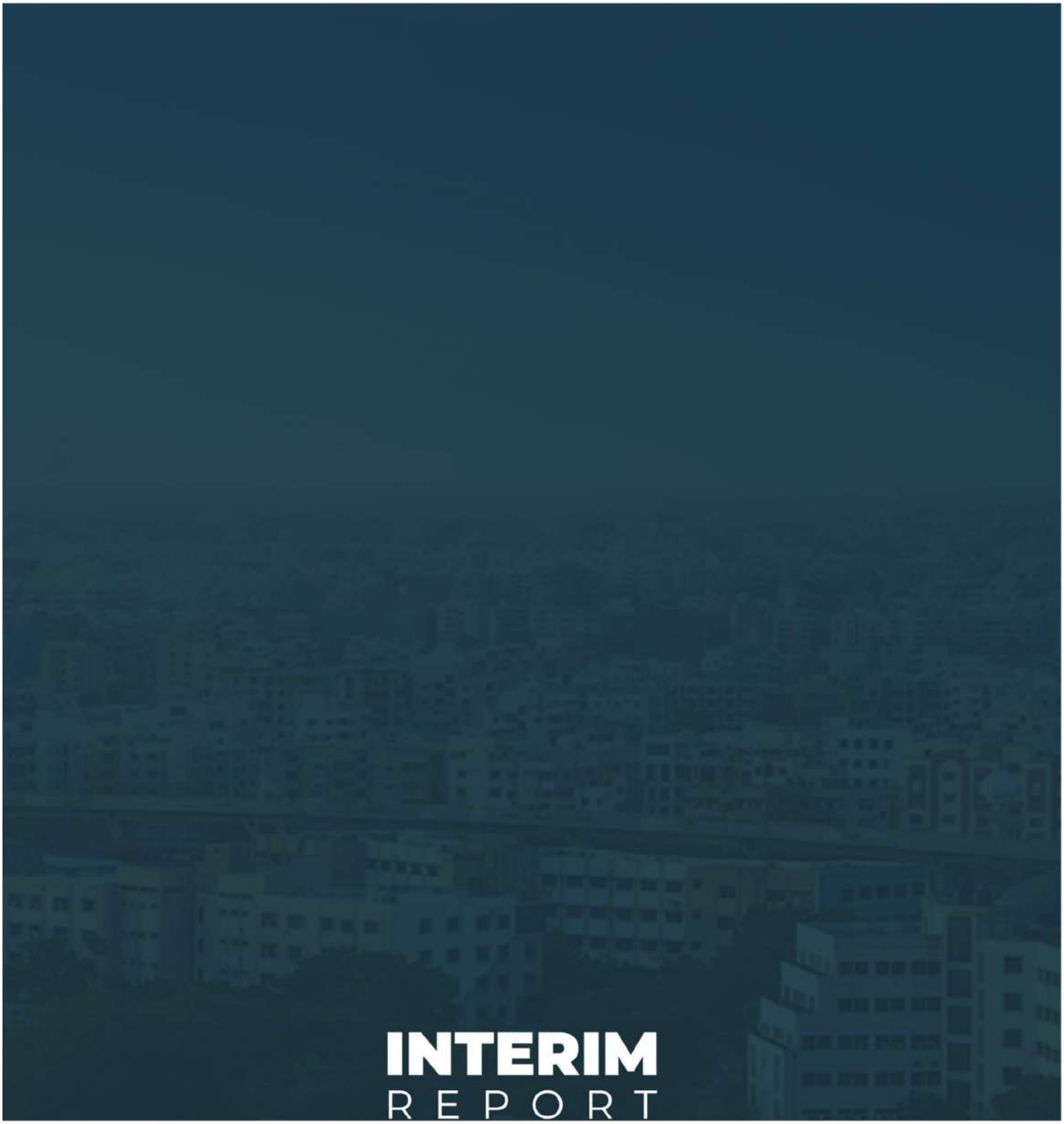
LB Nagar: Optimizing an Under-Built Growth Hub

LB Nagar’s goals center on transforming a horizontally spread, low-rise area into a high-intensity, vertically integrated transit hub.

- **Vertical Optimization:** Unlike SR Nagar, **73% of LB Nagar’s plots are identified as "under-built,"** meaning they have the potential to add floors under current regulations. The goal is to shift the urban form from G+1 structures to vertically optimized TOD environments.
- **Infill and In-Situ Development:** The plan seeks to capitalize on the **8.71% of vacant land** and large under-utilized parcels for strategic infill development and land consolidation.
- **Overcoming "Siloed" Planning:** A major objective is to transition from traditional "siloed" planning where residential and commercial uses are horizontally separated to **vertical integration** of living and working spaces.
- **Infrastructure Management:** Because LB Nagar serves as a major regional terminal, a critical redevelopment goal is fixing "core bottlenecks" through improved signalization and junction management at massive intersections like Bairamguda and LB Nagar Junction.

Table 6-1 Summary of Differences in redevelopment goals between SR Nagar and LB Nagar

Feature	SR Nagar Redevelopment Goal	LB Nagar Redevelopment Goal
Primary Focus	Restructuring and enhancing a stable, dense core.	Optimizing and densifying an under-built growth hub.
Land Strategy	**Plot consolidation** to overcome size restrictions.	**Infill development** on vacant and under-utilized parcels.
Urban Form	Breaking compact blocks with **new open spaces**.	Transitioning from **horizontal spread to vertical density**.
Mobility	Developing **secondary corridors** to balance traffic.	Solving **severe junction congestion** and adding NMT.



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Submitted By:

AMRUT Centre of Urban Planning for Capacity Building at School of Planning and Architecture, Vijayawada (SPAV)
योजना तथा वास्तुकला वद्यालिय, वजयिवाड़ा
S.No. 4/4, ITI Road, Vijayawada - 520008, A.P., India.

http://www.acupcb.spav.ac.in/