Sustainable City Strategy - Jaipur

Sustainable Cities - Integrated Approach Pilot (SCIAP)

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SUBMITTED TO:

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PROJECT DONORS:

June 2022

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This report has been prepared under the Sustainable Urban Planning and Management component of the Sustainable Cities Integrated Approach Pilot (SCIAP) project funded by the Global Environment Facility (GEF-6). It documents the Sustainable City Strategies (SCS) which are intended to be targeted and cater to specifically identified issues for each of the five pilot cities - Bhopal, Guntur, Jaipur, Mysuru and Vijayawada during the City Profile and Diagnostic stage. The report is produced using data provided by the state and urban local bodies of the four participating states and additional geospatial data collected from the National Platform for Sustainable Cities, European Space Agency. Knowledge material published by UN-Habitat, The World Bank, other agencies are referred to formulate the Sustainable City Strategies. While UN-Habitat checks data, information to the fullest extent possible, the responsibility for the accuracy of the data, information lies with the original providers of the data. Information contained in this Report is provided without warranty of any kind, either express or implied, including, without limitation, warranties of merchantability, fitness for a particular purpose and non-infringement. UN-Habitat specifically does not make any warranties or representations as to the accuracy or completeness of any such data, information.

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SUSTAINABLE CITY STRATEGY- JAIPUR

Sustainable Cities Integrated Approach Pilot (SCIAP)

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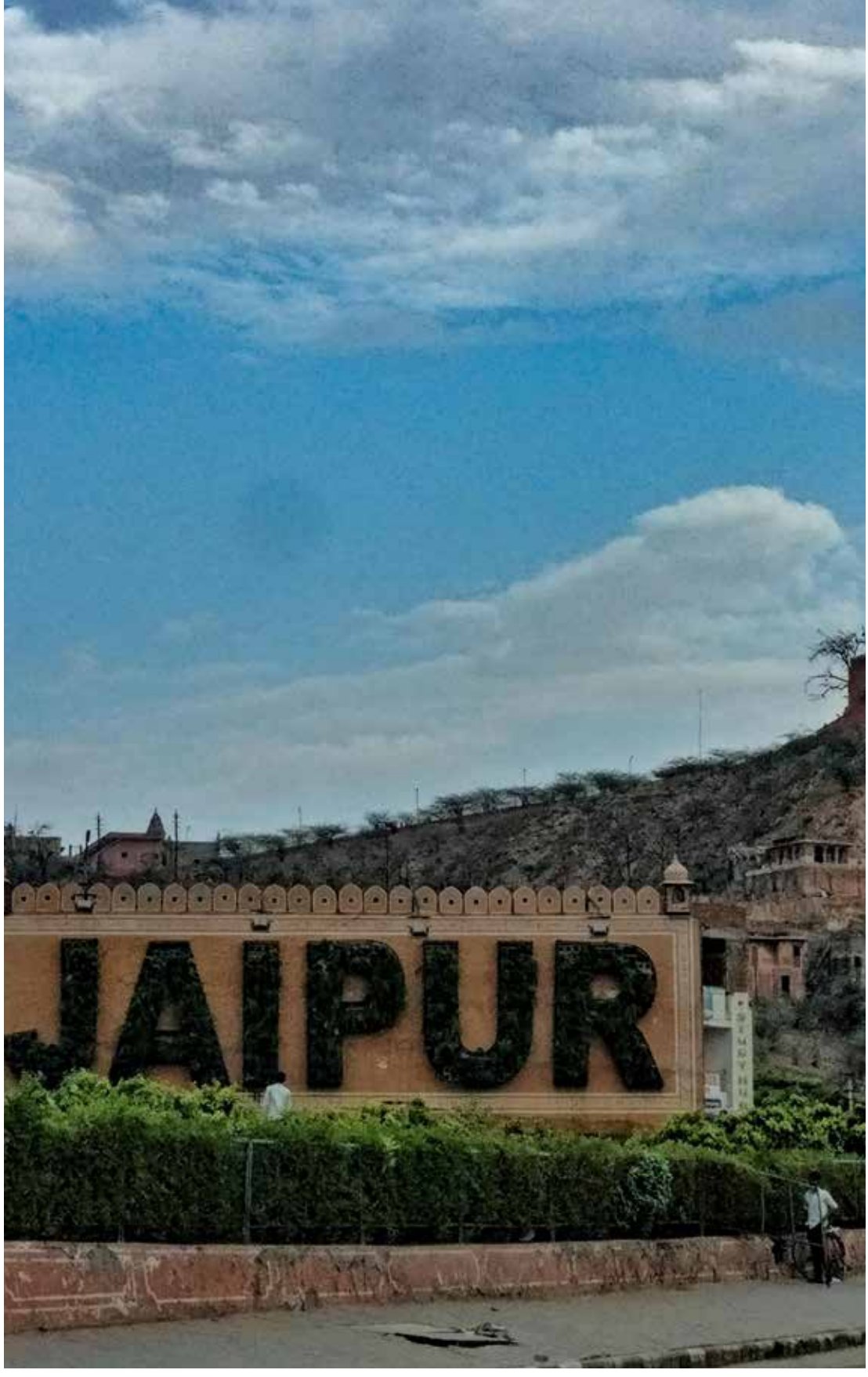
AFOLU	Agriculture, Forestry, and Other Land Use
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
CAA	Constitutional Amendment Act
CAGR	Compounded Annual Growth Rate
CCTV	Closed-Circuit Television
CDP	City Development Plan
CGWB	Central Ground Water Board
CPCB	Central Pollution Control Board
CRISIL	Credit Rating Information Services of India Limited
CTTS	Comprehensive Traffic and Transportation Study
DoIT&C	Department of Information Technology and Communication
DPR	Detailed Project Report
ELU	Existing Land Use
EOL	Ease of Living Index
EKW	East Kolkata Wetland
FSSM	Faecal Sludge and Septage Management
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIS	Geographical Information System
GoR	Government of Rajasthan
GPSC	Global Platform for Sustainable Cities
Ha	Hectare
INR	Indian Rupee
INTACH	Indian National Trust for Art and Cultural Heritage
IPPU	Industrial Processes & Product use
IPT	Intermediate Public Transport
JCTSL	Jaipur Transport Services Limited
JDA	Jaipur Development Authority
JMC	Jaipur Municipal Corporation
JMRC	Jaipur Metro Rail Corporation
JVVNL	Jaipur Vidyut Vitran Nigam Limited
LED	Light-Emitting Diode
LPCD	Litres Per Capita Per Day
LSG	Local Self Government Department
MDP	Master Development Plan
MLD	Million Litres per Day
MoHUA	Ministry of Housing and Urban Affairs
MPI	Municipal Performance Index
MTCO2e	Metric Tonnes of Carbon Dioxide equivalent

NH	National Highway
NIUA	National Institute of Urban Affairs
NMT	Non-Motorised Transport
NRW	Non-Revenue Water
ODF	Open Defecation Free
OSM	Open Street Maps
PHED	Public Health and Engineering Department
PMAY-U	Pradhan Mantri Awas Yojana – Urban
PPH	Persons Per Hectare
RSPCB	Rajasthan State Pollution Control Board
RSRTC	Rajasthan State Road Transport Corporation
RUIDP	Rajasthan Urban Infrastructure Development Project
SHG	Self Help Group
SBM	Swachh Bharat Mission
SCIAP	Sustainable Cities – Integrated Approach Pilot
SCS	Sustainable City Strategies
SH	State Highway
SLB	Service Level Benchmark
STP	Sewage Treatment Plant
Sqkm	Square Kilometre
TPD	Tonnes Per Day
ULB	Urban Local Body
UDH	Urban Development and Housing Department
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UN-HABITAT	United Nations Human Settlements Programme
UN-HABITAT ROAP	United Nations Human Settlements Programme Regional Office for Asia & the Pacific
UNIDO	United Nations Industrial Development Organization
URDPFI	Urban and Regional Development Plans Formulation and Implementation
USAF	Urban Sustainability Assessment Framework
WPPR	Workforce Participation Rate
ZDP	Zonal Development Plan



1 INTRODUCTION

1.1 Report Objectives

The Sustainable City Strategy (SCS) consitutes the final step of a three-step process under the Sustainable Cities Integrated Approach Pilot (SCIAP) Component 1 of the project. The first two steps are the application of the Urban Sustainabilty Assessment Framework (USAF) captured in the Urban Sustainability Indicators Report (USIR) and the City Profile and Diagnostics Report. The City Profile and Diagnostic Report identified very specific diagnostic issues, which essentially were the key problem areas, obstacles and developmental challenges being faced by Jaipur. These challenges were ascertained on the basis of evidence collected and assesed through the USAF.[1] As the third and final step, this report documents the SCS for Guntur, which is a spatial strategic plan with very specific actions and interventions designed to be targeted and impact-oriented on the ground. These strategies will strengthen and enable city leadership and managers to drive future development based on quantifiable data and assessment using rationale decision-making.

In this context, the main objectives of this report are:

i) To identify strategic development opportunities for the city based on spatial evidence aligned with local, state and national policies and regulations.
ii) To design cross-sectoral and intra-sectoral strategies for an equitable, sustainable and resilient future development of the city, and contribute towards improving the city's climate emissions profile.
iii) To design and develop area-based, transformative interventions to demonstrate changes on ground.
iv) To ascertain specific actions and interventions necessary for transformative impact over a 5-year period.
v) Recommend convergence with national/ state missions for financing and technical resources

1.2 Approach and Methodology

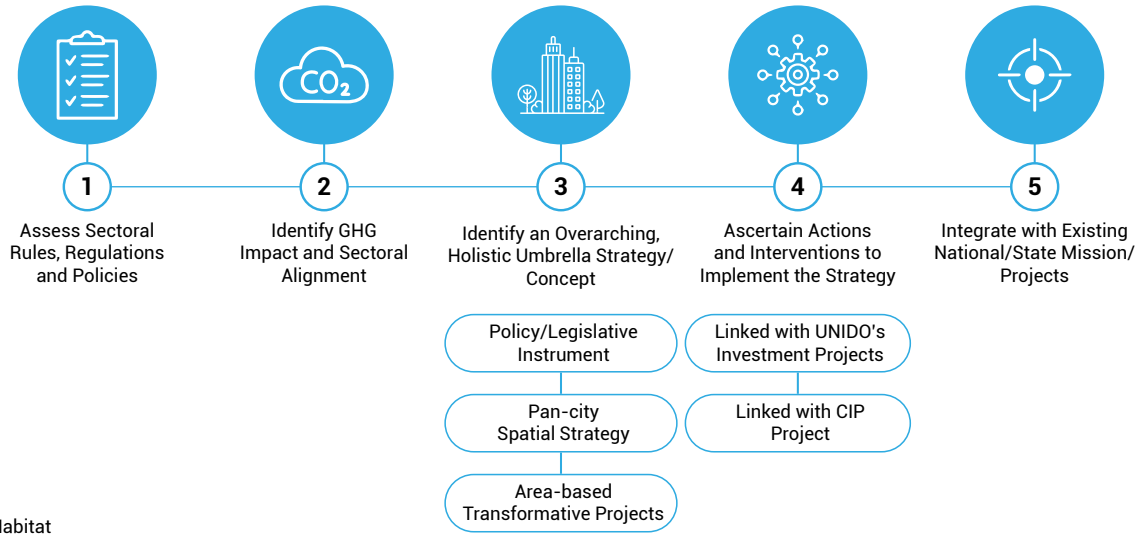
The foundation of the SCS is in the New Urban Agenda (NUA) with the following five pillars (except Pillar 1, since it is beyond the scope of SCIAP) of the NUA as the guiding document in framing the SCS.

i) National Urban Policies (NUPs)
ii) Rules and Regulations
iii) Urban Planning and Design
iv) Financing Urbanisation
v) Local Implementation

A detailed guidance note on the development of the SCS has been given in Annex 1. The strategies could take the form of pan-city intersectoral spatial interventions, area-based projects and even legislative/policy based instruments. Emphasis was given to the carbon footprint profile of sectors and the relationship with the intended strategic interventions to ensure that maximum carbon capturing is achieved. Significant effort has been made to ensure convergence with projects and sectors covered by the national missions and state schemes/policies with the recommended interventions.

The overarching steps followed for the development of the SCS have been illustrated in Figure 1.1.

FIGURE 1.1 Sustainable City Strategies development process



Source: UN-Habitat

1 The Urban Sustainability Assessment Framework was developed by UN-Habitat India as a part of the SCIAP project. Further details are available in the Urban Sustainability Assessment Framework Report.

1.3 Scope and Limitations

The SCS is intended to be very targeted and cater to specifically identified issues in the previous stage of the project. Unlike a master plan with a longer horizon year of 10 to 20 years, this strategic plan has an outlook of five years. It does not intend to be a master plan and look at all development sectors and resolve all challenges of a city. However, the SCS does base its recommendations considering their impact on various sectors from the USAF and their interrelatedness.

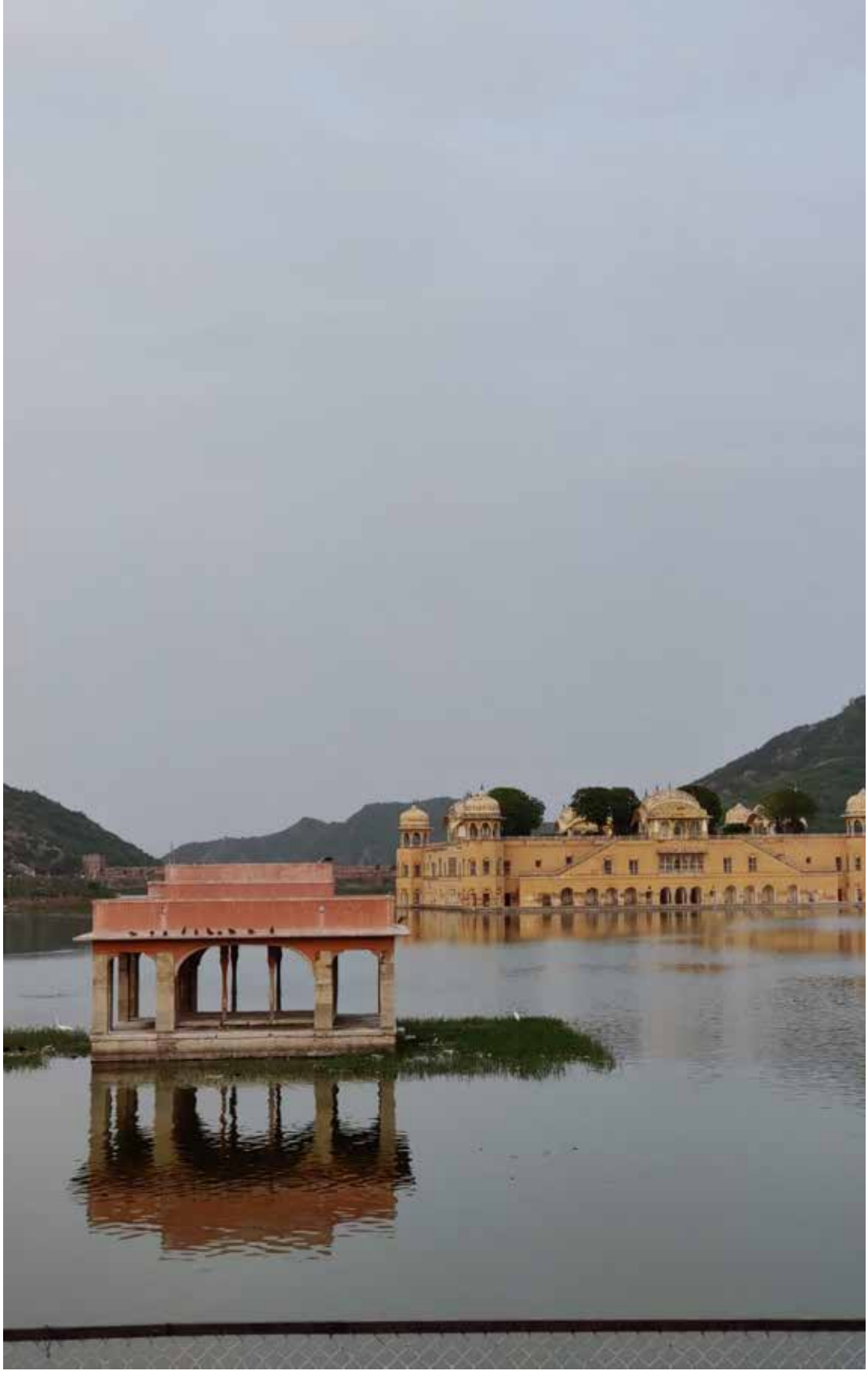
This SCS will help the municipal corporations to identify the following[2]

1. Where are the areas of growth and what type of growth?
2. Where should investments from various national and state missions/schemes be located to maximize their impact on vulnerable sections of the society?
3. How can the existing natural and economic assets of the city be preserved and enhanced?
4. How can quality of life and equitable provision of urban amenities be enhanced?
5. How to prioritise interventions to ensure practicality and maximum impact?

The following limitations need to be considered while assessing the strategic interventions:

1. The cost estimates have been calculated on block cost thumb rules derived from industry standards being used in the national missions. All assumptions have been listed out in detail for context building and understanding.
2. The concept designs and spatial location of proposed interventions are shown for approach demonstration purpose only, the interventions would require detailed planning and engineering studies to arrive at accurate costing and spatial design.
3. The GHG savings given for the strategic interventions are based on very high-level standards and metrics since these must be calculated at the detailed design stage with site-specific inputs.
4. The analysis of legislations and policies is limited to its high-level implication of diagnostics issues. The SCS does not intend to provide detailed assessment of legislative framework and amendments to the policy and legislative framework.
5. The data and information used in the SCS are based on secondary sources available in public domain only. Primary data collection is limited to site visits and stakeholder consultations.
6. In some cases, latest spatial data, specifically land use and population density was not available with the Urban Local Bodies (ULBs) and many assumptions had to be made by the teams, which have been mentioned.
7. GESI recommendations are based on secondary data collection and analysis. This could be further refined based on additional on site discussion and consultations with stakeholders and government bodies.

2 https://unhabitat.org/sites/default/files/2014/07/A-guide-for-Municipalities-Inclusive-and-Sustainable-Urban-Development-Planning-Volume-1.pdf



2 CITY DIAGNOSTICS

2.1 Climate Context

Jaipur has a humid subtropical climate and receives 650 mm of rainfall annually. Mostly rainfall takes place during June and September. During the rainfalls, there are frequent, heavy rains and thunderstorms. Temperatures remain high throughout the year. Summer months of April to early July have average daily temperature of around 30 degree centigrade. The winter months are mild and pleasant with temperature ranging from 15 – 18 degree celcius with little or no humidity. Occasionally, there are cold waves nearing freezing temperatures duing December and January. Highest temperature goes upto 48 degrees celcius and lowest drops to 2 degree celcius.

According to Jaipur District Disaster Management Plan 2014, Jaipur falls under multi-hazard zone of the state. Low rainfall coupled with erratic monsoon makes Jaipur vulnerable to drought. Some of the low-lying areas in city are water logged during the monsoon, largely due to temporary and permanent blockages of natural drainage channels, inadequate storm water drainage network, increased run-off due to non-permeable surfaces, and increased frequency and intensity of rain due to climate change.

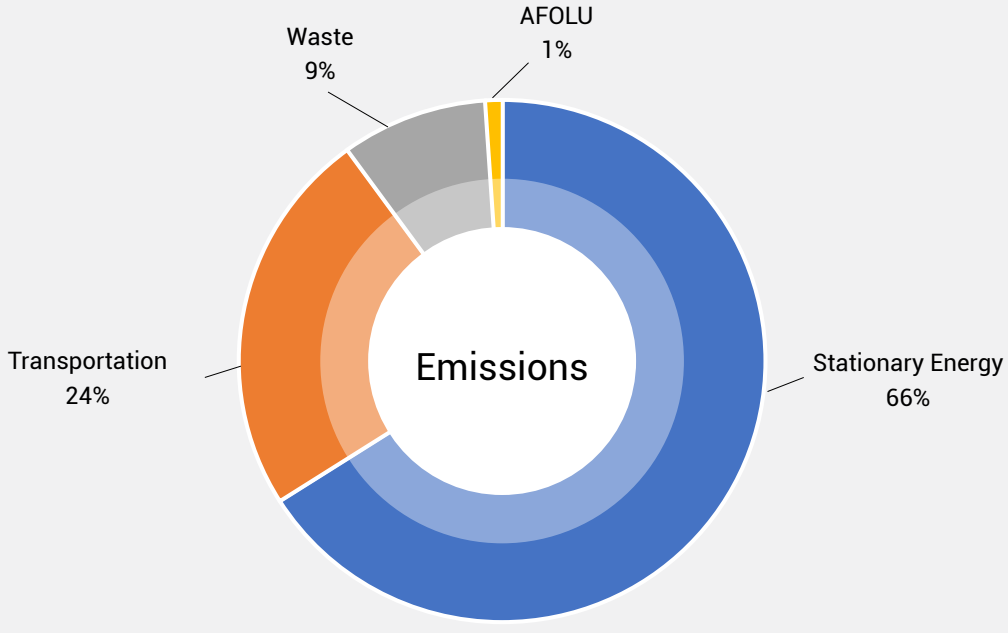
2.1.1 GHG Emissions Profile

The city of Jaipur lacks a mechanism to monitor greenhouse gas emissions (GHG) on a continuous basis. According to a 2017 UNIDO study, the GHG was estimated at 51,36,817 Mt CO_2-eq in 2015-16. CO_2, CH_4, and N_2O emissions were 46,24,149 Mt, 16,511.29 Mt, and 190.01 Mt, respectively. The stationary energy sector contributed the most, accounting for 66%, followed by the transportation sector (24%), the waste sector (9%), and the AFOLU sector (1%). The average emissions per capita were 1.39 Mt CO_2-eq/capita.[3]

2.1.2 Air-Pollution Scenario

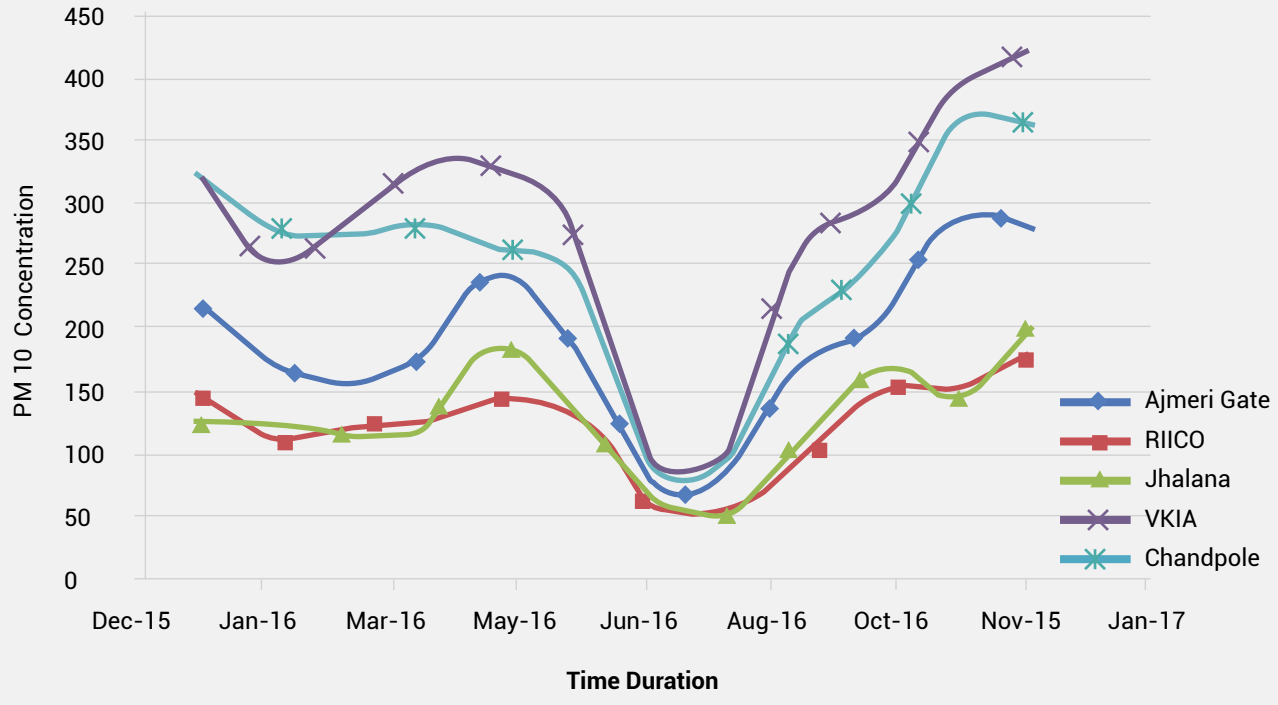
At VKAI, Chandpol, Ajmeri Gate, Science Center, and RIICO Sitapura, the city of Jaipur maintains five air quality monitoring stations. The AQI in Jaipur changes with the seasons, with the worst air quality being from November to February. In 2019, the annual AQI was in the 'Moderate to Poor' range. PM10 (residual particulate matter) is a type of particulate matter that is created mostly by the combustion of fossil fuels and by dust from development operations,

FIGURE 2.1 Sector-wise GHG Emissions (UNIDO)



3 GHG Accounting and Capacity Building for the Cities of Jaipur, Bhopal, Mysore, Vijayawada and Guntur as a first step under the GEF-UNIDO-MoUD Project (2017)

FIGURE 2.2 Monthly average of PM10 levels in Jaipur



Source: https://sacleanwater.com/rainwater-harvesting-systems/

and it can cause breathing problems and respiratory diseases. In 2019, the annual mean concentration of PM10 was 150, which is much higher than the CPCB air quality standards. In 2016-17, except during the monsoon season, the PM10 in Jaipur ranged from 'Poor to Extremely Poor' as shown in Figure 22. The main causes of air pollution in Jaipur are increasing number of vehicles, frequent traffic congestions, industries emitting pollution and road dust.[4]

2.2 Sectoral Assessment

Jaipur was assessed across the 12 sectors of the Urban Sustainability Assessment Framework (USAF). 86 indicators were collected for Jaipur out of 131 indicators across 12 USAF sectors, accounting for 66% of all indicators. Jaipur received a 3 out of 5 score, indicating average performance. Environmental and ecological sector, as well as solid waste management and sanitation, fared well. Among the low-performing sectors were disaster management, water, transport, and urban form. The chart in Figure 2.3 depicts each sector, its score, and the amount of data collected. For more information on the method and outcomes, please see the USAF report for Jaipur.

2.3 Key Diagnostic Issues

Multi-sectoral diagnostic issues for strategic intervention in Jaipur were identified based on a USAF assessment. The four diagnostic issues are discussed below:

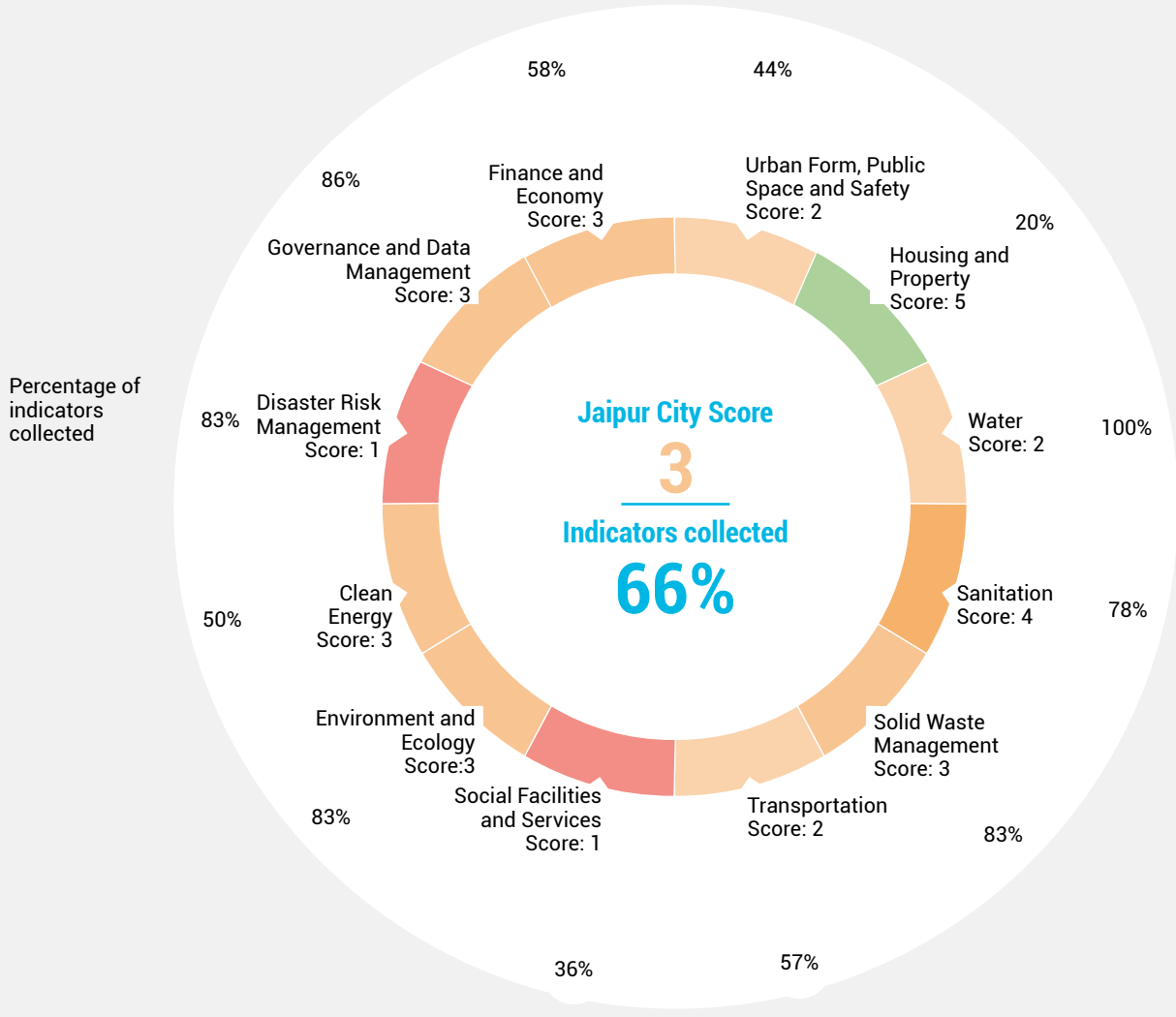
2.3.1 Urban Sprawl

Jaipur is spreading horizontally in two directions: north-northwest and south-southwest. Its urban velocity increased by 2.5 times over the previous decade. The majority of peri-urban regions have low density or structures with no tenants, according to spatial analysis of global open data sets including satellite images. UN-Habitat's five principles for Sustainable Urban Development state that compact cities should aim at developing the recommended density of 150 PPH.[5] If UN-Habitat's recommended density is applied to the present conditions of available vacant land, the current amount of vacant land within JMC limits could inhabit about 8.4 lakh people, which is about 20 per cent of the city's existing population. Considering Jaipur's present population of 37.07 lakh (as per Swachh Survekshan 2019 reporting) and the population

4 Accessed at https://timesofindia.indiatimes.com/city/jaipur/clean-roads-can-put-brakes-on-air-pollution-experts/articleshow/90528664.cms on 25.05.2023.

5 A new strategy of sustainable neighbourhood planning: Five Principles; UN-Habitat (2015)

FIGURE 2.3 USAF sectoral performance across sectors



Source: UN-Habitat

that could be accommodated in the vacant land, the area's total population capacity would add up to 45.4 lakh. The population projection of Jaipur for 2025 is about 44 lakhs.[6] Thus, the existing urbanised land, including vacant land, can possibly accommodate expected population growth till 2025, if citizens are provided with adequate infrastructure and services, including improved access to public transport.

2.3.2 Weak Urban Mobility

Private transportation is used by more than half of the population. Bus or metro-rail travel accounts for only 10% of total trips. Bus routes have not been optimised, and many of the neighbourhoods that have risen in the last 10-15 years are not served. Despite the fact that walking or cycling accounts for more than 30% of all trips, there is a lack of supporting infrastructure like pedestrian footpaths and cycle lanes. Among women who travel for work major modal share is via walking, 37% commute is by walking followed by 25% who travel by bus. Average home-based trip length in Jaipur is 8.7km, while average total trip length is 9.1km. According to a survey, 3.25 million trips a day are made in Jaipur (Jaipur Metro Rail Corporation Limited, 2018). The survey also found that about 2.1 million trips

6 https://worldpopulationreview.com/world-cities/jaipur-population

take place along north-south direction, while remaining trips move along east-west direction. Table 2.1 shows average trip lengths for various modes in Jaipur.

TABLE 2.1 Average trip lengths by various modes

Mode	Average home-based trip length (in kms)
Bus	11.4
Car	12.6
Two-wheeler	5.8
Auto rickshaw	5.4
Bicycle	2.4
Walk	1.8
Metro	6.1
Total home-based trip	8.7
Total non home-based trip	7.9
Total trip	9.1

Source: Comprehensive Mobility Plan, Jaipur, Vol 1,

2.3.3 Multi-Hazard Vulnerability

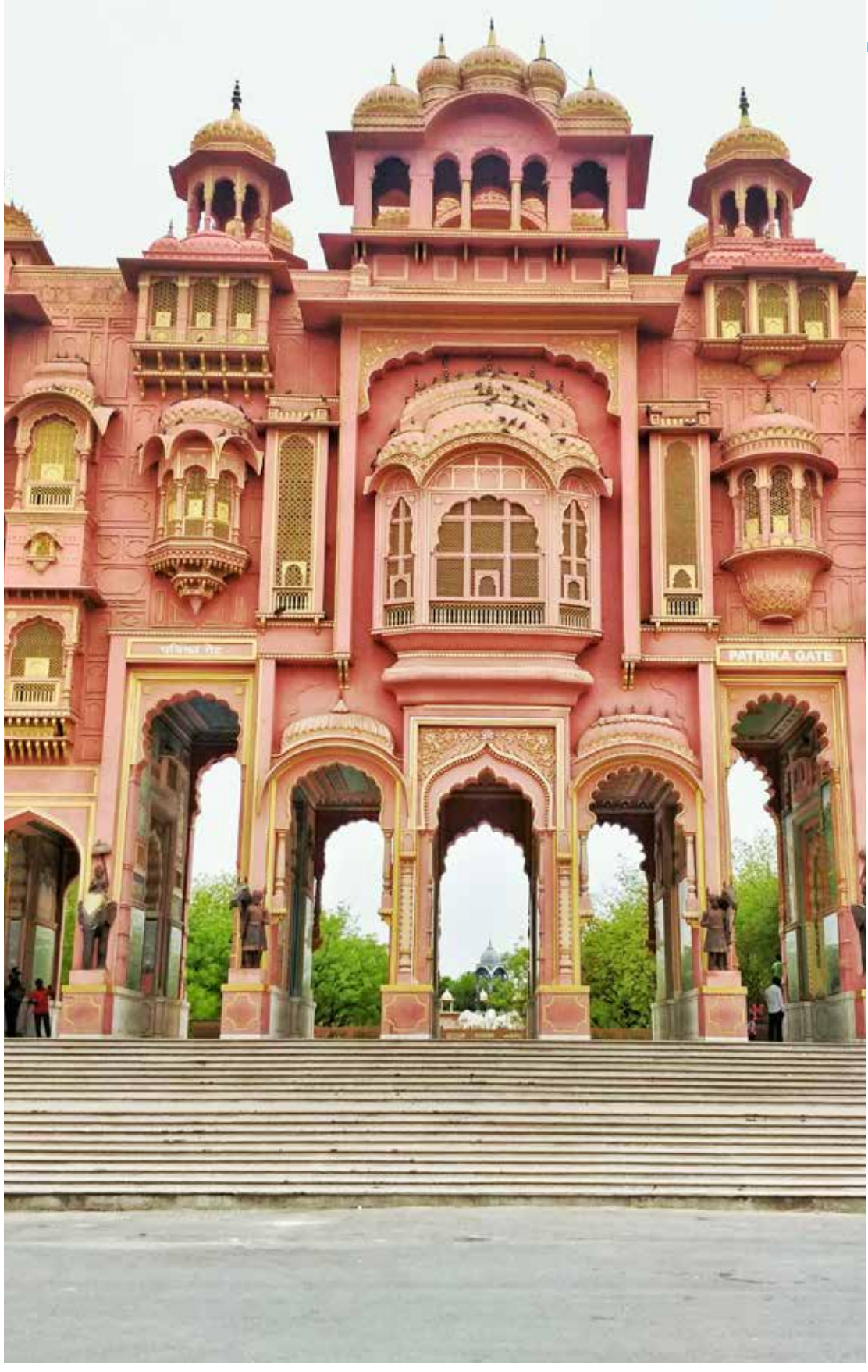
Droughts, urban flooding, and heat waves are all common in Jaipur. Jaipur has been historically experienced extremely hot days. The hottest day recorded was 48.5 degree Celsius on 6th May, 1980. 45.4 degree Celsius was recorded in May 2022.[7] In 2019-20, three cases of urban flooding were reported in Jaipur. With the urban development blocking the natural drainage network with low coverage of dedicated stormwater network, Jaipur is ill-preapared to cope up with urban flooding. On the other hand, Jaipur has a severe water scarcity. Ramgarh Lake, which served as the city of Jaipur's principal water source until the late 1990s, ran dry in 2000. Between 2016 and 2018, the city's principal source of water, the Bisalpur Dam, which is around 120 kilometres away, was on the edge of drying up completely. The city is in need of a water resources evaluation and management plan, which it currently lacks. It is also to be noted that impact of hazards is more significant for vulnerable groups (women, elderly, adolescent and children) who constitute 72% of the total population. Being a city majorly based on tourism, there are conflicting basic needs of residents and tourists, especially in terms of water supply.

2.3.4 Green-Blue Infrastructure Disconnect

Keeping aside the ecological area within the municipal area, the green cover contributes to just about 1 per cent of Jaipur's municipal area (JMC). This indicates that the city faces a scarcity of green spaces and recreational areas. Lack of green spaces imply city's incapability to manage microclimatic factors influencing urban heat island effect, rainwater percolation through ecosystem services and urban ecology. As per the data shared by the JMC the city has an average green space of 1.46 sq. mt. per person, which is less than a tenth of the national URDPFI recommended average of 12 sq. mt.

The surface water bodies in the city are under constant threat to unauthorised land reclamation the weaker section of urban dwellers by filling water bodies located on adjoining forest land. Rate of urbanisation through migrants is highest in Jaipur (73.6%) in Rajasthan. Vulnerable communities build new dwellings encroaching the reclaimed land, shrinking the water catchment and reducing the permeable surface area that rainfall cannot penetrate and floods road surfaces. This also leads to permanent loss of natural habitat and disrupts the natural drainage profile.

7 Accessed at https://timesofindia.indiatimes.com/city/jaipur/city-sizzles-at-44-9c-may-get-hotter/articleshow/4532351.cms on 25.05.2023.



3

STRATEGIC RESPONSES

3.1 Core Planning Principles

In response to the diagnostic issues, the following urban planning principles have been showcased, which serve as the foundation for the challenge's strategic solutions and recommended interventions. These planning principles may be studied and incorporated into the upcoming revision of the Jaipur Master Plan, as well as other pertinent plans and reports.

3.1.1 Principle 1: Compact City

Compact cities are relatively higher density, mixed-use settlements, which enable high per-capita access to urban amenities, facilities and public open space within a given area. Densification has the potential to counter the tendency for sprawl and the consequential high cost of infrastructure, while leveraging the positive aspects of urbanisation.[8] However, it is not possible to densify the walled city of Jaipur as it is a UNESCO Heritage site, and has building height restriction.

Compact city development provides an opportunity for a guided densification process and planned urban regeneration, redevelopment, and revitalisation of the urban core through infill development. This approach also offers opportunities for slum upgrading, innovation in housing typologies and layouts, brownfield development and building refurbishment. Compact urban settlements may also lead to a significant reduction in the overall GHG emissions for the city, due to shorter travel distances that are convenient for walking or other NMT, significantly reducing emission through modal shift from private vehicles to public transport and non-motorised transport, reduced emissions from materials used for the construction of new housing, public services, and infrastructure, as well as more efficient usage of existing facilities. A compact city may increase economic opportunities as more places of livelihood become accessible within shorter distances, especially for the urban poor. It can also improve the quality of life and public health.

Compact development may also improve community well-being by ensuring that a variety of basic services, infrastructure and employment are within reach of mixed-income housing. This development pattern also helps to ensure that the urban poor are not marginalised.[9]

3.1.2 Principle 2: 15-Minute city

15 Minute city concept as per Moreno's 2021 article, is a way to ensure that urban residents can fulfil six essential functions within a 15-minute walk or bike from their dwellings: living, working, commerce, healthcare, education and entertainment.[6] The framework of this model has four components; density, proximity, diversity and digitalisation. The development of Jaipur, as 15-minute city aims to create a polycentric city, where everyone is able to access essential urban services within 15 minutes. In light of the global COVID-19 pandemic and the climate crisis, the concept has gained traction, in spite of heavy criticism for being threat to civil liberties including death threat. Its major tenets are accessibility (easily accessible), diversity (vibrant mixed-use), density (compact urban form), and ubiquity (easily affordable).[6]

3.1.3 Principle 3: Sponge City

The concept of 'sponge city' is an approach to manage flooding, water conservation, water quality improvement, and natural ecosystem protection, reduce urban heat island effect and enhance the amenity value. The sponge cities concept proposes ecologically suitable alternatives to transform natural resources, urban green areas and urban infrastructures into green infrastructures that can capture, control and reuse rainwater in a useful and ecologically efficient manner.[23] The on-going national programme, Jal Jeevan Mission (Urban) promotes 'sponge cities' for integrated urban water management.

The sponge city model for urban management strengthens the ecological infrastructure and drainage systems of the urban areas by absorbing and retaining rainwater and using it to reduce storm water volume. It can help to alleviate urban flooding, water shortages, and the urban heat island effect, as well as benefit the ecological environment and biodiversity. Rainwater collected can be used to create a long-term drainage system. In contrast to the typical approach of grey infrastructure, the principal of sponge city aims to distribute and hold water at its source, slow water as it flows away from its source, clean water naturally, and be adaptive to water at the sink when water collects. Protecting the natural urban environment, ecological restoration, and low-impact development are the three key features of constructing such systems.

8 Planning compact cities: exploring the possibilities and limits of densification, UN-Habitat, 2017 https://unhabitat.org/sites/default/files/documents/2019-06/planning_compact_cities_exploring_the_possibilities_and_limits_of_densification.pdf

9 Planning compact cities: exploring the possibilities and limits of densification, UN-Habitat, 2017 https://unhabitat.org/sites/default/files/documents/2019-06/planning_compact_cities_exploring_the_possibilities_and_limits_of_densification.pdf.

6 Moreno, Carlos, Zaheer Allam, Didier Chabaud, Catherine Gall, and Florent Pratlong. 2021. "Introducing the "15-Minute City": Sustainability, Resilience and Place Identity in Future Post-Pandemic Cities" Smart Cities 4, no. 1: 93-111. https://doi.org/10.3390/smartcities4010006

3.1.4 Principle 4: Ecological city

An ecological city is a human settlement designed after natural ecosystems' self-sustaining, resilient structure and function. It focuses on bringing humans and nature closer together and lowering their ecological footprint. Natural cities, according to the World Bank,[10] improve peoples' and societies' well-being through integrated urban planning and management that harnesses the benefits of ecological systems while protecting and nurturing these assets for future generations. Ecological cities take cues from ecosystems' efficient and self-organizing processes and apply them into management and design solutions. A few of the significant interventions include nature-based solutions for efficiently connecting the green-blue infrastructure of the city by tree planting, green space creation, intervening through ecosystem approaches, and the implementation of environment-friendly policies.

3.2 Strategic Response 1: Jaipur as A Compact City

Jaipur is governed and managed by three major government institutions, namely, Jaipur Development Authority (JDA), Jaipur Municipal Corporation – Greater and Jaipur Municipal Corporation – Heritage. JDA plans and develops the entire JDA region spanning over 3000 sq. km. (Source: JDA official website). It includes Jaipur, multiple satellite towns and villages within Jaipur region. JDA region comprise of JDA boundary (total area under Jaipur development region), Jaipur Urban Area (JUA) boundary (area under urbanisable limits) and JMC boundary (area under jurisdiction of municipal bodies of Jaipur). JMC-G and JMC-H operates and manages urban infrastructure and services within their respective jurisdiction under Jaipur municipal limits spanning about 383 sq. km. Jaipur metropolitan area has an estimated population of around 4.2 million in 2023.

10 The World Bank (2018), Eco2 Cities : Ecological Cities as Economic. Retrieved from https://openknowledge.worldbank.org/bitstream/handle/10986/2453/544320PUB0EPI01BOX0349415B01Public1.pdf?sequence=1&isAllowed=y

Jaipur's urban area is experiencing sprawl

During 2011-21, Jaipur has registered a decadal population growth rate of 22%. Rate of urbanisation through migrants is highest in Jaipur (73.6%) in Rajasthan, dominated by rural to urban migration.[11] The overall population density of the city as of 2021 is 100 persons per hectare, which increased from 80 persons per hectare in 2011. The growth rate of Jaipur's population has been slowing down since the year 2001. But the trend suggests **urban sprawl,** and due to large number of migrants, it could be largely the result of unplanned urbanisation. The built-up footprint area growth rate is 2.5x higher than population growth rate as shown in Table 3.1.

The urban extent has increased by about 480% in the last three decades

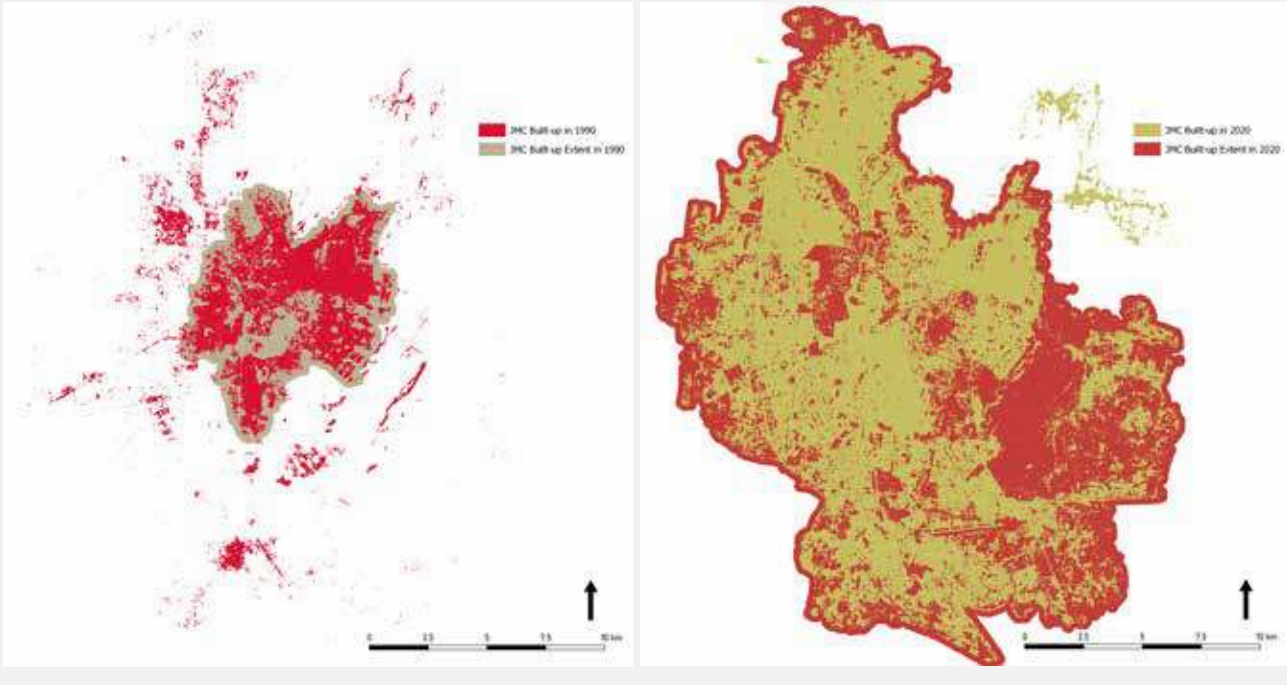
Using the methodology proposed by New York University Marion Institute of Urban Management researchers, urban extent and built-up footprint for Jaipur Municipal area (JMC boundary) was calculated. The urban extent* of Jaipur increased 480% from 63 Sq.km in 1990 to 366 sq.km. in 2020 which can evidently be seen in Figure 3.1. However, the built-up area of Jaipur in increased 170 per cent from 47 sq. km. in 1990 to 217 sq.km. in 2020 in the Table 3.1.

TABLE 3.1 JMC Population Density (1991 – 2021)

Year	1991	2001	2011	2021	1991 - 2021
JMC Population (millions)	1.5	2.3	3.0	3.7	2.2
Population Growth Rate (% per decade)	-	59%	31%	22%	147%
JMC Built-up Area (sq.km)#	47	95	154	217	170
Built-up Growth Rate (% per decade)	-	102%	62%	41%	362%
JMC Population Density (PPH)	40	60	80	100	60

#As per built-up footprint extracted from open-source satellite data for respective time period

FIGURE 3.1 Built-up extents of JMC in 1990 and 2020.

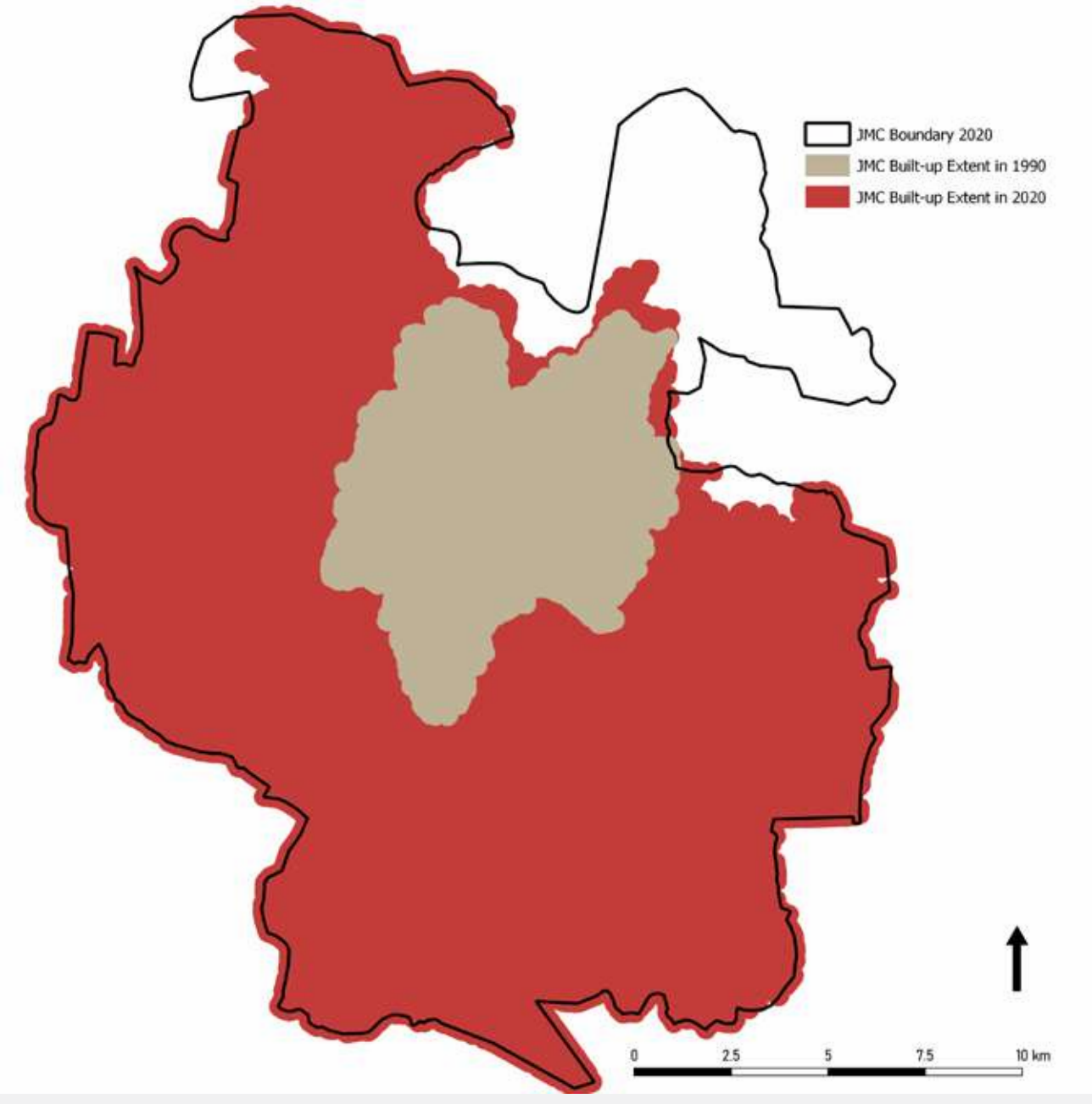


Source: UN-Habitat

11 Accessed at https://arxiv.org/pdf/0912.0458.pdf#:~:text=Rate%20of%20urbanization%20through%20migrants,are%20settling%20in%20urban%20areas.

The built-up area extents are calculated by identifying and merging the primary clusters of existing built-up footprint. The clusters not attached to the primary clusters are not considered within the urban extent. Jaipur-Dausa Industrial Area is within the influence area of Delhi Mumbai Industrial Corridor, which introduces a new scale of urban hierarchy.[12] Hence, in the future, there could be even larger urban contiguity. The urban extent encompasses not just the built-up footprint, but also considers the open spaces, infrastructure and facilities used by majority of the population. Figure 3.2 shows the comparison between the urban extents of Jaipur from 1990 to 2020. The area has increased by 480% over the past three decades.

FIGURE 3.2 Comparison of built-up extents of JMC in 1990 and 2020



Source: UN-Habitat

12 Accessed at https://www.rajras.in/delhi-mumbai-industrial-corridor-dmic-rajasthan/.

City is expanding largely in SW followed by NW direction

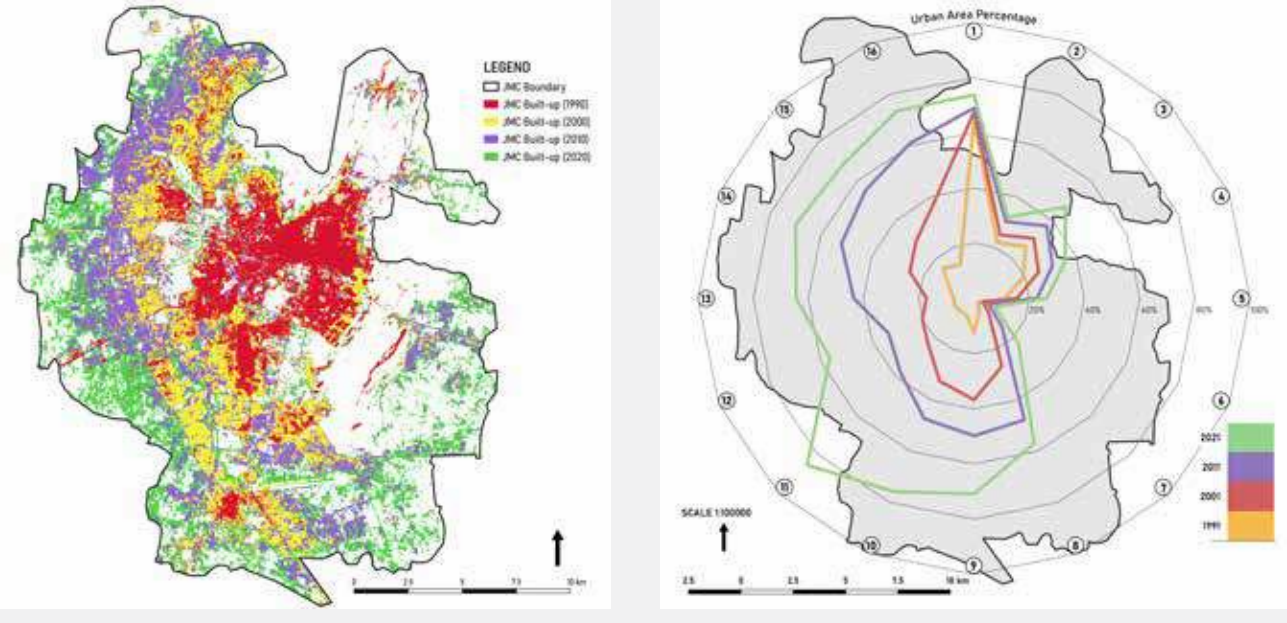
Table 3.2 and Figure 3.3 demonstrate the growth of the city in various directions. The entire municipal area of the city is divided into 16 quadrants. Taking the geographical center of the city, total growth in urban footprint is calculated in each of the quadrants. Based on the analysis, it is found that major growth has taken place from South direction to SW-W direction in the last decade. During 1991-2021, the trends indicate major growth took place in south to south-southwest direction and west to north direction.

TABLE 3.2 Direction-wise urban area percentage for JMC (1991 – 2021)

Direction	Urban Area Percentage					
	1991	2001	2011	2021	2011-21	1991-2021
1 – N	65%	68%	69%	74%	5%	9%
2 – N-NE	22%	25%	30%	32%	2%	10%
3 – NE	27%	31%	37%	47%	10%	20%
4 – NE-E	19%	25%	31%	36%	5%	17%
5 – E	11%	16%	23%	26%	3%	15%
6 – E-SE	3%	3%	6%	8%	2%	5%
7 – SE	2%	7%	14%	23%	9%	21%
8 – SE-S	5%	27%	48%	57%	9%	52%
9 – S	12%	37%	50%	71%	21%	59%
10 – S-SW	7%	33%	47%	76%	29%	69%
11 – SW	7%	24%	38%	85%	47%	78%
12 – SW-W	8%	20%	33%	56%	23%	48%
13 – W	7%	17%	44%	64%	20%	57%
14 – W-NW	10%	25%	52%	70%	18%	60%
15 – NW	16%	30%	55%	68%	13%	52%
16 - NW-N	13%	38%	61%	73%	12%	60%

Source: UN-Habitat

FIGURE 3.3 Urban area growth trend for JMC (1991 – 2021)



Source: UN-Habitat

Jaipur's building footprint density in expansion area is very low compared to the city core

An area swatch was selected from JMC municipal area, JDA urbanisable area and city expansion area to understand the development pattern. It was found that building footprint was around 27% in municipal area while only 2% in JDA urbanisable area. Further, road density was 32 km / sq.km. compared to 13 km / sq. km. in JMC boundary and JDA urbanizable area, respectively. It indicates that urbanisable area is sparsely populated in spite of public investments in urban infrastructure.

TABLE 3.3 Comparison of City Core and City Expansion Swatch

Area of Swatch = 9 sq.km	JMC Municipal Area	JDA Urbanisable Area
Road Length (km)	284	116
Road Density (km/sq.km)	32	13
Building Footprint (km/sq.km)	2.5	0.2
Building Footprint (%)	27%	2%

Source: UN-Habitat

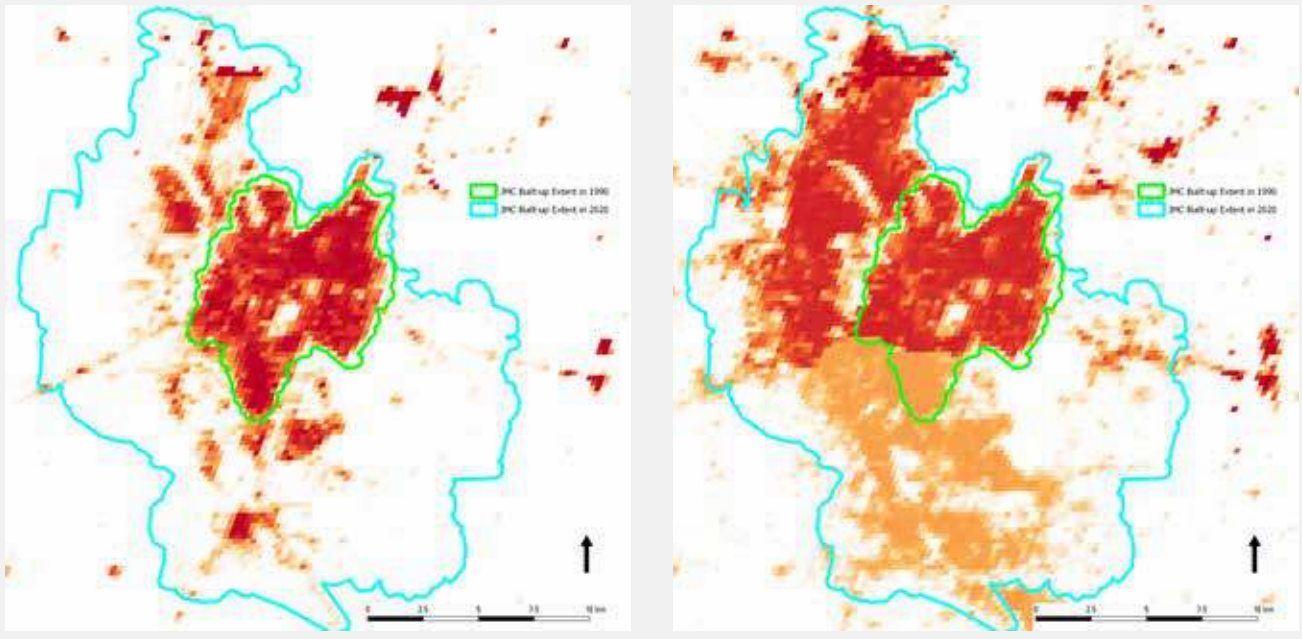
FIGURE 3.4 Comparison of City Core (JMC area) and City Expansion (JDA urbanizable area)

Source: UN-Habitat

The S-SW direction urban extent is low-density development

The population density of JMC in 1990 within the 1990 extent was in between 200 – 300 PPH indicating a highly dense city core. In 2020, the population density decreased within the 1990 extent and areas outside 1990 extent were densified. In 30 years, the development pattern in the south-southwest direction is low density and extends to the outer periphery of the city extent. The development pattern supports opportunities for redensification within the city limits contrasted with low density sprawl and leapfrog development.

FIGURE 3.5 Comparison of population density of JMC in 1990 and 2020

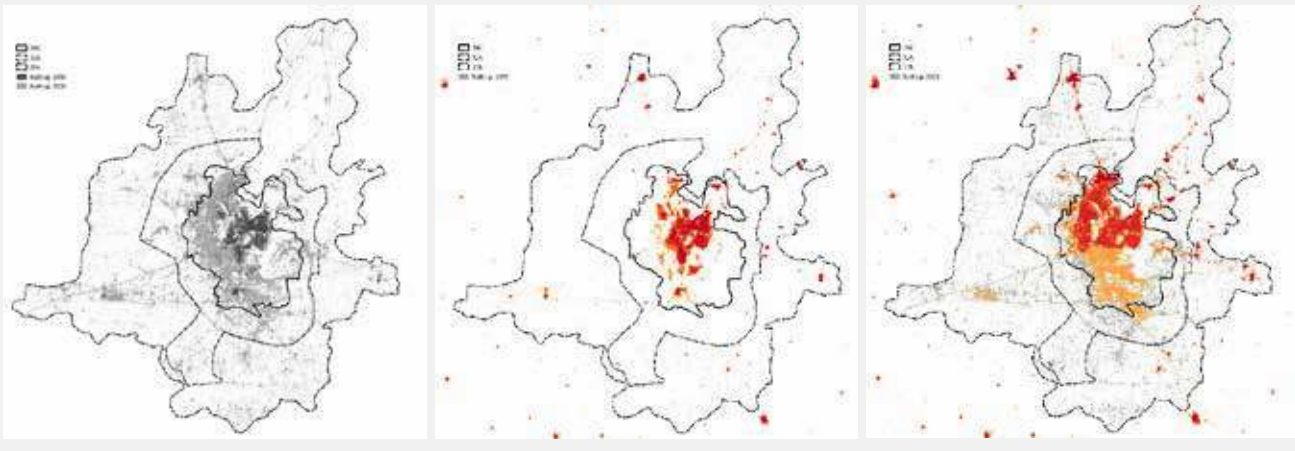


Source: UN-Habitat

Large number of buildings outside Jaipur municipal area are vacant and underutilized

When the population of density map of 1990 is superimposed over the built-up of 1990, it is observed that most of the built-up area is well populated within JMC and JDA limits. When the same is done for density map of 2020 and built-up of 2020, there are a lot of built-up patches that are not populated within JMC and JDA limits. It could indicate that a vacant or underutilised building stock or inventory especially in JDA region (outside JMC limits).

FIGURE 3.6 Built-up for JMC in 1990 and 2020 and population over built-up for JMC in 1990 and 2020



Source: UN-Habitat

TABLE 3.4 Comparison of footprint, population and built-up saturation for JMC, JUA and JDA.

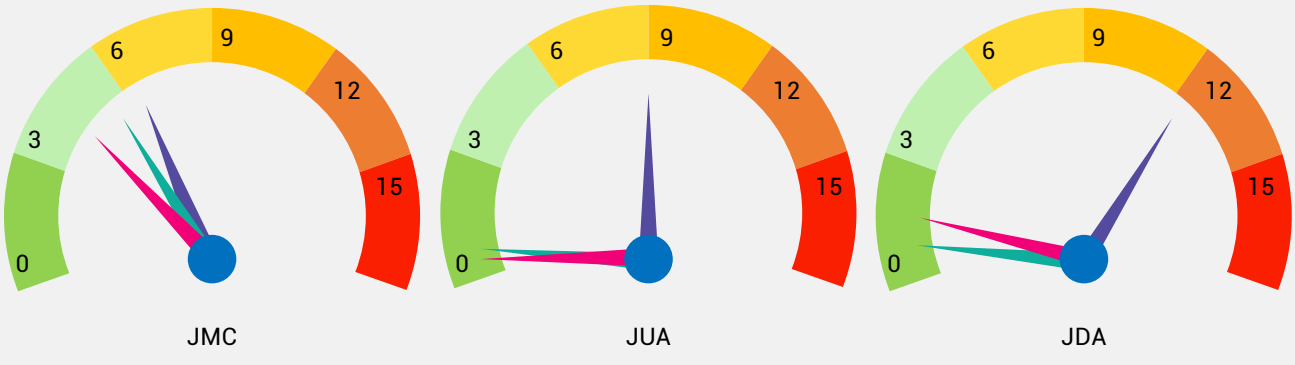
Footprint	JMC	JUA	JDA
Total Exclusive Area (in sq.km)	383	555	1779
1990 Built-up footprint (in sq.km)	47	3	14
2020 Built-up footprint (in sq.km)	216	105	152
Multiplier	4.5	35	11
Population			
1990 population (in million)	2.1	0.1	0.5
2020 population (in million)	3.5	0.5	1.0
Multiplier	1.6	5	2
Built-up Saturation			
1990 Built-up Saturation	12%	0.5%	0.8%
2020 Built-up Saturation	58%	19%	9%
Multiplier	5	38	11

Source: UN-Habitat

Jaipur's urban velocity increased by 2.5x in the last decade.

Urban velocity is defined as the annual growth rate of urban area within a period. It indicates the absolute differences (in terms of footprints) of urban areas within a certain time period.[13] The diagram below represents the urban velocity (in sq.km. / year) for JMC, JUA and JDA area (exclusive area) during 1991-2021 period. It is observed that urban velocity has increased 1.5 times from 4.8 to 6.3 in JMC limits between 19991 to 2021 period. On the other hand, it increased 30 times in JUA limits and nearly 10 times in JDA limits. Further, the urban velocity is 6.3, 9.0 and 12.1 in JMC, JUA and JDA limits in last decade. It indicates higher momentum of urban built-up area growth in JUA and JDA limits compared to JMC limits.

FIGURE 3.7 Urban velocity of JMC, JUA and JDA



Source: UN-Habitat

13 Zhang J and others (2016), Implementation of Geographical Conditions Monitoring in Beijing-Tianjin-Hebei, China, ISPRS International Journal of Geo-Information, 2016, 5, 89. DOI:10.3390/ijgi5060089. Retrieved from https://www.mdpi.com/2220-9964/5/6/89

TABLE 3.5 Urban velocity of JMC, JUA and JDA

Year	JMC	JUA	JDA
1991 – 2001	4.8 sq.km	0.3 sq.km	1.3 sq.km
2001 – 2011	5.8 sq.km	0.9 sq.km	0.4 sq.km
2011 – 2021	6.3 sq.km	9.0 sq.km	12.1 sq.km

Source: UN-Habitat

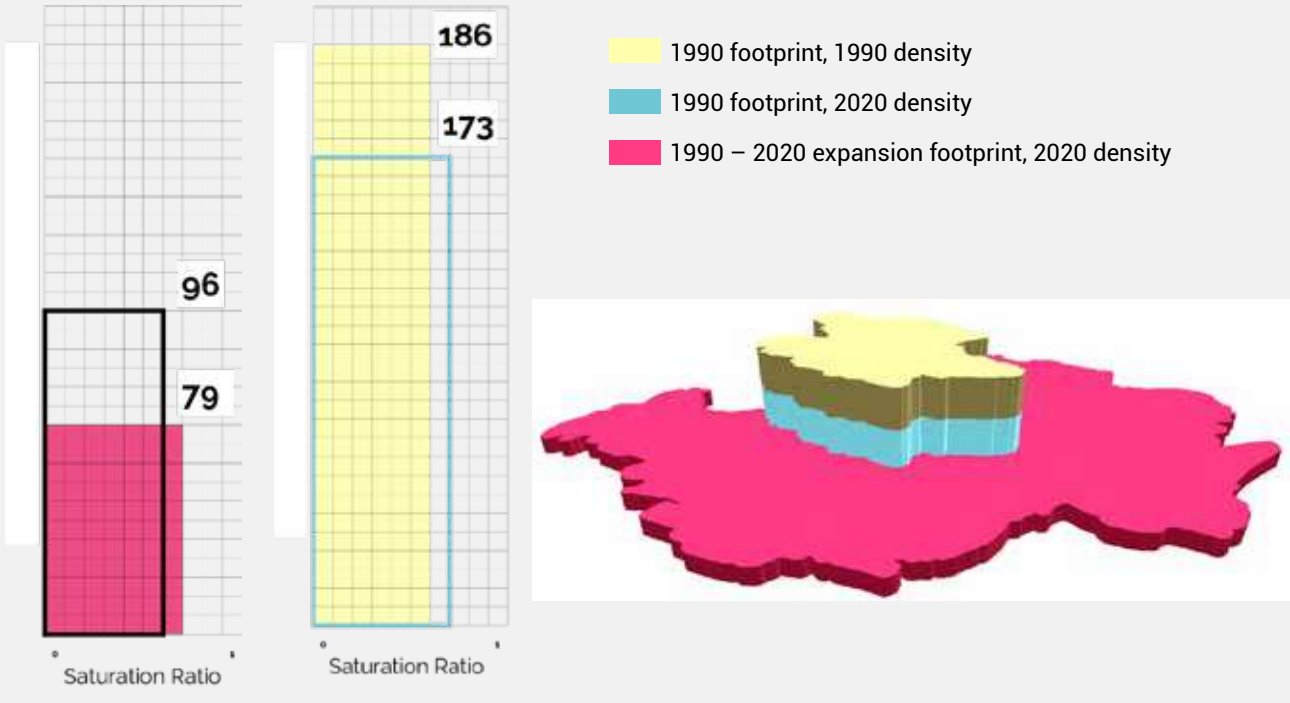
City population is growing but gross city density is declining

Gross city density of 1990 built-up footprint of Jaipur decreased from 186 persons per hectare (PPH) (show in yellow) to 173 PPH (shown in blue) during 1990-2020. Further, low-density development of 79 PPH (shown in pink) in built-up area expanded during 1990-2020 led to decline in gross city density to from 186 PPH to 96 PPH in Figure 3.8.

Jaipur limits are saturating but at a low population density

Saturation ratio is defined as total built-up area footprint divided by total area of the city. The total built-up area was 47 sq.km. in year 1990 and 216 sq.km. in year 2020. Based on 2020 municipal limits, the saturation ratio increased from 0.12 to 0.56. The growth in saturation ratio is 4.5 times while growth in population is 1.6 times during the same period. It indicates that built-up area is growing at a much faster rate than the population. This is leading to declining densities and resulting in urban sprawl.

FIGURE 3.8 Density comparison of JMC of 1990 and 2020



Source: UN-Habitat

Jaipur can accommodate growing population till year 2044 within JMC limits without overcrowding

As per global practices, 150 PPH to 200 PPH is the recommended optimum population density for compact and sustainable city. The existing population density within JMC is 96 PPH. JMC boundary can accommodate between 5.7 to 7.6 million persons if the underlying population density is increased to 150 PPH and 200 PPH. The saturation ratio within JMC boundary at the proposed densities would be 0.65 to 0.70 which allows sufficient open spaces and road space without overcrowding. Assuming that the population growth rate[14] remains constant, the population projection till 2044 can be accomodated within existing JMC limits.

TABLE 3.6 Built-up area density and saturation ratio comparison (1991 – 2021)

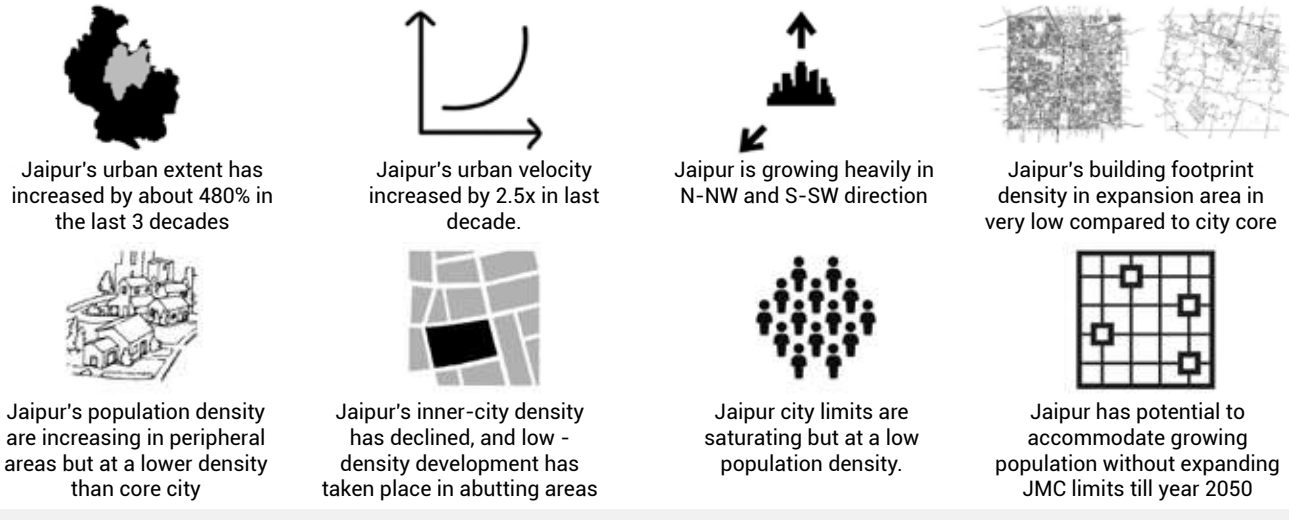
Year	1991	2001	2011	2021	Lower Density Range	Higher Density Range
JMC Population (in millions)	1.5	2.3	3.0	3.7	5.7	7.6
JMC Area (in sq.km)				383		
JMC Area (in persons per hectare)	39	60	78	96	150	200
JMC Built-up Footprint Area (in sq.km)	47	95	154	217	230	268
Built-up Footprint Area Population Density (in persons per hectare)	319	242	194	170	250	290
Saturation Ratio (built-up footprint area to JMC area)	0.12	0.24	0.4	0.58	0.65	0.70

Source: UN-Habitat

Jaipur's urban sprawl is a result of low-density development in urban expansion areas

Jaipur's urban extent has increased by about 480% in the last three decades. Jaipur's urban velocity increased by 2.5x in last decade. Jaipur is growing heavily in north-northwest and south-southwest directions. Jaipur's building footprint density in expansion area is very low compared to city core. Jaipur's population density is increasing in peripheral areas but at a lower density than core city. Jaipur's inner-city density has declined, and low-density development has taken place in abutting areas. Jaipur limits are saturating but at a low population density. Jaipur has potential to accommodate growing population without expanding JMC limits till year 2050.

FIGURE 3.9 Jaipur Urban Sprawl Capture



Source: UN-Habitat

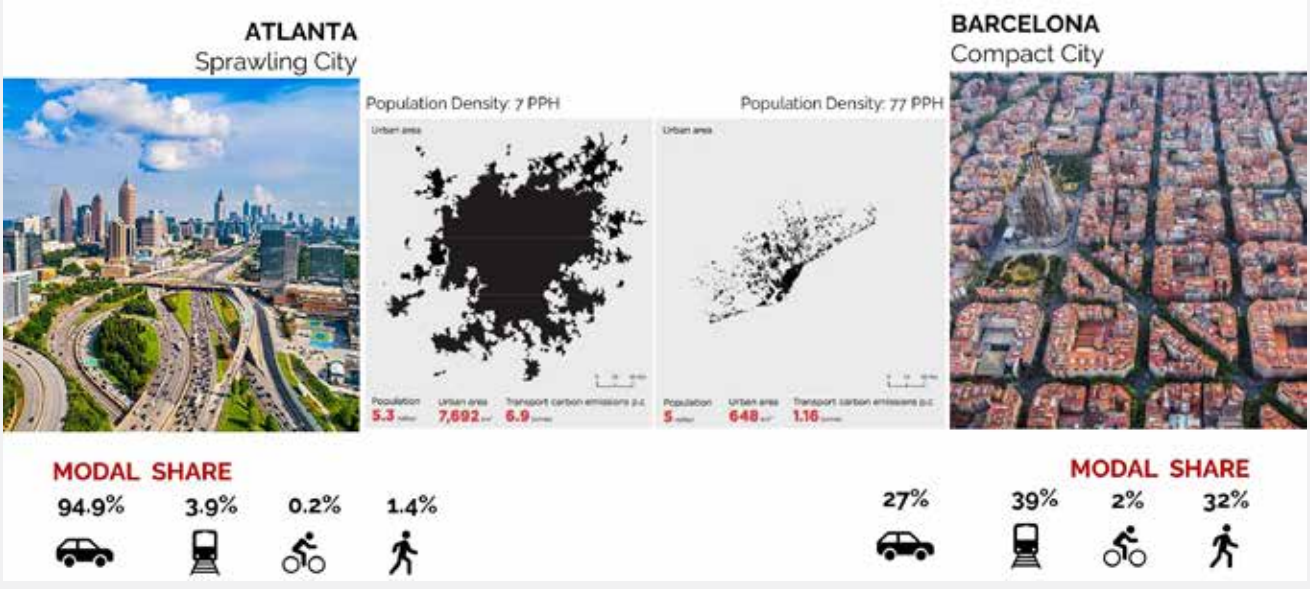
14 The cumulative average decadal population growth rate is calculated as 35.7% per decade during 1991-2021. The same has been used for population projection using geometric progression method.

Following are some concepts that would help to derive the strategies to combat urban sprawl.

BOX - 1: CASE STUDY: COMPARING ATLANTA AND BARCELONA FOR CORRELATION BETWEEN URBAN SPRAWL AND DENSIFICATION

Global precedents, examining the development pattern in Atlanta and Barcelona, demonstrate the importance of densification strategies for sustainable and green growth. Figure 3.10 shows a comparison of Atlanta and Barcelona, which have similar population as municipal area of Jaipur (JMC). The average population density of Barcelona Metropolitan Area (77 PPH) is 11 times larger than Atlanta's (7 PPH) , attributable to the vastly different spatial structures of these two cities. Considering the transport network length, this would imply that in Atlanta, transport network has to be 11x larger than in Barcelona to move the same number of people. In Barcelona, 60% population lives in close proximity to metro-rail stations, whereas in Atlanta, only 4% of total population lives close to metro-rail stations.

FIGURE 3.10 Examples of correlation between urban sprawl and densification



Source: UN-Habitat

Jaipur's urban sprawl can be addressed through densification.

It is inferred from the above example of Atlanta and Barcelona that a city's urban morphology and densification strategy are important factors for addressing the challenge of urban sprawl. Thus, Jaipur's existing urban density must be evaluated to formulate a comprehensive strategy prepared to curb GHG emissions from new construction, mobility and public transportation. It can be accomplished using the following methods in the order of priority:

1. Infill development: Infill development is the process of developing vacant land parcels within existing largely developed urban areas.
2. Redensification: Redensification is the process of increasing the density of a residential area. This is done by adding floor space to the existing buildings through building extensions and construction of additional floors.
3. Redevelopment: Redevelopment implies demolishing old structures and replacing the same with new structure with new dimensions and space, preferably at relatively higher densities and permitting higher floor area ratios.

Generally, retrofitting of infrastructure is required in all above scenarios to accommodate the need of additional population on the carrying capacity of existing infrastructure.

Jaipur has the potential for densifying through a compact city model

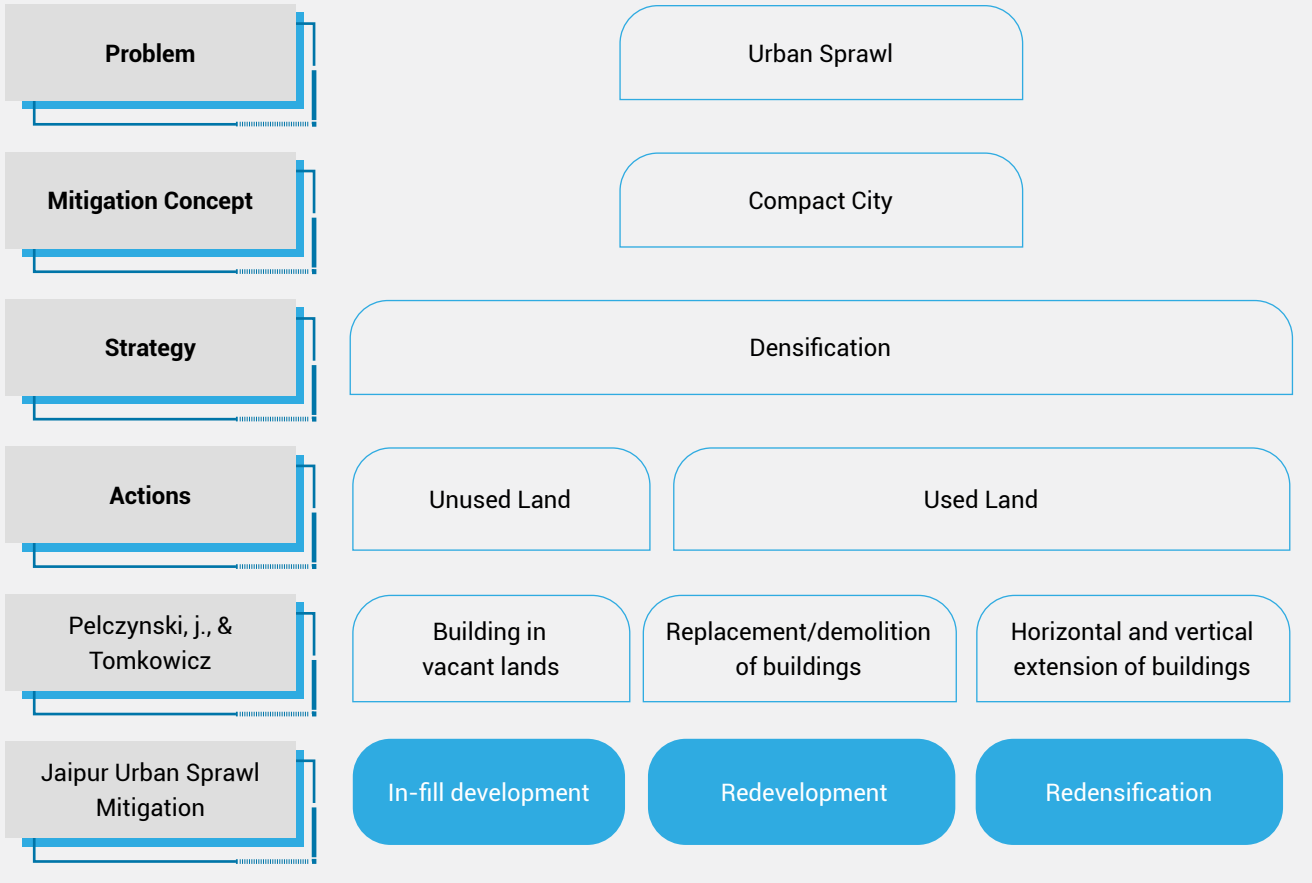
With a population density of 100 persons per hectare, Jaipur is one of the least densely populated metropolitan cities in India. For cities of similar size, the recommended density is around 150-200 PPH. It indicates that Jaipur has potential to densify without becoming overcrowded. According to analysis, population growth through 2044 may be supported within existing municipal boundaries if appropriate infrastructure is made available. Densification of cities can be done through three different ways as shown in Figure 3.11.[15]

3.2.1 Proposed interventions with strategic responses

The three actions and interventions for strategic densification are indicated in Figure 3.11, are described in detail in the following sections.

1. **In-fill development**
   Construction of buildings in vacant lands by utilizing unused land parcels across the city.
2. **Redevelopment**
   Demolishing old buildings and low-density development and replacing it with new buildings that can accommodate relatively higher densities.
3. **Redensification**
   Existing buildings to accommodate more people by making changes in the building bylaws.

FIGURE 3.11 Urban sprawl mitigation through Compact Cities for Jaipur



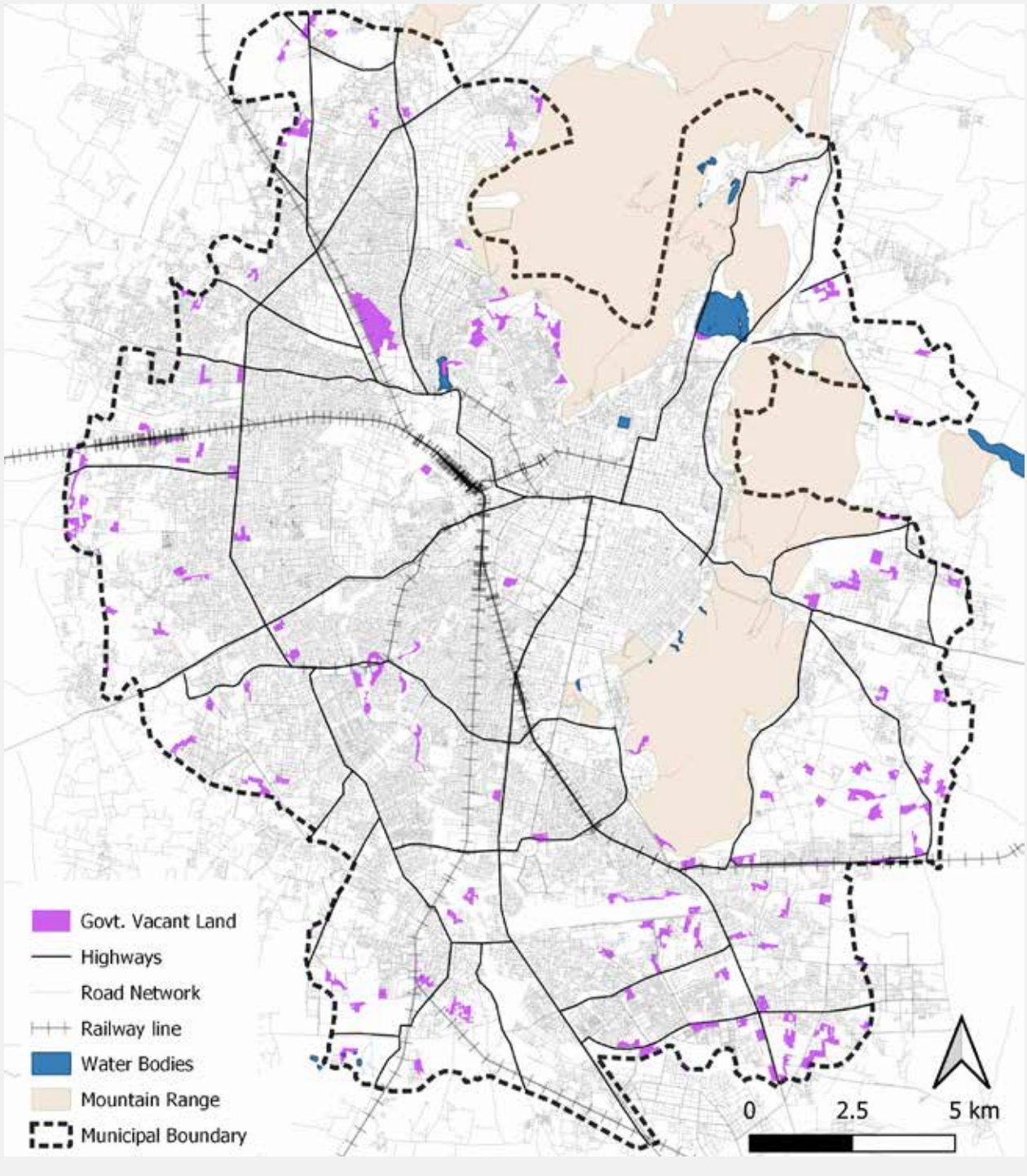
Source: UN-Habitat

15 Pelczynski, J., & Tomkowicz, B. (2019). Densification of cities as a method of sustainable development. In IOP Conference Series: Earth and Environmental Science (Vol. 362, No. 1, p. 012106). IOP Publishing.

Intervention 1.1: In-fill development of vacant land parcels within JMC limits

A landbank has to be created administered by JMC for promoting infill development. Multiple areas throughout the city have been identified to have vacant land parcels based on satellite imagery analysis, represented in Figure 3.12. After superimposing the land use map on the satellite image, a list of areas under residential use, where land is available for new development has been determined. The map below depicts vacant sites with a total area of over 5100 hectares available within JMC boundaries. If these areas are used to build new housing complexes with an average density of 250 PPH, it could meet the housing demand of nearly 1.2 million(12,50,250) people in the future.

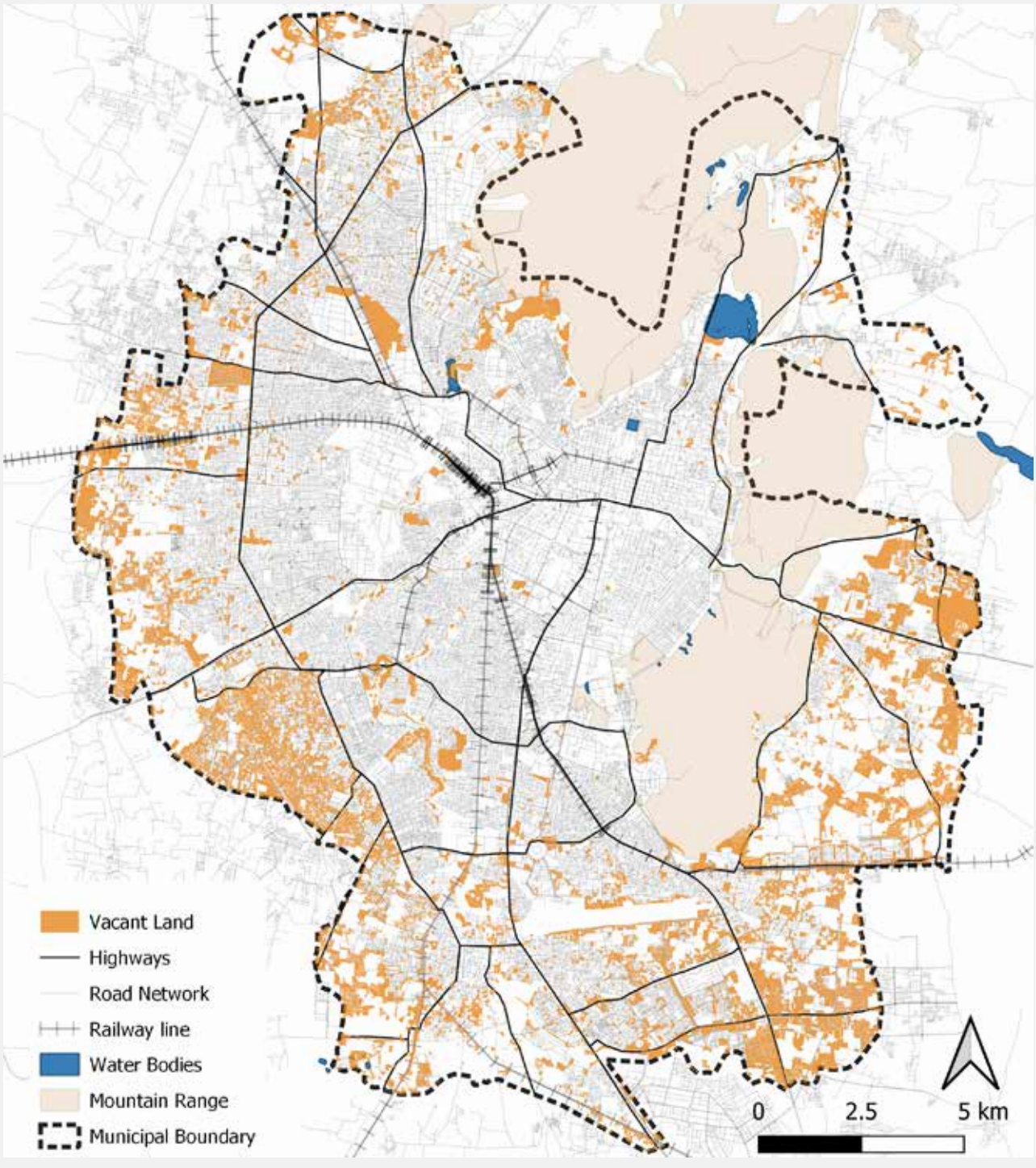
FIGURE 3.12 Map of vacant land parcels under residential land use



Source: Prepared by UN-Habitat with data from the Development Authority

Furthermore, there are a number of privately owned land parcels that remain undeveloped. These unoccupied parcels in prime locations lead to low-density development than what is planned. All privately held vacant residential land parcels can be identified using property tax records. New housing and development schemes may be developed by the JDA and JMC to encourage people to develop these land parcels.

FIGURE 3.13 Identified contiguous vacant land parcels above 10 acres within JMC for residential development.



Source: Prepared by UN-Habitat with data from the Jaipur Development Authority

We can administer a 6-step plan for in-fill development for the land parcels in JMC limits.

1. Inventorisation of vacant lands present in the JMC limits using geo-database.
2. Classify the land parcels based on ownership into publicly owned and privately owned.
3. Identification of land parcels under residential and mixed land use.
4. Prioritize the public owned parcels based on residential density in 500 mt buffer zone, including redensification of areas within city limits, and redevelopment of low-density government housing.
    a. Priority 1 – Above 200 PPH
    b. Priority 2 – Between 100 and 200 PPH
    c. Priority 3 – Lesser than 100 PPH
5. Preparation of feasibility studies, concept plans and block cost estimation.
6. Preparation of DPRs and tender document for appointment of private developers and builders.

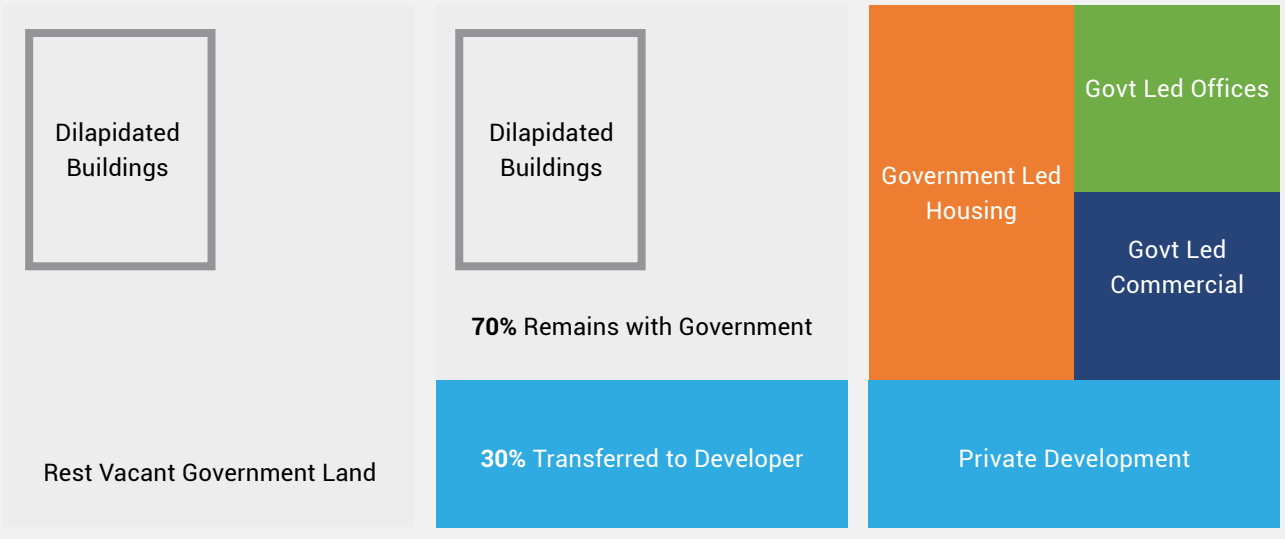
An example of densification through in-fill development can be seen from the New Redensification Policy of Madhya Pradesh.[16]

A provision has been made in the New Redensification Policy 2022 that residential buildings can now be built on government lands. In the policy, government property is chosen whose large part of the land is lying vacant. Around 30% of the government property will be sold to a builder or developer for a fixed amount. The money will be used by the government to build shopping complexes, government buildings and houses in the remaining 70%. These properties remaining with the government can be utilised as affordable housing for very low-income groups, who could be migrants.

Intervention 1.2: Redevelopment through Local area planning

Many areas of Jaipur started out as unauthorized colonies that were eventually regularized due to state intervention. Based on discussions with JDA and JMC, many of these neighbourhoods, such as Bapu Nagar, Barkat Nagar, and Hasanpura, have a low-rise (G+1 or G+2), low-density, small streets, and little open spaces. Most of these areas lack basic infrastructure and services like ample parking and planned sewerage system. The amount of open space, parking, and street network is insufficient by URDPFI and NBC[17] standards. Over a period, such locations are getting more crowded and less liveable as a result of saturation.

FIGURE 3.14 Pictorial representation of process of densification through in-fill redevelopment.



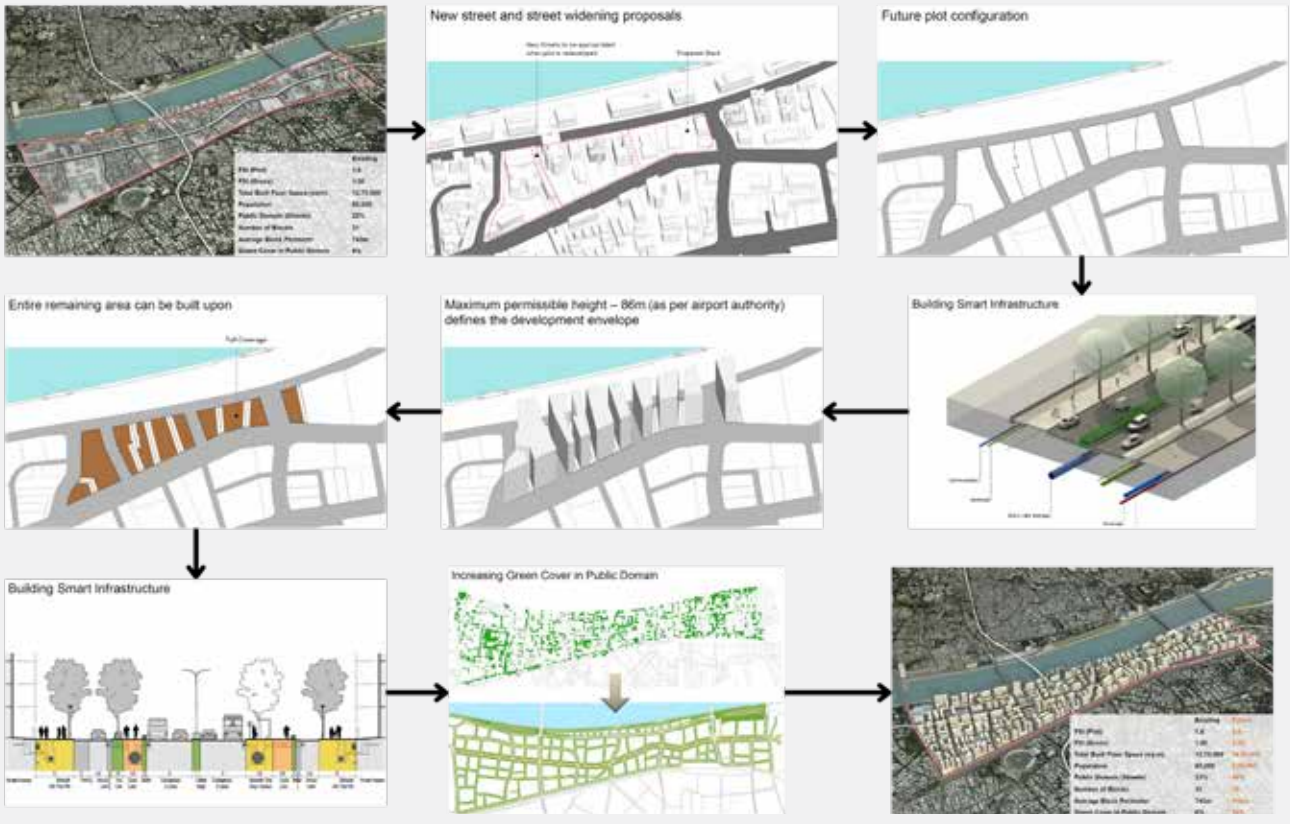
Source: UN-Habitat

16 Accessed at http://mphousing.in/pdf/Redensification_Guidelines-english.pdf
17 National Building Code

BOX - 2: CASE STUDY: REDEVELOPMENT IN SABARMATI RIVERFRONT DEVELOPMENT, AHMEDABAD

Local area planning can be used to redevelop the area, which includes densification of the area as well. It can help in optimizing the density and make provision for better infrastructure. The diagram below depicts the approach adopted by Ahmedabad for the redevelopment of an area along the Sabarmati River.

FIGURE 3.15 Ahmedabad CBD redevelopment process illustration



Source: HCP Design, Planning and Management Pvt. Ltd.

These three components, i.e., infill development, redensification, and redevelopment will attract new population, however, it should be strictly mentioned that only after accommodating the existing communities to avoid gentrification. Since it is difficult to accommodate low-income communities in vertical housing, innovative designs should be made to include more shared horizontal spaces to accommodate their livelihood.

Step 1: Mapping of existing street network: Identify total number of blocks, area under public streets and average perimeter to establish the baseline.

Step 2: Develop built-up area profile: Identify all existing building blocks using satellite or drone image, capture their heights and building use with primary building surveys, and build a mass and void diagram for the entire areas.

Step 3: Develop new blocks with improved street network: The proposed blocks shall be created by proposing new streets and reducing the block perimeter. The street alignment shall avoid passing through newly constructed buildings and major built-up mass. The street network will be developed in future by carving out land from plots undergoing redevelopment.

Step 4: Appropriation of setbacks along roads to expand public realm: Setbacks of all plots along the roadside shall be appropriated when they undergo redevelopment. After leaving the setback with adjacent plots on other sides, the plots can build up to plot line with up to 100% ground coverage.

Step 5: Relaxation in FAR, building height and ground coverage: The plots undergoing redevelopment shall be allowed to build up to the building line on the roadside. On the other side adjacent to other plots, they must leave the setback for proper light and ventilation. Same shall be determined during the LAP preparation process. The FAR lost in final configuration of plot shall be allowed to be used on new plot configuration. Building height may be allowed up to permissible limits as per local conditions.

Step 6: Allow additional FAR and transfer of development rights: Authorities may consider selling additional FAR based on the carrying capacity of the upgraded infrastructure. Further, it will be allowed to buy and sell transfer of development rights within the area from one plot to another.

Step 7: Upgrade Street network and public infrastructure: Over a period, as land becomes available new street network shall be developed and public infrastructure must be retrofitted and developed to accommodate relatively higher densities.

JDA and JMC shall start with pilot approach to different areas. Regulations may be suitably modified to allow such redevelopment. Based on learnings from the pilot project, a policy and regulatory framework may be developed at the city level.

Intervention 1.3: Redensification of low-density urban form

A list of 10 large parcels of public housing land located in Jaipur's core areas has been identified through desk based research. The parcels are developed with low density and provide an opportunity for redensification for compact and sustainable development to promote affordable housing, vibrant economy, walkable to open spaces, while maximizing the carrying capacity of existing network infrastructure and utilities. Based on preliminary assessment, the public housing in Table 3.7 covers 225 Ha and with redensification initiatives will be able to accommodate an additional population of 56,000. The map below shows a list of all significant housing complexes.

A comprehensive exercise needs to be carried out by JDA and JMC to identify land parcels that can be taken up for in-fill development and re-densification. Such residential and mixed-use land parcels could be developed at optimal densities to accommodate additional population within existing developed areas. All such in-fill development and redensification shall consider carrying capacity of off-site infrastructure and must make provision for retrofitting of

TABLE 3.7 Public/Government Housing Lands

S. No	Public/Government Housing	Area (Ha)
1.	Jyoti Nagar	17.0
2.	Gandhi Nagar	91.1
3.	Bajaj Nagar	29.2
4.	Railway officer housing, Jagatpura	24.1
5.	Chambal GSS Colony	2.91
6.	Police Line Sodala	2.79
7.	Ganpati Nagar	18.6
8.	MNIT faculty housing	21.8
9.	Rajasthan University faculty housing	15.2
10.	MLA housing	2.95

Source: UN-Habitat

infrastructure to accommodate the additional population load. Building control regulations can be modified at an area level as per the site condition. Provisional measures are indicated below.

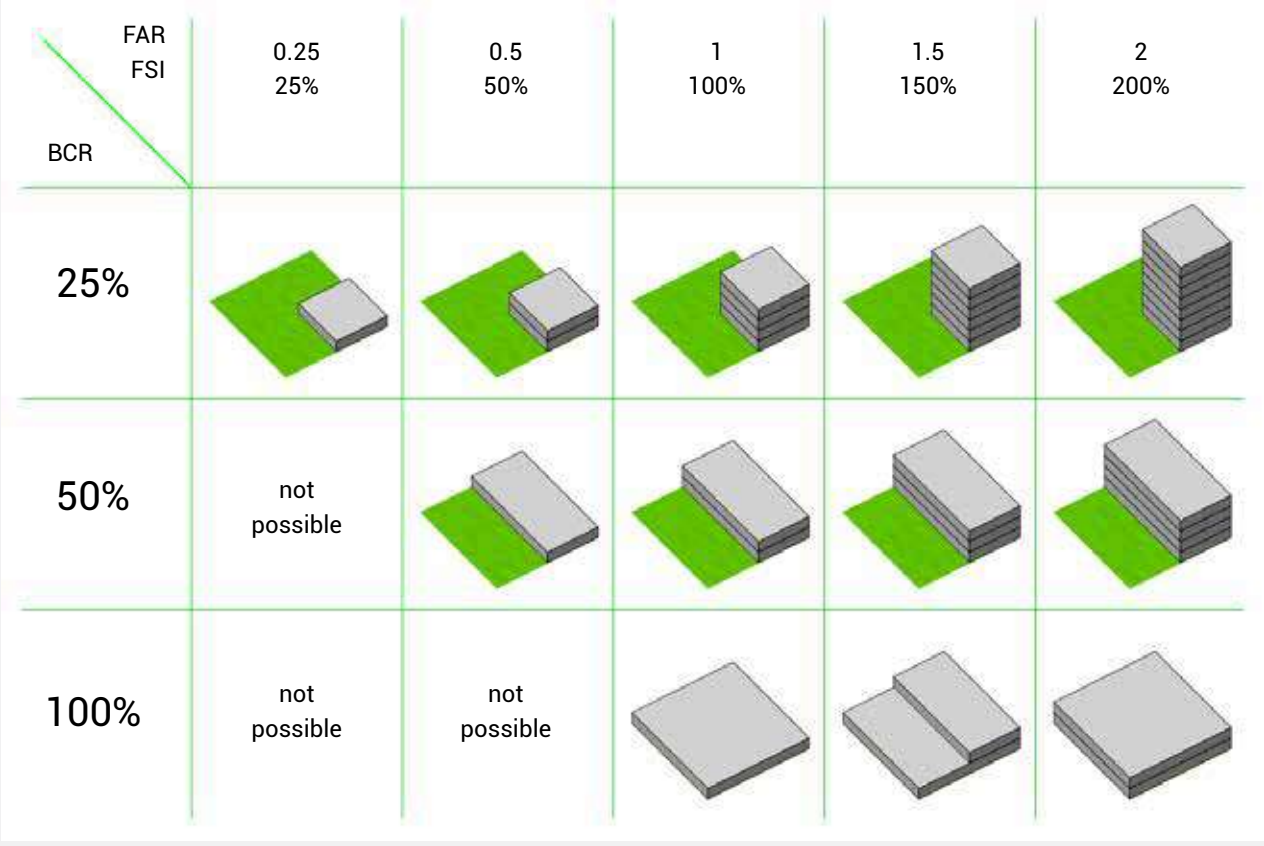
BUILDING HEIGHT: Allowing the addition of residential floors on existing buildings.

FAR: Allowing higher FAR to develop more floor space.

GROUND COVERAGE: Allowing an increase in ground coverage.

An illustration is shown below to demonstrate how FAR and Ground Coverage related to each other.

FIGURE 3.16 Pictorial representation of FAR (Floor Area Ratio) vs BCR (Building Cover Ratio)



Source: UN-Habitat

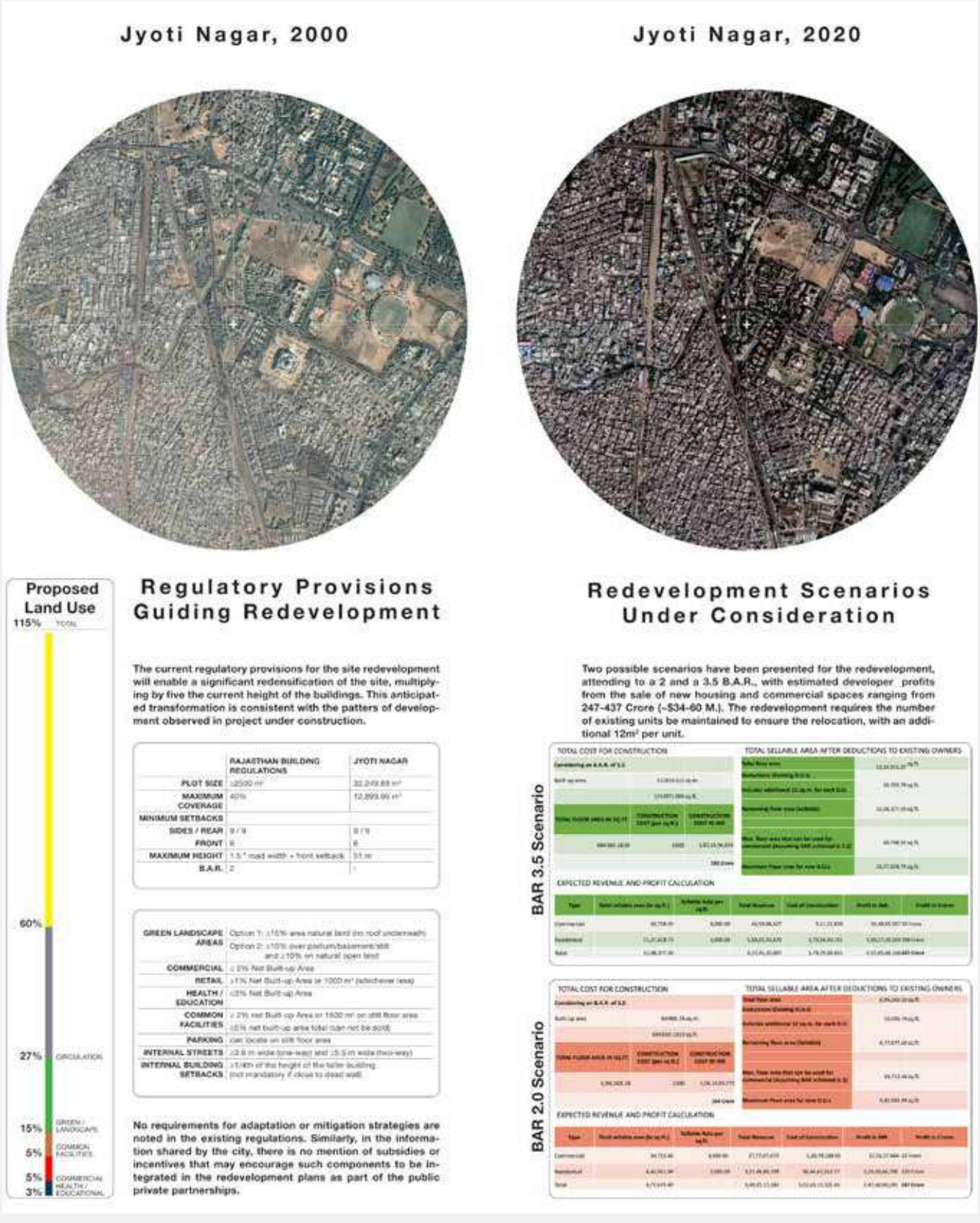
Demonstration of Redevelopment Strategy in Jyoti Nagar

Jaipur Development Authority had shown a keen interest in showcasing the redevelopment strategy at an area level. JDA suggested to prepare a proposal for Jyoti Nagar redevelopment. In this context, UN-Habitat collaborated with the University of Michigan to prepare redevelopment strategy for Jyoti Nagar Housing Board Flats. An extract from the study is presented here to demonstrate the strategy at an area level.

The Jyoti Nagar neighbourhood was built in 1980s sprawling over 3.2 ha to provide for low- and middle-income housing. Located in the central area of Jaipur, it is surrounded by government buildings, the SMS stadium grounds, and a short distance from the Walled City, recently declared a World Heritage site. The Jyoti Nagar Housing Board Flats redevelopment aims to upgrade the housing stock, increasing the dwelling sizes of the existing units, and to create additional housing in the district. With rapid redevelopment taking place in the area, this site offers an opportunity to use Public Private Partnership (PPP) to address housing shortage through dense and compact development schemes in central city areas. At the same time, this is an opportunity to establish innovative redevelopment parameters accelerating climate change action.

The original site plan for the Jyoti Nagar Housing Board Flats included the Om Shiv Jyoti Park at the heart of the neighbourhood, 70 low income-units averaging 44 sqm, 372 low-income units averaging 56 sqm, and 28 middle-income units averaging 70 sqm. The plan also included commercial space and a nursery school. Five different gates marked access to the neighbourhood. Real time data retrieved from Google Maps indicate that site usage has changed over time, and some buildings have already been demolished. The current planning regulations for the site establish a maximum land coverage of 40%. Setbacks and maximum heights define a higher buildable volume than the existing constructions. The redevelopment plan should follow the uses outlined on the right. B.A.R for the new development range from 2 to 3.5.

FIGURE 3.17 Comparison of Jyoti Nagar between 2000 and 2020



Source: UN-Habitat

FIGURE 3.18 Original Layout of Jyoti Nagar Colony

JYOTI NAGAR HOUSING BOARD COLONY, ORIGINAL LAYOUT

RESIDENTIAL BUILT-UP AREA OF EACH BLOCK

BLOCK TYPE	GROUND FLOOR (m^2)	G+1 (m^2)	G+2 (m^2)	TOTAL (m^2)
LIG1 - A	532.76	362.59	362.59	1257.95
LIG1 - B	621.56	408.97	408.97	1439.49
LIG1 - C	177.59	135.97	135.97	449.53
LIG2 - A	671.73	443.58	443.58	1558.90
LIG2 - B	895.64	664.06	664.06	2223.76
LIG2 - C	783.69	632.87	632.87	2049.43
MIG1	835.75	569.48	569.48	1974.71
TOTAL BUILT UP AREA (m^2)				10953.78

NUMBER OF UNITS AND SIZE PER DWELLING TYPE

Low Income Group 1, D.U. average build-up area	70 Units	44.39 m^2
Low Income Group 2, D.U. average build-up area	372 Units	55.92 m^2
Middle Income Group, D.U. average build-up area	55.92 m^2	69.65 m^2

Source: UN-Habitat

The original site plan for the Jyoti Nagar Housing Board Flats included the Om Shiv Jyoti Park at the heart of the neighbourhood, with 470 low- and middle-income units averaging 45 m^2 to 70 m^2, in 14 blocks. With an average of ground level plus two floors, the total FAR was 0.34. The plan also included commercial space, a nursery school, land for shops and a kiosk. The ground coverage is 4616.64 m^2, adding to a 14.32%. The total built up area is 10,953.78 m^2. Five different gates marked access to the neighbourhood.

If the B.A.R is increased to 2, the total residential floor space increases by 4 times of the existing residential floor space, and with the increase to 3.5, the total residential floor space increases by 8.5 times. The estimated population that can be accommodated in this area can be increased from 2,350 persons to 19,975 persons keeping the same housing mix. Hence more people can be accommodated, without using extra land.

Infill development, redevelopment and redensification are not exclusionary; each technique includes certain components from other ones. These three techniques add to the new vocabularies for southern urban practice (adding to actions like squat, repair, consolidate, instead of destroying and construction of new structures (Bhan, 2019)).[18]

FIGURE 3.19 Redevelopment of Jyoti Nagar Colony

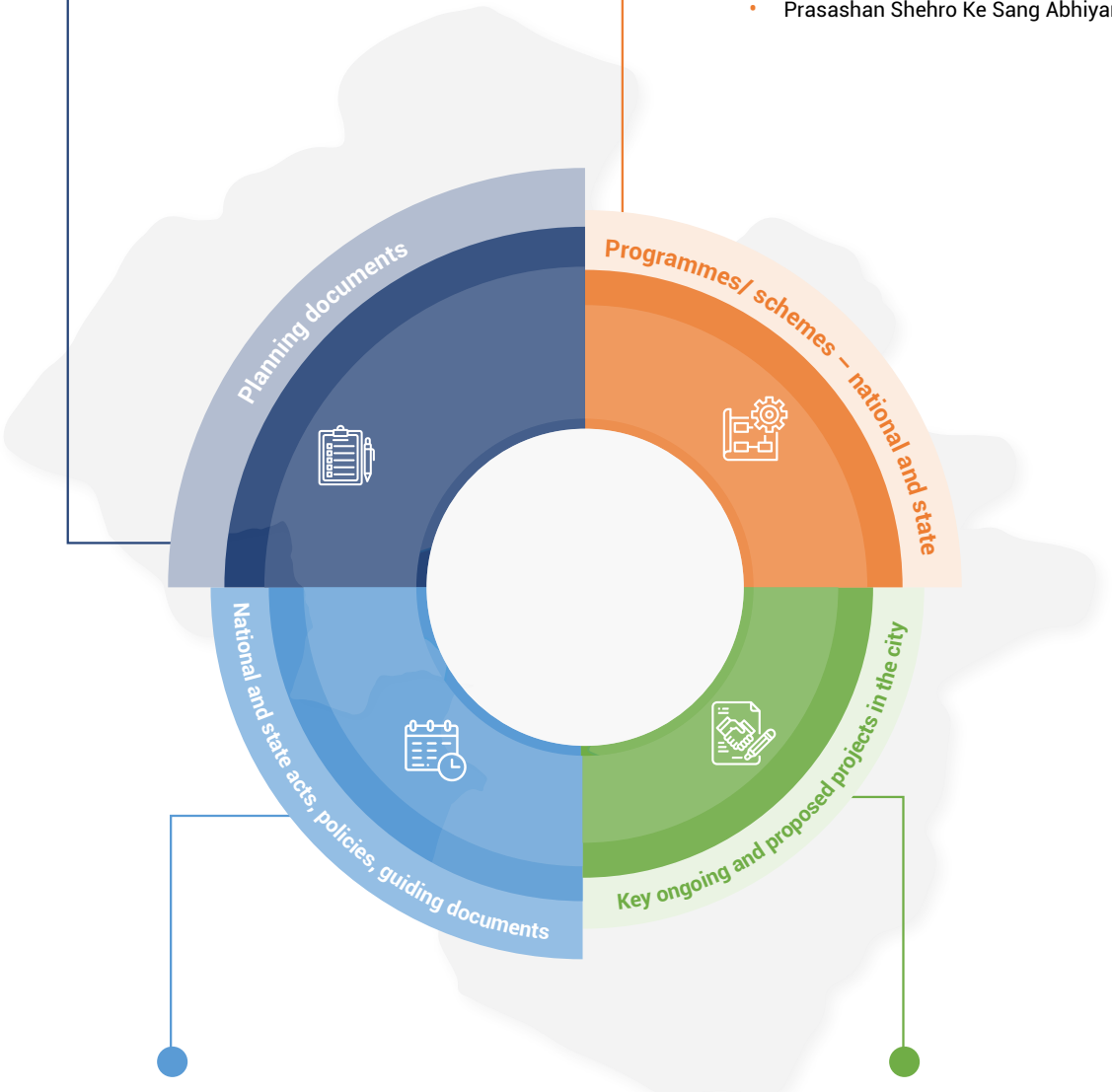
Source: UN-Habitat

18 Accessed at https://journals.sagepub.com/doi/pdf/10.1177/0956247818815792.

3.2.2 Alignment with national, state policies, programmes and on-going, proposed capital projects in the city

- Jaipur Master Development Plan 2025
- Jaipur Zonal Development Plans

- AMRUT
- AMRUT 2.0/ Jal Jeevan Mission (Urban)
- Pradhan Mantri Awas Yojana – Urban
- Mukhya Mantri Jan Awas Yojana – Urban
- Rajasthan Township Policy 2010
- Prasashan Shehro Ke Sang Abhiyan 2021



- National Mission on Sustainable Habitat 2021-2030
- Urban and Regional Development Plans Formulation and Implementation Guidelines (Volume 1) 2014
- Rajasthan Urban Development policy 2017
- State Sewage and Wastewater Policy 2016

- Master Development Plan 2050 (Process started in 2021)
- Development of MLA housing at Jyothi Nagar.
- Nehru Place Redevelopment Project
- Bapu Nagar Redevelopment Project
- Development of Central Park in Mansarovar.
- Extension of Jaipur Metro-rail Phase I (I-C and I-D) and Feasibility study for Phase II (TODs could serve as integrated land use-transport models.)

3.2.3 Gender Inclusion

In the housing redevelopment in public housing, creation of affordable rental housing for single women, single women with children, men and women with disability, or those with a single income suggested to be considered. At present 7 percent of all households in urban areas in Jaipur district are headed by women and significant gap in access to amenities in comparison to male headed households is found. Both housing price and loan for housing should take the component into consideration that women are lower-income than men in each socio-economic group, and low-income women are involved in informal sector employment with even lower and irregular income. Civil societies have innovative ways to finance such housing schemes (Nohn and Bhatt, 2014).[19]

In JMC, 72% are vulnerable groups (EWCA), with 26% women and 46% elderly, adolescents and children. The requirements of women, girls, people with disabilities, gender minorities in the city should be assessed and additional social infrastructure to be included. The facilities may include creches, shelters for survivors of domestic violence, shelters for homeless, counselling centers, working women's hostels. The high crime rate in Jaipur also emphasizes the need to be gender sensitive and incorporate needs of women. In total, crime reported in Jaipur 20 percent are GBV crime rate as per NCRB 2020.

Predominant share of gender-based violence (GBV) in Jaipur has been domestic abuse (46 percent of major reported GBV as per NCRB 2020). In case of Rajasthan more than one-fourth (25%) of women have experienced physical or sexual violence according to NFHS -5(2019-2021). The high gender gap in WPR in JMC, even though with less gender gap (12 %) in literacy (in comparison to Rajasthan state and Jaipur district), suggests that urban safety could also be a decisive factor for women in pursuing employment. It is recommended to include women and gender minorities in planning communities and incorporating concepts like Jane Jacob's "eyes on the street" to incorporate their needs in the housing infrastructure.

The interventions proposed within the strategic response-Jaipur as compact city supports towards gender equitable development in all its actions or interventions and specifically in redensification of public housing, in-fill development and TOD zones.

Redevelopment of public housing in PPP model could be of high impact in ensuring housing for all and equitable service provision. This could especially benefit vulnerable communities, including low-income groups and slum dwellers. Direct utilities and facilities provision in the redensification area should be sensitive to gender needs. As opposed to peripheralisation, redeveloping communities within central part of the city will mitigate women's time poverty aspect.

Creation of affordable rental housing for single women, or those with a single household income could be considered in redensification, with varied size and type of housing. The requirements of women, girls, people with disabilities, gender minorities in the city should also be included in the housing redevelopment. The facilities may include shelters for survivors of domestic violence, shelters for homeless, counselling centres, working women's hostels, etc. Civil societies that are working for low-income women should be engaged in the process.

The infill redevelopment of vacant land could improve urban safety by activating inactive zones and dark corners. Community parks, neighbourhood centres, vending zones, mixed use development; other activities proposed could create employment opportunities for women. In-fill development with the redensification of influence area of TOD with improved mobility infrastructure could encourage more women to travel with improved amenities. This may improve the women WFPR.

In providing social infrastructure gender inclusive bus stops, neighbourhood parks, as priority public infrastructure projects to be provided. Guidelines for gender inclusive recreational space design should be adopted from Annex X. A capacity building centre for women, people with disabilities and gender minorities as part of social infrastructure development could be considered. It can aid as a platform for representation, skill upgradation and initiate active engagement.

It is recommended to assess the existing shortage in social infrastructure for women, girls, people with disabilities, and gender and sexual minorities and allocate land for these. These include but are not limited to:

- Shelters for survivors of domestic violence
- Homeless shelters (men, women, families, gender minorities)
- Creches
- Primary education facilities
- Primary health care centers, along with skills development and information
- Working women's hostels
- Living facilities for the elderly

19 Accessed at https://www.wiego.org/sites/default/files/publications/files/Nohn-Mortgages-SEWA-WIEGO-TB8.pdf on 28.05.2023.

TABLE 3.8 Gender Inclusive Amenities

S. No.	Amenities	Requirements
1.	Nursing rooms	At least 1 nursing room in every bus terminal, ISBT, railway station and metro-rail station located in well-lit and easily accessible areas
2.	Public toilets	Male, female and universally accessible gender-neutral toilets in every bus terminal, ISBT, railway station and metro-rail station, available for using free of cost; located in well-lit and easily accessible areas.
3.	Waiting rooms	At least 1 AC waiting room for women, trans persons and families with public toilets at inter-state bus terminals and inter-city railway stations.
4.	Night shelters	Reserved accommodation for women, trans persons and boys of 15 years and below at inter-state bus terminals and inter-city railway stations at nominal cost, in line with NULM guidelines for night shelters. Emergency accommodation for women with boys of 15 years and below, and families.
5.	Pedestrian facilities	Universally accessible footpaths of at least 4m width in bus terminals, railway and metro stations, subject to a LOS approach.
6.	Bus stops	All bus stops have well-lit, shaded and universally accessible bus shelters with real-time and static information, display help-line and emergency phone numbers.
7.	Drinking water	Purified water for drinking to be provided, free of charge, at every bus terminal, ISBT, railway station and metro-rail station.
8.	Vending	Street vending areas to be provided within bus terminals for passenger convenience.
9.	Bus depots	Bus depots include at least one day-care centre, waiting room, nursing room, and well-maintained universally accessible gender-neutral toilets to encourage women and transgender staff.

Source: UN-Habitat

The mobility hubs are equipped with gender-inclusive amenities, and the requirements for major, mini and micro hubs be identified based on the mobility study and travel behaviour data.

3.2.4 Climate Convergence

The proposed interventions of infill development, redensification and redevelopment to make Jaipur a compact city shall not just help in compact city planning but also ease the access to urban infrastructure for the city residents. Promoting mixed-use mid-rise development shall help accommodate higher densities, which shall reduce the travel distances from home to workplaces, entertainment and institutional spaces. Currently, the city residents have average trip rate of 0.9 with an average trip length of about 11.9 Km as per UN ESCAP assessment of urban mobility in Jaipur using the sustainable urban transportation index (SUTI). Developing Jaipur as a compact city shall result in reducing the average trip length for the city residents. With a reduction of trip length by each kilometre keeping same modal share and vehicle type, it is estimated that city has a potential to reduce the GHG emissions by upto 16 per cent from the transportation sector.

3.2.5 Estimated Project Costs

TABLE 3.9 Cost estimates

S. No.	Intervention	Project	Block Cost Estimate (INR in Lakh)	Implementing Agency	Sources of Finance
1.	Redevelopment proposals for low density housing areas, targetting government housing areas, Railway colony, PWD housing, etc. Demolishing delapedated / old low rise structures and replacing them with new high rise high density built forms.	Prioritizing re-development through policy changes and making provisions for funding and Setting up PPP model for re-development and upgradation of old goverment and private housing from low density, low rise to High density mid rise.	909000	Housing Board / PWD	PPP
2.	In-Fill development of vacalt land parcels within JMC area.	1. Inventorisation of vacant lands present in the JMC limits using geo-database 2. Classify the land parcels based on ownership into public owned and private owned. 3. Identification of land parcels under residential and mixed land use. 4. Prioritize the public owned parcels based on residential density in 500 mt buffer zone. a. Priority 1 – Above 200 PPH b. Priority 2 – Between 100 and 200 PPH c. Priority 3 – Lesser than 100 PPH 5. Preparation of feasibility studies, concept plans and block cost estimation. 6. Preparation of DPRs and tender document for appointment of private developers and builders		Directorate of Local bodies. / Town Planning Department	PPP
3.	Development of high density nodes across city to create high density corridors across the city.	Special building regulations along identified public transport corridors to allow high density development.		Directorate of Local bodies.	NA
4.	Land use conversion charges under policy to be based on distance from the city core, distance from Public transport and urban infrastructure.	Development fee and levys for landuse conversion under the land revenue act to make provision of "surge" charges.		Directorate of Local bodies.	NA

3.2.6 USAF Indicators impacted

USAF indicators impacted are:
Urban sprawl is directly liked to 40 indicators (7 descriptive and 23 scored), the strategic interventions shall result in improvement of score for 25 indicators.

1.2,1.3,3.1,3.3,3.5,3.6,4.1,5.1,5.4,5.12,6.1,6.4,6.6,6.8,6.9,6.10, 6.13,7.1,7.3,8.3,8.4,8.9,8.12,10.4

3.3 Strategic Response 2: Jaipur As A 15-Minute City

Urban mobility has the highest number of interlinked urban sustainability indicators. The city's average transportation sector performance is a 'lower medium,' while the environment and ecology sector is a 'medium.' The examination of Jaipur's growth trends using spatial analysis, documents including the MDP 2025, Census 2011,

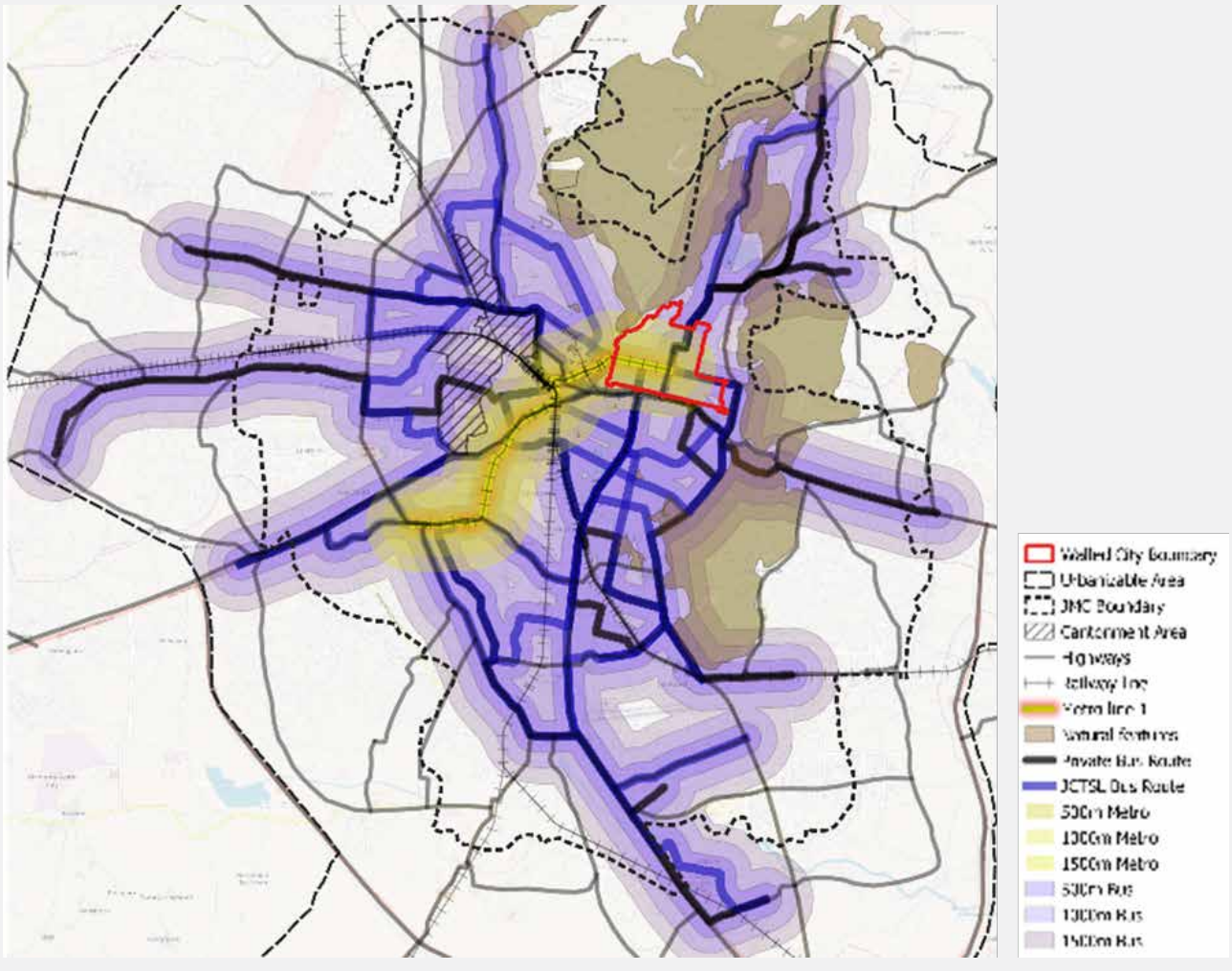
Comprehensive Traffic and Transportation Study 2019, and stakeholder interviews with numerous organisations, particularly the JDA, revealed some of the city's present growth and expansion problems.

To boost the public transportation system, route optimization is critical

Jaipur Transport Services Limited (JCTSL) operates and manages 31 bus routes in the city. On these routes, the city has minibuses run by private operators. After route optimisation, the JNNURM government launched a low-floor city bus service in 2007 with ten colour-coded city bus routes. Figure 3.20 depicts the routes served by Minibus routes in black and Low Floor bus routes in blue. The city bus routes are established for creating point-to-point connectivity around the city, with routes overlapping in many locations and connecting places from north to south and east to west.

Since 2008, Jaipur has grown and expanded in size significantly. The city bus service now serves 32.5 percent of the city's population within 500 metres of a bus stop, as seen in Figure 3.21. Public transportation coverage in newly constructed areas around the perimeter is severely constrained, with some city areas entirely without access to public transportation within a 1 km radius. The 14-kilometer long metro-rail network with 12 stations that serves a small population and overlaps with city bus routes. While as per CSE report, there are two buses per 1000 population in Indian cities, it is 0.000095 for Jaipur. For Jaipur Transport Service Limited (JCTSL), the wait time is as long as 40 minutes.[20] JCTSL has 273 buses as opposed to a requirement of 2000. The figure is 400 including private services.[21]

FIGURE 3.20 Public transport routes and their coverage in Jaipur

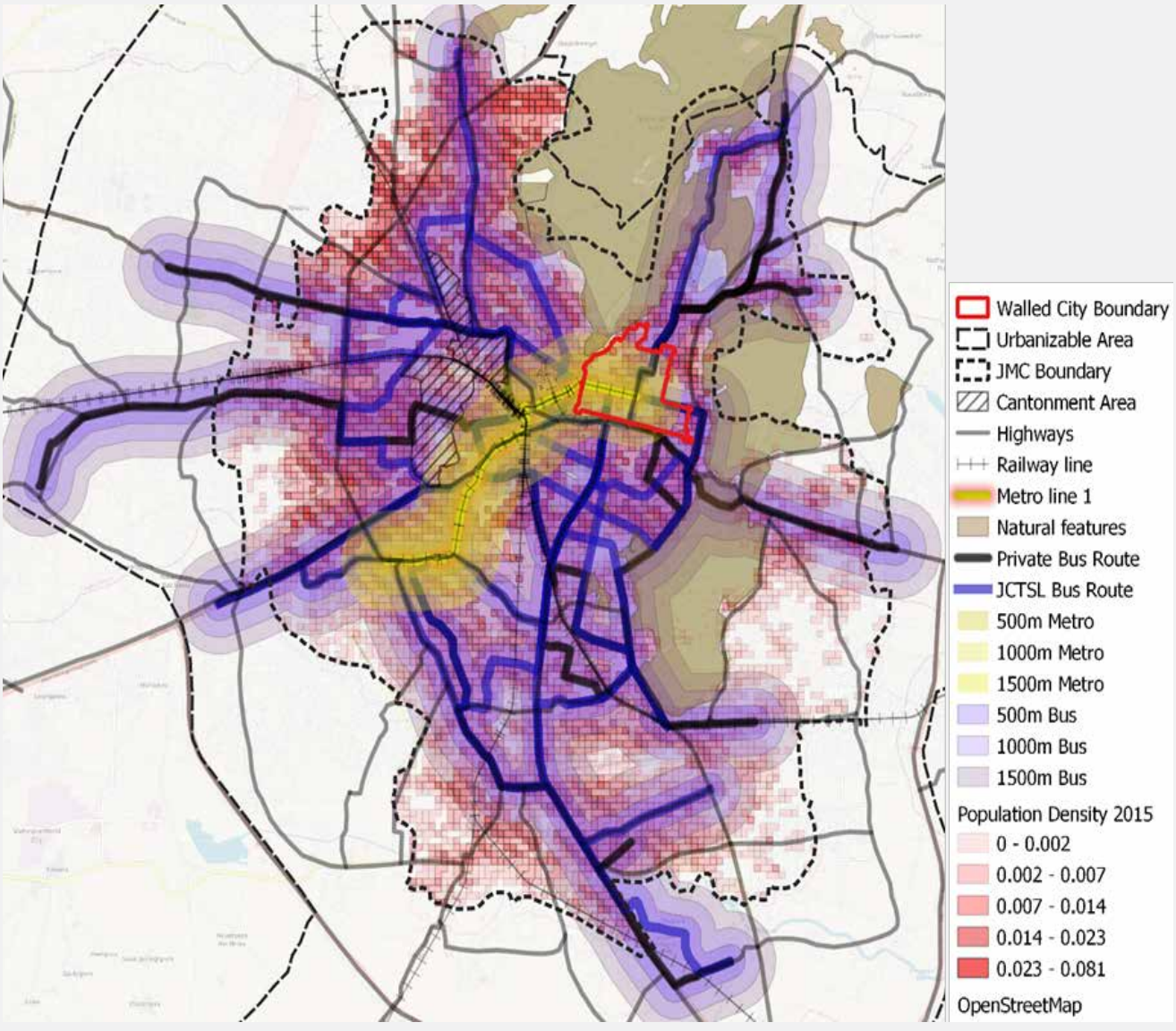


Source: UN-Habitat analysis with data from the Jaipur Development Authority

20 Accessed at https://timesofindia.indiatimes.com/city/jaipur/273-govt-buses-for-30-lakh-people/articleshow/71072071.cms on 28.05.2023

21 Accessed at https://www.unescap.org/sites/default/files/Jaipur%2C%20India.pdf on 28.05.2023

FIGURE 3.21 New developed areas with no coverage of Public Transportation Network



Source: UN-Habitat analysis with data from the Jaipur Development Authority

With only 14.4 percent of footpath coverage, the city has inadequate NMT infrastructure

First and last-mile connectivity is the backbone of any public transportation system. This is currently unavailable in Jaipur, except for informally operated paratransit system as an option. The average distance between transportation nodes is 100-1500 metres. To expand public transportation coverage, it is critical to provide first- and last-mile connectivity. The city has a significant fleet of e-rickshaws that serve as Intermediate Public Transportation (IPT). The sector is mostly unorganised, with no set route map or time intervals based on passenger demand. However, there is no structured network connecting them to formal public transportation. A few isolated segments of unprotected/ curb less bicycle pathways can be found along some of the major thoroughfares. At important crossings, there are no complete cycling loops or delineated pathways. Only 14.4 percent of roads have footpath. Due to encroachment and physical obstacles, there aren't enough contiguous walkways. Several pedestrian-vehicle collisions have occurred, raising safety concerns.

Low public transportation coverage and limited access to NMT affect urban mobility

Although Jaipur has a bus and metro network, analysis indicates that numerous areas of the city are underserved. Only, 32.5 percent of the city's population have access to a bus stop within 500 metres and only 2.5 percent have access to the metro rail. Because of its limited coverage, in addition to unaffordability of the low income groups to use metro-rail services, the Jaipur Metro-rail only serves a small number of local trips. JSCL has a larger service area, but its buses provide low comfort and convenience. They are mostly overcrowded, forcing commuters' to opt for privately-owned or rental vehicles. The number of buses are also much below standard as mentioned above.

The lack of NMT infrastructure, i.e., only 14.4% of the road length includes a sidewalk or bicycle lane on both or either side of the route, to meet first mile last mile connectivity, discourages people from taking public transportation. These sidewalks and bicycle lanes are even encroached upon by store owners or automobile parking.

A greater number of automobiles on the road causes two problems: traffic congestion and air pollution. Jaipur is the 8th most congested city in India and the most congested in Rajasthan.[22] In specific, certain areas like Tonk Road, JLN Marg, Hawa Mahal, and JDA circle face heavy traffic congestion during festivals.[23] In 2019, the annual mean PM10 and PM2.5 concentrations in Jaipur were 150 and 132, respectively, well above the CPCB air quality limits. Furthermore, the transportation sector accounted for 24% of the city's total GHG emissions in 2015-16. It has a negative impact on the residents of Jaipur's quality of life.

Weak urban mobility in Jaipur can be addressed using 15-minute city strategies

The 15-minute city is an urban planning concept that has been proposed as a way to make cities more efficient and reduce the amount of time people spend commuting. The idea is to break the city down into 15-minute walking zones, so that people can get to most of what they need without having to travel very far. This would also reduce the need for cars, since people would be able to walk to most destinations. First coined in 2016 by Sorbonne professor Carlos Moreno, the term defines a highly flexible urban model that ensures all citizens can access daily needs within a 15-minute distance.[24]

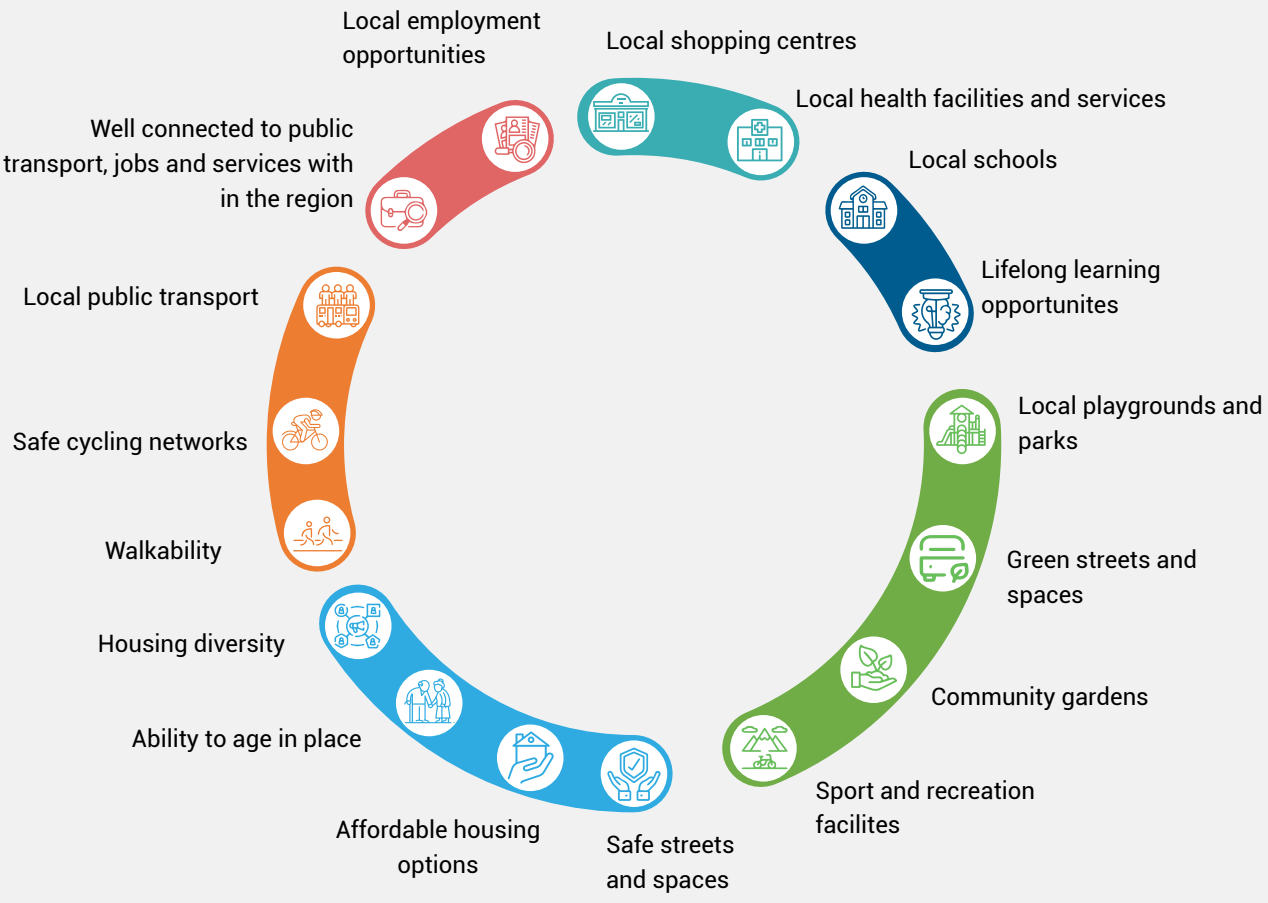
The following diagram represents the different features of a 15-minute neighbourhood. From these diagrams, it is noted that (1) local public transport, (2) safe cycling networks, and (3) walkability form the core principles for strengthening mobility in a 15-minute neighbourhood.

22 Accessed at https://timesofindia.indiatimes.com/city/jaipur/jaipur-8th-most-congested-city-in-india-us-study/articleshow/66572353.cms.

23 Accessed at https://timesofindia.indiatimes.com/city/jaipur/traffic-snarls-in-jaipur-due-to-heavy-rush-of-revellers/articleshow/73069128.cms.

24 https://www.archdaily.com/970873/the-concept-of-15-minute-city-wins-2021-obel-award

FIGURE 3.22 Different features of a 15-minute neighbourhood



Source: Authorities in Melbourne

3.3.1 Proposed interventions with strategic responses

Accordingly, the following strategic actions have been proposed that cut across these principles.

TABLE 3.10 Strategic interventions proposed

Intervention Matrix	Local public transport	Safe cycling networks	Walkability
Intervention 2.1: Creating multi-modal hubs to increase reach of public transport services through interconnectivity			
Intervention 2.2: Development of transit-oriented development zones along PT corridor with high density of built environment			
Intervention 2.3: Using NMT to improve first and last mile connectivity			
Intervention 2.4: Building a multi-functional complete street network			
Intervention 2.5: Promoting clean mobility through cleaner energy public and private vehicles			

Intervention 2.1: Creating multi-modal hubs to increase reach of public transport services

Intracity public transportation in Jaipur includes the metro-rail, low-floor bus service, minibus service, and e-rickshaws, with intercity connections provided via the airport, railway station, and bus stand. It is critical to combine the various modes seamlessly and allocate appropriate space for NMT, which can promote easy, safe, and universal access to people's mobility.

FIGURE 3.23 Schematic diagram of Multi-modal hub

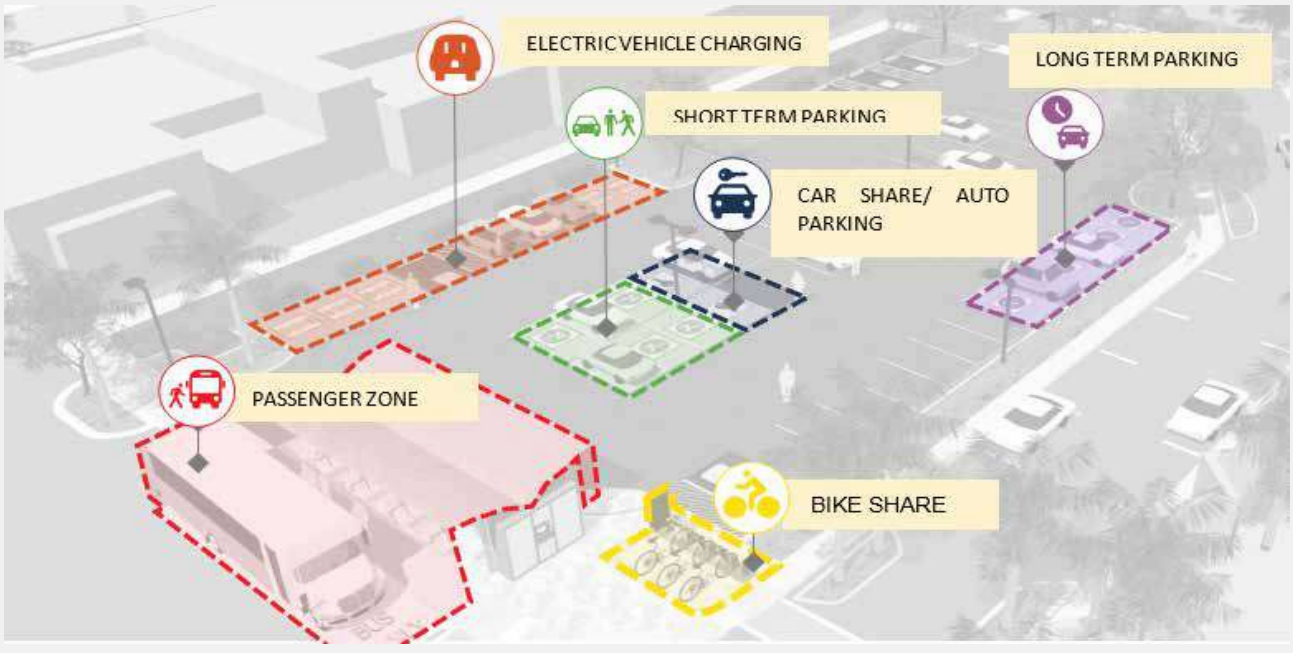
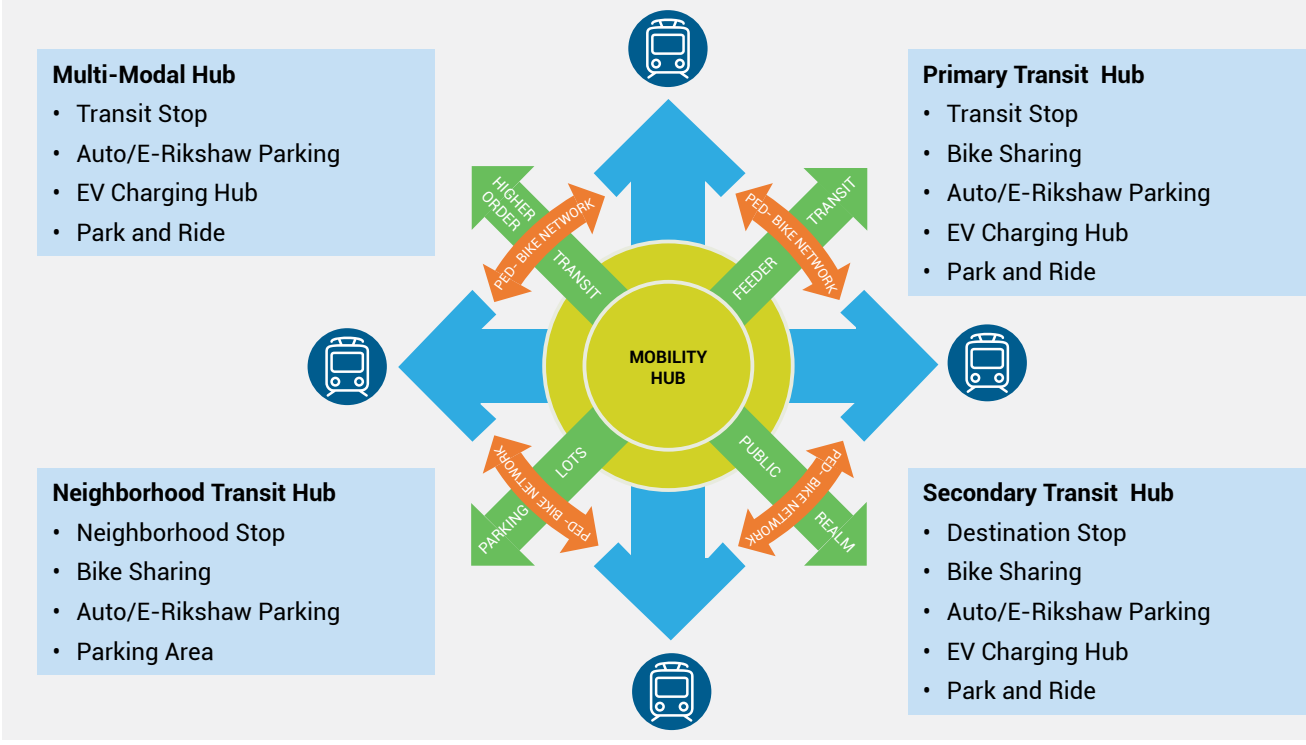
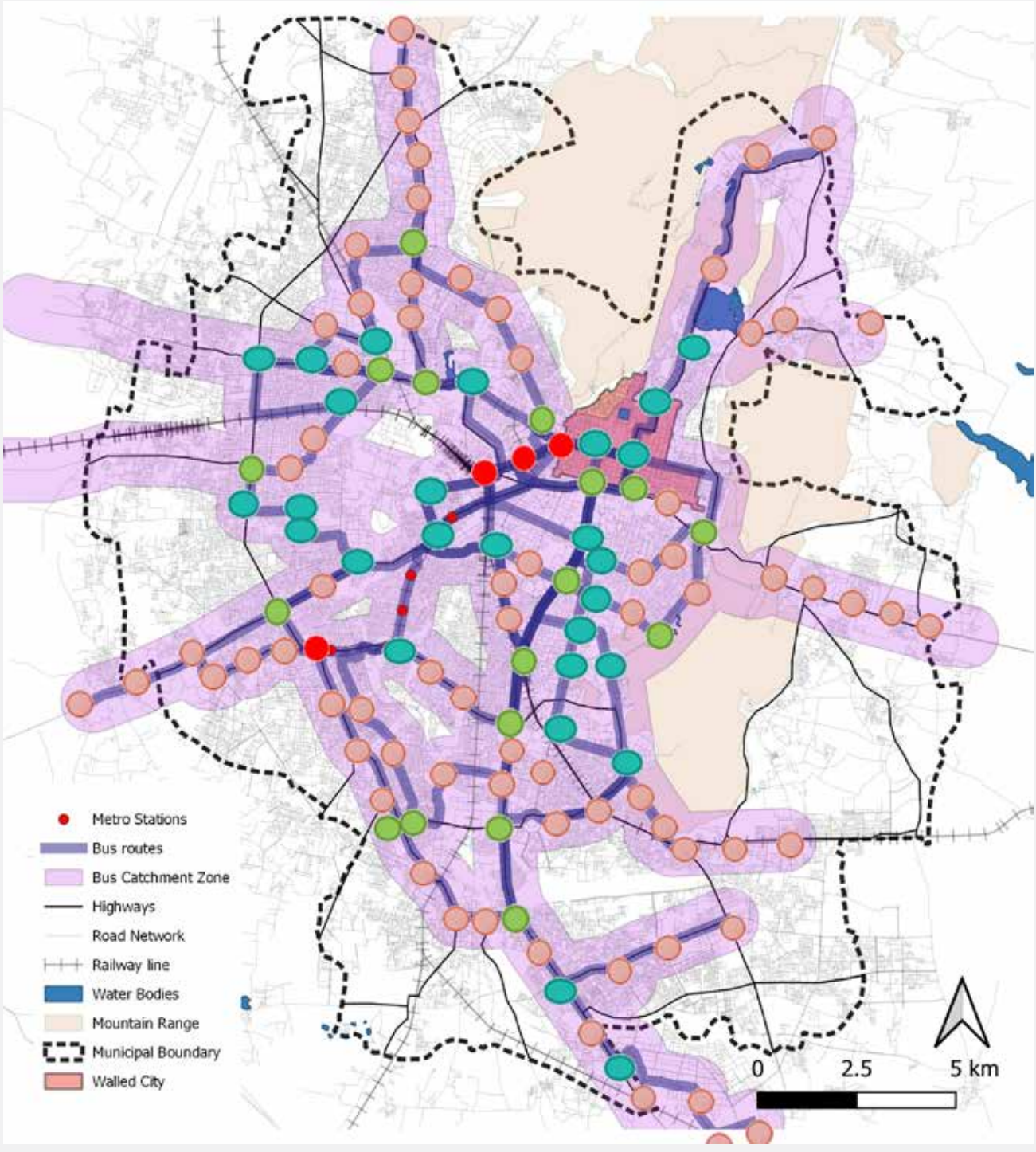


Figure 3.23 depicts a schematic concept for a multi-modal hub that includes NMT facilities, bicycle parking, e-rickshaw parking, personal vehicles, and EV charging stations to promote green infrastructure in the city. The amount of service at the node is used to classify transit hubs into four categories (see below).



Source: UN-Habitat

FIGURE 3.24 Location of Multi-modal hubs in Jaipur



Source: UN-Habitat analysis with data from the Jaipur Development Authority

Across the city, transit hubs are being proposed to improve passenger mobility from one mode to another. It links public transit networks such as the metro-rail and bus. Four multi-modal hubs are proposed near metro stations with more than six city bus lines. At nodes served by three to six bus routes, 17 secondary transit hubs are proposed. At nodes with one or two city bus routes, 25 neighbourhood transit hubs are proposed. Table 3.11 and Figure 3.24 depict the proposed transit hub locations throughout the city.

TABLE 3.11 Location of multi-modal integration nodes

Multimodal Hub	Primary Transit Hub	Secondary Transit HUB
Chandpol	Alka Cinema	Ramgarh Mod – Amber Road
Sindhi Camp Bus stand	Jhotwada Circle	Joravar Singh Gate
Jaipur Railway Station	Chomu House circle	Badi Chaupad
Mansarovar Metro Station	Panchawala Puliya	Choti Chaupad
	200-feet Bypass	Amba Bari
	SFS Mansarovar Junction	Boring Road
	Agarwal Farm	Kalwar Road
	Sanganer Junction	Jhotwada Industrial Area
	B2 Bypass Junction	Khirni Phatak
	Gopal Pura Flyover Junction	Kiran Palace
	Laxmi Mandir Junction	Gandhi Path Mod
	Rambagh Circle	Amrapali Marg
	Sanganeri Gate	Purani Chungi- Ajmer Road
	Ajmeri Gate	Sodala
	Old Transport Nagar	4 no. Dispensary
	Jawahar Nagar	India Gate Sitapura
	Pani Pech Chauraha	Haldi Ghati Marg
		Apex Circle
		Gaurav Tower
		OTS Crossing
		Jawahar Kala Kendra
		University Circle
		JDA Circle
		Trimurti Circle
		Narayan Singh Circle

Source: UN-Habitat

BOX - 3: CASE STUDY: MULTI-MODAL HUB AT VADODARA CENTRAL BUS STATION, GUJARAT

The bus terminal at Maharaja Sayajirao University, Vadodara, is in the city's centre. It serves 1550 buses each day and serves three states: Madhya Pradesh, Rajasthan, and Maharashtra. It is situated nearly 900 metres away from the railway station. The following are the key features on the multi-modal hub at the bus terminal:

1. Buses, private vehicles, and pedestrians have their own separate access and lanes to ensure safety and smooth flow of traffic.
2. Within the station, there are separate parking spaces for buses, private automobiles, auto rickshaws, and taxis to avoid traffic conflicts.
3. The terminal has public plazas in the shape of large foyers.
4. Passengers' pick-up and drop-off areas are zoned and well-designed with street furniture.
5. A pedestrian bridge connects the railway station and bus terminal, allowing for seamless transfers.

A schematic diagram of the multi-modal hub at Vadodara is shown in Figure 3.25

FIGURE 3.25 Emergent Design – Vadodara Bus Terminus

Source: CEPT Portfolio, 2018

In multi-modal integration, the commuters usually struggle and lose time to make payments and find change, which causes delays and traffic congestion. Fare integration for different modes of transport by introducing RFID enabled city travel cards will allow for "One trip – One payment" across all modes shall help reduce commuting time.

FIGURE 3.26 Multi-modal fare Integration

Source: UN-Habitat

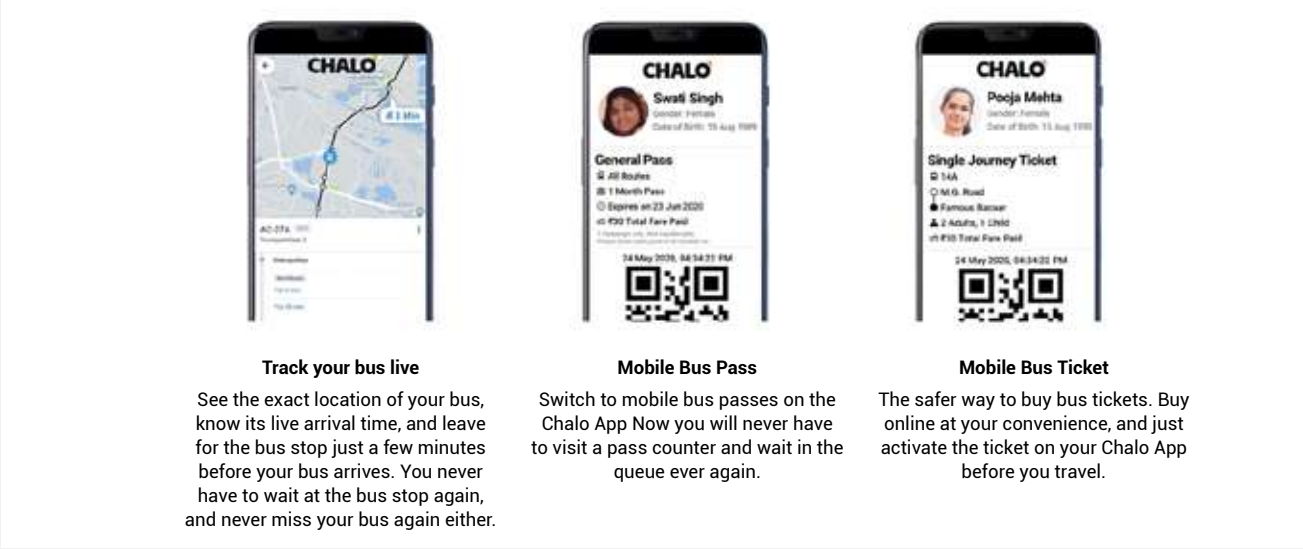
BOX - 4: CASE STUDY: IMPROVING CUSTOMER EXPERIENCE OF PUBLIC TRANSPORT BY CHALO

Chalo provides contactless one-tap card, Chalo Card (an NFC tap-smart card) processes the ticket with a simple QR scan and help the passenger avoid any physical contact with the conductor.

IMAGE 3.1 Chalo card

With a unique mobile number attached to each card or ticket, any single passenger can be traced through the bus network. Their entire bus-travel history can be plotted, and for each trip they've taken, all their co-passengers can also be traced and contacted. The company has partnered with bus operators, and various government entities involved in city transport services such as smart city special purpose vehicles (SPVs), city transport SPVs and departments, road transport corporations, etc.

IMAGE 3.2 **Chalo app**



Track your bus live

See the exact location of your bus, know its live arrival time, and leave for the bus stop just a few minutes before your bus arrives. You never have to wait at the bus stop again, and never miss your bus again either.

Mobile Bus Pass

Switch to mobile bus passes on the Chalo App Now you will never have to visit a pass counter and wait in the queue ever again.

Mobile Bus Ticket

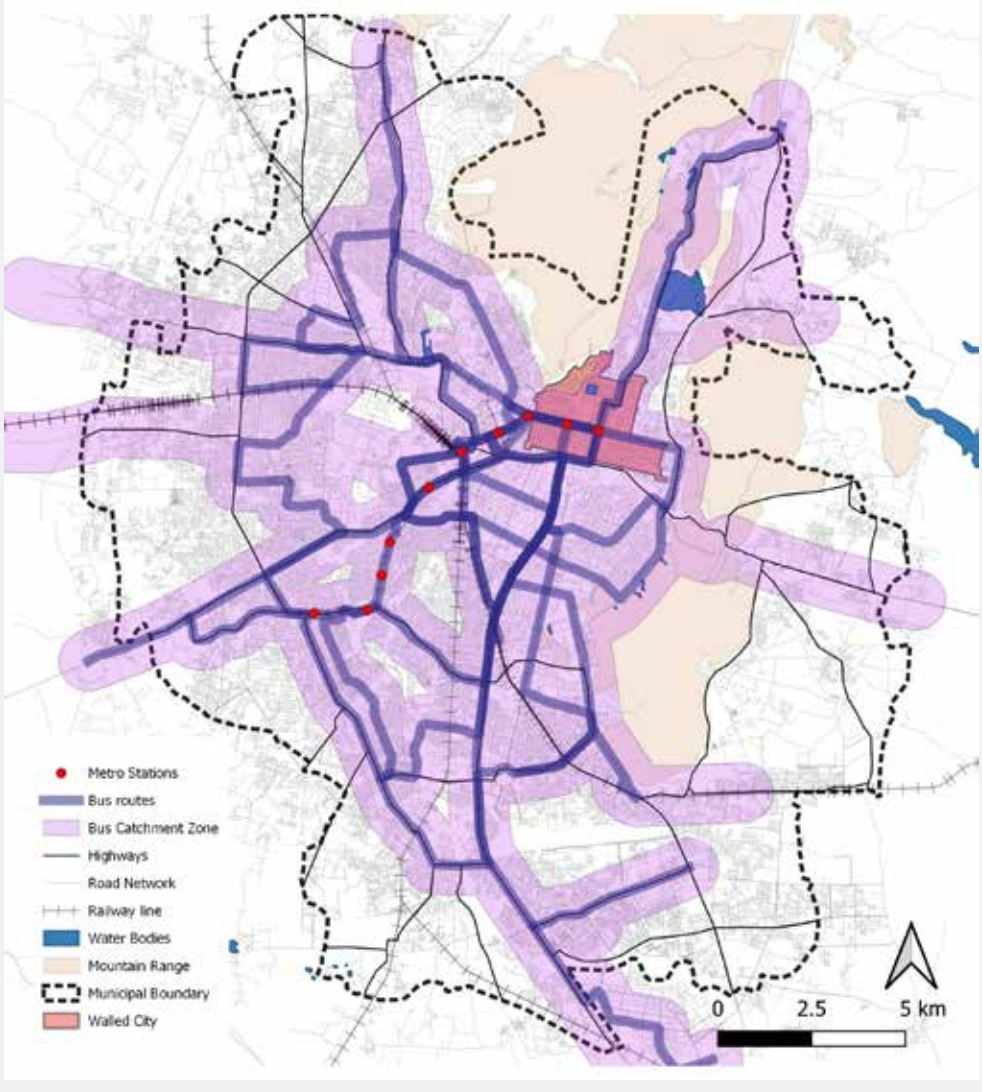
The safer way to buy bus tickets. Buy online at your convenience, and just activate the ticket on your Chalo App before you travel.

Intervention 2.2: Development of Transit-Oriented Development zones along PT corridor

Transit-oriented development (TOD) creates walkable neighbourhoods around transit stations. These neighbourhoods have mixed land uses including housing, office, retail, and other amenities that are accessible by foot, bicycle, or transit, with comparatively shorter trip lengths. TOD is increasingly popular as people prefer to live in walkable neighbourhoods.

TOD can help reduce trip length, traffic congestion, greenhouse gas emissions and pollution, as people will be able to get around more easily without having to use their cars. TODs should make provision for minimal parking requirement and impose high parking fee to discourage use of private vehicles.[25] It is important to include affordable housing within TODs as low-income population are captive users of public transport. Stakeholder involvement should be encouraged in the planning process including existing residents and property owners, to deliver sustainable and inclusive TODs, and avoid displacement of existing low-income communities (Chava and Newman, 2016).[26] It can also create more walkable and bike-friendly communities, which is great for public health. Jaipur was selected as one of 107 cities for Cycle4Change program promoted during Covid-19, even though it was not successful. TOD can also boost economic development. New businesses and developments tend to spring up around transit hubs, as they are seen as convenient and desirable locations. This can lead to increased job opportunities and a stronger local economy. TOD reduces the negative effects of urban sprawl while also providing residents with easy access to jobs, shopping, and other amenities.

FIGURE 3.27 Jaipur map showing public transit network, nodes and influence area



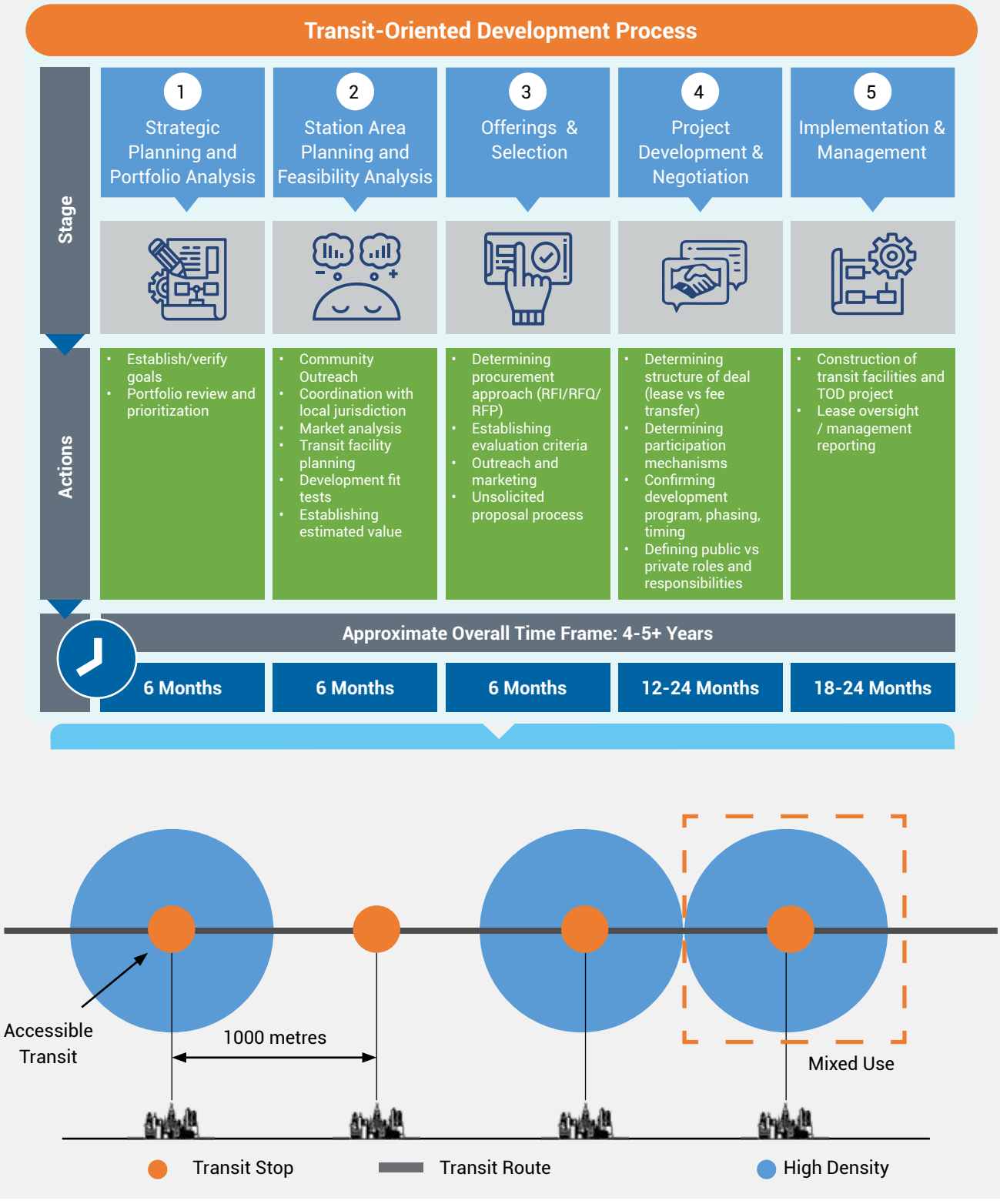
Source: UN-Habitat with data from JCTCL and JMRC

25 Accessed at https://mohua.gov.in/upload/whatsnew/59a4070e85256Transit_Oriented_Developoment_Policy.pdf on 30.05.2023.

26 Accessed at https://www.mdpi.com/2071-1050/8/10/1024.

Based on the analysis, the map above proposes transit hubs at the intersection of metro-rail and bus stations, at metro-rail stations, and at bus stations. According to NMT policy, influence zone is either established at a transit station or along the transit corridors. It is generally up to a radius of nearly 500-800m of the transit station. Where the distance between the transit stations is less than 1 km and there is overlap in the influence area, it can be identified as a delineated zone (around 500m) on either side of the transit corridor within 10-12 minutes walking distance.

FIGURE 3.28 TOD Process and Actions Example



Source: VTA Transit-Oriented Development Policy

BOX - 5: CASE STUDY: AN INCREMENTAL AND PROGRESSIVE APPROACH TO BUS-BASED TOD IN AHMEDABAD

The Ahmedabad Development Plan aimed to create a policy framework for incorporating TOD concepts into city planning and integrating present land-use and housing gaps with the expansion of transportation systems. The TOD zone will encourage and promote the area's regeneration and revitalisation, transforming it into a lively, mixed-use, transit-oriented, walkable district that attracts business, entertainment, and tourism.

The governing authorities have designated dense development zones termed Transit Oriented Zones around 200 metres on both sides of the BRT corridor in the Development Plan to encourage higher densities along BRTS corridors while maintaining the city's urban form. The city's central business district will be relocated from the east bank to the west bank of the Sabarmati River, primarily to integrate together high-density commercial land-use, waterfront recreational space, and the forthcoming Metro-rail corridor. Along the BRTS routes, the housing policy focuses on the integration of transit infrastructure and commercial activity. Offices, retail, and other business spaces, as well as some residential.

To develop TOD zones, the authorities implemented the following interventions:

- **Density:** The special zones, identified along the BRTS and the proposed Metro-rail corridors will have higher permissible FSI. Differential FSI in the city range from the highest of 5.4 in CBD, 4.0 in the transit corridors and 1.8 (with chargeable FSI up to 2.25) in other parts of the city. FSI of 4.0 is proposed to be implemented along a 41 km stretch.
- **Diversity:** The land-use distribution within the impact zone remains flexible and is broadly marked for mixed use as decided by the market. It is imperative that the areas marked under influence zone would not have segregated land-uses and single use zoning.
- **Parking management and NMT:** A pedestrian-only zone is intended to run parallel to the riverfront development in the existing CBD area. The updated Development Control Rules 2021 suggest changing parking regulations to include "restricted parking in pedestrian zones." The Development Plan also recommends raising parking fees in the central business district. In 2014, the AMC introduced "MYBYK," a bike-sharing service at four BRT stations (Shivranjani, Andhajan Mandal, Memnagar).

Housing: Low-income housing proposed along the Sardar Patel Ring Road about 16.5 km away from the city center, will be used for rehabilitating the city slum dwellers. The development strategy proposes to develop “nodes of intersection" between the SP Ring Road and the existing BRTS corridors to extend public transportation to the location, which will lead to a finger shaped development along the periphery of the city, and help maintain the compact nature of the development. This is in addition to infill development, redevelopment and redensification of the central part of the city.

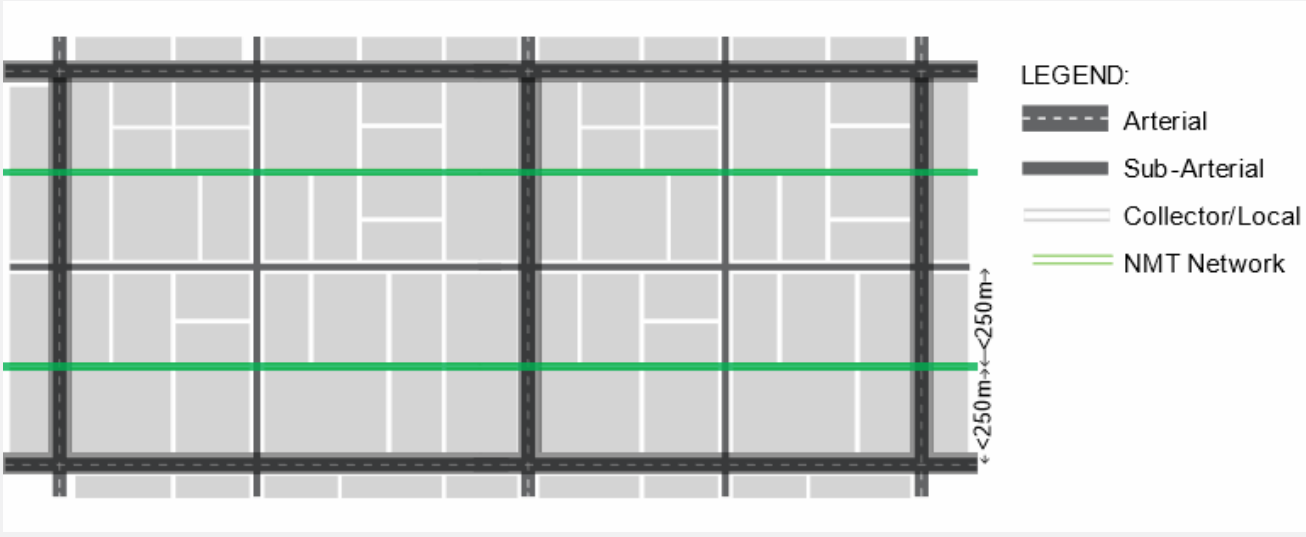
Intervention 2.3: Using NMT to improve first and last mile connectivity

Improved street connections between transit stops and other destinations can improve first and last mile connectivity. Figure 3.29 depicts the neighbourhood's schematic layout, identifying a clear hierarchy of streets to allow a wide range of traffic patterns and dedicated lanes for the NMT network, including pedestrian, bicycle, and vehicular movement within and among neighbourhoods. This will boost the city's public transit share.

Non-motorized transport (NMT) primarily includes walking and cycling. It provides an efficient, healthy, and affordable means of transportation for short and medium distances. It can provide people of all ages, abilities, and socio-economic groups with opportunities for recreation, physical activity, and social interaction. It also has environmental benefits by reducing traffic congestion and greenhouse gas emissions.

NMT has a number of advantages in metropolitan areas. NMT helps to improve the urban environment by reducing traffic congestion, increasing air quality, and reducing noise. Since the vulnerable groups, including urban poor, women, disabled population, who are structurally low-income due

FIGURE 3.29 Dedicated lanes for NMT



Source: UN-Habitat

to restricted mobility, generally captive users of NMT or 'forced walkers' (Mahadevia and Advani, 2016),[27] and for much longer trip length. The economic benefits of NMT include reduced fuel consumption, increased affordability, inclusiveness in urban areas, and more tourism. Among the social benefits are enhanced road safety (India has the highest numbers of fatal road accidents worldwide where pedestrians and NMT users are the main victims)[28] and accessibility, better placemaking, improved public transit access, and physical wellness.

Within a 500-meter walkable radius, 32.5 percent of the city's population has access to bus stops. With NMT infrastructures such as cycle tracks and a bike-share facility, these bus routes can be extended to serve the people residing beyond 500 metres. A network of e-rickshaws is also planned to serve the city's population beyond 1 km. Figure 3.30 illustrates that the present public transportation network can serve 92% of the city's population by extending bus routes through the e-rickshaw network.

The Ministry of Urban Development published the NMT guidance document in 2016 to promote non-motorized transportation in cities. NMT guiding principles emphasise connecting areas and making them accessible to people rather than automobiles. An interconnected NMT network, complete streets, bicycle friendliness, walkability, comfort, universal accessibility, safety, security, signage, and encroachment prevention are among the NMT principles. Although the government published appraisal checklist does not include, NMTs should be adaptive and resilient to climate change related events such as extremely hot days and urban flood. Since the vulnerable groups including urban poor are captive users of NMT, they should be able to use it during extreme weather events with comfort and safety. The existence of the informal sector, mixed-use development, transit priority, parking management, support for the bicycle industry, and establishing a cycling culture among city residents are all factors that support NMT in an urban area.

27 Accessed at https://www.sciencedirect.com/science/article/abs/pii/S1361920916000055.

28 Accessed at https://www.orfonline.org/expert-speak/why-do-indian-roads-top-the-international-table-of-road-deaths/.

FIGURE 3.30 NMT Guiding principles

Source: Consultancy Services For Developing Guidance Documents For Transit Oriented Development (TOD), Non-Motorised Transport (NMT) And Public Bicycle Sharing (PBS) by SUTP, Ministry of Urban Development, GoI, and UNDP (2016)

Accessed via https://smartnet.niua.org/sites/default/files/resources/nmtguidancefinal.pdf

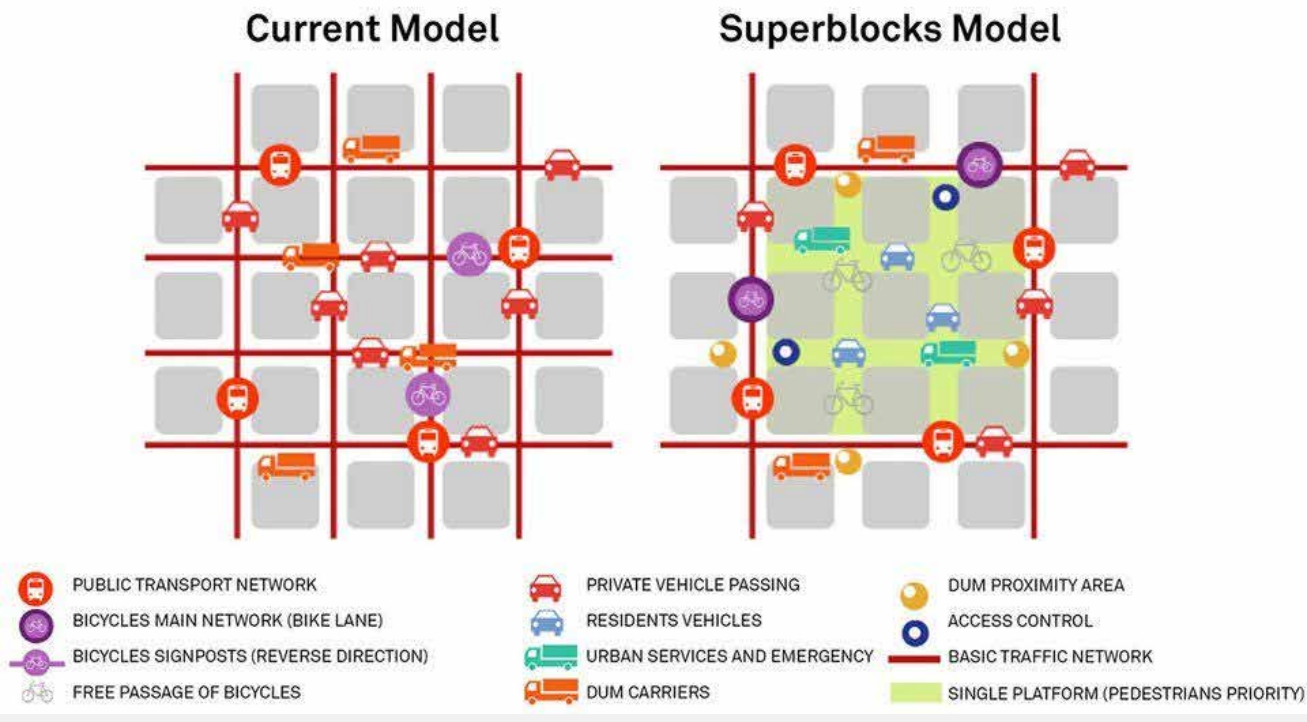
BOX - 6: CASE STUDY: SUPERBLOCKS APPROACH IN BARCELONA

The superblocks are an attempt to reclaim the streets from automobiles. This will aid in the creation of additional public areas and the facilitation of active transportation, as well as the reduction of noise and pollution, and the improvement of overall quality of life. These are slow-streets for cars with limited room, allowing other street users to take over.

Superblocks combine measures that improve local quality of life while maintaining mobility in residential neighbourhoods, despite taking space away from cars. With large footpaths, there are 'pop-up' cycle lanes, sitting spots, and minimal parking. Cafes and shopping places can expand out on the wider pathways within specific boundaries. These are 'temporary' measures, thus the street layouts may alter if needed.

Superblocks have the following benefits: reduce the number of passenger cars by a large amount; hence, reducing traffic congestion, improve the quality of life and make places more welcoming; strengthen local retail, trade, and hospitality; strengthen neighbourhood structures and social cohesion; make roads safer for everyone; create public spaces with low traffic; improve conditions for pedestrians and cyclists; and avoid urban heat islands.

FIGURE 3.31 A comparison between the current model and superblocks model



Source: https://barcelonarchitecturewalks.com/superblocks/

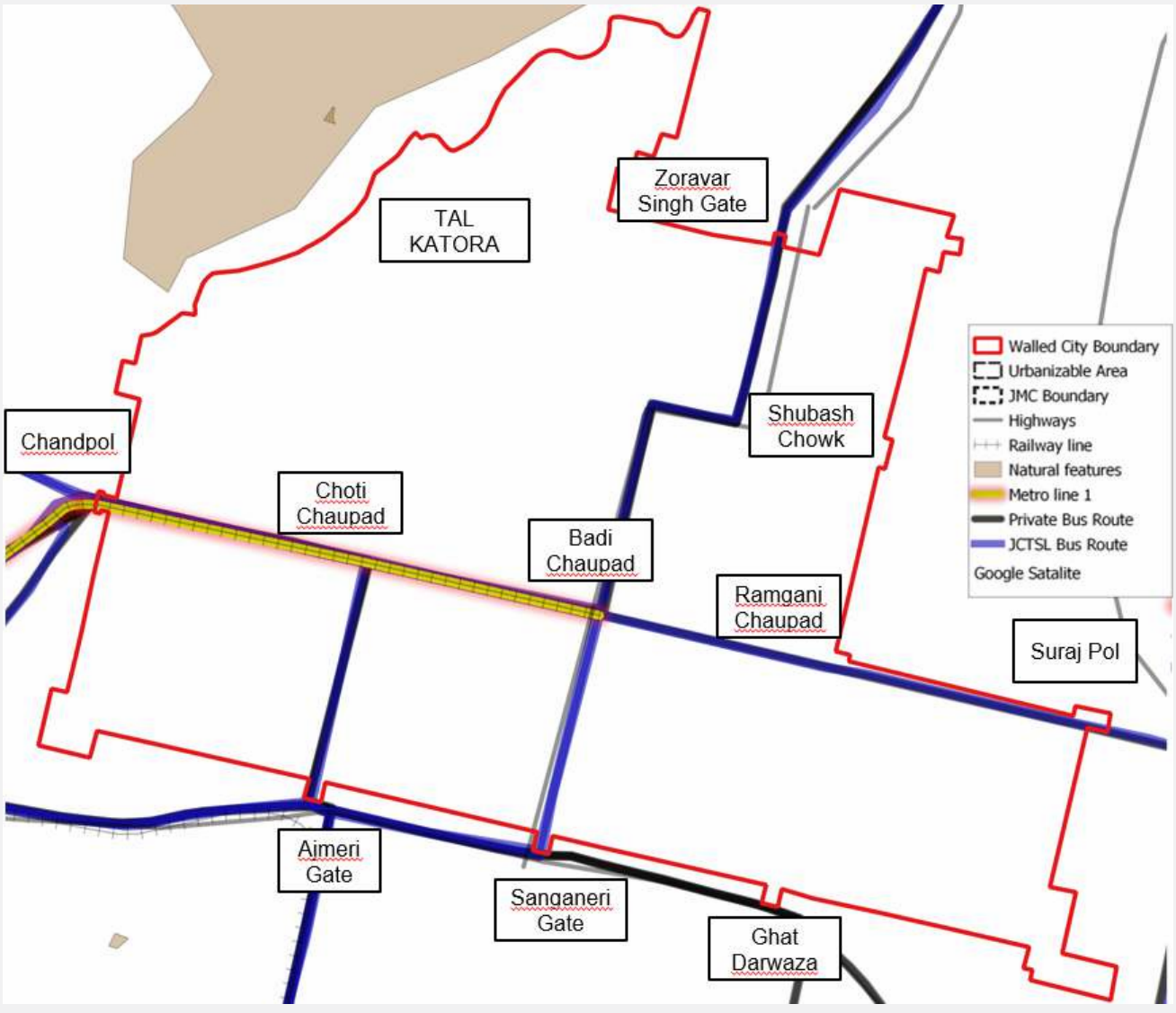
Two pilot locations, the Walled City of Jaipur, the UNESCO heritage site, and the area around Barkat Nagar, have been chosen to demonstrate how the concept of NMT can be integrated at local area level.

Area 1: Jaipur walled city

The city's central business district, the walled city area, is densely populated and has a large share of commercial land uses. This area is designated as a UNESCO world heritage city and contains a variety of historic buildings and tourist attractions. The Smart City of Jaipur has designated the area for physical and social infrastructure upgrades as part of its area-based development programme.

Metro-rail, low-floor buses, minibuses, and a vast fleet of informally running e-rickshaws serve the neighbourhood. Traffic congestion is typical due to mixed traffic with parking and the informal sector-operated IPTs and vendors. While informal sector vendors should be retained

FIGURE 3.32 Jaipur walled city area

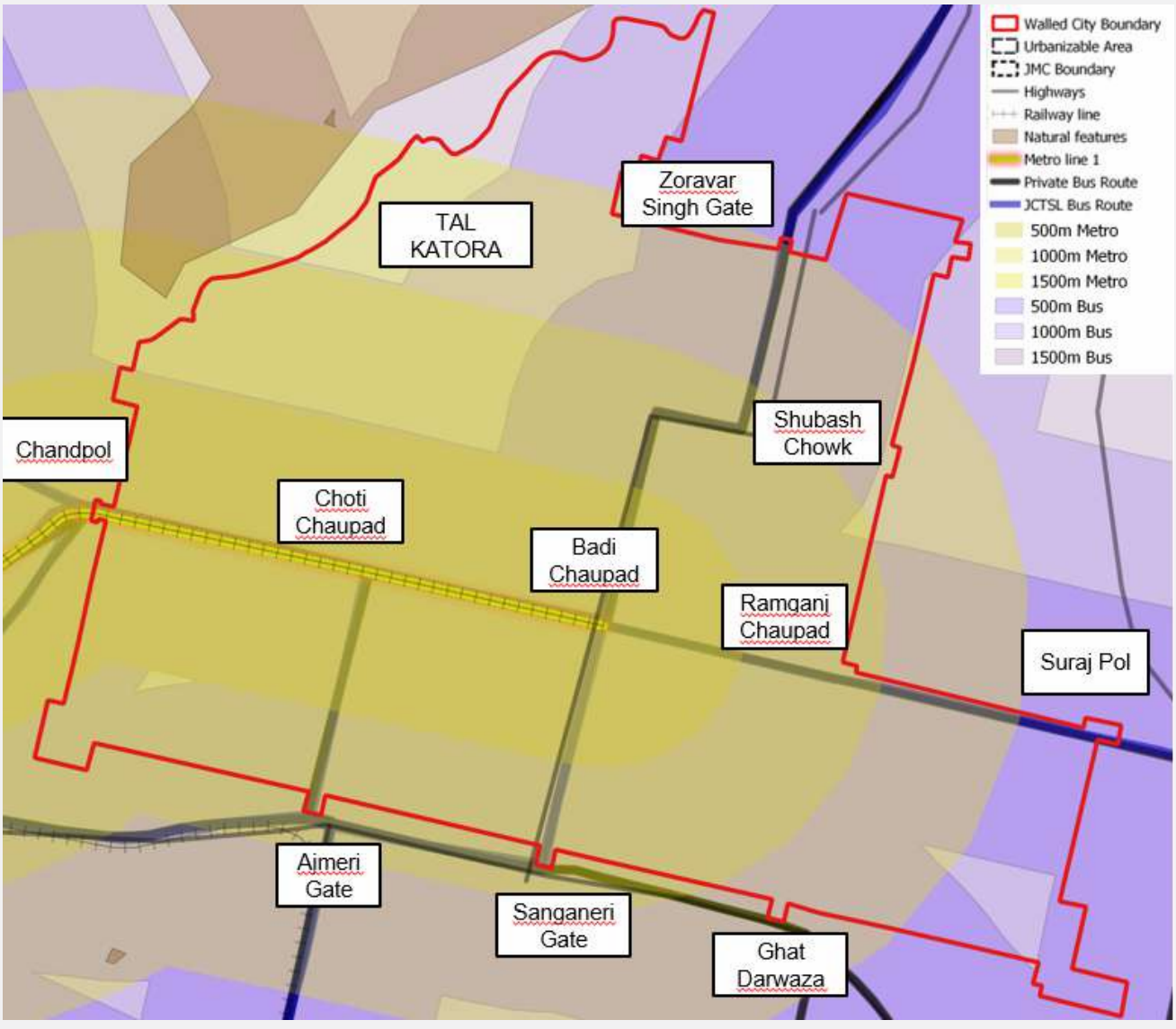


Source: Google earth – Base map

in pedestrian areas, especially with tourists, mixed traffic will have to be removed. With about 65 percent of the population living within walking distance of a bus stop, public transportation is fairly accessible.

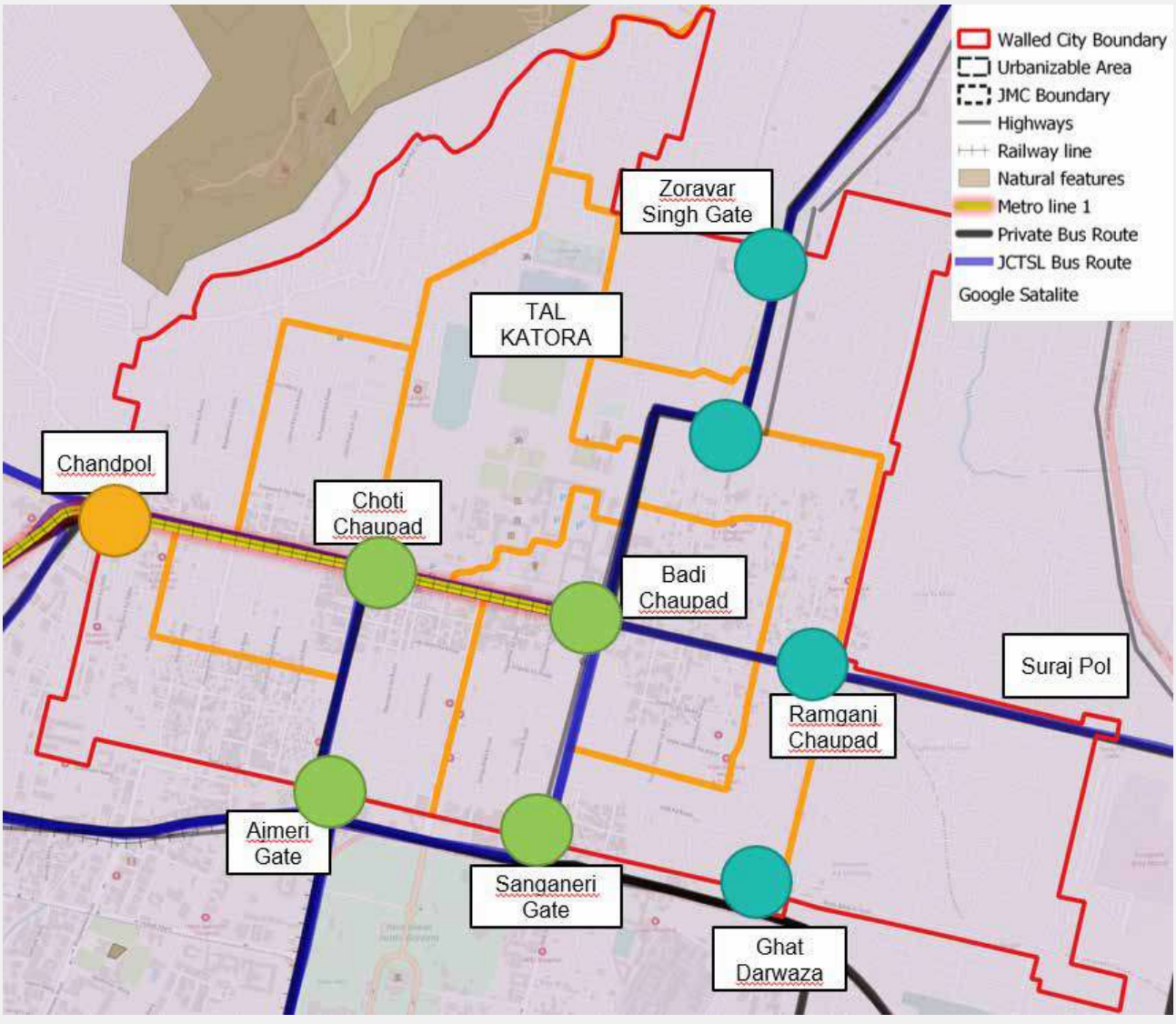
To cater to the population beyond the walkable distance, public transportation extension is planned by building transit hubs and transport nodes (Figure 3-33), with the provision of waiting rooms, e-rickshaw parking areas, cycling stands, and EV charging stations. Establishment of NMT priority corridors around the city to formalise routes for e-rickshaws and vehicles travelling at speeds of up to 25 kilometres per hour. The identified NMT routes in the walled city region are highlighted in orange in Figure 3-34. The route was chosen based on available road width and connecting the city's points of interest.

FIGURE 3.33 Coverage of Public transport network in the walled city area



Source: Public transport routes from JSCL & Metro, Google Maps

FIGURE 3.34 Public transportation nodes and identified e-rickshaw routes



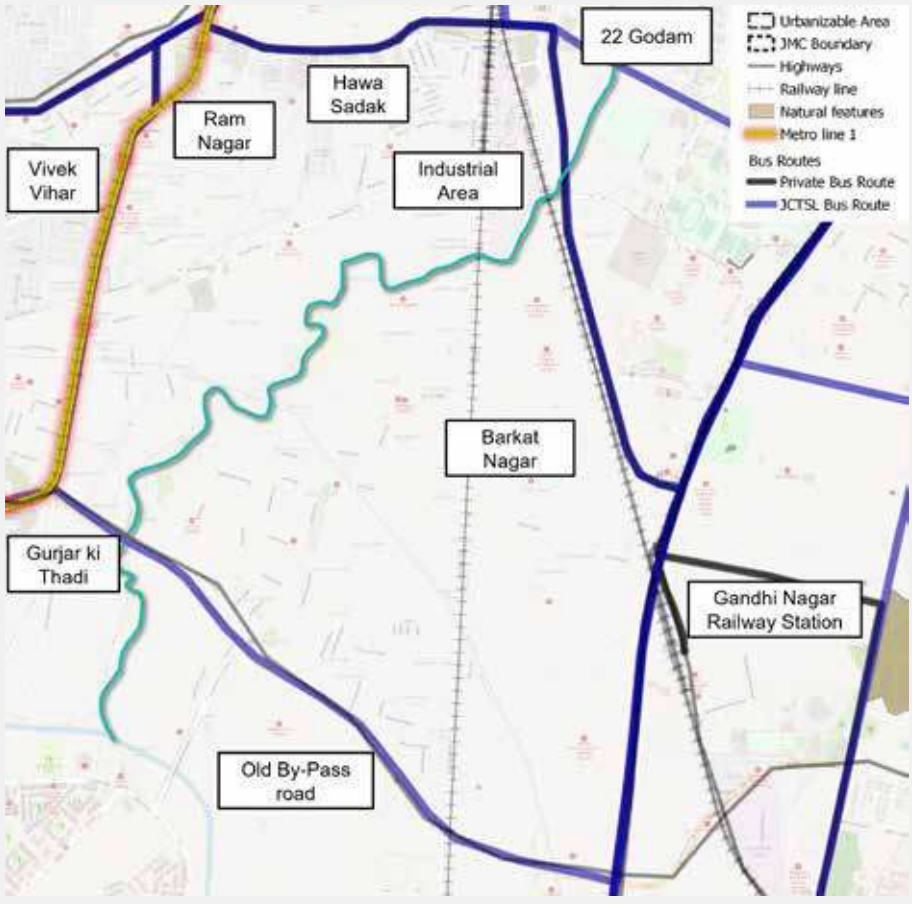
Source: UN-Habitat

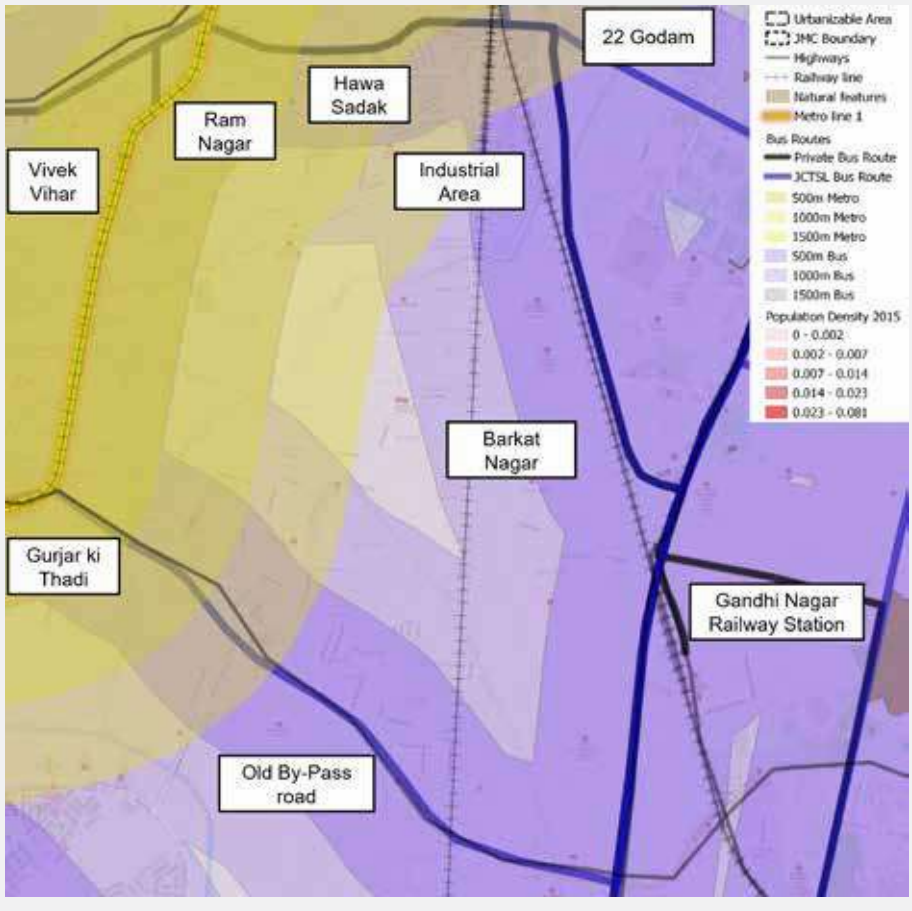
Area 2: Barkat Nagar

Hawa Sadak to the north, Sehkar Marg to the east, Tonk road to the south, and New Sanganer road to the west define the Barkat Nagar area, which spans 9.15 square kilometres. The neighbourhood is mostly residential, with some business activity along the major roadways. Sudarshanpura, the city's historic industrial neighbourhood, and Bais Godam, the city's former railway goods station, are also in the area. Physical impediments such as a drainage channel and a railway line split the area, making travel challenging.

Around the 1970s, the area began to expand into a dense residential neighbourhood. Farmers sold their land to build area for houses for city dwellers. Multiple housing schemes were designed in isolation in the area, therefore there is no road hierarchy or higher-order physical and social infrastructure. Several city bus routes and the metro-rail serve the area's fringe on the western side. However, due to physical impediments such as the railway line and the drainage canal, access to public transportation infrastructure is limited (Figure 3-35). Within a one-kilometer radius, almost 40% of the population does not have access to public transportation.

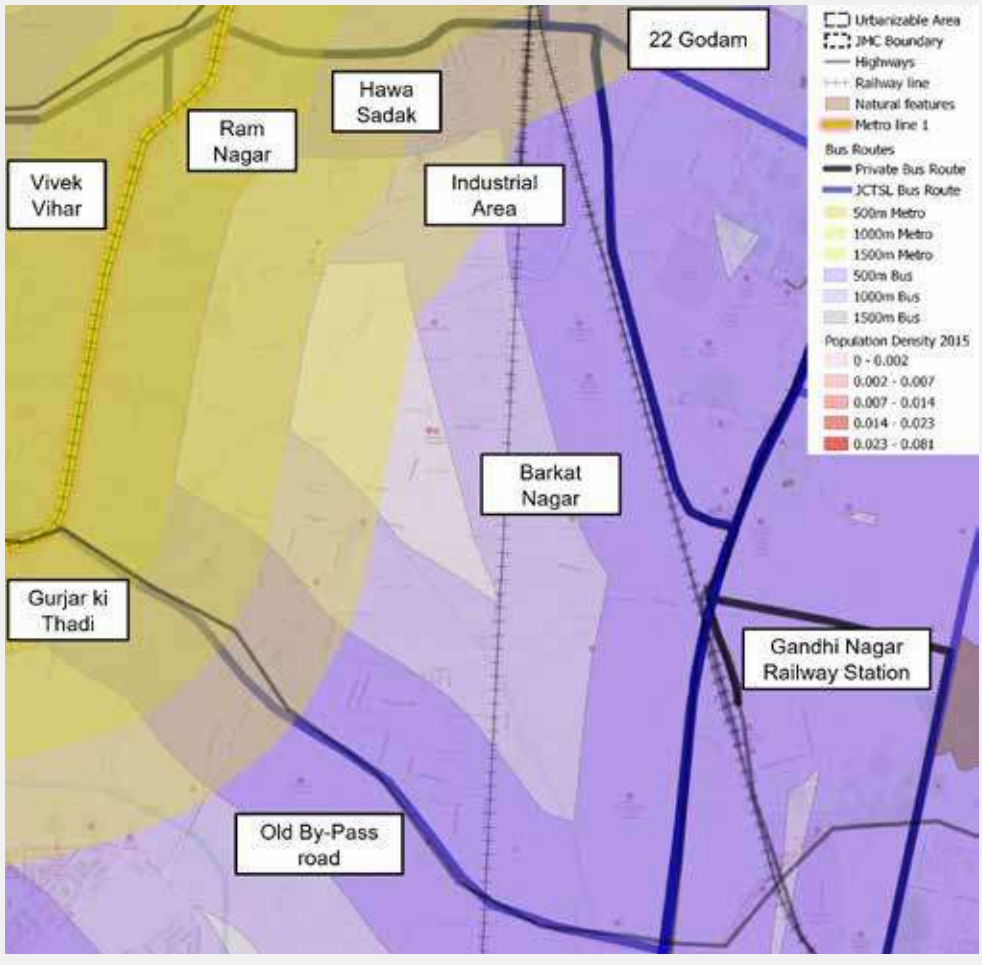
FIGURE 3.35 Location map of Barkat Nagar





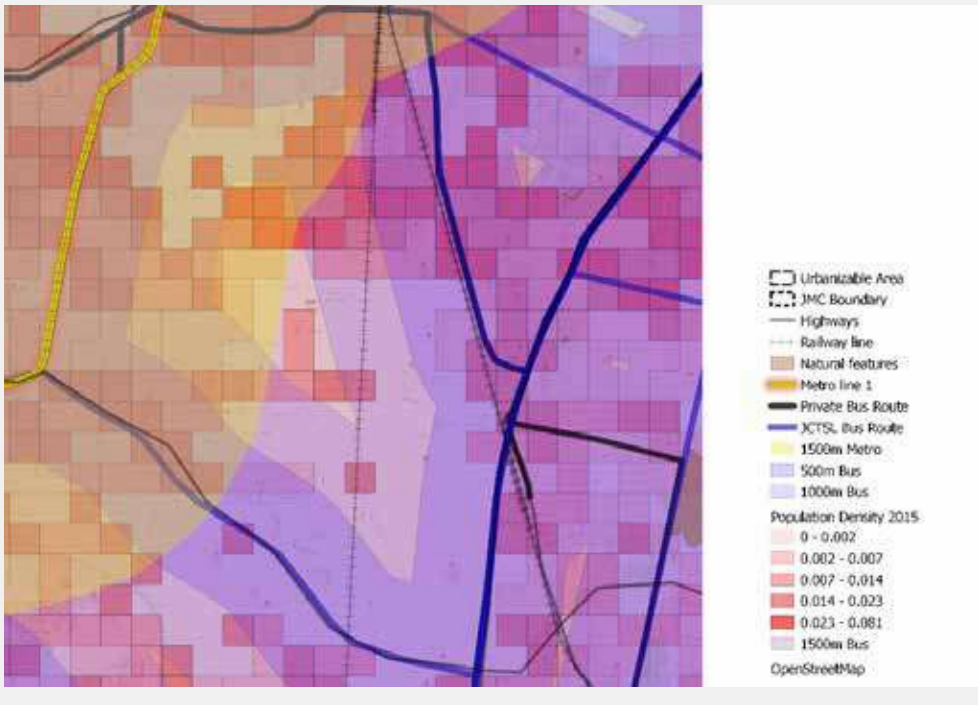
Source: Google earth, Un-Habitat

FIGURE 3.36 Population with access to public transport



Source: UN-Habitat

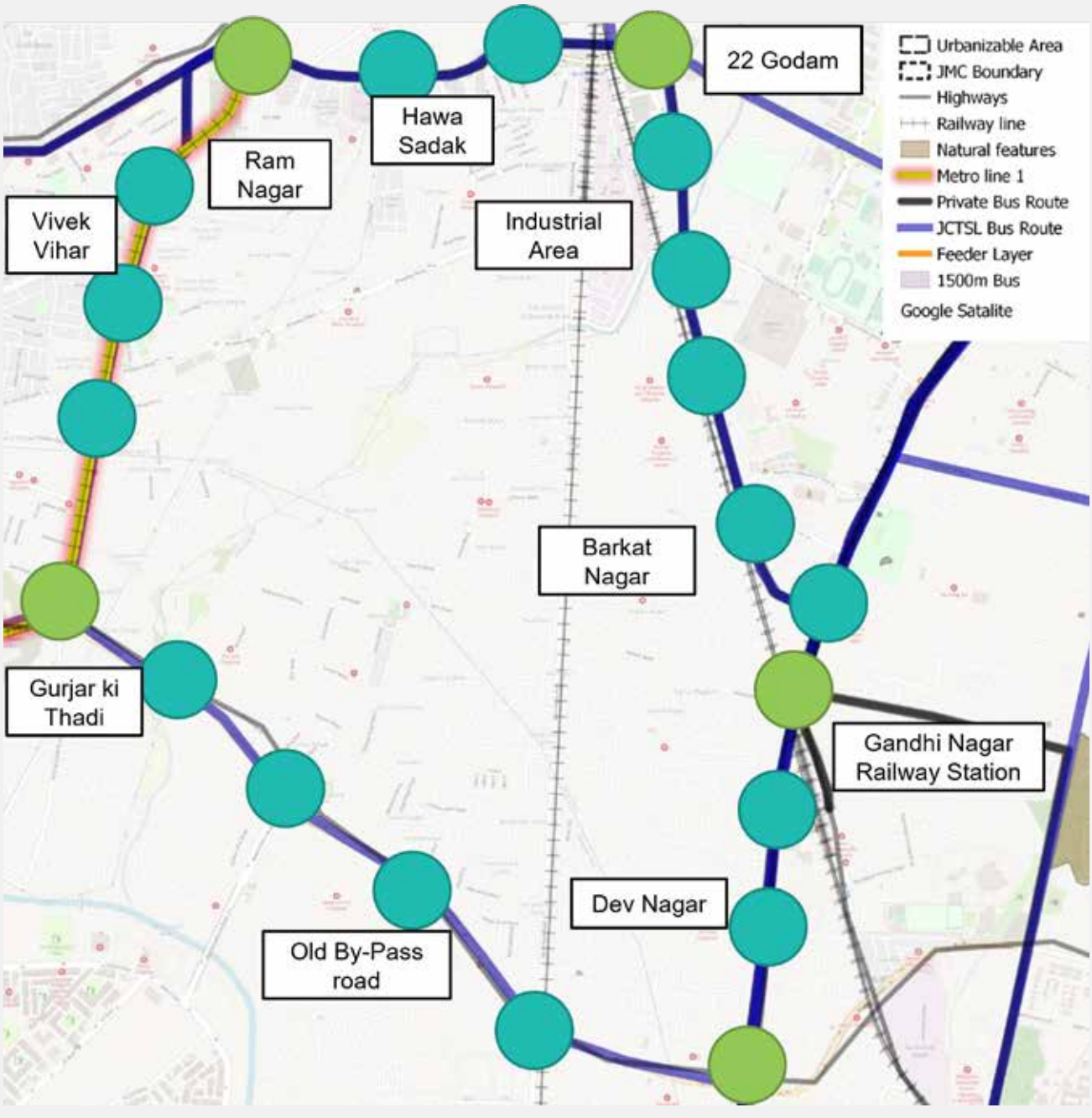
FIGURE 3.37 Public transport coverage in Barkat Nagar.



Source: UN-Habitat

Extension of the public transportation network for improved coverage by transit hubs and NMT infrastructure in the neighbourhood has been planned. Space allocation has been suggested to allow for the construction of a transit hub with e-rickshaw parking, a cycle dock, and a transit stop. As part of the NMT infrastructure planning, street design will include cycling lanes and pedestrian zones will aid in improving access to the people within walking distance of nodes.

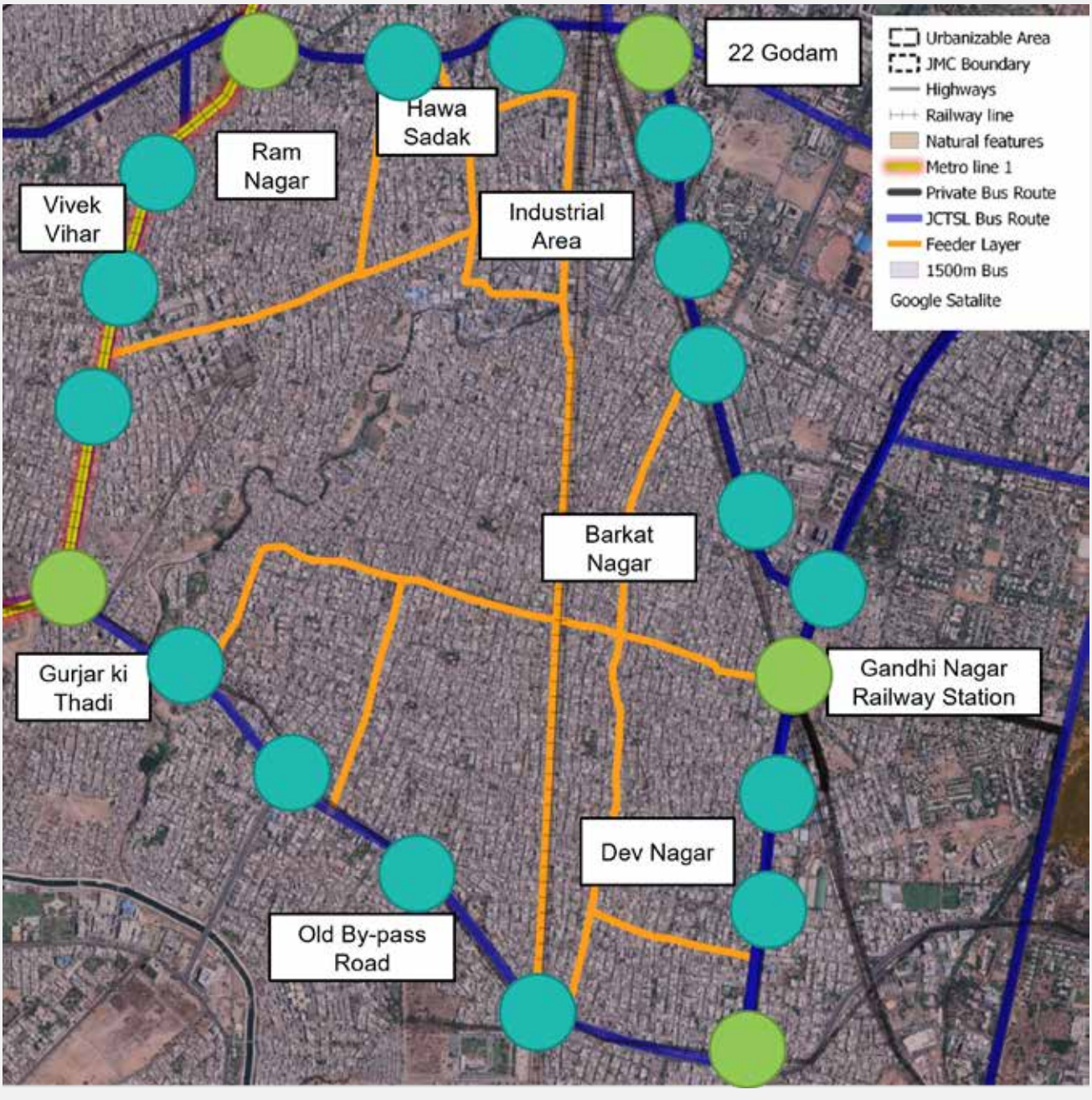
FIGURE 3.38 Identified transit nodes locations.



Source: UN-Habitat analysis

Partial formalized feeder service by e-rickshaws to improve safety and reliability along allocated routes has been proposed for communities residing more than 1 km as shown in Figure 3-39.

FIGURE 3.39 Feeder network for bus route extensions.



Source: UN-Habitat

Women in Jaipur rely on walking as a predominant mode for work related trips followed by public transit (bus). In JMC among female main workers 89% are other workers. In employed women more than half (56%) opt for job opportunities at a distance of 0-5 km. Among working women 52% did not travel for work and engaged in home based work.[29] Thus this strategic response with city in walking could promote more women to seek further employment opportunities, access markets and education facilities. Improved accessibility could improve the current negligible women WPR of 11 percent in JMC, as women commonly do not have access to jobs due to restricted

29 Source: Census of India. (2011). B-28 'Other Workers' By Distance From Residence To Place Of Work And Mode Of Travel To Place Of Work - 2011. Ministry of Home Affairs, Government of India

mobility. Those in the working ages (15-59 years) in the city comprise 65 percent of the population, who could highly benefit with better opportunities.

In NMT streets adequate resting places suggested to be designed to cater diverse user groups such as elderly, differently abled, pregnant women, caregiving women with children etc.

Intervention 2.4: Building multi-functional complete street network

According to ITDP, Complete streets are streets that are designed to cater to the needs of all users and activities, through equitable allocation of road space. Complete streets provide safe and inclusive environments that support users of all age groups, genders, and physical dispositions. They also guarantee efficient mobility by focusing on moving people, user safety, universal accessibility, vitality and liveability, sensitivity to local context, and environmental sustainability.

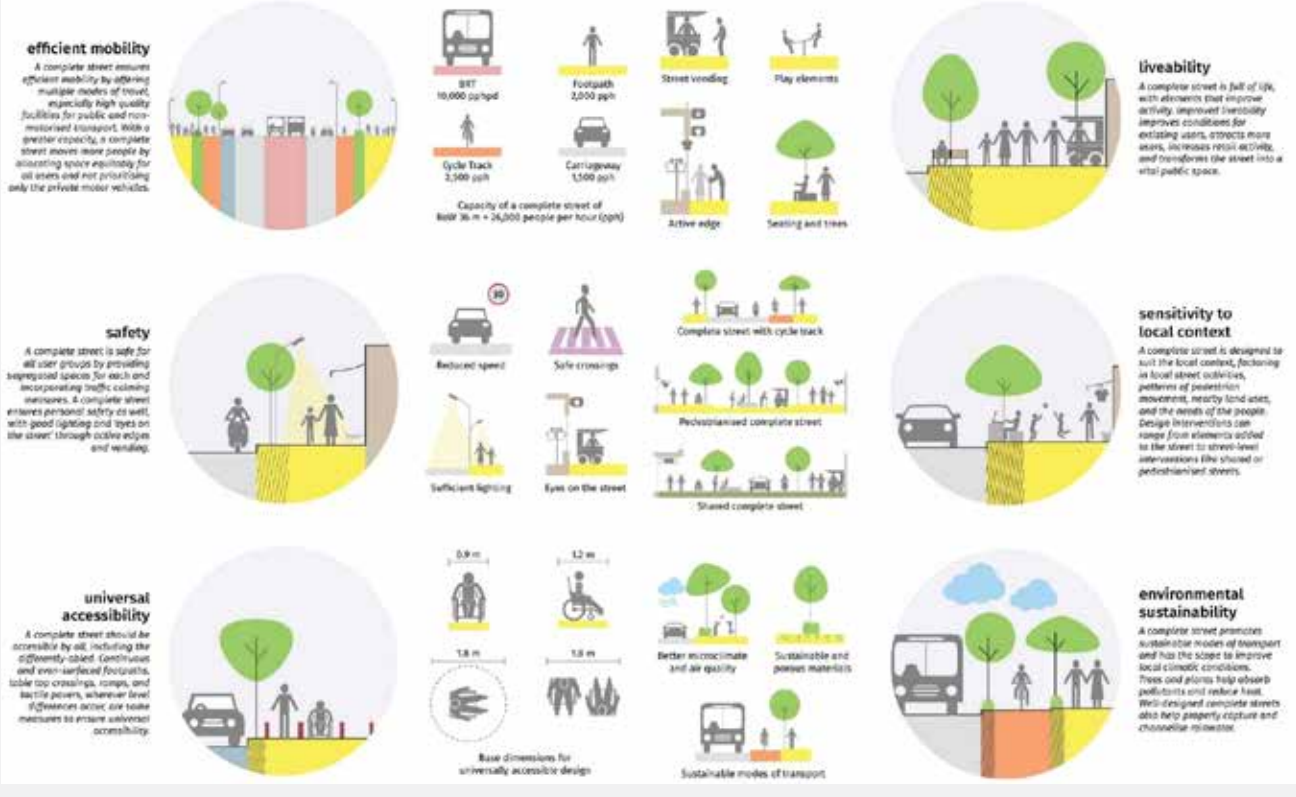
Principles of a complete street:

Efficient mobility: A complete street ensures efficient mobility by offering multiple modes of travel, especially high quality facilities for public and non-motorised transport. With a greater capacity, a complete street moves more people by allocating space equitably for all users and not prioritising only the private motor vehicles.

Safety: A complete street is safe for all user groups by providing segregated spaces for each and incorporating traffic calming measures. A complete street ensures personal safety as well, with good lighting, staggered building heights, and 'eyes on the street' through active edges and vending.

Universal accessibility: A complete street should be accessible by all, including the differently-abled. Continuous and even-surfaced footpaths, table top crossings, ramps, and tactile pavers, wherever level differences occur, are some measures to ensure universal accessibility.

FIGURE 3.40 Principles of a complete street



Source: ITDP (2020), Complete Street Design Manual

Liveability: A complete street is full of life, with elements that improve activity. Improved liveability improves conditions for existing users, attracts more users, increases retail activity, and transforms the street into a vital public space.

Sensitivity to local context: A complete street is designed to suit the local context, factoring in local street activities, patterns of pedestrian movement, nearby land uses, and the needs of the people. Design interventions can range from elements added to the street to street-level interventions like shared or pedestrianised streets.

Environmental sustainability: A complete street promotes sustainable modes of transport and has the scope to improve local climatic conditions. Trees and plants help absorb pollutants and reduce heat. Well-designed complete streets also help properly capture and channelise rainwater.

Street typology:

Arterial streets connect a city's different urban centres. These streets, whether narrow or wide, with or without frequent access to properties, promote efficient traffic flow throughout the city. Collector streets link local and arterial routes, collecting slower-moving traffic from the former and distributing it to the latter. They frequently travel to or from a particular neighbourhood. The majority of journeys begin or conclude on local streets. Local streets have the lowest speed limits and carry the least amount of traffic. Their primary function is to provide access to nearby properties.

FIGURE 3.41 Street elements and their presence in arterial, collector and local streets

Element	Presence in Arterial street	Collector street	Local street
Segregated footpath	✓	✓	Only on streets with RoW ≥ 12 m
Segregated cycle track	Only on streets with RoW ≥ 24 m	Cycling in mixed traffic with traffic calming	Cycling in mixed traffic with traffic calming
On-street parking	✗	✓	✓
Carriageway (*refer street design elements for details)	Not more than 3 lanes per direction	Not more than 2 lanes per direction	Not more than 1 lane per direction
At-grade crossings	✓	✓	✓
Public Transport	✓	✓	✗
Mass Rapid Transport	○	✗	✗
Service lane	○	✗	✗

✓ should be present
○ may be present
✗ should be absent

Table 01: Street elements and their presence in arterial, collector, and local streets

Source: ITDP (2020), Complete Street Design Manual

BOX - 7: CASE STUDY: DEVELOPMENT OF COMPLETE STREET ON BELLASIS ROAD, MUMBAI BY WRI

Safe walkable streets are fundamental components of cities. The current challenges faced by pedestrians in Bellasis Road are common in almost every urban street in India. Bellasis Road is an embodiment of a typical Indian street, with its varied land-uses generating a plethora of street activities, jostling shoulder-to shoulder with traffic. When designed strategically, these multiple elements can contribute to a safer environment for vulnerable road users, and help establish vibrant, mixed-use public spaces while ensuring smooth vehicular flow.

Originally built in 1793, Bellasis Road is an 823-meter-long street, stretching between Nagpada Junction and Mumbai Central Station Junction. The street is an important east-west urban connector, with ground floor retail frontage along the corridor, which generates high pedestrian and vehicle volumes every day. The common issues observed on this road included lack of continuous walkable footpaths, vehicular congestion, bottlenecks, multiple layers of street side parking and poor pedestrian crossing infrastructure.

FIGURE 3.42 Common issues observed in Bellasis Road

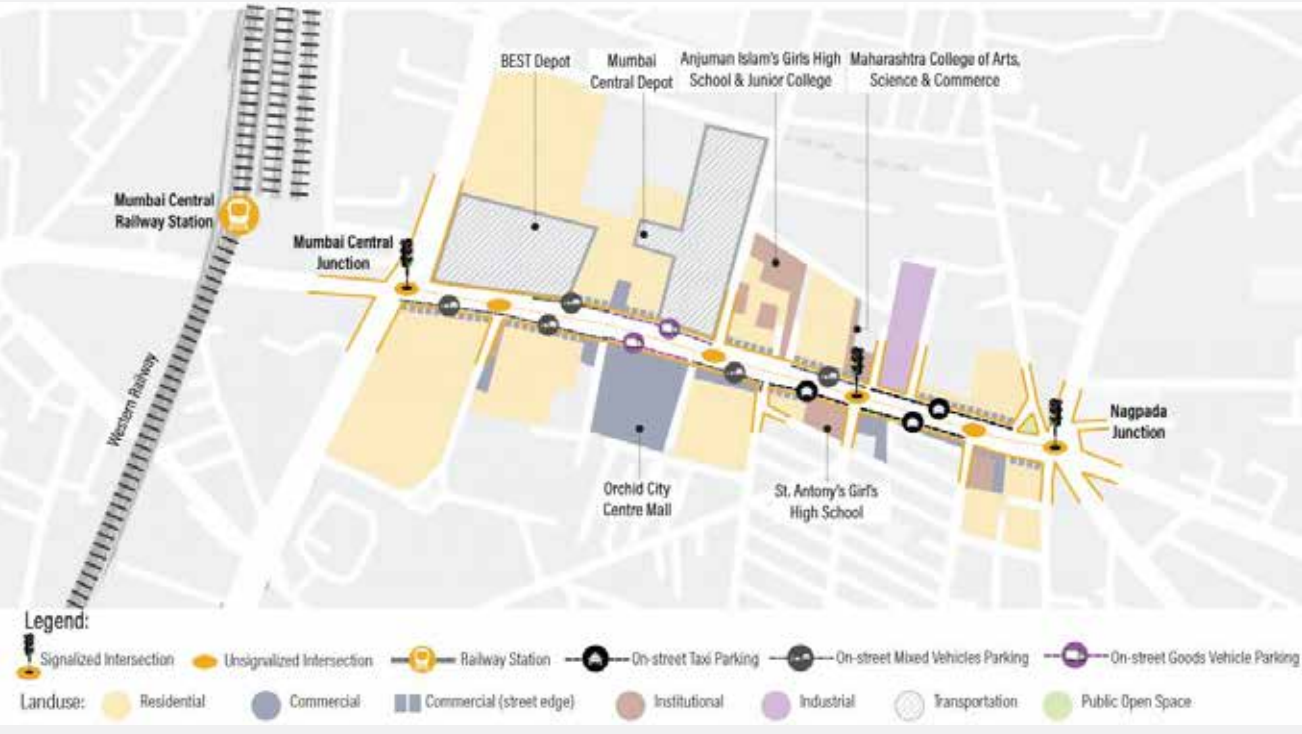


Illustration by Lekshmy Hirandas/WRI

During a road safety audit conducted on Bellasis Road, a pedestrian environment data scan (PEDS) showed that most of the pedestrians use footpath despite its less-than-ideal condition. The haphazard placement of bus stops, utilities, shop extensions, vendors, planters, etc., reduced the walkable space on the footpath. Unorganised parking was another obstacle that every pedestrian had to negotiate. Along with the absence of safe pedestrian crossings, Bellasis Road was indeed every pedestrian's nightmare.

IMAGE 3.3 Existing pedestrian environments at Bellasis Road.

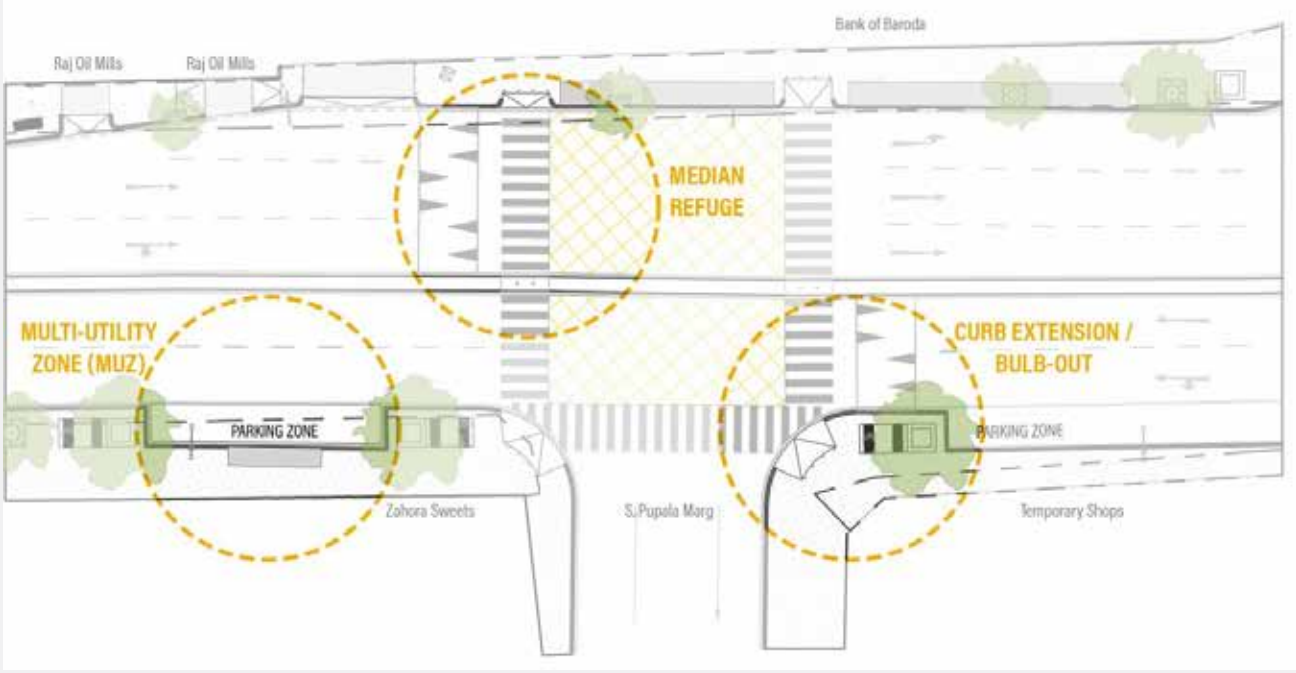
Photo by: Rohit Tak/WRI India

Proposed Design and Design Elements

The proposed design of Bellasis Road included the following principles:

- Maintaining contiguous vehicular traffic lanes: Two lanes on each side
- Introducing continuous unobstructed footpaths
- Introducing 'placemaking' to manage the footpaths
- Creating multi-utility/parking zones all along the street
- Introducing protected pedestrian crossings
- Introducing barrier free development

FIGURE 3.43 Proposed changes on Bellasis Road



Source: https://wri-india.org/blog/design-elements-rejuvenate-indian-streets-case-bellasis-road-mumbai

Following these principles in the new design, existing median alignment was retained and the effective carriageway of two lanes each side was maintained. The space left between the carriageway and footpath was further analyzed based on the adjoining land-use to determine the quality of pedestrian environment on the road. For example, at the stretch where schools are, it became waiting/pick-and-drop zone while at the mall, it became parking zone and at smaller retail shops it became two-wheeler parking zone.

Towards the street frontage, a clear walking zone was identified to increase walkability and eliminate pedestrian-vehicular conflicts on the street. To facilitate this, shifting of certain above ground utility boxes, bus stops, etc., was recommended.

These proposed changes to the Bellasis Road design are based on three chief design elements: curb extensions, refuge islands and multi-utility zones. Modules for these elements were developed keeping the adjoining land-uses, pedestrian walkability and safety as a priority.

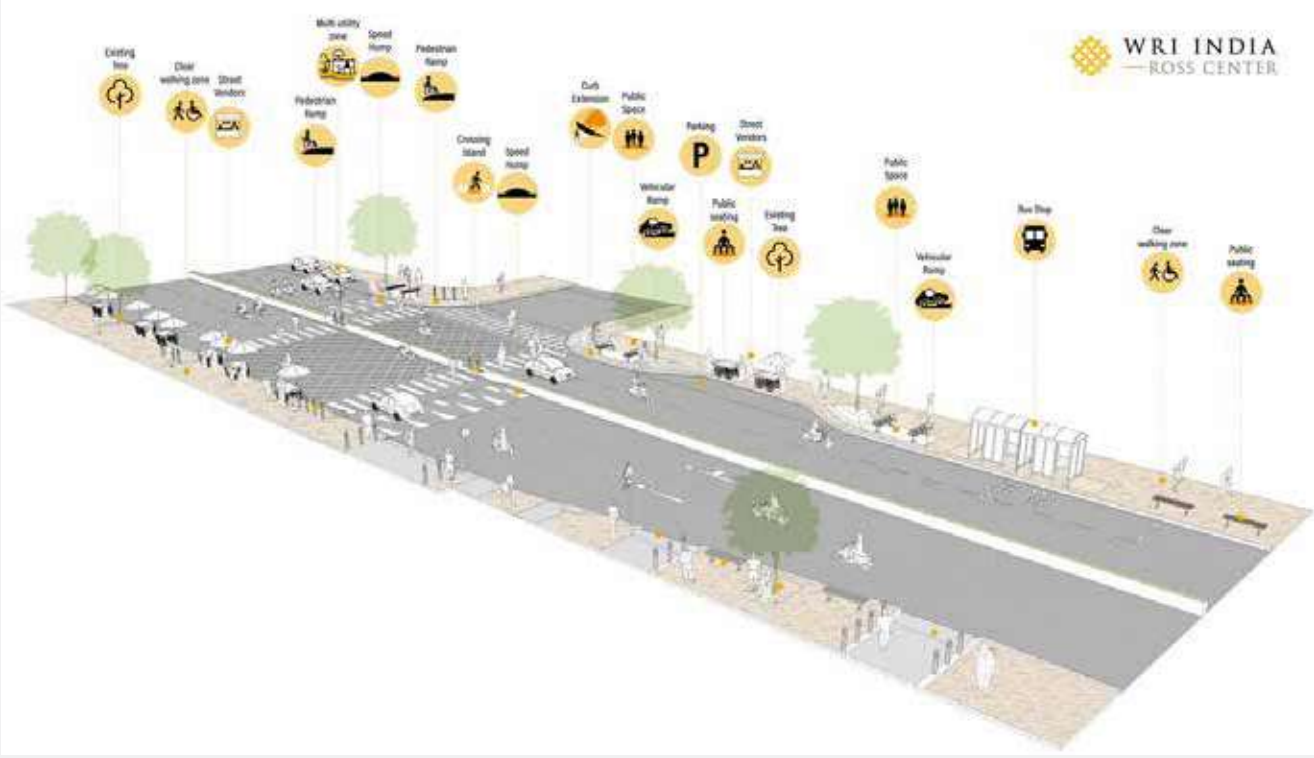
1. **Curb Extensions (Bulb-Outs):** A curb extension, known as a bulb-out, is a footpath extension at strategic locations to reduce pedestrian crossing distance and control their exposure to the moving vehicles. Curb extensions also increase the pedestrian and driver's visibility towards each other and act as a traffic calming measure.

   On Bellasis Road, at locations where street side parking obstructed the pedestrian crossings, curb extensions have been suggested. The space required for one such extension would be no more than the space taken by one parked car. At corners, curb expansions would allow extra space to introduce good quality place making and creating identity of the street.

2. **Pedestrian Refuge Islands:** A pedestrian refuge island is a paved portion in the median of the street, where pedestrians can stop and wait while crossing. While refuge islands may be used on both wide and narrow streets, they are generally applied at locations where speeds and volumes make crossings prohibitive. In the case of Bellasis Road, median refuge islands will be used where pedestrians need safe harbour after crossing one direction of traffic and before starting the other.

3. **Multi-Utility Zones:** Multi-utility zone (MUZ) is the footpath area allocated for various utilities necessary for the functioning of a street, such as vendors, public seating, landscaping, bus bays, parking, utility boxes, streetlights, signage etc. Provision of MUZs ensure that adequate clear walking space is available while accommodating ancillary activities within the footpath area. MUZs are best suited for neighbourhood streets with mixed land-use, where multiple activities are present.

FIGURE 3.44 A schematic diagram of multi-utility zone



Source: WRI India

Bellasis Road is known for its street side everyday informal activities. An organised space along the street for these activities will help to maintain the character of the street as well as smoothen the pedestrian and vehicular movement.

4. Strategic design for safer roads:

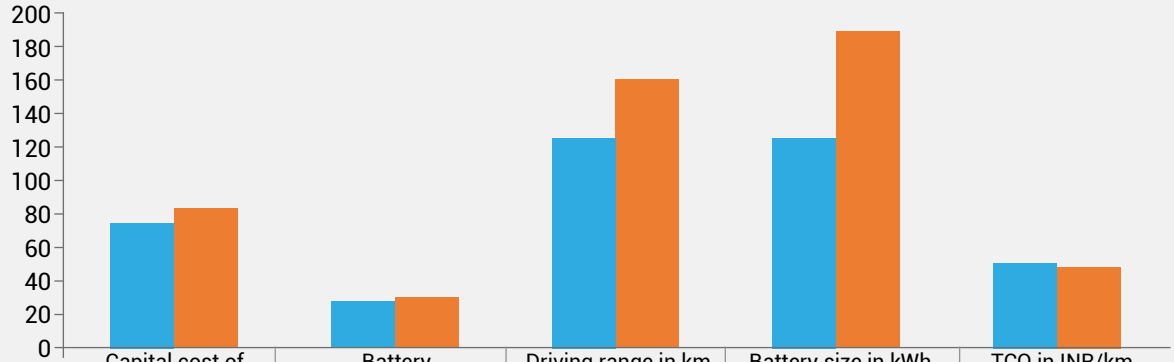
IMAGE 3.4 Before-after photographs of on-going improvement on Bellasis Road.

Photo by: Rhea Antony/WRI India

BOX - 8: CASE STUDY: ELECTRIC BUSES PROCUREMENT AND OPERATION: CASE OF KOLKATA

Aiming to reduce air pollution resulted from vehicular emission, the Government of India has taken various initiatives, amongst which electric mobility has been the prime focus. In the case of Kolkata, the Department of Transport, Government of West Bengal has already introduced 80 electric buses under the Phase-I of the FAME scheme (Faster Adoption and Manufacturing of (hybrid) & Electric Vehicles in India), operating in and around the city starting with 20 buses since February 2019 to the recently procured lot of 10 buses, introduced in January 2020. Electric buses based on bus length: 9m and 12m are operational under 12 different routes with an average distance travelled per route equal to 20 km. The cost break-up and component-wise characteristics of the e-buses are shown in the graph below.

FIGURE 3.46 Cost break-up and component-wise characteristics of the e-buses: 9m and 12m



	Capital cost of e-buses in INR (Lacs)	Battery replacement cost in INR (Lacs)	Driving range in km	Battery size in kWh	TCO in INR/km
9 meter e-bus	74.9	28	125	125	50.21
12 meter e-bus	82.5	31	160	188	47.58

Source: TERI, 2020

There are multiple co-benefits related to mobility for the electric buses programme in Kolkata. The reliability of electric bus operation has seen to be improved up to 98% despite several initial challenges. Moreover, overwhelming responses have been received from the e-bus riders (based on a survey conducted through social networking) in terms of comfort and reliability. Furthermore, the cost of Li-Ion batteries has been reducing drastically over the last few years and it is expected to drop further in the next 2-3 years positively impacting the viability of e-buses using Li-Ion batteries. Although, the impact on air pollution levels has not been as significant as anticipated since very few conventional vehicles have been replaced by e-buses (5% of total conventional fleet) till date, it is expected that annual CO2 emissions will reduce by 3,094 tons, considering daily round trip of 100 kms per bus and an emission factor of 1.19 Kg CO2 emissions/km per bus.

Further, the city must resolve and adopt an EV policy to setup vision and framework for clean mobility. For instance, Delhi Government has adopted Delhi EV Policy 2020. It has set a target of EVs accounting for 25% of vehicles sold by 2024. As part of the policy, Delhi became the first state in the country to fully exempt EVs from road tax and registration fee.

The policy is proposed to be implemented through the following verticals: a) Financial Incentives - Purchase incentives, Scrapping incentives, Interest subvention on loans. b) Waiver of road tax and registration fees. c) Establishment of a wide network of charging stations and swappable battery stations, and development of publicly owned database of the same. d) Administration of the policy including constitution of State Electric Vehicle Board, establishment of a dedicated EV cell, and developing an intensive public outreach programme focused on creating the awareness about the benefits of electric vehicles and key elements of the policy. e) Setting up of Skill Centers with provision for training related to jobs in the EV eco-system and creation of jobs. f) Setting up of Recycling Ecosystem for Batteries g) Creation of an umbrella, non-lapsable 'State EV Fund', to be funded through the air ambience fund, levy of additional taxes, cess, fee etc. on inefficient or polluting vehicles.

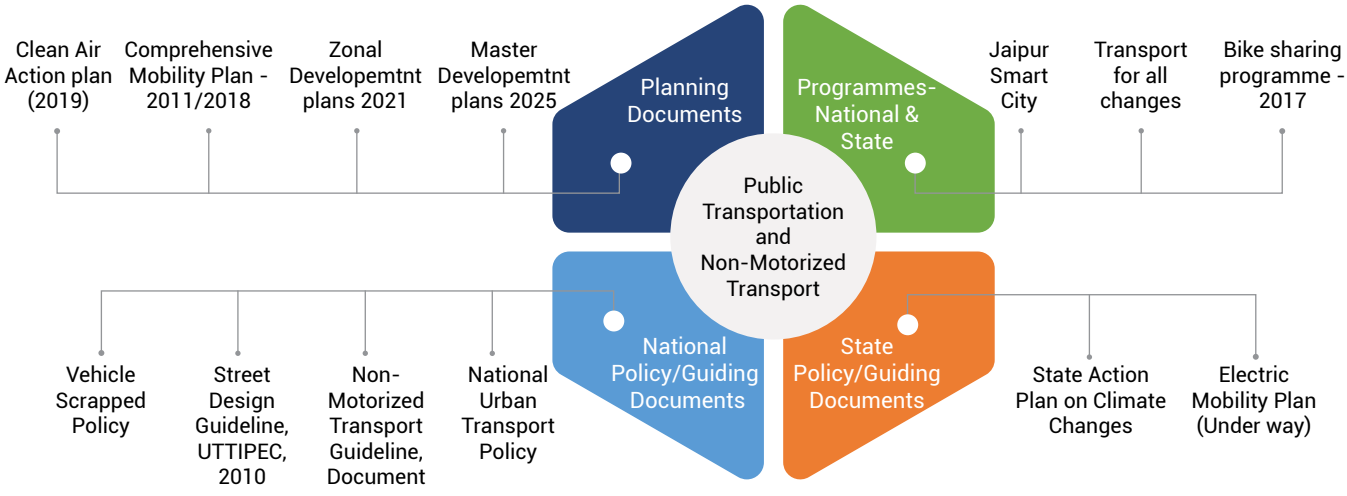
For two-wheelers, a purchase incentive of Rs. 5,000/- per kWh of battery capacity shall be provided per vehicle to the registered owner and subject to maximum incentive of Rs. 30,000/- per vehicle. For four-wheelers, a purchase incentive of Rs. 10,000/- per kWh of battery capacity shall be provided per electric four-wheeler (subject to a maximum incentive of Rs.1,50,000/- per vehicle) to the registered owners of the first 1000 e-cars to be registered in Delhi after the issuance of this policy. Similar provisions can be incorporated in EV policy for Jaipur.

Intervention 2.5: Promoting clean mobility through shift to cleaner energy (e.g. electric vehicles)

As per the UNIDO GHG inventory study 2017 for Jaipur, the transportation sector, is the second highest source of greenhouse gas emissions.[30] The transportation sector emitted 12,41,812 Mt of CO2 eq., which was 24% of the total GHG emissions. It is critical to minimize this sector's emission intensity to reduce emissions. To enable this, a transition from conventional vehicles is required in both public (including para-transit) and private modes of transportation. An integrated and systematic approach to promote clean mobility could be adopted. This would entail changing the fleet of public (buses, autorickshaws) and private vehicles (4-wheelers and 2-wheelers) to cleaner energy, especially EVs, while also keeping CNG vehicles as an option. Transition to both new and retrofitted vehicles could be kept as options. Since, large bus fleet is operated by JCTSL, a green transition can be planned over time.

According to service level benchmarks (SLBs) for Urban Transport, a metropolitan city shall have more than 0.6 buses per 1,000 persons. Based on the same, Jaipur requires a bus fleet of 2,220 buses for an estimated population of 3.7 million. However, the city is severely constrained with only 220 buses operational for intra-city travel. As per media reports, JCTSL is adding another fleet of 100 electric buses and 100 diesel buses to its fleet. It is proposed future bus fleet shall be primarily consisted of electric buses. The city must ensure that at all times, at least 50% of fleet has cleaner energy, with pre-dominantly electric buses, while CNG buses could be used as well. Over next five years, the city must augment its bus fleet and support infrastructure to meet the requirements as per service level benchmarks. It is proposed that in next one year additional 500 electric buses must be added to bus fleet to give a one-time thrust to clean mobility.

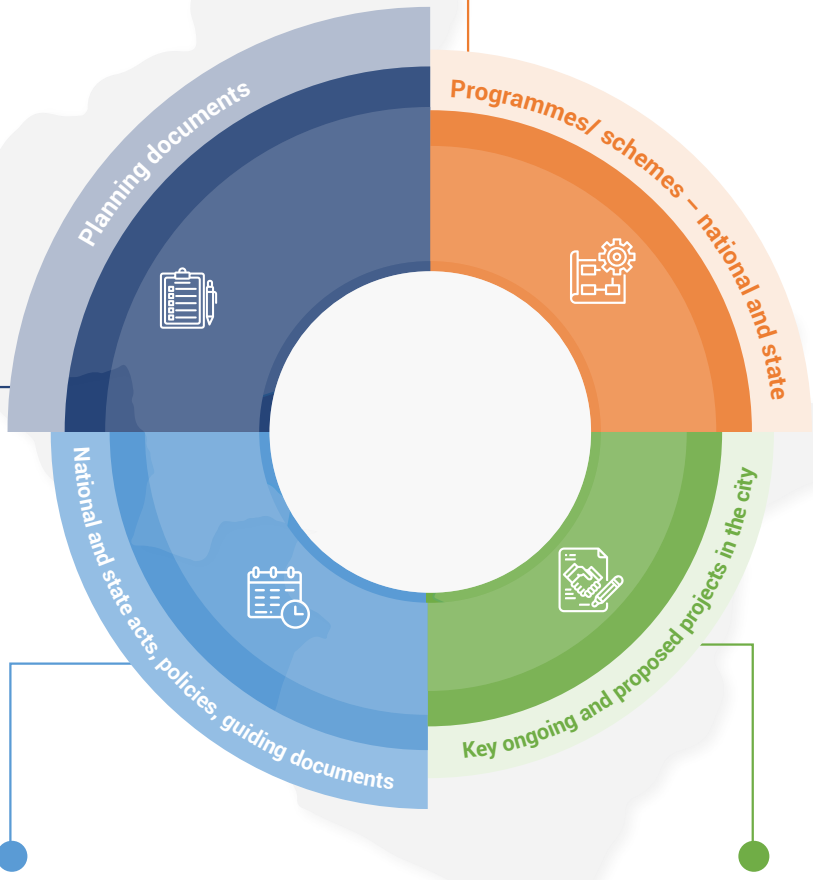
3.3.2 Alignment with national, state policies, programmes and on-going, proposed capital projects in the city



30 Accessed at https://www.thegpsc.org/sites/gpsc/files/partnerdocs/ghg_inventorization_for_cities_in_india_using_the_gpc_protocol.pdf on 25.05.2023.

- Jaipur Master Development Plan 2025
- Jaipur Zonal Development Plans 2021
- Comprehensive Mobility Plan 2010/2018
- Clean Air Action Plan 2019

- AMRUT
- AMRUT 2.0/ Jal Jeevan Mission (Urban)
- Jaipur Smart City
- Transport 4 All Challenge



- National Urban Policy 2020
- Rajasthan Electric Vehicle Policy 2021
- National Mission on Sustainable Habitat 2021-2030
- Non-Motorized Transport Guidance Document, 2016
- Street Design Guidelines UTTIPEC, 2010
- Vehicle Scrappage Policy
- National Urban Transport Policy, 2014
- Urban and Regional Development Plans Formulation and Implementation Guidelines (Volume 1) 2014

- Master Development Plan 2050 (Process started in 2021)
- Development of North and South Corridors of Jaipur Ring Road Project
- Extension of Jaipur Metro Phase I-C and I-D to connect 200 feet Bypass to Transport Nagar
- Hawa Sadak Elevated Road Project
- Jhotwada elevated Road Project
- Civil lines ROB Construction
- Metro Phase – II, North-South corridor connecting Amba Bari to Sanganer

3.3.3 Gender and Inclusion

The strategic response of the 15-minute city would be of high impact to marginalised groups and specifically women and low-income group. Prioritising equitable transportation with seamless integration of multi-modal transport systems and improving coverage of urban amenities could aid towards gender equitable development. All the actions under this strategic response, specifically, actions 1-4 actively could support gender transformative approach.

This could significantly benefit the pedestrians and could promote walking as major mode of commute in Jaipur (ADB, 2013; UN Women, 2014; UNICEF, 2020).[31]

Prioritising creating a city-wide network of high-access public transport corridors and improving NMT networks offer affordable and efficient transportation system. It is suggested to design the transit corridor and streets under this strategic response as per universal design codes and gender sensitive needs (gender inclusive mobility

31 ADB. (2013). Gender Tool Kit: Maximizing the Benefits of Improved Mobility for All. Asian Development Bank.
UN Women. (2014). World Survey on the Role of Women in Development, 2014: Gender Equality and Sustainable Development. UN Women.
UNICEF. (2020). Technical Note on Gender Transformative Approaches-A Summary for Practitioners. Retrieved from https://www.unicef.org/media/58196/file

amenities-further details in Annex VI). Improving the safety and comfort of pedestrian routes through infrastructure such as lighting, street furniture, shading elements can encourage more pedestrians on the street and specially create safer streets for women, children, and other vulnerable groups. Adequate resting places to be designed to cater diverse user groups such as elderly, differently abled, pregnant women, and caregiving women with children etc. Designated vendor zones also recommended to support informal economy and improve the urban safety in Jaipur.

This strategic response with city in walking could promote more women to seek employment opportunities, access markets and education facilities. The physical and digital integration could ensure seamless transition and reduce waiting time for public transport. It would enable to address time poverty faced by women who often trip chain caregiving and work trips. Time poverty is shortage of time available to devote to personal requirements, including leisure and recreational activities. The intervention could reduce the additional time spent on unpaid care work and improve leisure activity rate of women in the city.

Employing women SHG for electric buses and vehicles -in sectors such as drivers, conductors, planners, in the management of EV charging infrastructure could be considered, which would add to safety for women. Jaipur already has a Pink Rickshaw service that is run by women from poor household.

Improving public transportation and transit hubs should focus on offering safer travel in night programmes. Some components of safer travel are women led police patrols, night accommodation for women, streets vendors as street marshals, request stop service etc. (further details in Annex VI and X).

3.3.4 Climate Convergence

Upon the implementation of the projects for improvement of public transport infrastructure, it is envisaged that the modal share of public transport will increase. It is estimated that trips currently undertaken by private modes of transport shall shift to public modes of transport and help bring down the emission per trip in the city. It is estimated that 5% shift to public transport modes shall help reduce the emissions by 5.25% from the current levels of carbon emissions. There will be further reduction in GHG emission due to use of cleaner fuel. Public transport, para transit modes and NMT infrastructure should deliver climate change adaptation and resilience. Considering there are increasingly extreme weather events like extremely hot days and uncertain but frequent urban flood events, users must comfortably use public transport, para-transit modes and NMT infrastructure during extreme weather events.

3.3.5 Cost Estimate

TABLE 3.12 Cost estimates

S. No	Intervention	Project	Block Cost Estimate (INR in Lakh)	Implementing Agency	Sources of Finance
1.	Formulation of Comprehensive mobility Plan and PT route optimization	Need for a comprehensive study on the mobility patters and public transport throught the city to formulate CMP and PT route optimization for feasibility of modes and better service throught the city	-	JDA, JSTCL	AMRUT
2.	Proposal for Multi-Modal Hub on Major city Nodes	Development of infrastructure to facilitate use of public transport services. Provision of Auto / Rikshaw parking, EV charging points, bike share stand and parking to be provided.	852.75	JDA	AMRUT
3.	Proposal for Primary transit Hub on Nodes		2448.85	JDA	AMRUT
4.	Proposal for Secondary transit Hub on Nodes		3056.3	JDA	AMRUT
5.	Proposal for Neighborhood transit Hub on Nodes		5925.96	JDA	AMRUT
6.	Multi-modal fare integeration. Standardazie mode of payment with one trp one payment across different modes	Building an IT-infrastructure which enables contact less hustle free payments integerating the different modes of public transport.	878.4	Smart city	Smart city

Source: UN-Habitat

3.3.6 USAF Indicators impacted

USAF indicators impacted are:

Weak urban mobility is directly liked to 35 indicators (6 descriptive and 20 scored), the strategic interventions shall result in improvement of score for 27 indicators.

1.1,1.6,1.8,6.1,6.2,6.3,6.4,6.5,6.6,6.7,6.8,6.9,6.10,6.11,6.12,6.13,6.14,8.1,8.7,8.9,8.13,8.14,8.15,8.16,8.17,8.18.

3.4 Strategic Response 3: Jaipur as a Sponge City

Jaipur has experienced floods, an earthquake, and severe storms, causing significant damage to lives and infrastructure. The city's multi-hazard vulnerability, linked to urban sprawl and the disconnect between green spaces and water bodies, has been identified as a key issue through the USAF analysis. The floods result from the overflowing River Saraswati and stagnation of storm-water run-off in low-lying areas. Jaipur's desert location adds complexity to urban flooding.

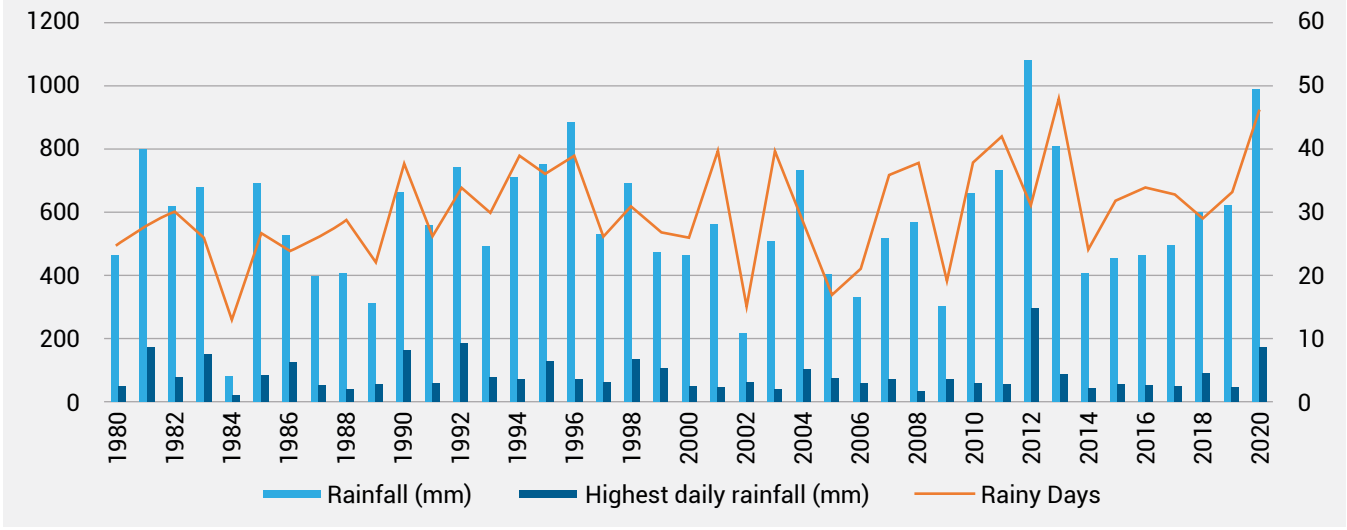
Jaipur tends to flood when it receives daily rainfall above 150mm

Jaipur has witnessed heavy urban floods in 1981, 2012 and 2020. The analysis of annual and daily maximum rainfall data for the past 40 years (Figure 3-46) shows that the city flooded when it received over 150 mm of rainfall in 24 hours. Due to climate change, there is uncertain but frequent urban flooding. The causes of flooding can be attributed to urbanisation, which reduces pervious surfaces, densification, and informal development encroaching the floodplains. Other factors include city residents' awareness including what constitutes garbage, cleaning and desilting of drains, waste disposal in streams, and usage of sewer networks for stormwater drainage, which proves to be inadequate.

IMAGE 3.5 Images from urban flooding on 15 August 2020

Source: Economic Times and Times of India news articles

FIGURE 3.46 Maximum Annual and daily rainfall in Jaipur over 40 years.

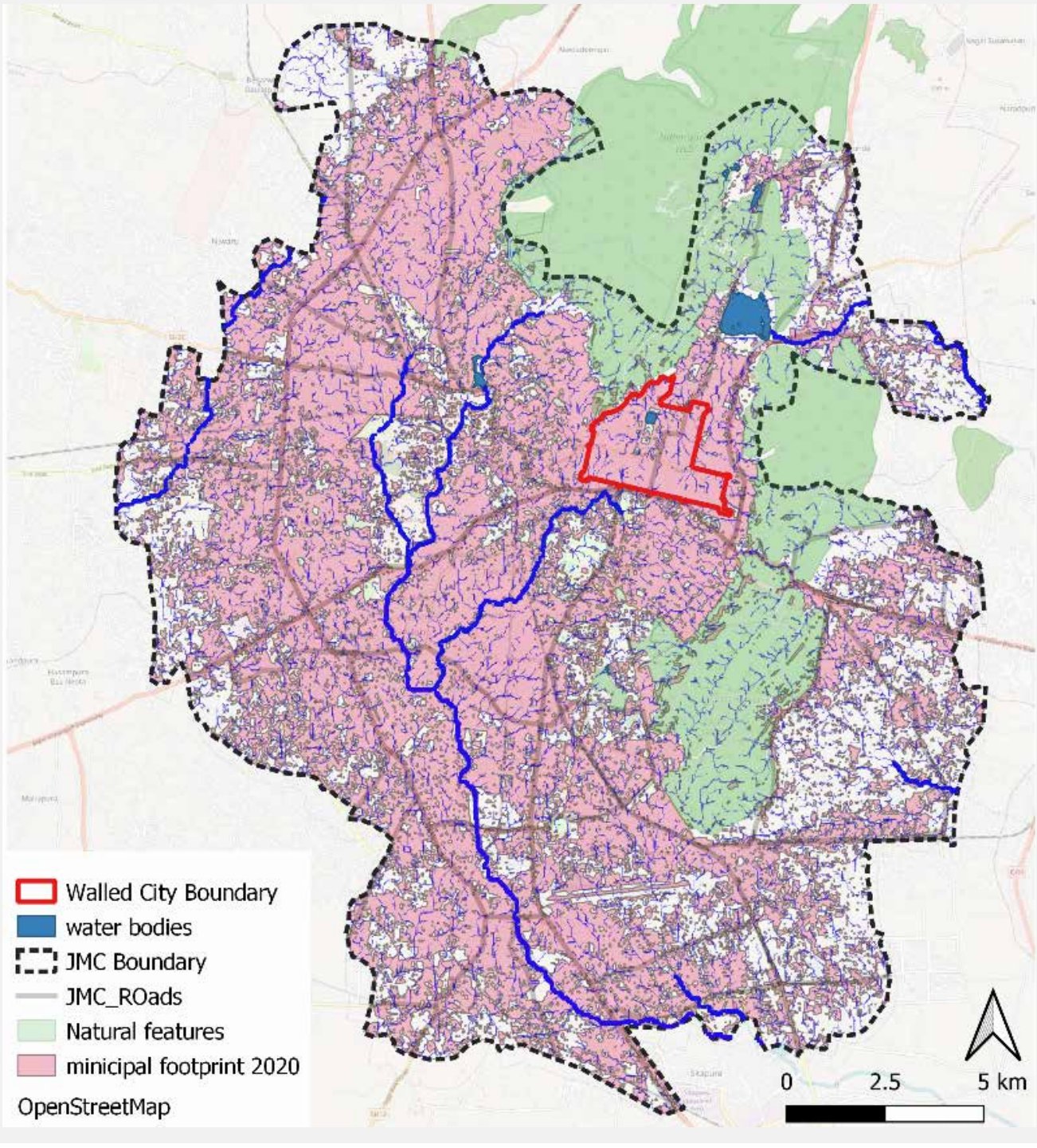


Source: UN-Habitat

Urbanisation in Jaipur has encroached the natural drainage network of the city

To understand the causes of urban flooding, an analysis of urbanisation and drainage pattern was carried out. To access the city's basin and natural drainage profile, sentinel data from USGS has been used to create flow patterns, overlaid with the urban footprint and Google image (Figure 3-47). It reveals that there is a stark mismatch between the natural drainage network and urban footprint. This means that the natural drainage lines have been completely ignored during urbanisation. The water networks and streams have been encroached upon, reducing their cross-section and carrying capacity.

FIGURE 3.47 Jaipur drainage profile and urban development.

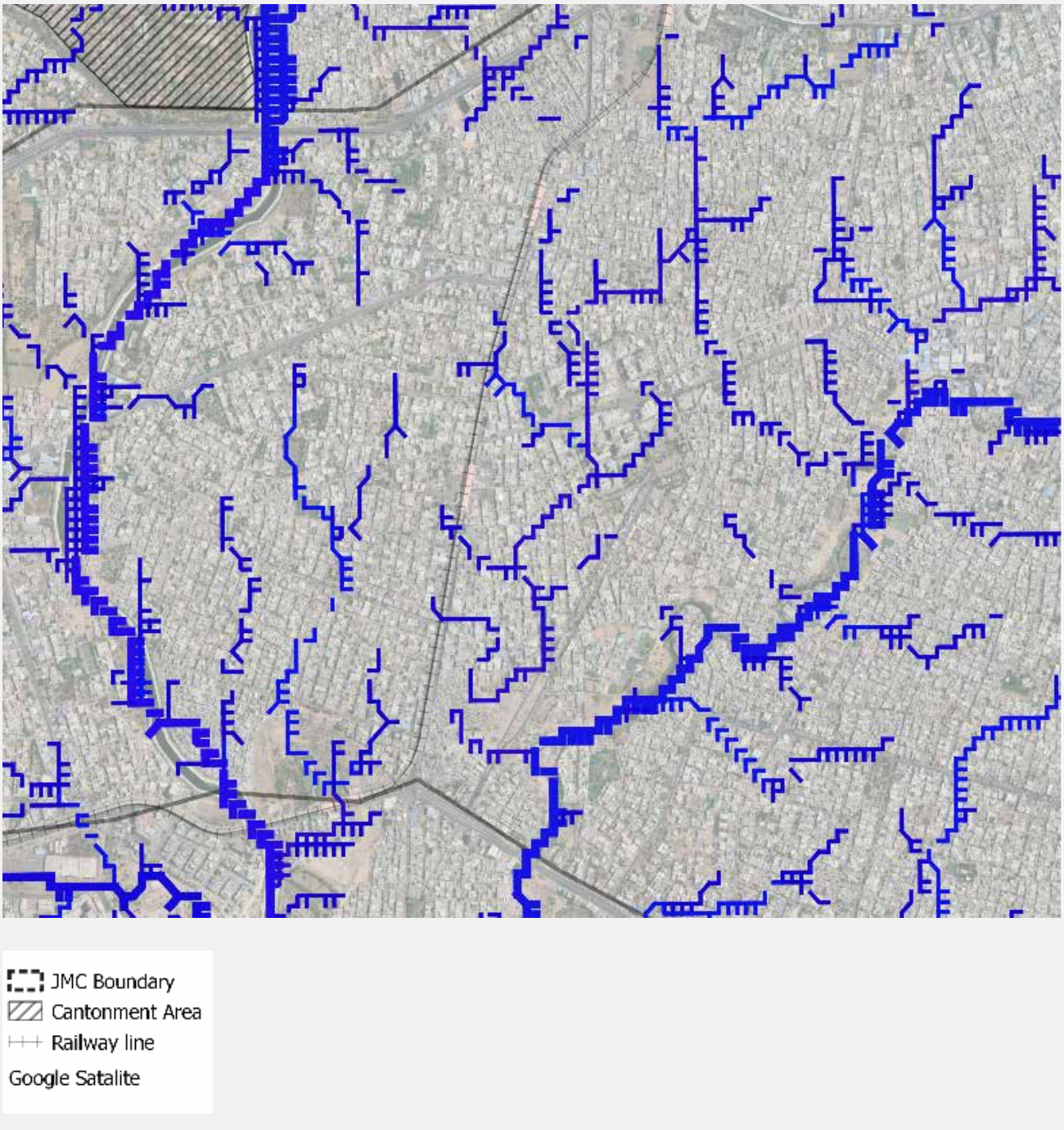


Source: UN-Habitat compiled with data from USGS and Google Earth

The open and porous surfaces in Jaipur reduced by 45% in the last three decades

The building footprints in the city is growing at a fast pace, with an urban velocity of 4.3 sqkm/year, 5.8 sqkm/year, and 6.3 sqkm/year recording during 1990-2000, 2000-2010 and 2010-2020 respectively. On overlaying the city swatch on top of the natural drainage, it is observed that there is stark mismatch between the natural drainage network and urban footprint, as shown in Figure 3.48.

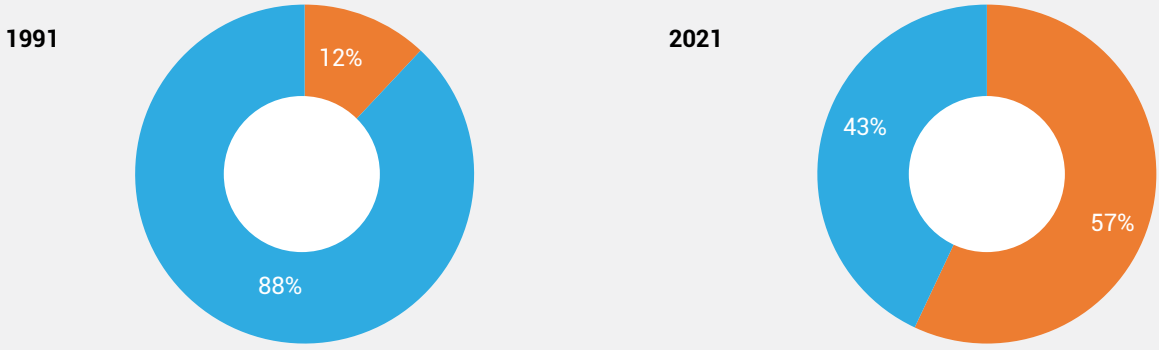
FIGURE 3.48 City swatch overlayed with natural drainage profile.



Source: UN-Habitat analysis

Analysing the porous surfaces it is evident that the open surfaces reduced from 88% in 1991 to about 43% in 2021 as shown in Figure 3.49.

FIGURE 3.49 Percent of porous and open surfaces in the last three decades

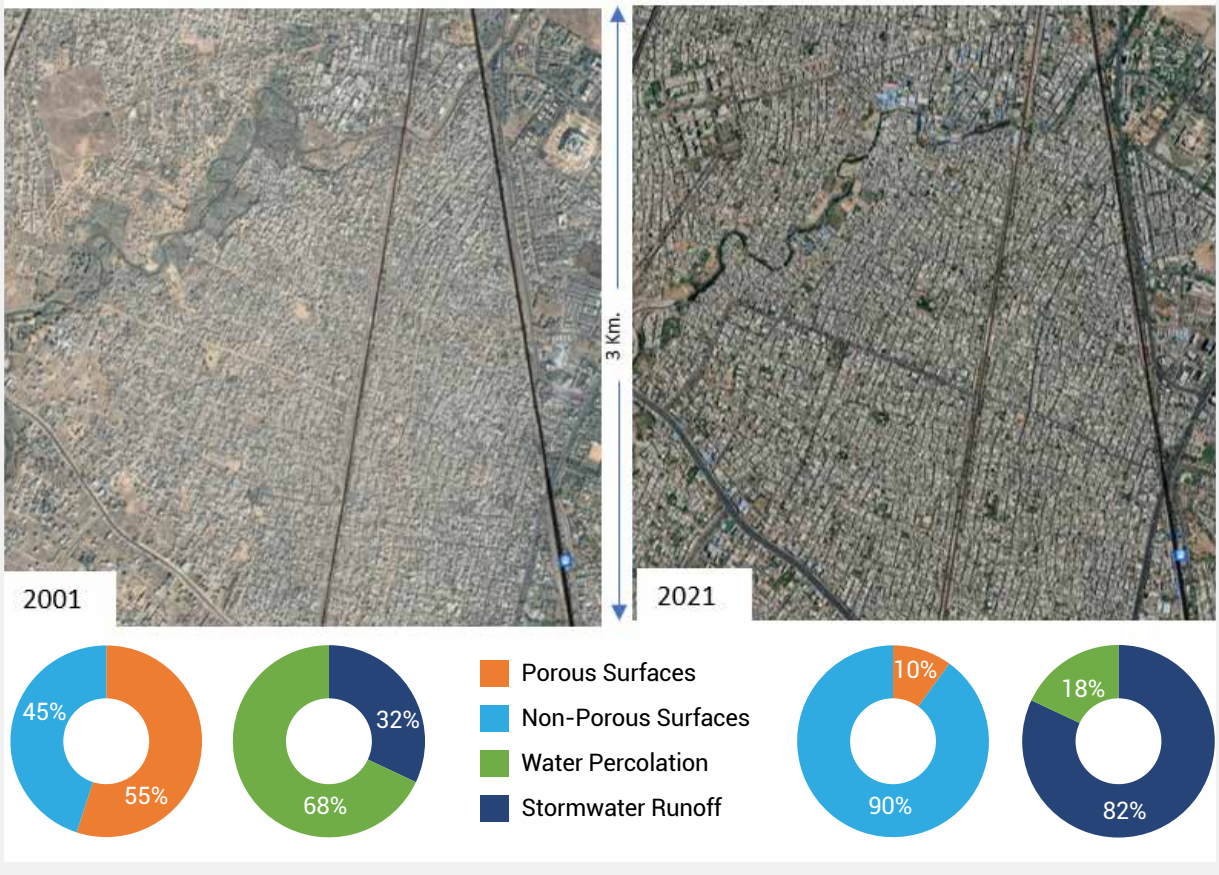


Source: UN-Habitat

The surface runoff has increased by 50% over the last three decades.

A city swatch of about 9 sq.km. has been selected from the city core to understand the impact of porous surface reduction on stormwater. The city swatch was classified into porous surfaces (vacant land, grass cover, soft escape area, water bodies) and non-porous surfaces (roads, buildings and hard paved surfaces). It is observed that porous surfaces in the city swatch reduced from 55 per cent to 10 per cent during 2001-2021. This has led to increase in the volume of stormwater runoff from 32 per cent to 82 per cent.

FIGURE 3.50 Swatch analysis for stormwater runoff in Jaipur



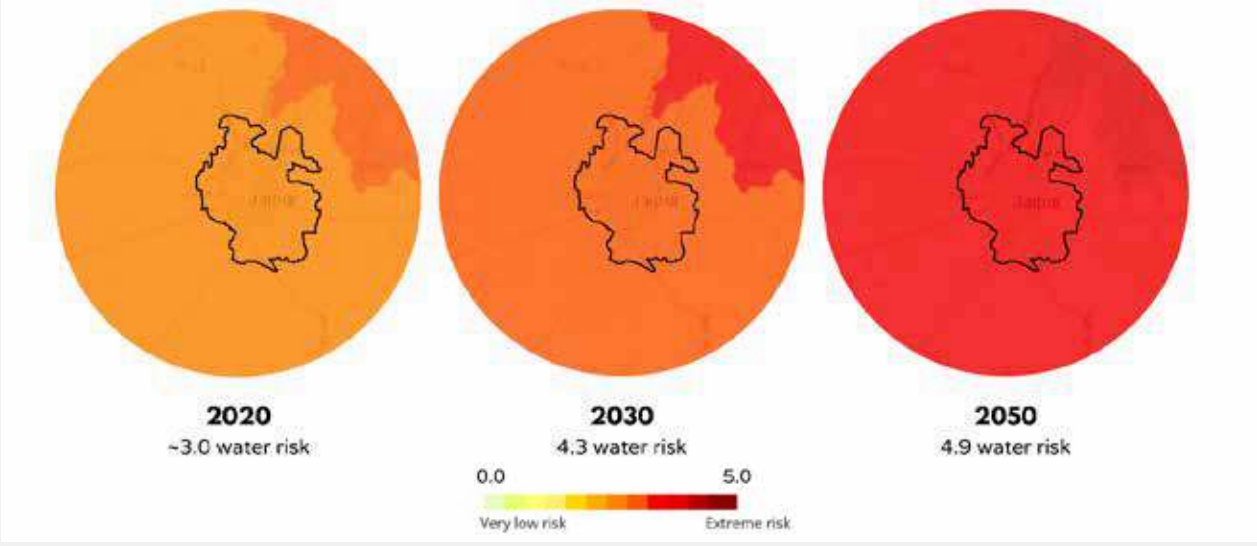
Source: UN-Habitat

Jaipur will most likely reach zero-day by 2050

The city poses a high risk of drought and water scarcity. Jaipur has been featured in the WWF list of 100 cities to face the zero-day by 2050. The city has reported several instances of drought in the recent past, and with the depleting water resources and increasing population creates an alarming situation.

The Water Risk Filter is a comprehensive risk layer, which aggregates three water risk types: physical, regulatory, and reputational that are aligned to the UN Global Compact CEO Water Mandate framework. Based on the current water usage trend, by 2030, the water risk would reach 4.3, and by 2050, it would reach a very high 4.9, leaving the city dry of any water sources.

FIGURE 3.51 Water Risk Filter for Jaipur

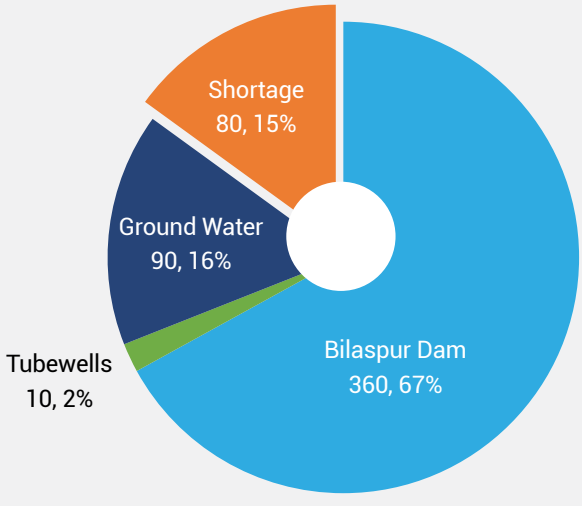


Source: WWF, 2020

Jaipur is currently facing a water shortage of 80 MLD

The assessment of water demand and supply to the city of Jaipur reveals that currently the city faces (80 MLD) 15 percent shortage. The city has a total demand of about 540 MLD, taking 150 LPCD, the national benchmark for cities with piped water supply. On the supply side, the city receives 360 MLD (67%) from the Bisalpur Dam and the rest is met by drawing groundwater (16%) and tube wells (10.2%) close to 100 MLD.

FIGURE 3.52 Jaipur- Total water demand



Source: WWF, 2020

Urban water management in Jaipur can be addressed through Sponge City strategies

Sponge City is an innovative solution to the problem of excessive rainwater runoff and flooding. It is a city designed to soak up and store excess water during storms, then release it slowly over time to prevent flooding. Here are two technical definitions of Sponge Cities.

- A sponge city is an urban area, which has been designed to cope with excess rainfall using a variety of techniques. Existing urban areas often have to deal with flooding caused by heavy rain, high tides or swollen rivers, and sponge city design can mitigate or prevent such events by providing the area with the ability to naturally absorb the water (Chapman Taylor, 2022). Ecosystem services must be introduced in the city landscape with connected greens[32] and wetland as buffer area for the excess water to be absorbed.
- A Sponge City is a city that has the capacity to mainstream urban water management into the urban planning policies and designs. It should have the appropriate planning and legal frameworks and tools in place to implement, maintain and adapt the infrastructure systems to collect, store and treat (excess) rainwater. In addition, a "sponge city" will not only be able to deal with "too much water", but also reuse rain water to help to mitigate the impacts of "too little" and "too dirty" water.[33]

In order to deal with increased flooding and drainage issues, some cities are adopting Sponge City strategies. This involves installing a system of permeable surfaces and green infrastructure that can absorb and store excess water. This can help to reduce the amount of water that ends up in sewers and drainage systems, and can also help to cool the city by absorbing heat. They can help to reduce flooding, improve air quality, and create new green spaces. They can also help to reduce the

FIGURE 3.53 Sponge City Model

Source: Chen, Y., & Chen, H. (2020).[34]

32 Accessed at https://www.sciencedirect.com/science/article/abs/pii/S1618866716300097.

33 Zevenbergen, C., Fu, D., & Pathirana, A. (Eds.). (2018). Sponge cities: Emerging approaches, challenges and opportunities.

34 Chen, Y., & Chen, H. (2020). The collective strategies of key stakeholders in Sponge City construction: a tripartite game analysis of governments, developers, and consumers. Water, 12(4), 1087.

amount of energy used for cooling and heating. By simply reducing the number of hard surfaces and increasing the amount of absorbent land, particularly green space, it can make a significant difference in reducing the severity and frequency of flooding events. Supplementing this approach with efficient channeling and storage systems can help to counter the frequency of water shortages, which can be particularly acute as observed in the case of Jaipur.[35] Urban flooding could also contaminate groundwater table, which is a major source of water.

Other measures can include:

1. The provision of rooftop green spaces
2. The storage and harvesting of rainwater
3. Building roads with porous surface materials
4. The use of water-intensive plants and trees
5. Creating land basins to hold excess water
6. Introducing more ponds and lakes, which can hold some of the excess water

BOX - 9: CASE STUDY OF JINAN IN SHANDONG PROVINCE

Jinan is the capital of China's middle-east Shandong Province. Jinan is known for its karst springs, but some dry up over time. Impervious surface sprawl reduces rainfall infiltration and groundwater storage and level. Jinan is a typical water-shortage city that needs to develop rainwater harvesting and storm water reuse. Extreme flooding caused by 180 mm of rain in 3 hours killed more than 30 people and cost 1.32 billion Yuan.

Sponge city construction (SPC) guidelines are based on Jinan's analysis. Jinan's SPC programme focuses on storm water storage and infiltration; detention, clean, use, and discharge are secondary goals. Jinan's SPC will have four components. First, storm water drainage must be improved to meet new discharge and flooding standards. Second, dredge the Xiaoqing River to handle larger floods. Third, build more LIDs to increase storm water infiltration and reuse and protect karst springs. Fourth, intercept and purify surface water below fifth class standards. Storm water runoff could contribute 36.7% of total water pollution. Almost all urban wastewater plants are built around Xiaoqing River, leaving little land for storm water facilities. Jinan's sewers stretch 1,737 km. Each SPC project has 9 phases: planning, project approval, bidding, contract awarding, project launch, inspection, construction-completion acceptance, operation and maintenance, and performance evaluation.

35 Chapman Taylor. (2022, February 1). What are sponge cities and why are they the future of urban design? https://www.chapmantaylor.com/insights/what-are-sponge-cities-and-why-are-they-the-future-of-urban-design

FIGURE 3.54 An impression of a sponge city

Source: UN-Habitat

3.4.1 Proposed interventions with strategic responses

Intervention 3.1: Increasing porous surfaces to increase water absorption in the city.

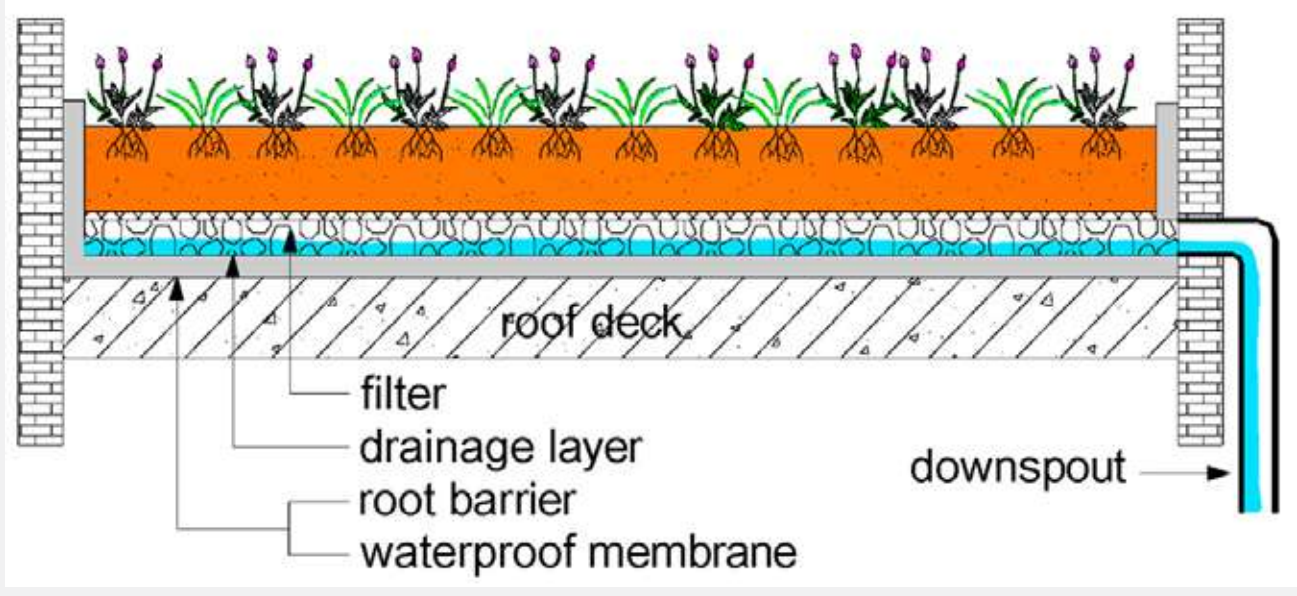
To increase the surface absorption of water, porous surfaces need to be increased. There are two ways in which porous surfaces can be effectively increased using nature-based solutions by controlling rainwater runoff and increasing absorption from the urban surfaces.

- **Soft surfaces:** For soft surfaces, the heavy soils can be enhanced by rainwater infiltration strategies to meet the groundwater requirement, especially in arid regions. In such soils, water infiltration and deep percolation can be enhanced by constructing deep ditches filled with permeable materials, such as sand.[36]
- **Hard surfaces:** For hard surfaces, both green roofs and pervious pavements could absorb excess water.

Green roofs have the potential to reduce surface run-off from buildings, mitigate the urban heat island effect, reduce greenhouse gas emissions, and energy demand of buildings by naturally cooling them down. The green cover helps increase carbon sequestration, apart from the added advantage of urban agriculture production. A representative illustration in depicted in Figure 3-55.

36 Abu-Zreig, M., Fujimaki, H., Elbasit, A., & Ahmed, M. (2020). Enhancing water infiltration through heavy soils with sand-ditch technique. Water, 12(5), 1312.

FIGURE 3.55 Green roofs for collecting rainwater

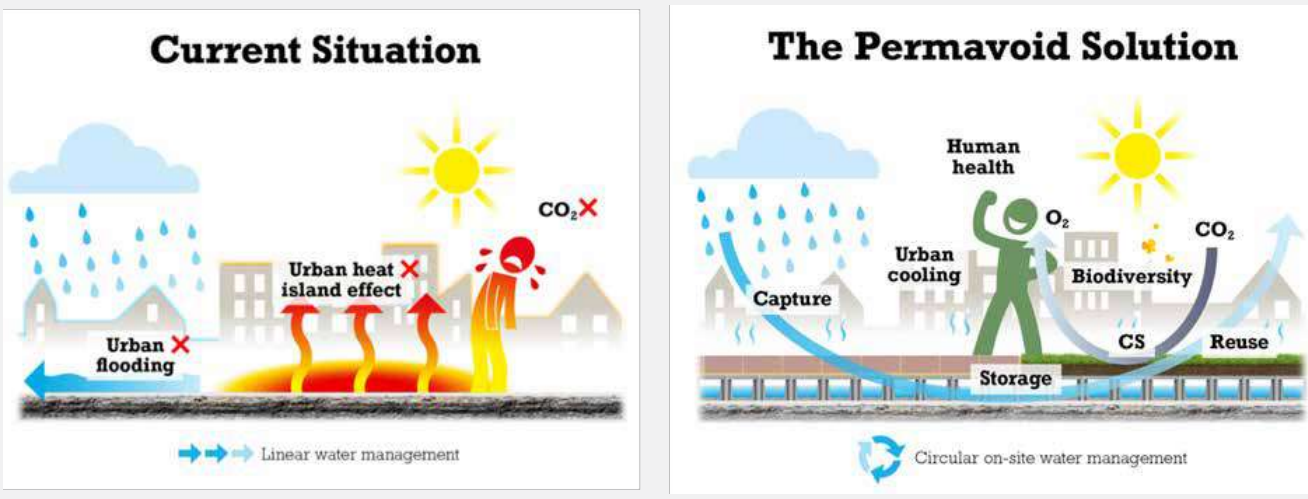


Source: https://zipgrow.com/funding-your-urban-farm and https://www.mdpi.com/2073-4441/12/12/3579

BOX - 10: CASE STUDY OF PROJECT SMARTROOF 2.0 IN AMSTERDAM

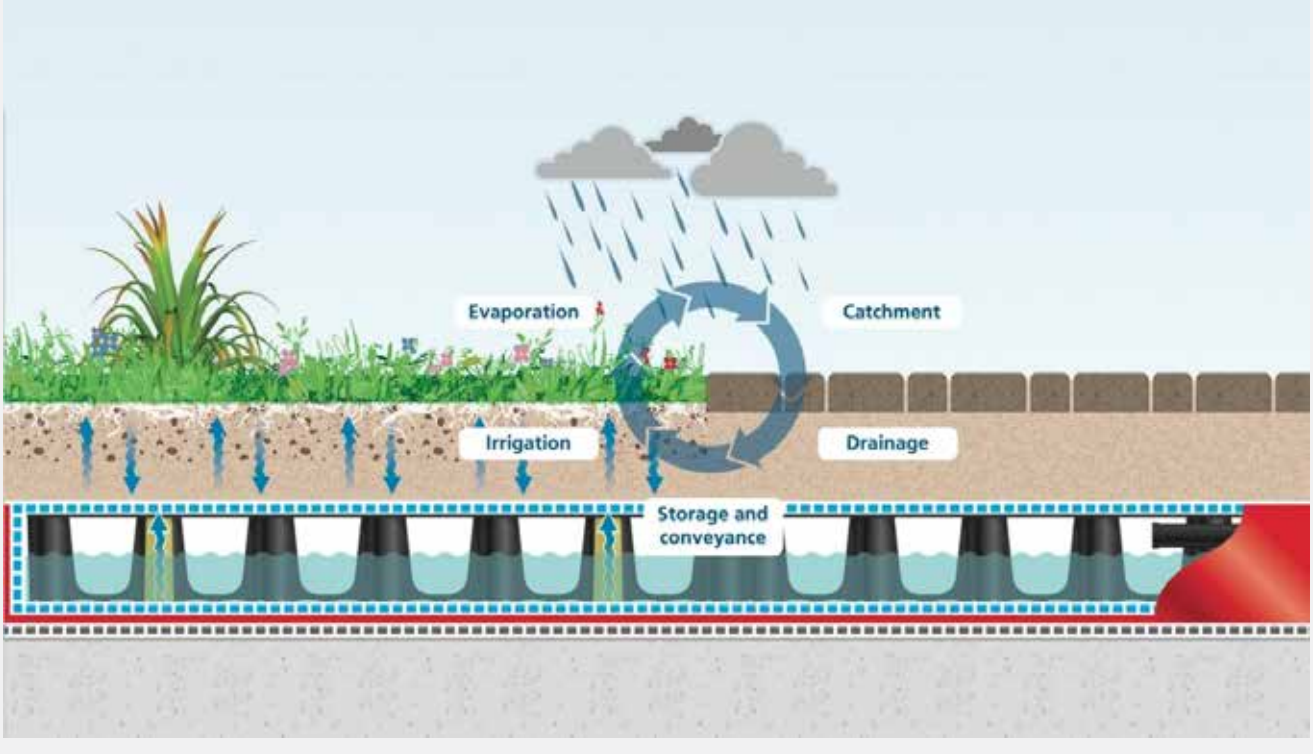
Paved surfaces, such as rooftops and podium decks, can be transformed into flourishing green oases with the help of blue-green infrastructures. These oases help to cool the environment by deflecting the sun's rays and evaporating the water that is present on their surfaces.

FIGURE 3.56 Impact of Project SmartRoof 2.0 on urban flooding and heat island effect



Source: Project SmartRoof 2.0

FIGURE 3.57 The blue-green solution for roofs

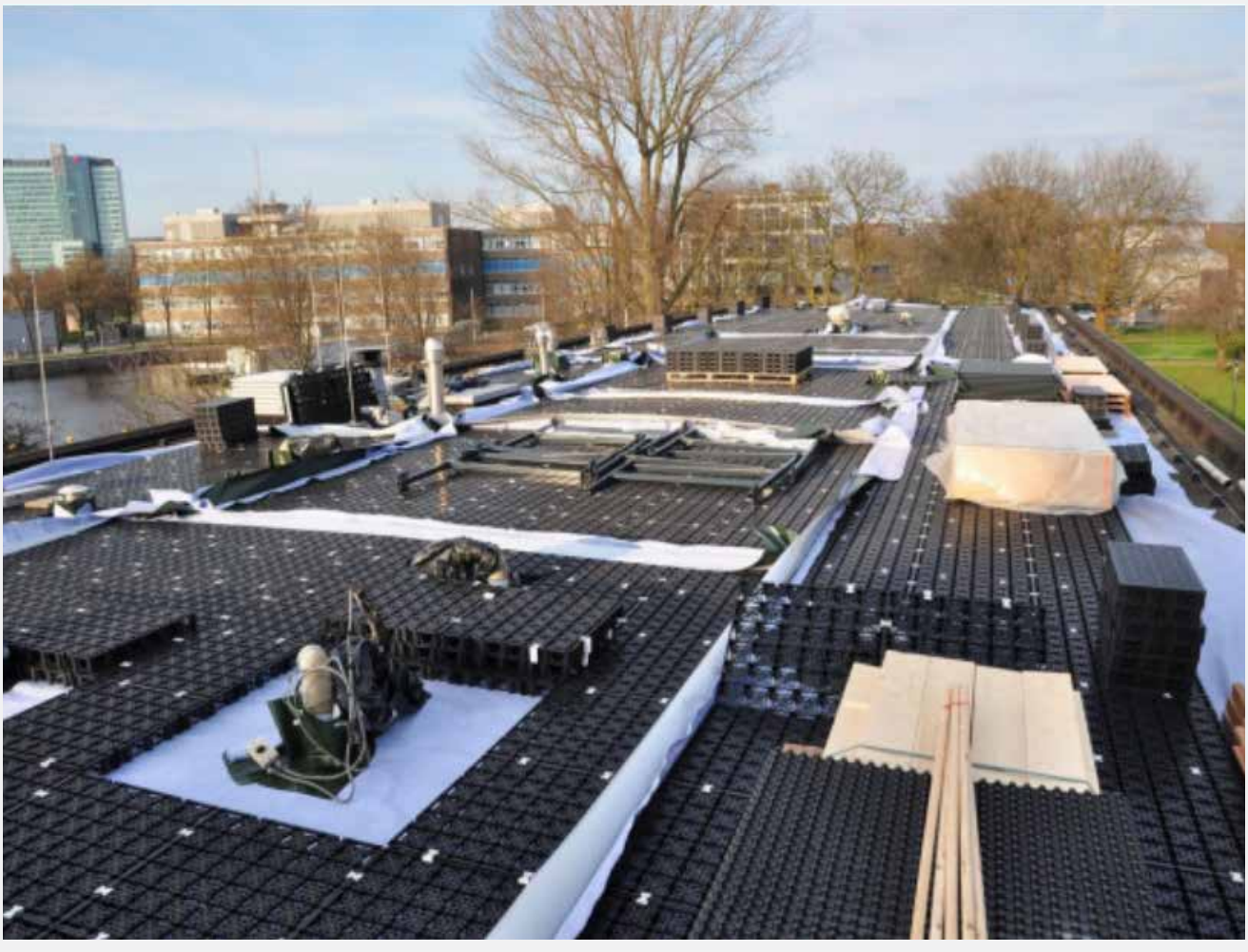


Source: Project SmartRoof 2.0

Project SmartRoof 2.0 is an innovative, lightweight, blue-green roof, that has been installed on Building 002 at the Marineterrein Amsterdam. Water management (blue) and plants (green) are carefully monitored using sensors. Rainwater is collected by a blue-green system that has been retrofitted onto the roof of Building 002 in the former Navy Yard in Amsterdam. This system stores the collected water. Permavoid Ltd. is the company that came up with the idea for the lightweight recycled plastic drainage units. These units are equipped with integrated fibre technology, which enables capillary transport from storage to soil in order to naturally irrigate the wide variety of plants.

All of this is accomplished without the use of pumps, hoses, valves, or any form of energy. The blue-green roof features an 85 mm-high permavoid hollow drainage layer that stores rainwater directly under the planted layer. These permavoid units have special fibre cylinders that use the capillary effect to provide the plants with water during dry spells. This creates natural irrigation without using pumps, hoses, or energy, similar to nature.

FIGURE 3.58 Project SmartRoof 2.0 rooftops



Source: Project SmartRoof 2.0

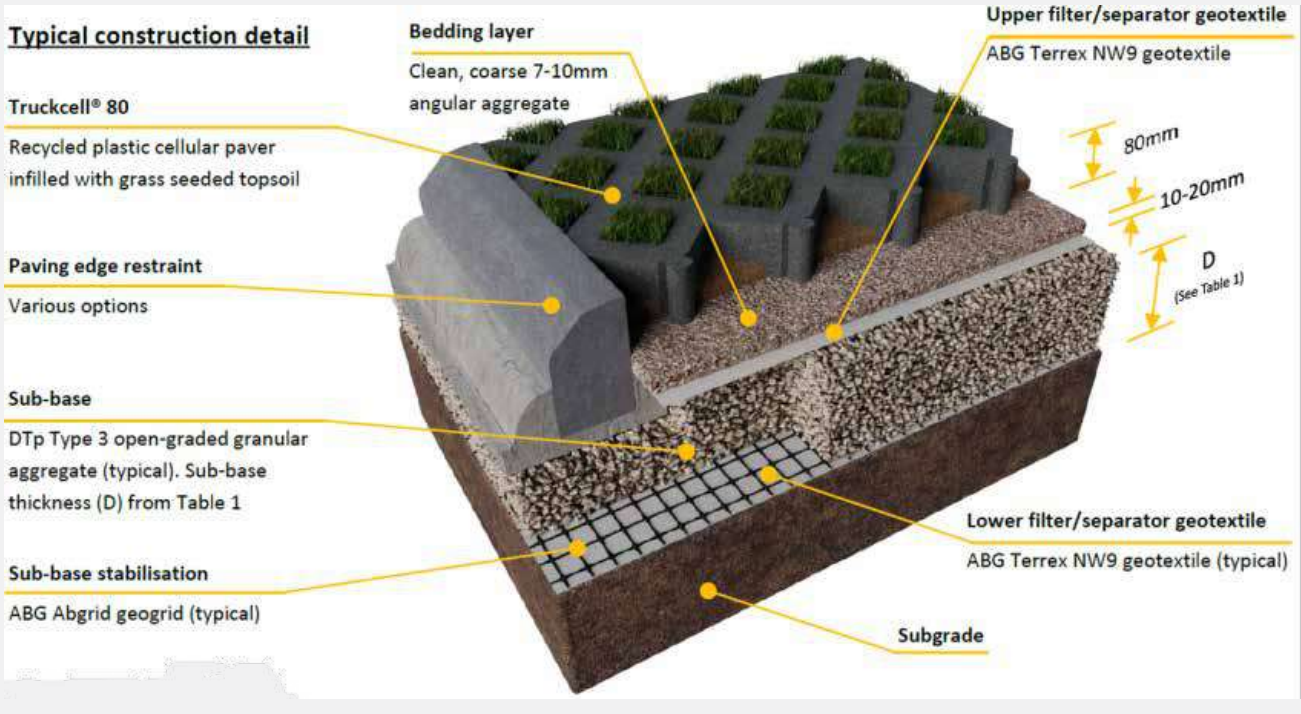
Permeable pavements are hard surface on which water percolation can be increased. It is a porous urban surface composed of open pore pavers, concrete, or asphalt with an underlying stone reservoir. Permeable pavement catches precipitation and surface runoff, storing it in the reservoir while slowly allowing it to infiltrate into the soil below or discharge via a drain tile.

FIGURE 3.59 Types of permeable pavements

Source: Selbig, 2018[37]

An alternative to permeable pavements are grass block pavers—also known as turf block pavers or grow-through pavers. They are an alternative to asphalt, concrete, and traditional pavers. They're made of concrete or recycled plastic with open cells that allow grass to grow through them. They're a porous, eco-friendly option for driveways and parking areas.

FIGURE 3.60 Grass grit paver blocks for increased percolation



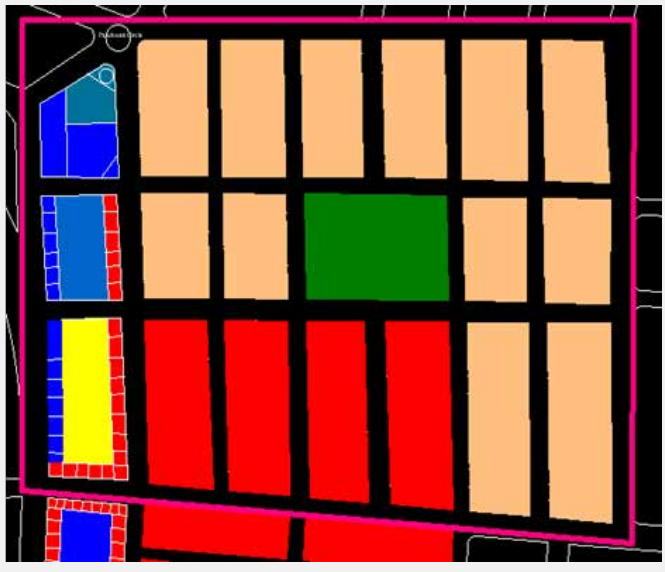
Source: https://www.abg-geosynthetics.com/technical/design-guidance/truckcell-design-and-installation-guidance-for-grass-surfaces/

37 Selbig, W. (2018). Evaluating the potential benefits of permeable pavement on the quantity and quality of stormwater runoff.

Applying permeable pavements to sidewalks in a neighbourhood

The groundwater percolation has been reduced with a steep reduction in the pervious surfaces. There is a need to promote pervious paving materials, like grass grit pavers for pavement of sidewalks and parking lots. Replacing interlock paver blocks with grass grit pavers can help reduce the runoff from sidewalks and parking lots by up to 70%, resulting in an overall stormwater volume reduction of up to 7% as seen in the analysis in Figure 3 61.

FIGURE 3.61 Increasing porous surfaces in neighbourhood and reduction in stormwater



Source: UN-Habitat

	Area (m2)	Runoff Coefficient	Water Volume (m3)	Runoff Coefficient	Water Volume (m3)	Total Reduction %
Sidewalks	10669.5	0.8	8535.6	0.3	3200.85	70%

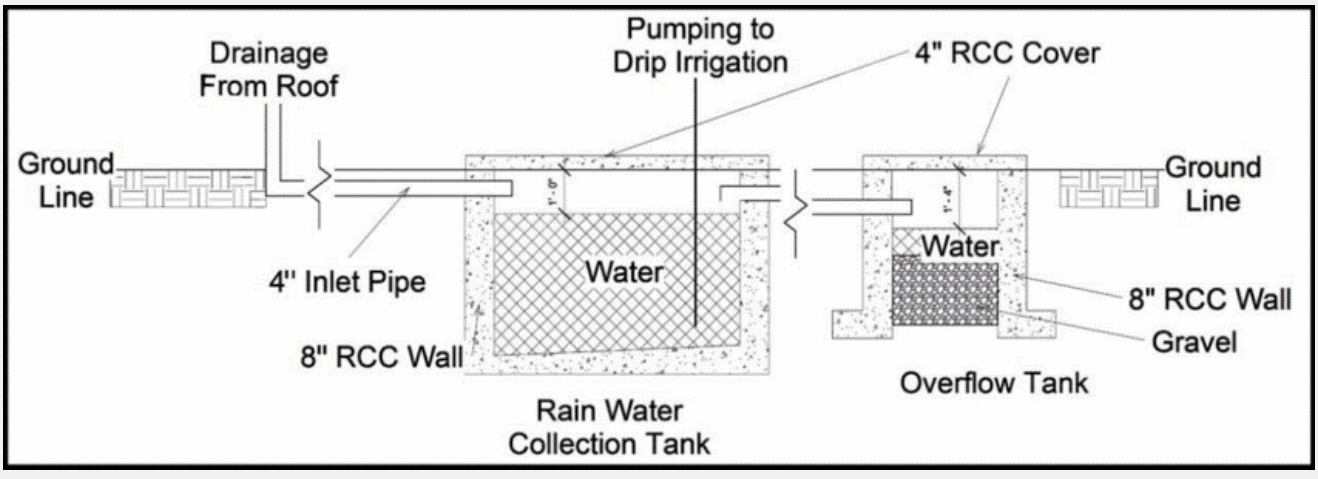
Intervention 3.2: Stepwell revitalization plan to improve water security

Rainwater harvesting is a traditional practice in Rajasthan, as 61.1% of the state is desert. The traditional water storage systems, such as, step wells (Baori's), kunds and tankas, have been redundant with the introduction of piped water supply system. However, the current building bylaws mandate to have a rainwater harvesting system in all modern buildings for plots above 350 square meters.

The existing dense urban areas in Jaipur, such as, the walled city, has limited scope for new construction. Historically, the city residents extracted water from 800 open wells and tube wells within 7.09 sq. km. Connecting the stormwater drainage channels to these wells that are otherwise redundant infrastructures shall help increase stormwater storage capacity and groundwater recharge, addressing the issue of flooding and water scarcity.

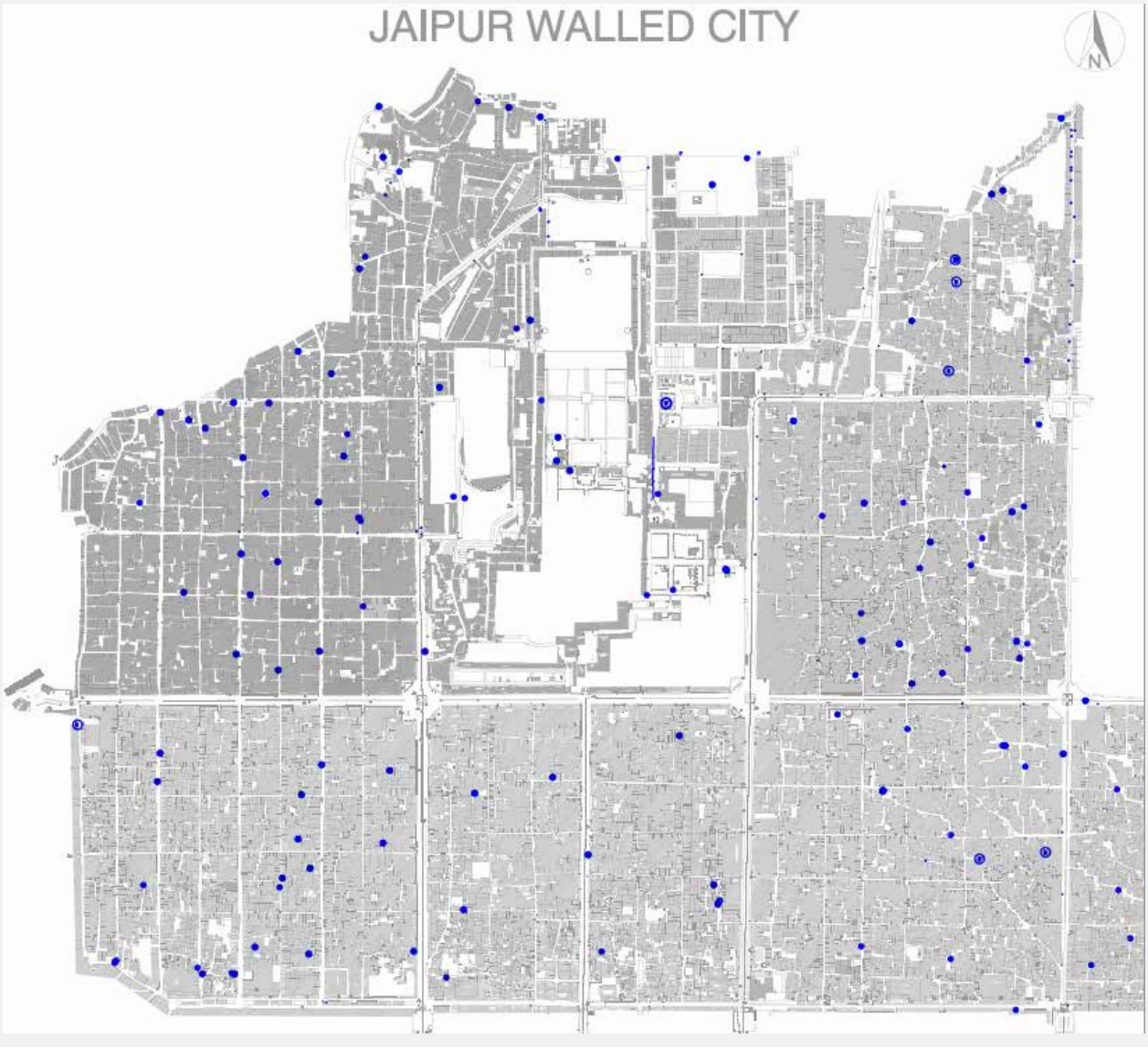
The vast number of historic stepwells located in Jaipur provide an opportunity to revive the traditional methods of water storage complemented with new rainwater harvesting structures in newly developed areas. Nearly 75LPCD can be conserved using rain water harvesting (RWH) with Jaipur municipal limits (JMC). Currently, RWH is mandatory for buildings with area above 350 sqm only. Jaipur must roll out a scheme to retrofit old structures. In areas, wherein RWH pit is not technically feasible community recharge pits must be constructed in open areas. All such pits must be complemented with a natural or man-made drainage channel for easy runoff to the recharge pits. A typical plan and cross-section of RWH structure is depicted in Figure 3-63 for reference.

FIGURE 3.62 Typical detail of RWH system



Source: Fiocchi, 2010[38]

FIGURE 3.63 Map showing the location of Public wells in the walled city of Jaipur.



Source: Heritage Cell, Jaipur Municipal Corporation Jaipur.

38 Fiocchi Jr, L. C. (2010). A Sustainable Design for the American Commercial Strip Mall.

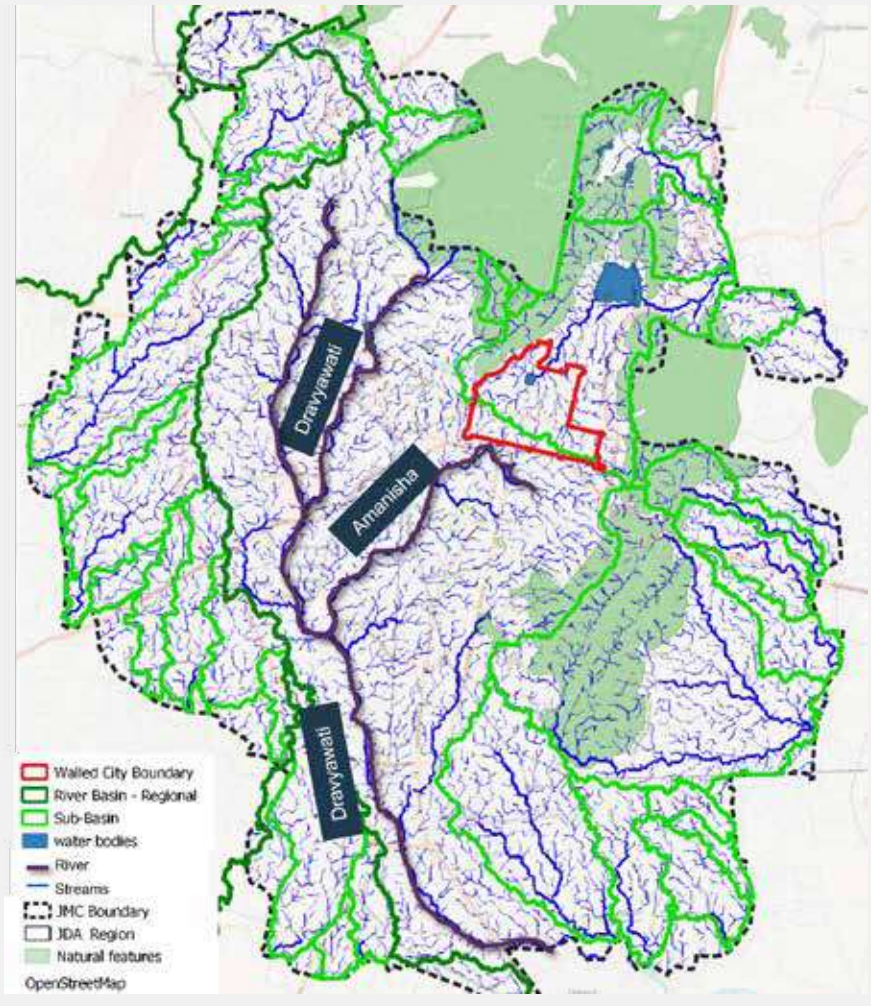
IMAGE 3.6 Dried up wells in the walled city of Jaipur

Source: Jaipur Municipal Corporation (Heritage)

Intervention 3.3: Channelization of natural drains to avoid inundation in low lying areas

Jaipur development region falls in the Banas basin, with sub-basins and tributaries making a complex water system. The Development region has Dravyavati and Ban Ganga rivers, connecting to the Banas river. There is a need for a basin management plan to manage stormwater and water resources in the region efficiently.

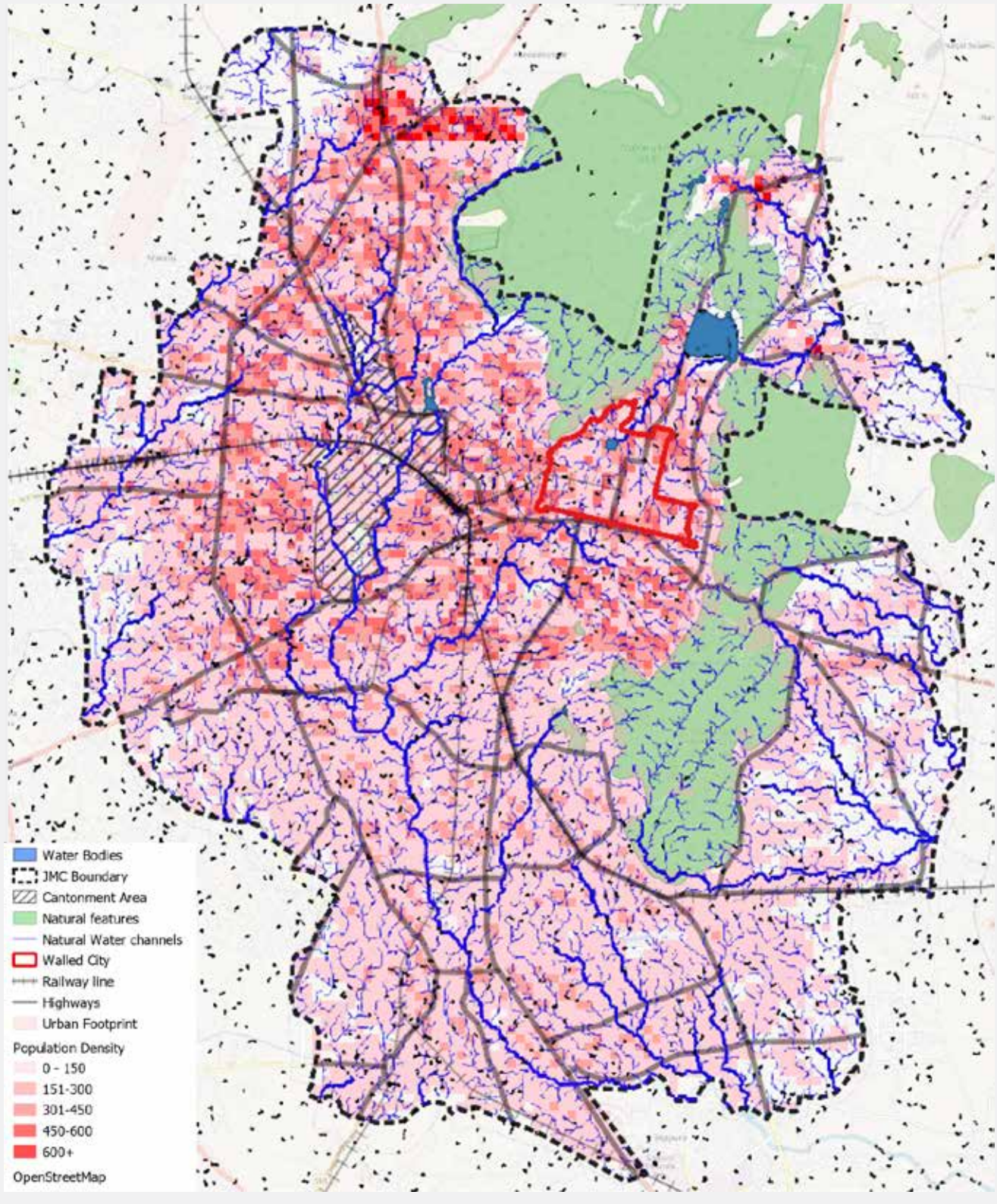
FIGURE 3.64 River basin in Jaipur urban area.



Source: Irrigation department, Development plan 2025

The urban area of Jaipur falls under the catchment of Banas river basin with its tributary Dravyavati extending from north to south connected by the Jhotwada from north-west and Amanishah from north-east. The Jaipur Development Authority recently renovated the Dravyavati river with treated wastewater and developed its 47.5 km long river edge as open green space.

FIGURE 3.65 Development obstructing natural drainage channels



Source: Un-Habitat, Google base map.

The mismatch between natural drainage network and urban footprint, as discussed above, has resulted in obstruction and reduction of drainage channels, significantly increasing the time required for stormwater drainage. The strategy is to channelise and strengthen the natural drainage system and build around it for resilient infrastructure.

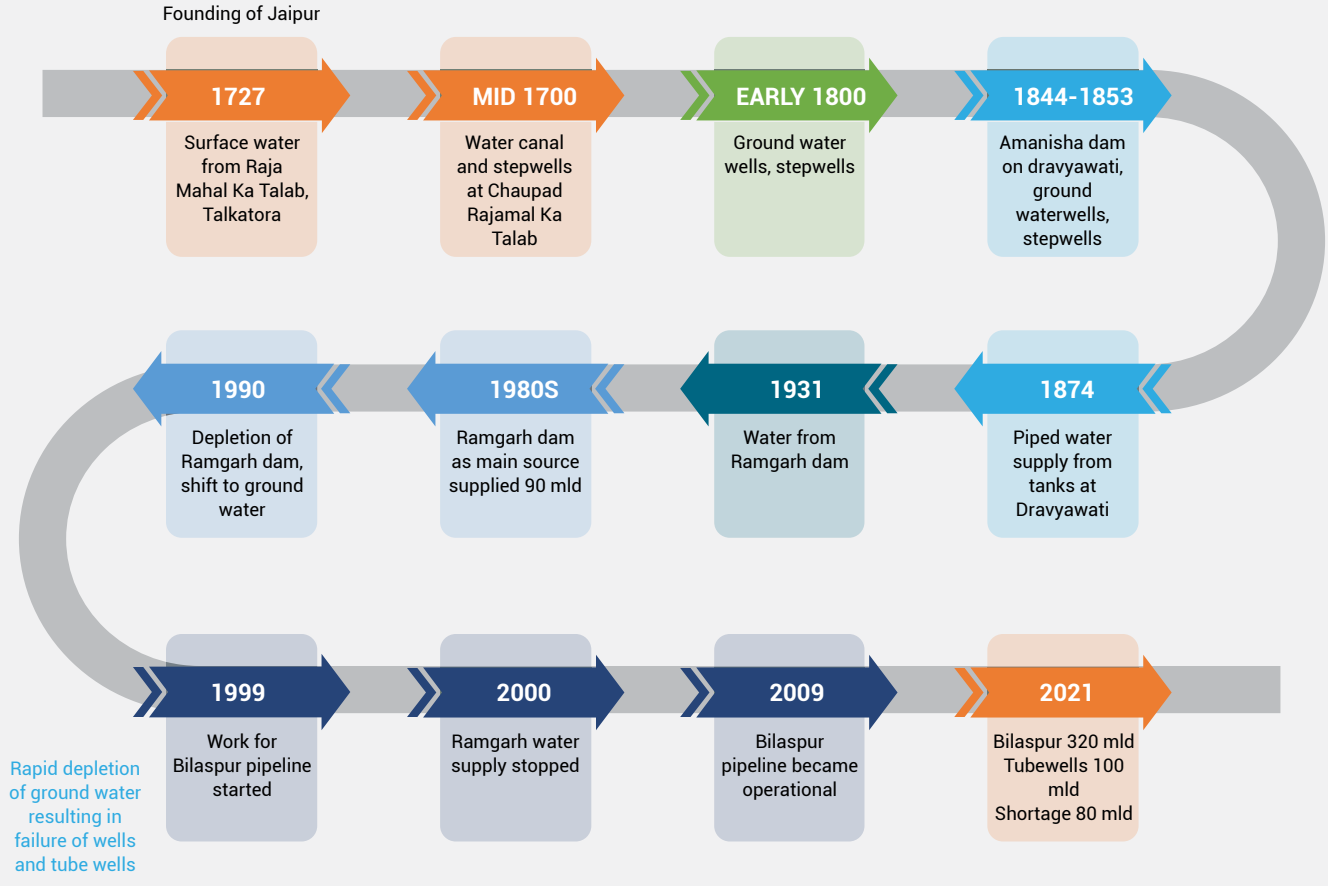
Jaipur's watershed and natural drainage system has been adversely impacted due to the current pattern of urban development and encroachments leading to inundation, and flash floods during heavy rainfall. The city's low-lying areas such as Sanjay Colony, Panipech, etc. are the worst impacted, which are also typically inhabited by urban poor and marginalized communities.

A drainage system could be developed and connected to the river Dravyavati. New drainage channels can be built to complete the existing network of drainage that is broken to connect to the larger drains and to remove blockages in the natural flow of stormwater to the larger drains. It will cut down on greenhouse gas emissions (caused by additional pumping required to drain water in water logged areas), improve water percolation, reduce runoff, and improve flora and fauna.

Intervention 3.4: Augmenting water supply through rain water harvesting

Historically, the planned walled city of Jaipur relied on the surface water bodies of Rajamal Ka Talab and Tal Katora's surface for their water demand. As the city grew in the mid-1700s, the underground water canal from the north-west brought water to the step wells on city cross junctions. During the 1800s, surface water bodies became redundant, and the city relied on groundwater and water from the canal. The project construction of the Amanishah dam was undertaken, which served the city from 1844 to 1853 until the heavy rains destroyed it. Looking at the international cities, Jaipur initiated piped water supply infrastructure, and the city received piped water from the Dravyavati tank in 1874. As the population grew, the water demand also increased, in 1931, the Ramgarh dam served the water demand until the 1990s, before it started to dry up; the project of Bisalpur dam, located 120 km from the city, had already started. Before completing the project, Ramgarh dried up completely, and the last drop of water from Ramgarh was received in 2000. The city entirely relied on groundwater until 2009, when the supply from Bisalpur dam started.

FIGURE 3.66 Timeline for sources of water in Jaipur



Source: UN-Habitat

While the city has traditionally relied on groundwater table, it is currently expensive to treat groundwater for consumption due to its quality (as discussed below). Water scarcity and urban flooding are the two pressing issues faced in Jaipur. Rainwater harvesting could be used in the advantage of mitigating water scarcity, as rainwater requires minimal treatment to be used as potable water. The strategic intervention for mitigating the issue of water scarcity in the city of Jaipur is based on the guiding principle of increasing water use efficiency, augmenting the water sources, and rainwater conservation and harvesting.

Centre for Science and Environment (CSE) with Tata Consultancy Services (TCS) have estimated water demand for an urban Indian household. It typically needs about 184 litres of water per capita per day for various activities. Bureau of Indian Standards (BIS) has developed a draft for water efficiency rating system of water fixtures, mandating the use of water-efficient fixtures is estimated to bring down the demand by 20.2 per cent, as shown below in Table 3.13 from 184 litres to about 146.48 litres.

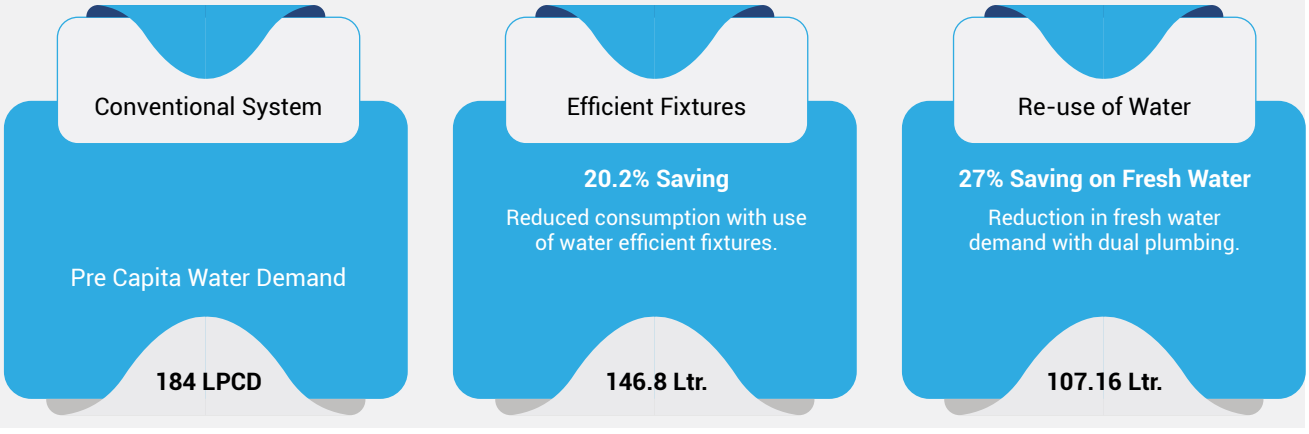
TABLE 3.13 Water saving and efficiency of various fixtures

Fixture	Saving	Conventional fixture	Water Efficient fixture
Showers	19.5	80	64.40
Cloth Washer	22.1	28	21.70
Toilets	18	27	22.14
Kitchen	23.9	42.5	32.34
Leakage	8.8	6.48	5.90
		184	146.48
Saving of 20.2 % water			

Source: UN-Habitat

In terms of increasing efficiency, installation of dual pipe plumbing to re-use treated greywater can decrease freshwater demand by 27%. Freshwater demand for irrigation and landscape can entirely be met with treated greywater bringing the freshwater demand to nil. Using the water-efficient fixtures and dual-pipe plumbing together in the urban centres can bring down the demand for freshwater by 42 per cent.

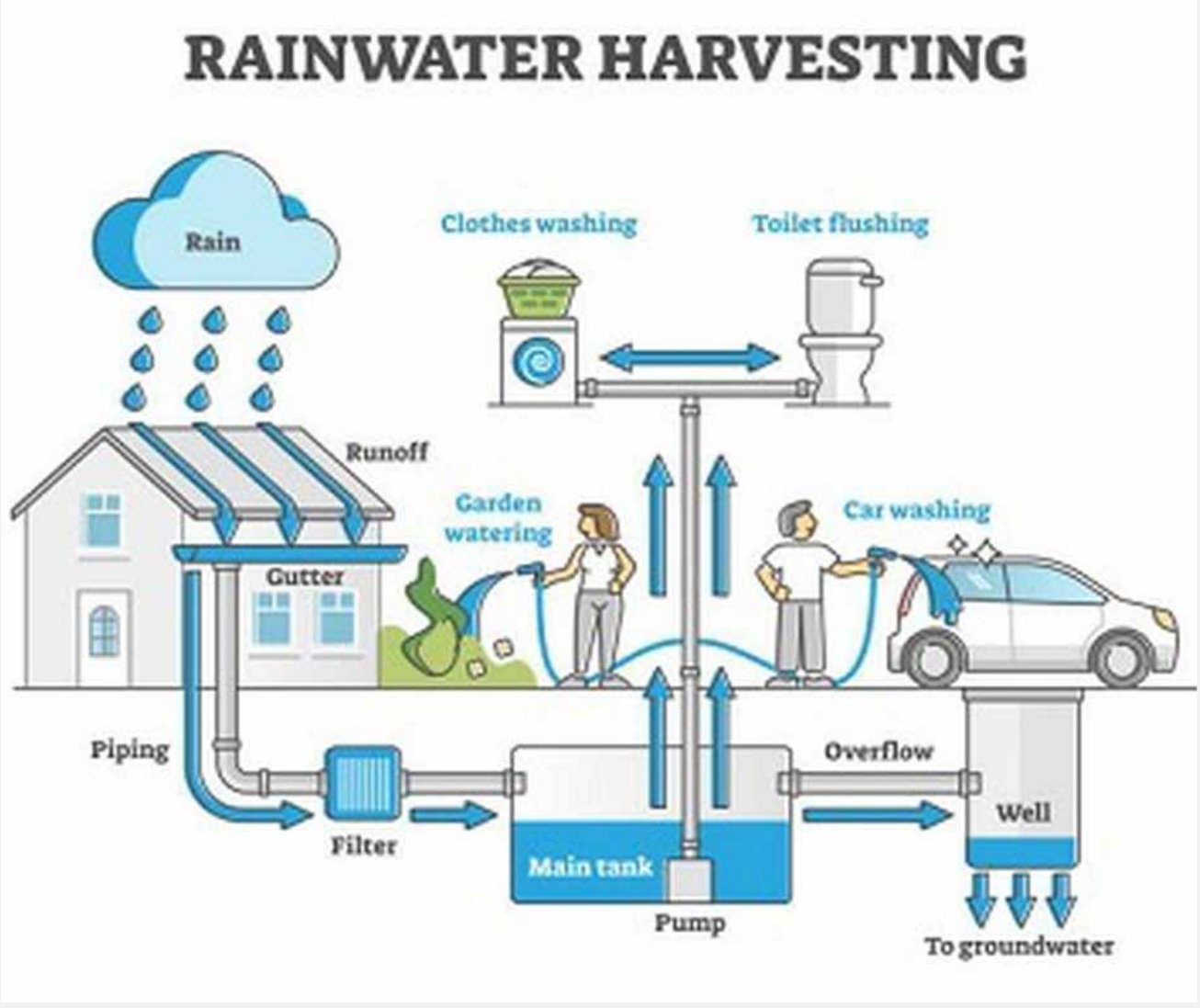
FIGURE 3.67 Estimate reduction in water demand with efficient use of water.



Source: TCS 2009, Average household water consumption report

With the groundwater table at a depth of more than 40 meters in the urban area, the value of total dissolved solids in water is very high with the presence of nitrite and fluorides.. With minimal treatment, the rainwater can be used as portable water with uses ranging from cooking and drinking to fire protection.

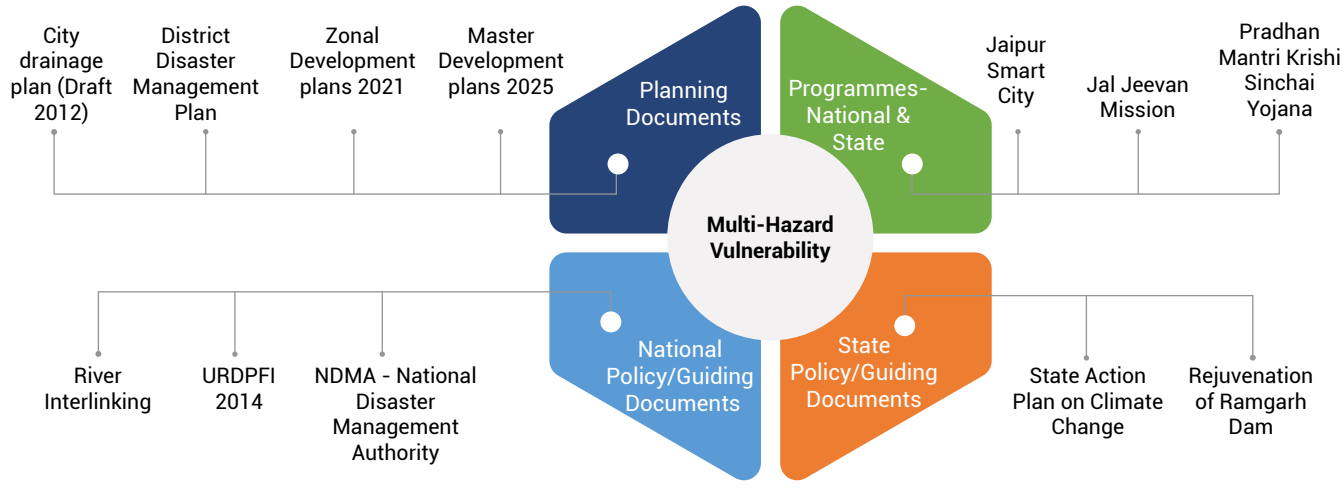
FIGURE 3.68 Re-use of Rainwater



Source: https://sacleanwater.com/rainwater-harvesting-systems/

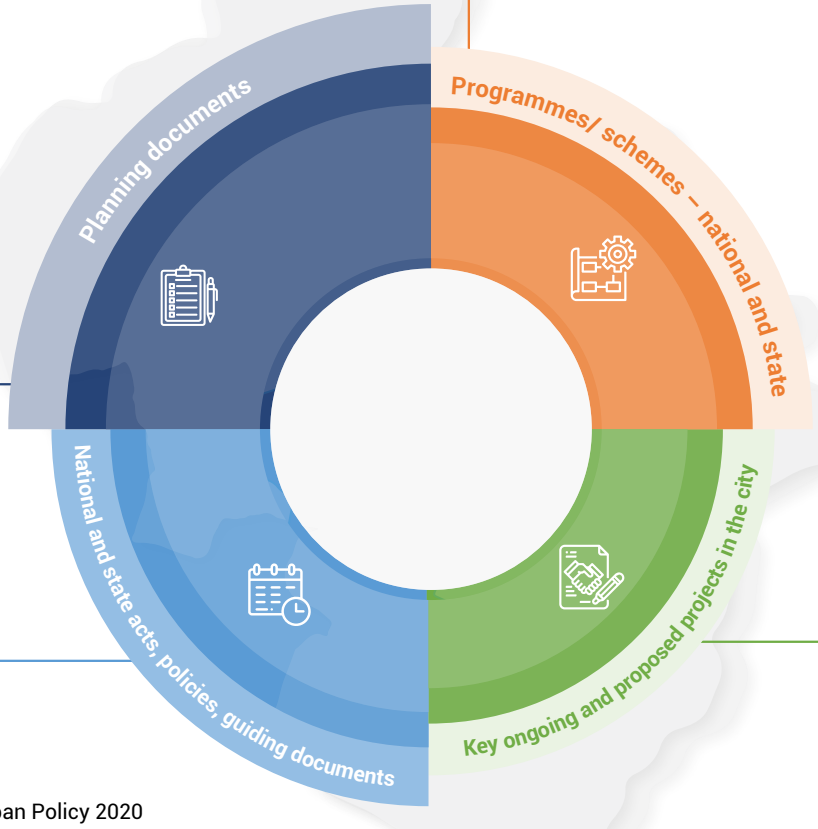
Rainwater could potentially meet 56 per cent of the annual water demand considering the average annual rainfall in the city is 570 mm. 384 sq. km. of municipal area has 57 per cent impervious surfaces; rainwater from 219 sq. km. can be collected considering the 0.8 runoff coefficient. The potential total harvested 99,864 million litres of rainwater can meet the demand of 20.26 lakh people.

3.4.2 Alignment with national, state policies and on-going, proposed capital projects in the city



- Jaipur Master Development Plan 2025
- Jaipur Zonal Development Plans 2021
- District Disaster Management Plan 2014
- City Drainage Plan (Draft 2012)

- AMRUT
- AMRUT 2.0/ Jal Jeevan Mission (Urban)
- Jaipur Smart city
- Jal Jeevan Mission
- Pradhan Mantri Krishi Sinchai Yojna



- National Urban Policy 2020
- National Mission on Sustainable Habitat 2021-2030
- Urban and Regional Development Plans Formulation and Implementation Guidelines (Volume 1) 2014
- State Level Action Plan on Climate Change
- Rejuvenation of Ramgarh Dam

- Master Development Plan 2050 (Process started in 2021)
- Eastern Rajasthan Canal Project
- Integrated State Water Management Plan

3.4.3 Gender and Inclusion

The strategic response via its actions addresses the water scarcity and multi-hazard vulnerability would benefit vulnerable groups and specifically women. Water scarcity, drought and urban flooding impact livelihood of vulnerable communities and significantly women more than men. Multi-hazards such as in case of flood/drought could lead to additional caregiving work from women towards elderly and children (by possible health hazard in case of hazards) (UNIDO, 2015).[39] Modelling and early warning system for floods and improving surface condition to absorb more rainwater could mitigate and minimize impact on elderly and children. Improving water security, cleansing natural water sources, augmenting domestic water supply could also reduce the existing domestic unpaid work of women and girls.

In the sponge city proposal existing women Self Help Groups (SHG) of city could be enabled to undertake water-sensitive planting, maintenance and management of water bodies as public spaces. They could be employed in paid remunerative work in rain water harvesting, water filtration, flood protection. It is also recommended that gender disaggregated data be collected to ensure inclusive climate policies to address multi-hazard vulnerability (age, income, person with disability).

3.4.4 Cost Estimates

TABLE 3.14 Cost estimates

S. No.	Intervention	Project	Block Cost Estimate (INR in Lakh)	Implementing Agency	Sources of Finance
1.	Mandatory provision of Green Roofs.	Building byelawas to make mandatory provision for green roofs on large plots and promote urban greens by providing relaxations in UD tax for its maintainance		JDA/ JMC-G / JMC-H	NA
2.	community level ground water recharge pits in parks and open spaces to reduce runoff	de-centrilization of stormwater drainage system by providing recharge pits on public land and neighborhood parks for increased percolation.	687.5	JMC-H / PWD	Jal Jeevan Mission / JMC / CSR
3.	Building Robust stormwater drainage system.	Formulation of River basin management plan / storm water management plan at the city level.		JDA	AMRUT
4.	Building Robust stormwater drainage system.	installation of porous U or V type storm water drain for increased percolation.	8125	JMC/JDA/PWD	PPP/ New Development/ JMC
5.	Using water efficient fixtures	Provision for Mandaroy use of ISI marked water efficient fixtures for highrise and commercial projects.	NA	PWD / NBC	NA
6.	Re-Use of Water	Making Dual pipe plumbing Mandaroy for highrise and commercial projects.	288	PPP/ JMCG and JMC H	PPP / Amrut

Source: UN-Habitat

3.4.5 USAF Indicators impacted

USAF indicators impacted are:

Multi hazard velunerability is directly liked to 38 indicators (6 descriptive and 23 scored), the strategic interventions shall result in improvemement of score for 20 indicators.

1.3,3.2,3.3,3.5,4.3,4.4,7.8,7.9,8.2,8.4,8.6,10.1,10.2,10.4,10.5,10.6,9.7,11.6,11.8,12.12

3.5 Strategic Response 4: Jaipur as an Ecological City

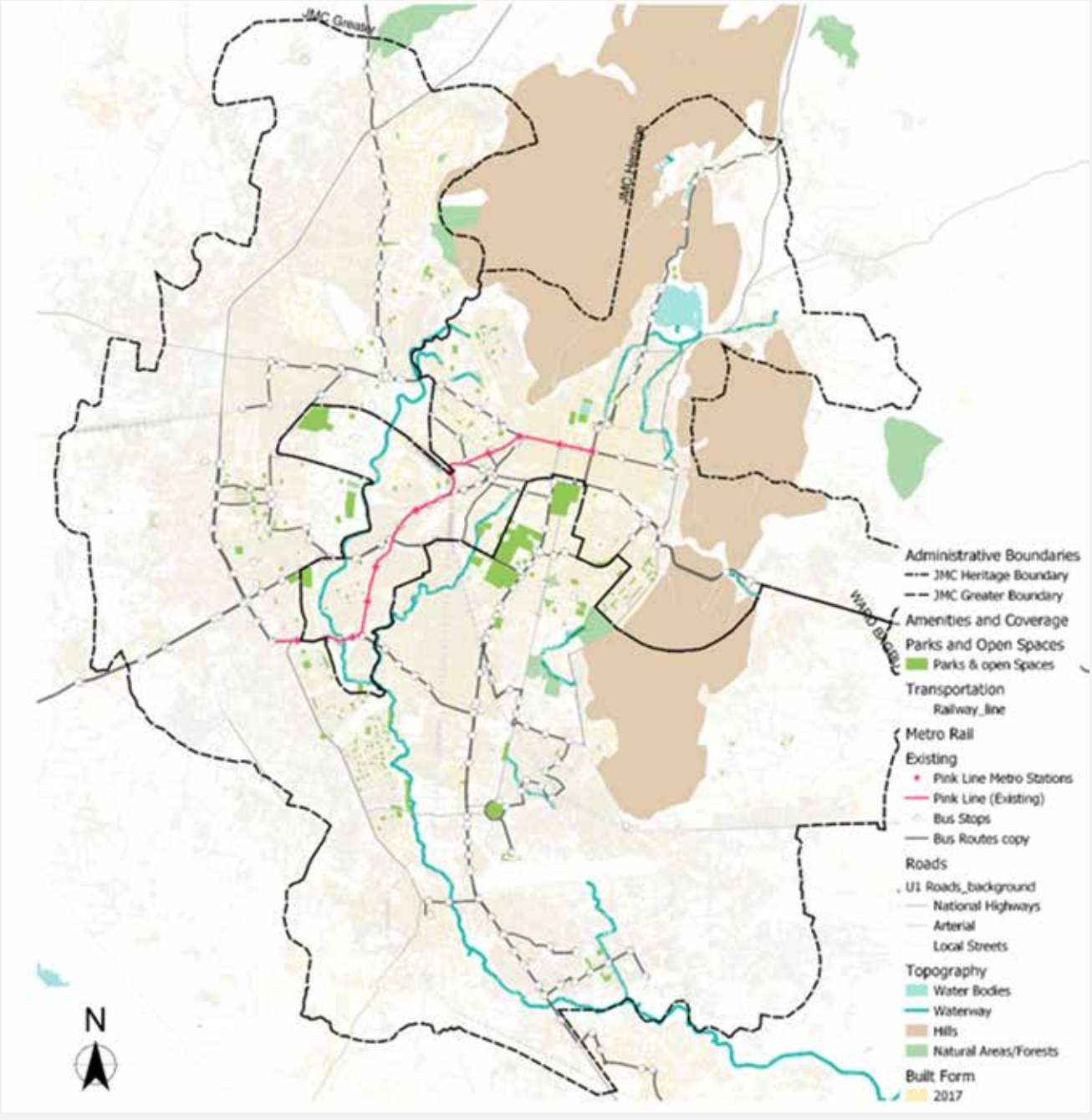
Over decades, the urban growth of Jaipur has resulted in a lack of green spaces. The rapid urbanisation has contributed to the city's high levels of air pollution, and a rise in temperature. The city also does not meet the minimum standard of access to open space per capita, including access to recreational spaces. Analysis of the existing condition, especially in terms of green and blue infrastructure in the city, raises the following points:

39 UNIDO. (2015). Guide on Gender Mainstreaming Environmental Management Projects. UNIDO.

Jaipur fulfils a mere 12% of the USAF benchmark for per capita access to green space.

Based on the data shared by the municipal corporation, the city of Jaipur (JMC) has only about 1.46 sq. mt. per person of green space, which is extremely low when compared to the USAF benchmark of 12 sq.mt. As shown in Figure 3 69, the green spaces in the city are located mainly in the center with the Central Park, Ramniwas Bagh, Golf Club, Sawai Mansingh Stadium, and large government and administrative buildings.

FIGURE 3.69 Urban green open spaces in Jaipur

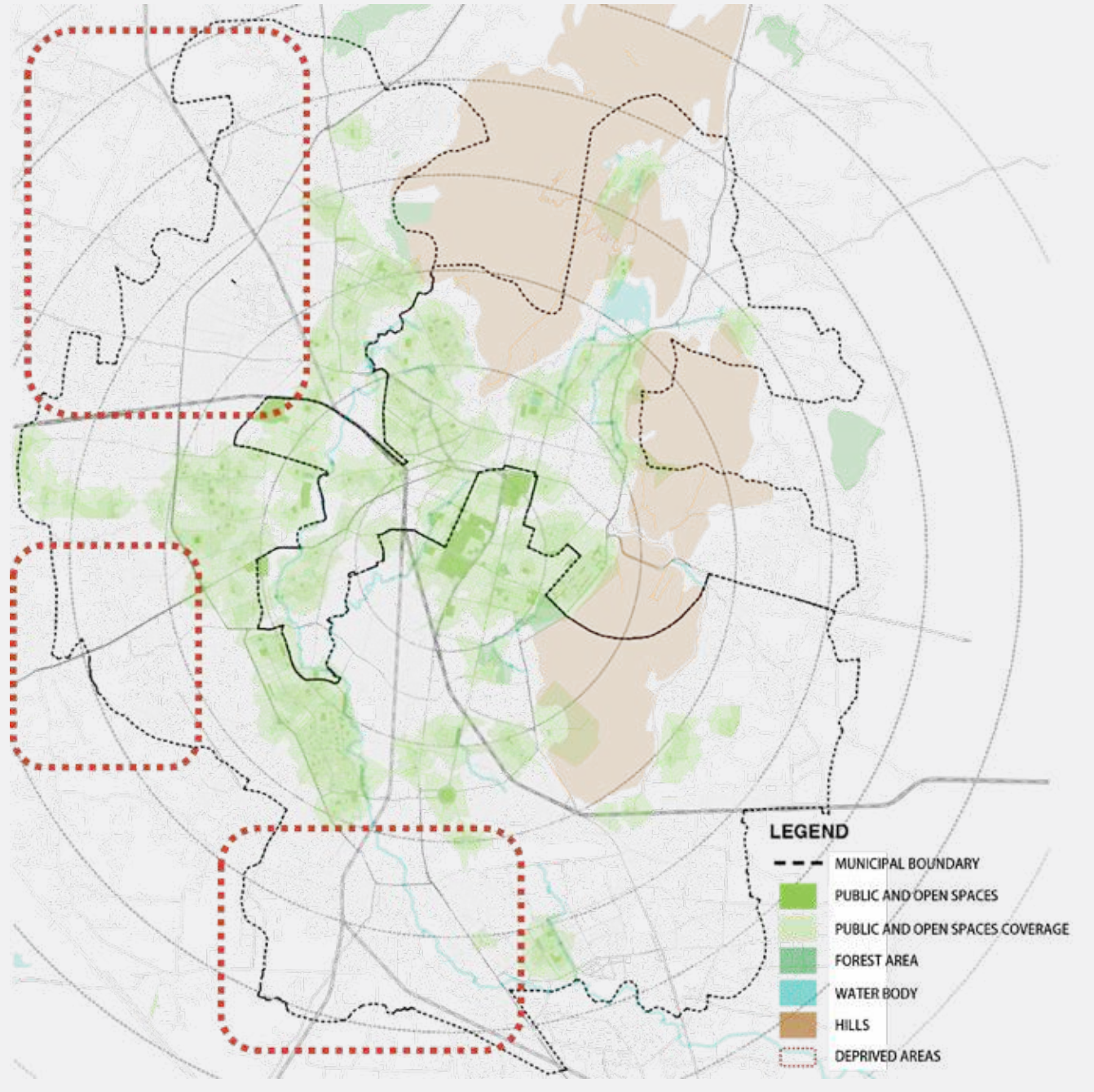


Source: Jaipur Municipal corporation

Only 30% of the city population lives within 500-metre of available green spaces.

As shown in Figure 3 71, only about 30 per cent of the city population lives within 500-metres of an open space with easy accessibility; this is much lesser than the USAF[40] benchmark of 80 per cent.

FIGURE 3.70 Area within 500-metre coverage of park



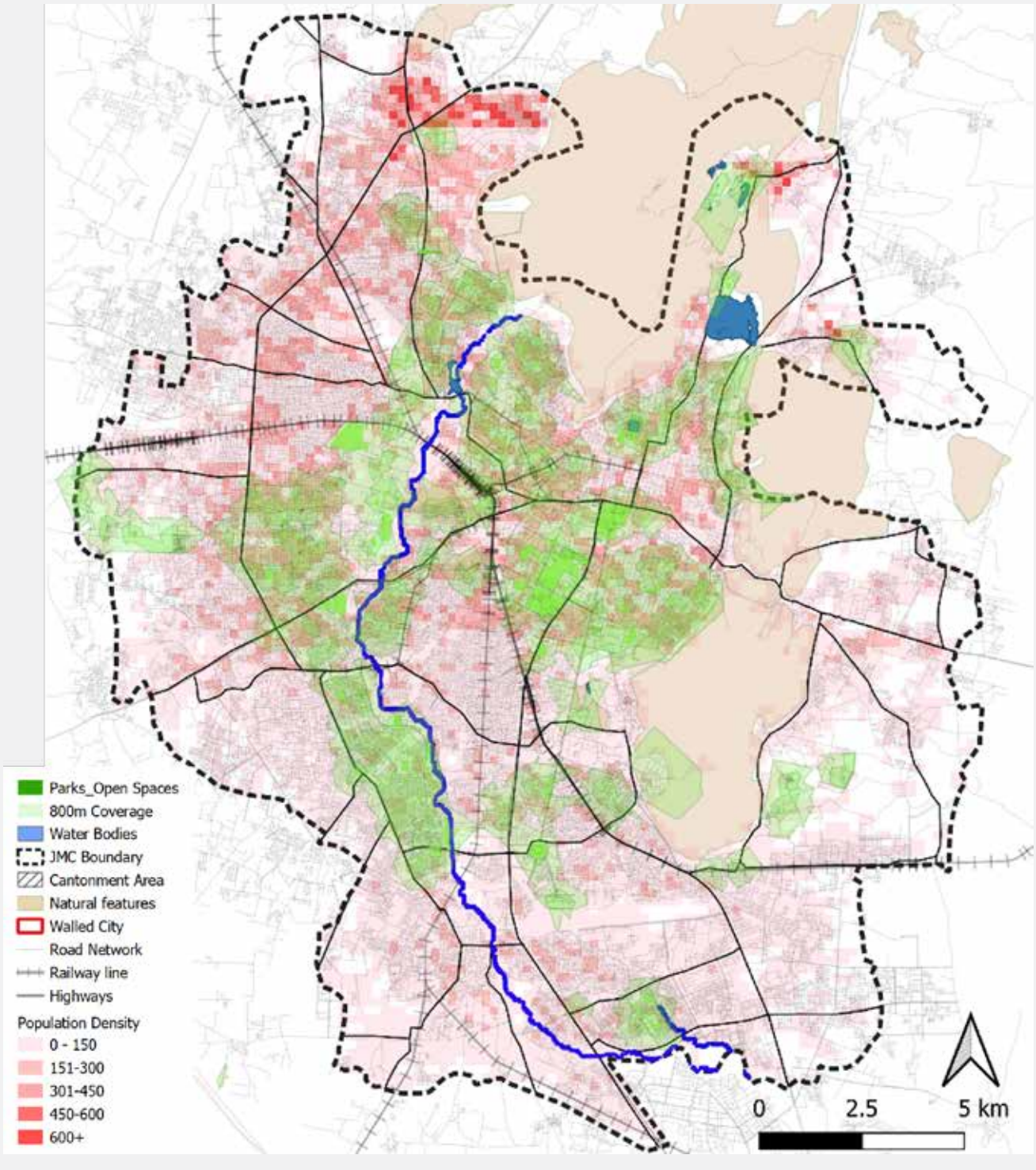
Source: UN-Habitat

40 Urban Sustainability Assessment Framework

Because of rapid urban expansion, there are pockets of city without any access to green spaces

The pace of urbanization is increasing sharply with urban velocity increasing from 4.3 to 6.3 sqkm/year between 1990 to 2020. The spatial analysis reveals that the rapidly developing parts of the city in the north-west, south, and south-west barely have access to green open spaces (Figure 3 71).

FIGURE 3.71 Area where residents are without access to open space.



Source: UN-Habitat

The land use share of recreational spaces and water bodies has decreased from 1991 to 2011

Based on the Master Development Plans for Jaipur, there has been a drop in the planned recreational spaces as the city expanded. Table 3-15 shows that the planned recreational space in the three Master Development Plans of 1971, 1991 and 2011 has been 3.3%, 3.4%, and 1.94%, respectively. At the same time, the percentage of water body has halved from Master Development Plans in 1991 to 2011 from 2.25% to 1.15%.

The blue-green spaces are encroached and reclaimed for urban expansion and development

The undeveloped and unprotected blue-green spaces are most prone to urban encroachment. Considering the case of a water body located in the foothills of the Jhalana forest, as shown in Figure 3 73, the Google earth images show that land under blue and green cover has been reclaimed for urban development.

TABLE 3.15 Land use distribution as per Master Development Plans

Land Use	1971	1991	2011
Recreational (As per Master Development Plan)	330 **(3.3%)**	530 **(3.4%)**	543 **(1.94%)**
Waterbody (As per Master Development Plan)	—	350 **(2.25%)**	322 **(1.15%)**
Total area (in sqkm)	10,000	155,88	279,89

Source: UN-Habitat

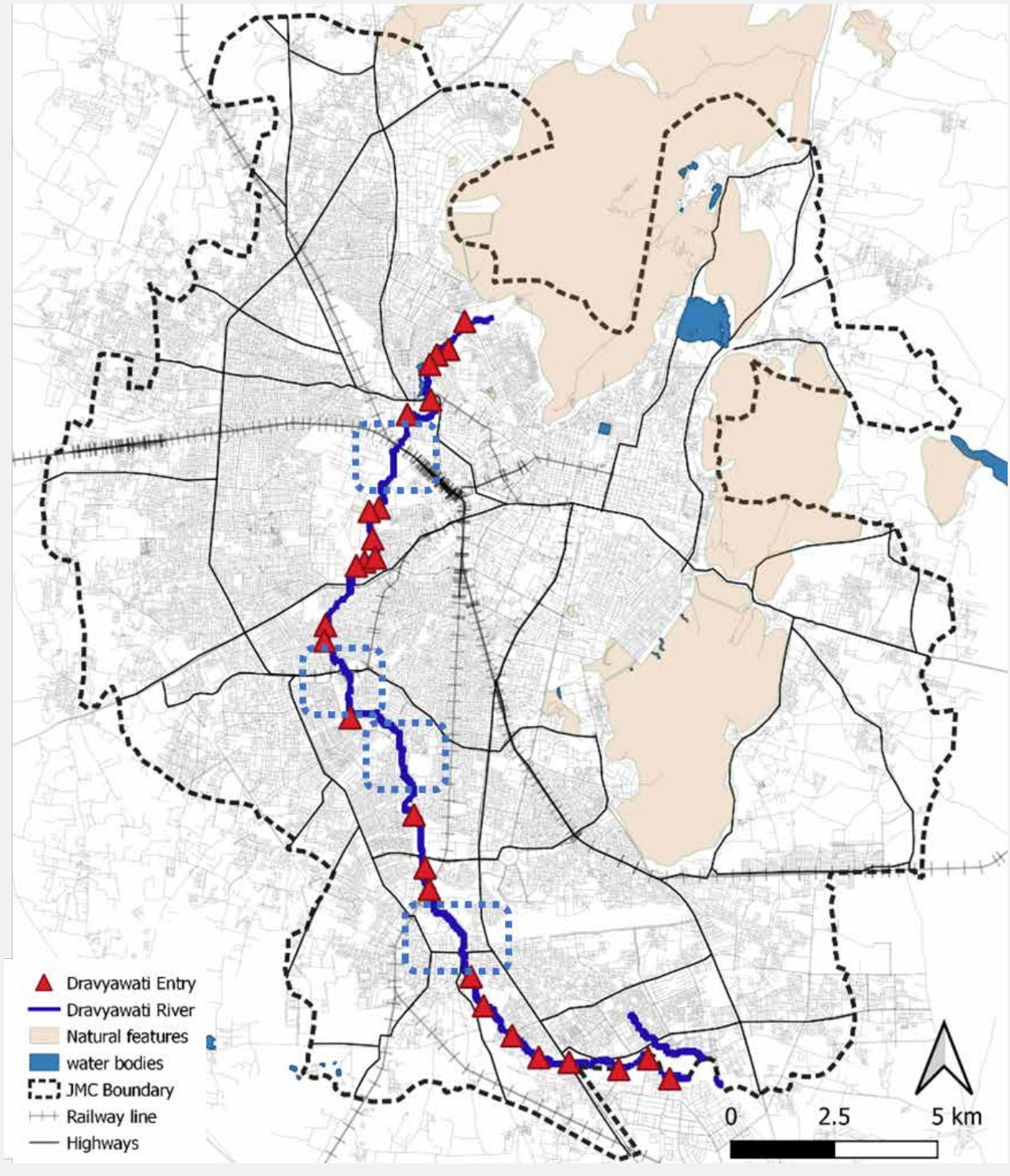
FIGURE 3.72 Encroachment of water body along Jhalana foothills

Source: Google Earth

The embankment walls restrict public view and access, and curtails storm water drainage

The riverfront along the Dravyavati River extends north to south of the city, having a total length of 47.5 km, and is undergoing development with an investment of INR. 1,677 crores. It plans to develop a retaining structure with a walking cum cycling track and green space on both sides. The riverbank is protected with a high embankment wall. The wall constructed along the river edge acts as barrier and curtails public access. It also curtails storm water from draining into channel. Figure 3 73 shows the entrance points to the walkways along the riverfront, which are not evenly spaced and are more than 1000 m apart along identified stretches. The river is a physical barrier between two halves of the city on both sides of the river with limited crossing points.

FIGURE 3.73 Entrances along Dravyavati river



Source: UN-Habitat

The blue-green disconnect in Jaipur can be addressed through Ecological City strategies

Ecological cities, also known as eco-mobile cities, eco-cities, or green cities, apply ecological principles to city design, construction, and management. They prioritize environmental considerations and aim for reduced pollution, greenhouse gas emissions, and resource consumption. These cities feature efficient transportation systems and prioritize pedestrian and cyclist-friendly development.

The European Commission's definition of green infrastructure is: "strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services such as water purification, air quality, space for recreation and climate mitigation and adaptation. This network of green (land) and blue (water) spaces can improve environmental conditions, and therefore, citizens' health and quality of life. It also supports a green economy, creates job opportunities, and enhances biodiversity."[41]

Spatially, rivers, canals, ponds, wetlands, flood plains, water treatment plants can be referred to as blue spaces, and trees, lawns, hedgerows, parks, fields, and forests as green spaces (Figure 3-74).

Ecological cities promote harmony between human activities and nature (Chengzhong Ma et al 2018;[42] Saad et al., n.d.).[43] Urban greens enhance the city's image, improve air quality, and provide numerous benefits such as climate improvement, energy savings, water catchment protection, flood control, erosion prevention, and biodiversity promotion. In addition, urban green serve agricultural, fodder, and forest production purposes, and offer livelihood opportunities for marginalized communities.

FIGURE 3.74 Examples of Blue-Green Infrastructure/Spaces

Source: UN-Habitat

41 Accessed at https://environment.ec.europa.eu/topics/nature-and-biodiversity/green-infrastructure_en#:~:text=Green%20infrastructure%20has%20been%20defined,example%2C%20water%20purification%2C%20improving%20air.

42 Accessed at https://iopscience.iop.org/article/10.1088/1755-1315/186/3/012058/pdf.

43 Accessed at https://core.ac.uk/download/pdf/235050174.pdf.

BOX - 11: CASE STUDY: EAST KOLKATA WETLAND, INDIA

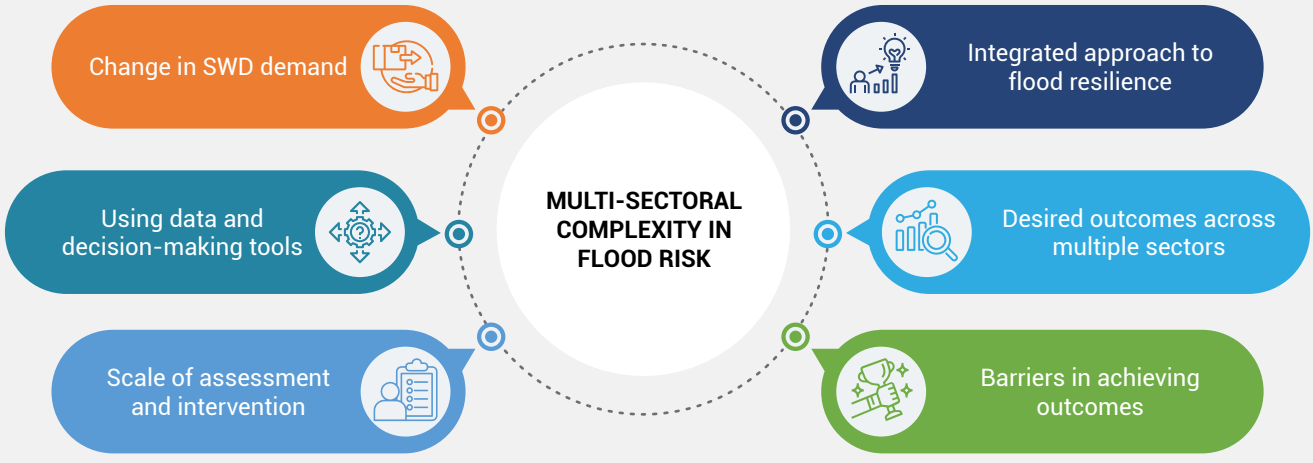
Beyond blue-green infrastructure, grey network such as storm drain network could use nature-based solution in ecological cities. East Kolkata Wetland in the eastern part of India is a 12,500 hec Ramsar site. It naturally treats sewage of Kolkata Metropolitan Area through fishing and farming, which is a great example of nature-based solution for grey infrastructure with potential to be replicated in other cities. However, since these are informal communities living in urban periphery, in spite of treating the whole cities' sewage, they depend on non-networked, local infrastructure for water supply and sanitation (Allen et al., 2016) . Image 3.7 shows an image of East Kolkata Wetland with infrastructures like lock gate receiving the sewage flow from the city.

IMAGE 3.7 Bantala lock gate at East Kolkata Wetland receiving sewage flow from the city

BOX - 12: CASE STUDY: NATURE BASED SOLUTION TO ADDRESS URBAN FLOOD IN MUMBAI

Mumbai has adopted nature-based solutions for flood risk management, combining them with traditional grey infrastructure as needed. These solutions help divert stormwater runoff, increasing the city's drainage capacity and addressing climate change impacts. By integrating nature-based and hybrid grey-green solutions, the cost of ownership is reduced, and communities can actively participate in implementation. However, a critical barrier is the need for local authorities to understand and embrace these solutions. Innovative financing mechanisms, such as Public Private Partnerships and Corporate Social Responsibility, alongside municipal budgets, are proposed for effective implementation.[1]

FIGURE 3.75 Understanding multi-sectoral complexity in flood risk in Mumbai



Source: Consultative stakeholder workshop[43]

3.5.1 Proposed interventions with strategic responses

Intervention 4.1: Conserve and protect the existing natural assets

To protect natural features like water bodies and forests from encroachment, it is crucial to document them, spatially demarcate them in the city's master plan, and monitor them using real-time data. Integration of water management into urban planning and design is necessary to enable water bodies, the blue assets, to function as sponges to absorb excess water, recharge groundwater table, mitigate urban flooding and urban heat island effect, and preserve ecological systems. This can be achieved through actions and interventions planned under initiatives like the Jal Jeevan Mission (Urban). Citizen groups play a significant role in driving the rejuvenation of water bodies by bringing its importance to the authority's attention.[44]

Inventorizing and bunding water bodies with physical barriers protect against urban encroachment. Nature-based solutions for bunding rejuvenate water bodies and promote biodiversity. Developing waterfronts as active public spaces establishes city identity and improves the communities interaction with them. The waterfront development along Mansagar Lake (Image 3 8) has transformed it into a functional public space for the local communities and tourists, generating income for the informal sector and the city alike. Similar projects to be proposed for development around Chandlai Lake, Neota Dam, Sagar, Amanishah Talab and other similar water bodies threatened by urban expansion pressures.

44 Accessed at https://thelogicalindian.com/exclusive/rachenahalli-lake-bengaluru/.

IMAGE 3.8 Waterfront development along Mansagar lake

Chandlai Lake has tremendous potential for waterfront activation and protection. As shown in Figure 3 77, located south of Jaipur along Tonk Road, the lake is a popular spot among migratory bird watchers during winter. The natural water body has a deep edge along the south side, as shown in Image 3 9. The intervention of bunding the deep edge with stone pitching (Image 3 11) and the waterfront development shall help uplift the tourist experience while generating employment for the locals. The lake has an undefined shallow edge along the north, as shown in Image 3 10, which is most prone to encroachment. The shallow edge can be protected using nature-based solutions such as bioswales and tree plantations, demarcating a physical boundary to avoid further encroachment during the summer months when the water table is low, as seen in images from 2010 to 2021, Figure 3 76.

FIGURE 3.76 Encroachment of water catchment area along the shallow edge of the lake

Source: UN-Habitat

IMAGE 3.9 Deep edge of Chandlai Lake

Source: UN-Habitat

IMAGE 3.10 Shallow edge along Chandlai lake

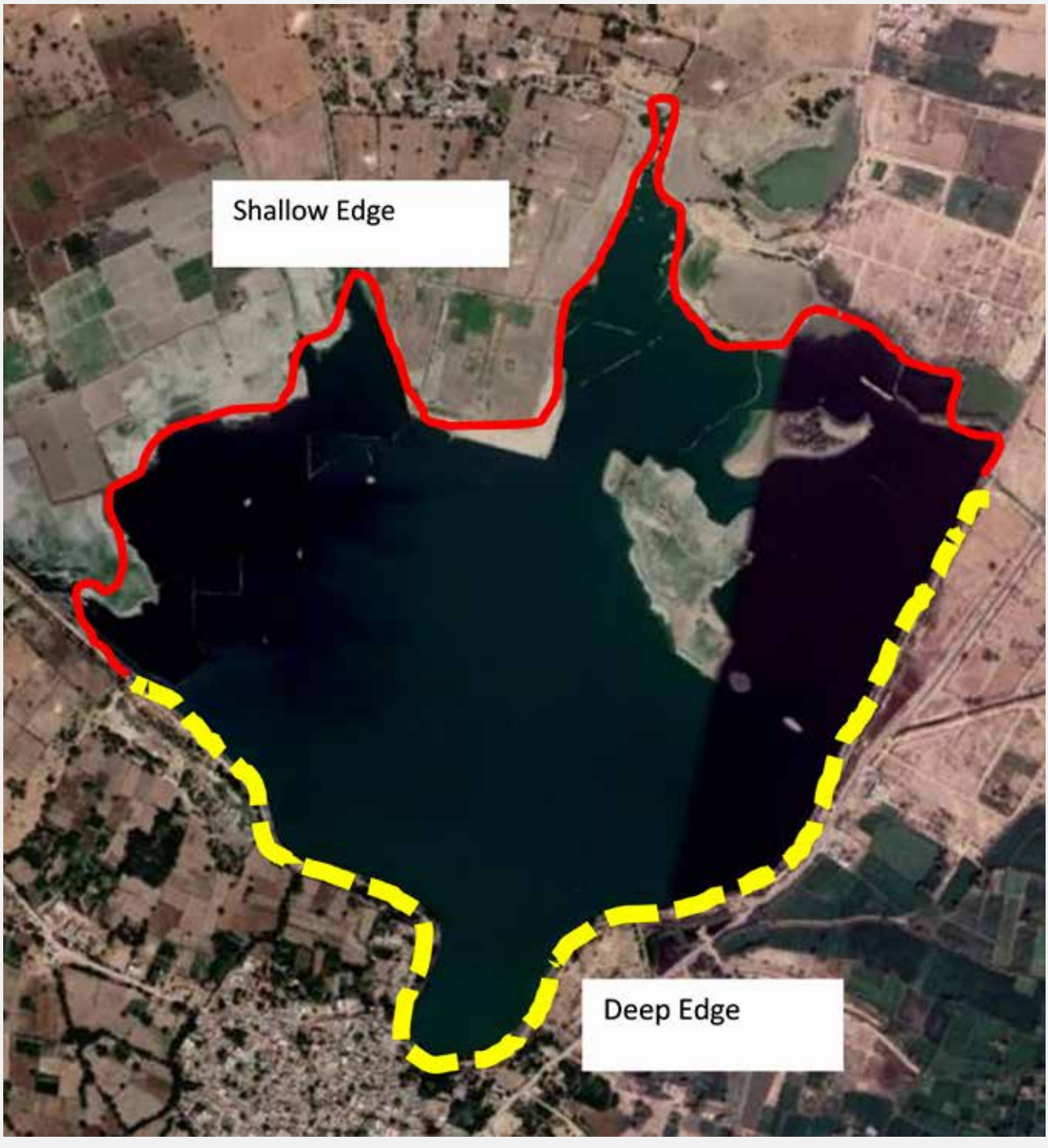
Source: Google images

IMAGE 3.11 Stone pitching along the deep edge. Source: Google Images

Source: Google images

The development plan of Jaipur earmarks public open spaces, as green assets, to be developed in 16 planning zones. The open spaces are identified based on area and the population it shall serve. All the identified spaces fall along the city's central axis from north to south, except the localities of Indira Gandhi Nagar, Kalwar Road and Hasampura deprived of such spaces. However, only five such places have been developed and activated so far.

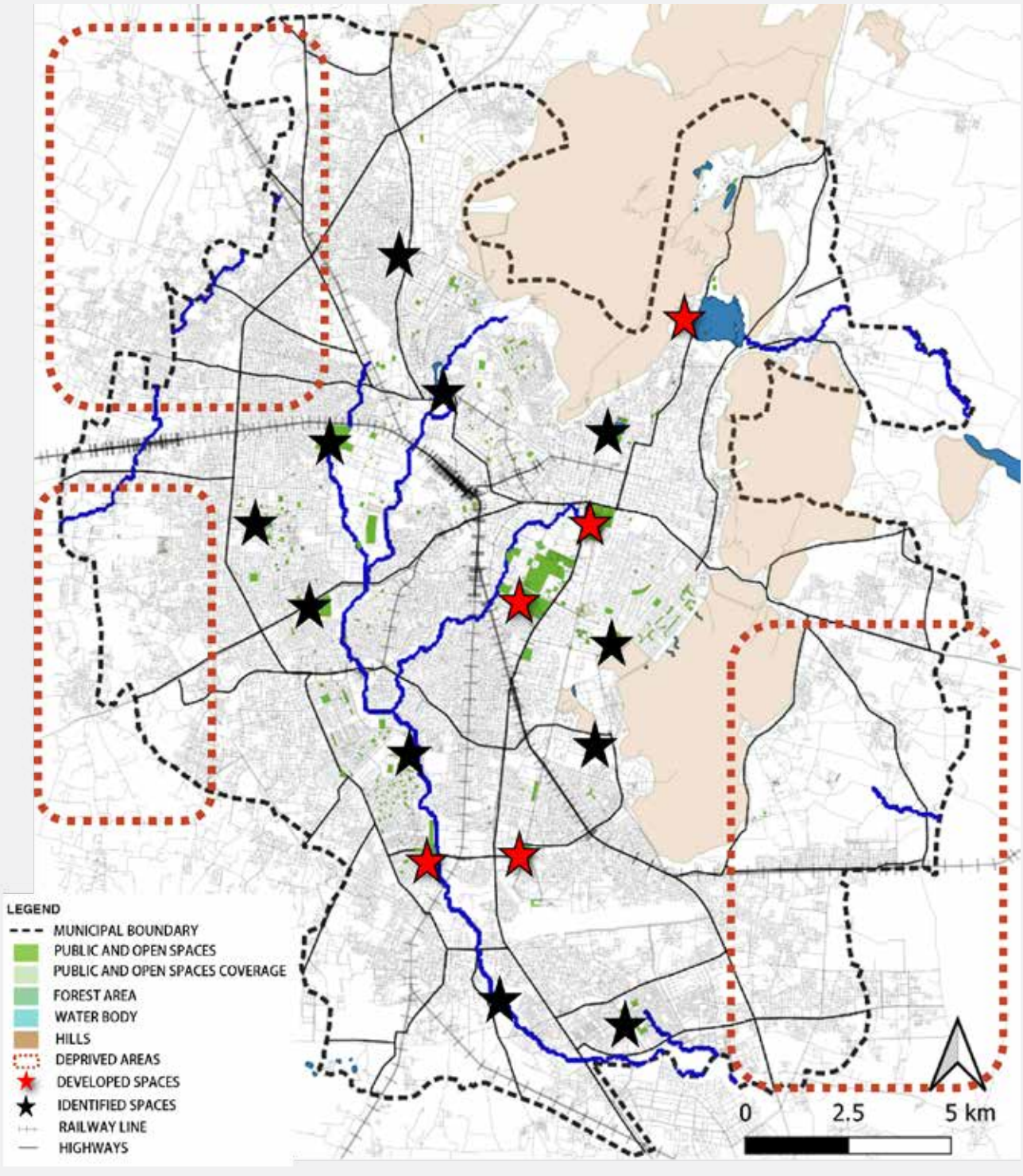
FIGURE 3.77 Map showing catchment of Chandlai lake



Source: Base map Google earth, Un-Habitat

The development plan of Jaipur earmarks public open spaces to be developed in the city zones, based on area and the population it shall serve. All the identified spaces fall along the city's central axis from north to south, excluding the localities of Indira Gandhi Nagar, Kalwar Road and Hasampura. However, only five such places have been developed in the city.

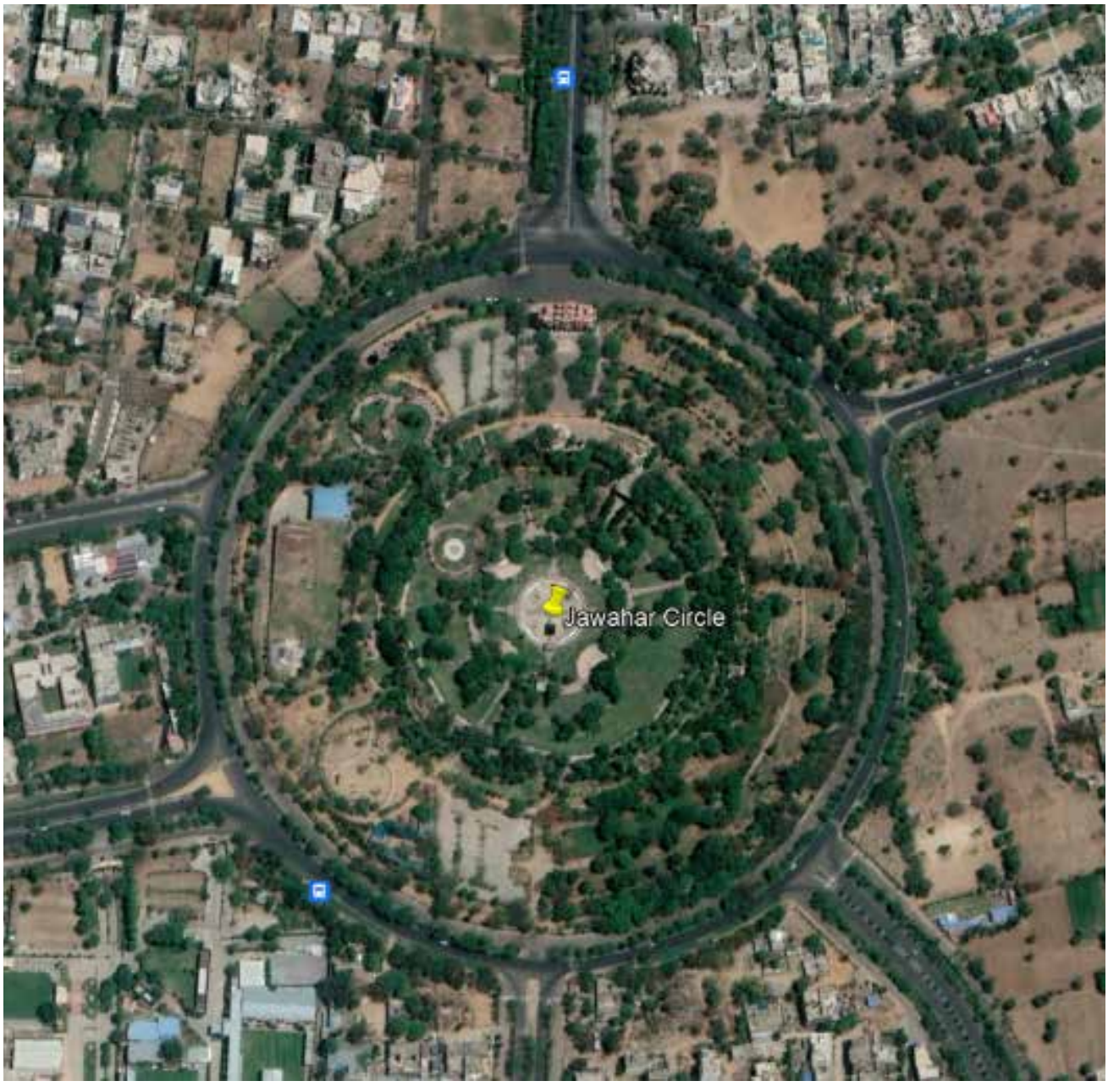
FIGURE 3.78 Identified open public spaces in the development plan



Source: UN-Habitat, (baseline information from Master Development Plan 2025- Jaipur Development Authority)

The urban open spaces can be actively used by introducing activities for different age groups, which help attract people towards it. Jawahar Circle, as shown in Image 3-12, a planned open space, is one such example. Patrika Gate, shown in Image 3-13, developed as a landmark building, has become a popular tourist attraction. The provision of spaces for parking and informal sector vendors, shown in Image 3-14, makes it convenient for visitors. Activities like skating rings, laser and fountain shows attract users of varied age groups, and open spaces for community gatherings are used to host local events and festivals.

IMAGE 3.12 Jawahar circle



Source: Google Earth

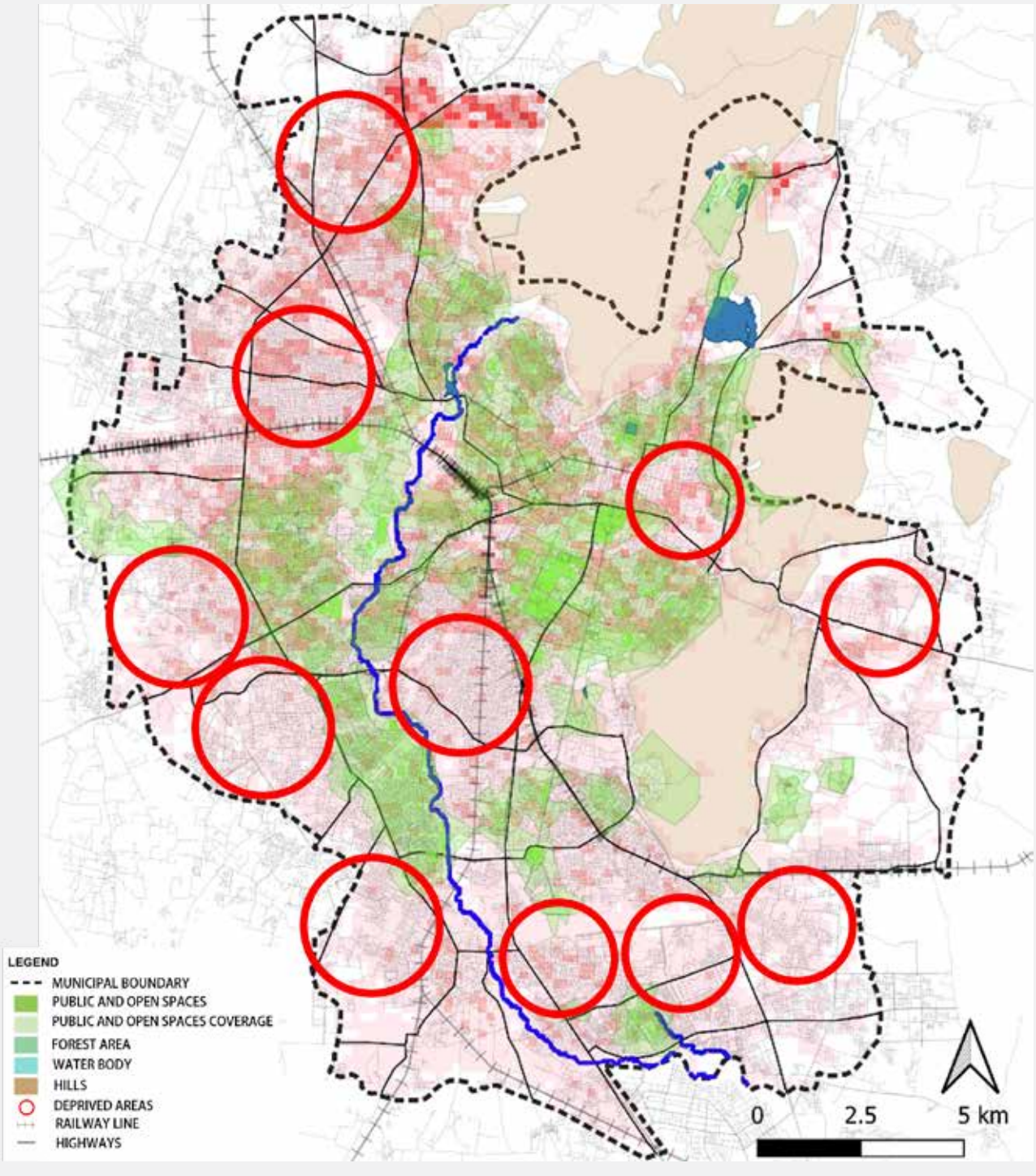
IMAGE 3.13 Patrika Gate

IMAGE 3.14 Space for informal sector at Jawahar circle

Intervention 4.2: Re-development of proposed green belts and open spaces

Figure 3 79 shows that the residents of Barkat Nagar, Prathvraj Nagar, Murlipura, Budhsingh Pura, Kamla Nehru Nagar, Jagatpura, and Chetak Pura do not have access to open green spaces. The development of open green spaces is primarily the real estate developer's responsibility. Post approval, it gets transferred to the development authority and later to the municipal corporation for its development and maintenance. In some cases, due to lack of funds and ownership, such open spaces lie vacant and undeveloped (Image 3-15). The same spaces can be made available to prominent businesses for adoption as corporate social responsibility or by community-led organizations for maintenance.

FIGURE 3.79 Neighbourhoods lacking urban open spaces

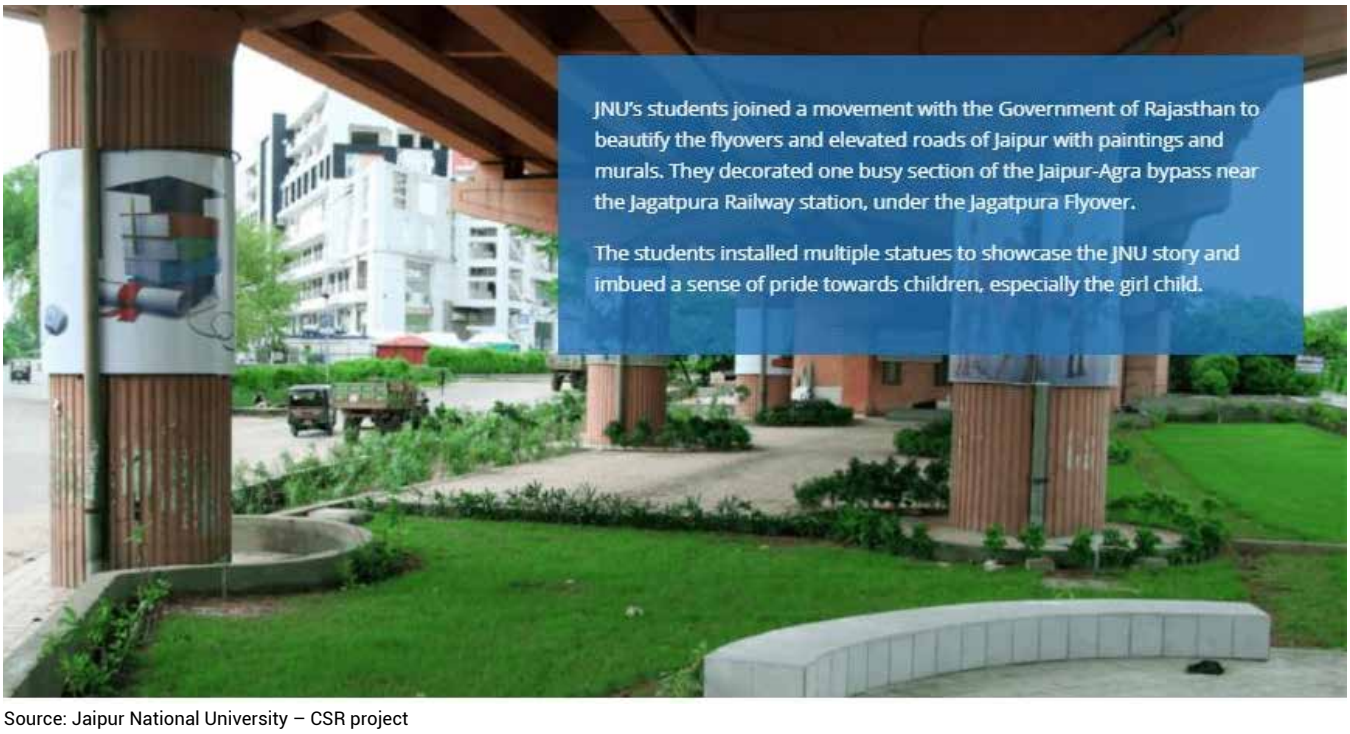


Source: UN-Habitat

IMAGE 3.15 Undeveloped opens spaces in Neighbourhoods

Source: Google Images

IMAGE 3.16 Under flyover space developed by Jaipur National University



Source: Jaipur National University – CSR project

Jaipur National University has adopted the under-flyover space and green belt at Jagatpura railway crossing, as shown in Image 3-16, which they develop and maintain as a community space while acquiring advertisement rights. Jaishree Periwal High School, located in the Chitrakoot area, upkeeps and maintains the stadium behind the school (Image 3-17).

The school has developed sports facilities in the stadium to be used by their students during the day, and are available for community use post-school hours.

IMAGE 3.17 School and the stadium at Chitrakoot

Source: Google Earth

IMAGE 3.18 Spaces developed CSR scheme

Source: Google Images

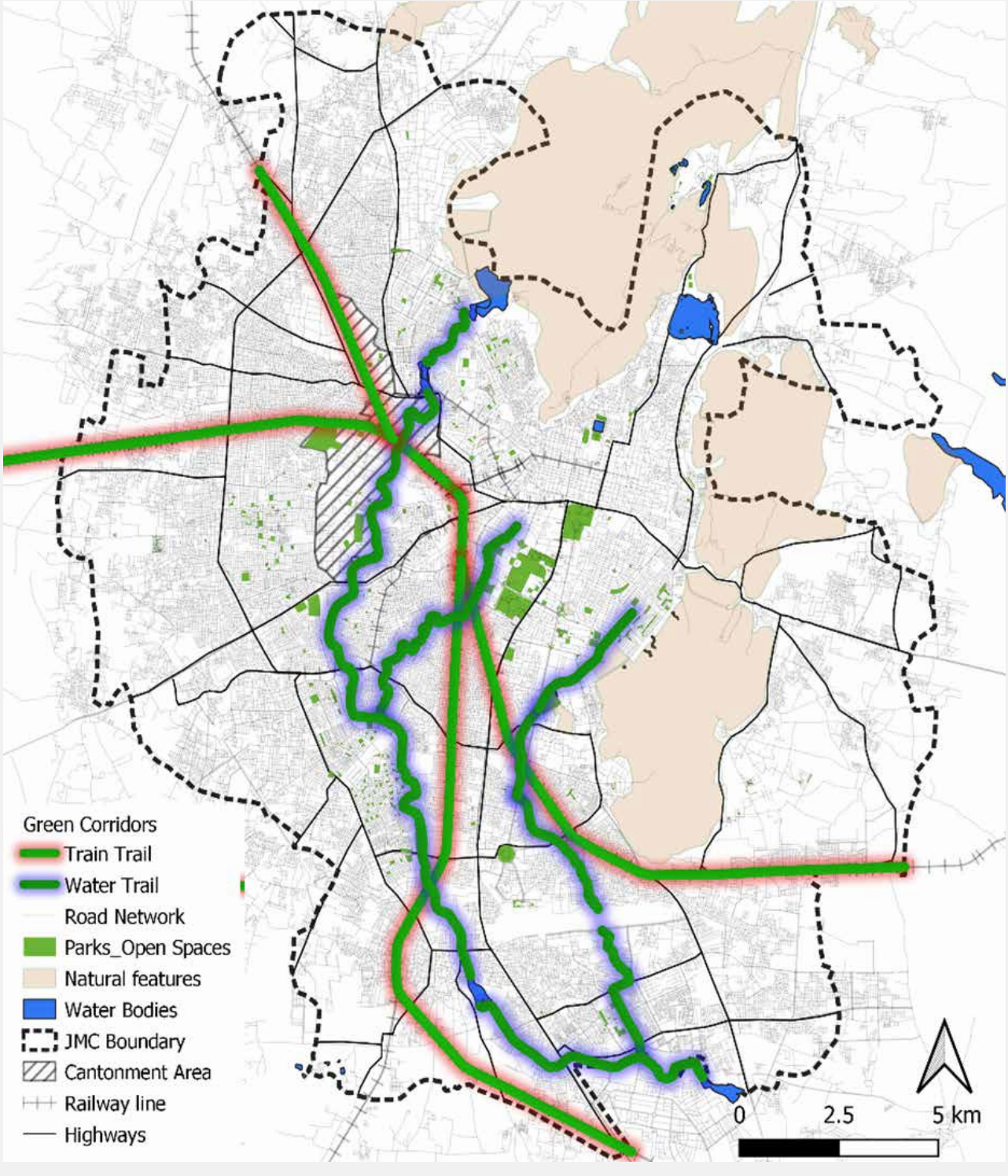
IMAGE 3.19 School and the stadium at Chitrakoot

Source: Google Earth

Intervention 4.3: Connecting green blue through eco-trails

The proposed eco-trails along the natural drainage channels and the railway line shall help meet the minimum standard of open spaces per capita in the city. The railway line and water streams form a complex network expanded throughout the city. The proposed interventions with green assets will maintain land use, connectivity, and availability of government-owned land as essential parameters. The eco-trail runs for 112 Km, comprising of 55 Km railway corridor and 67 Kms river streams, as shown in Figure 3-80. The proposal for the eco-trail integrates with the ongoing Dravyavati Rejuvenation Project of 47 km, being undertaken by JDA.

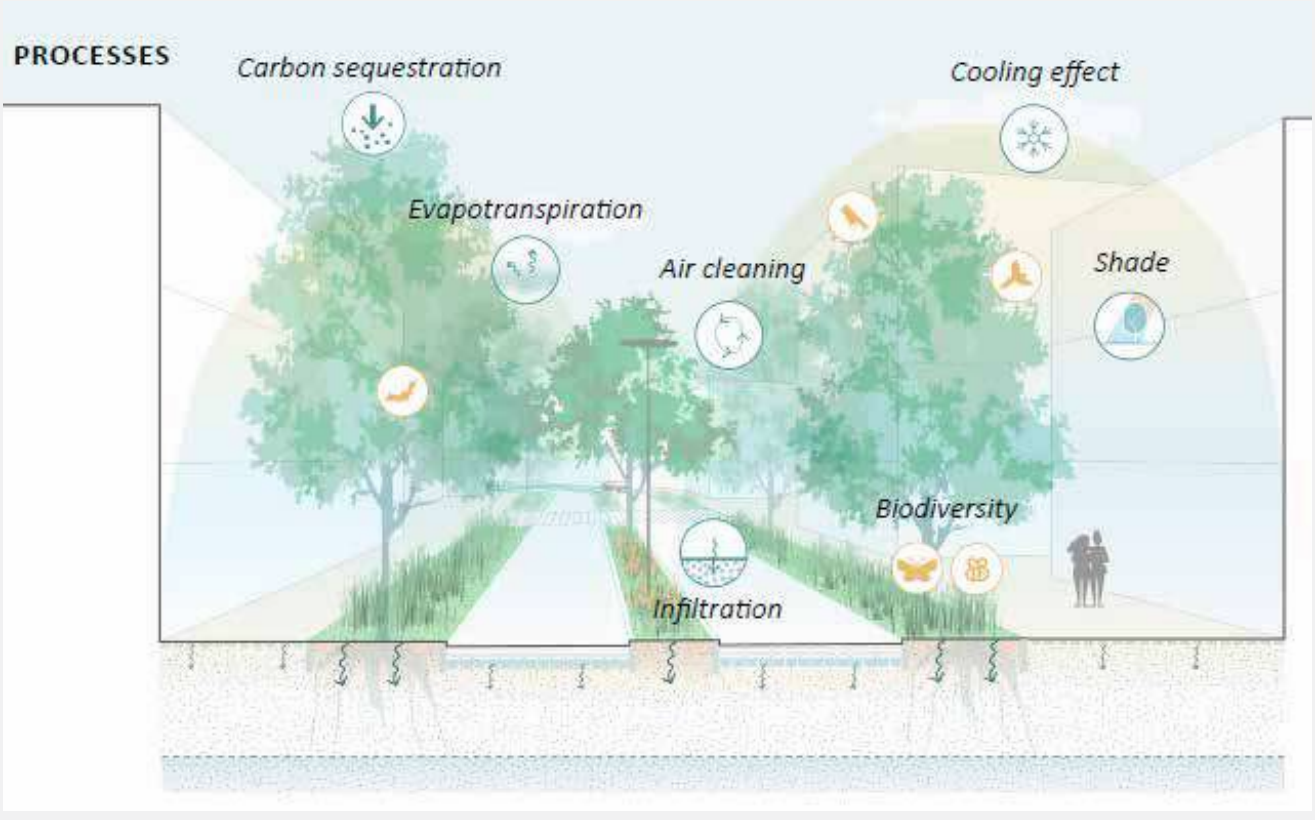
FIGURE 3.80 Proposed Eco-trails across the city



Source: UN-Habitat

The proposed eco-trails connect with the neighbourhoods through eco-corridors, which help build a cityscape with connectivity across neighbourhoods through the green network by establishing a hierarchy with primary, secondary and tertiary level streets. The identified primary eco-corridor lanes are provided with non-motorised transport infrastructure and green assets that improve the air quality, create a cooling effect with shaded spaces, and promote bio-diversity, as conceptually shown in cross-section in Figure 3 81.

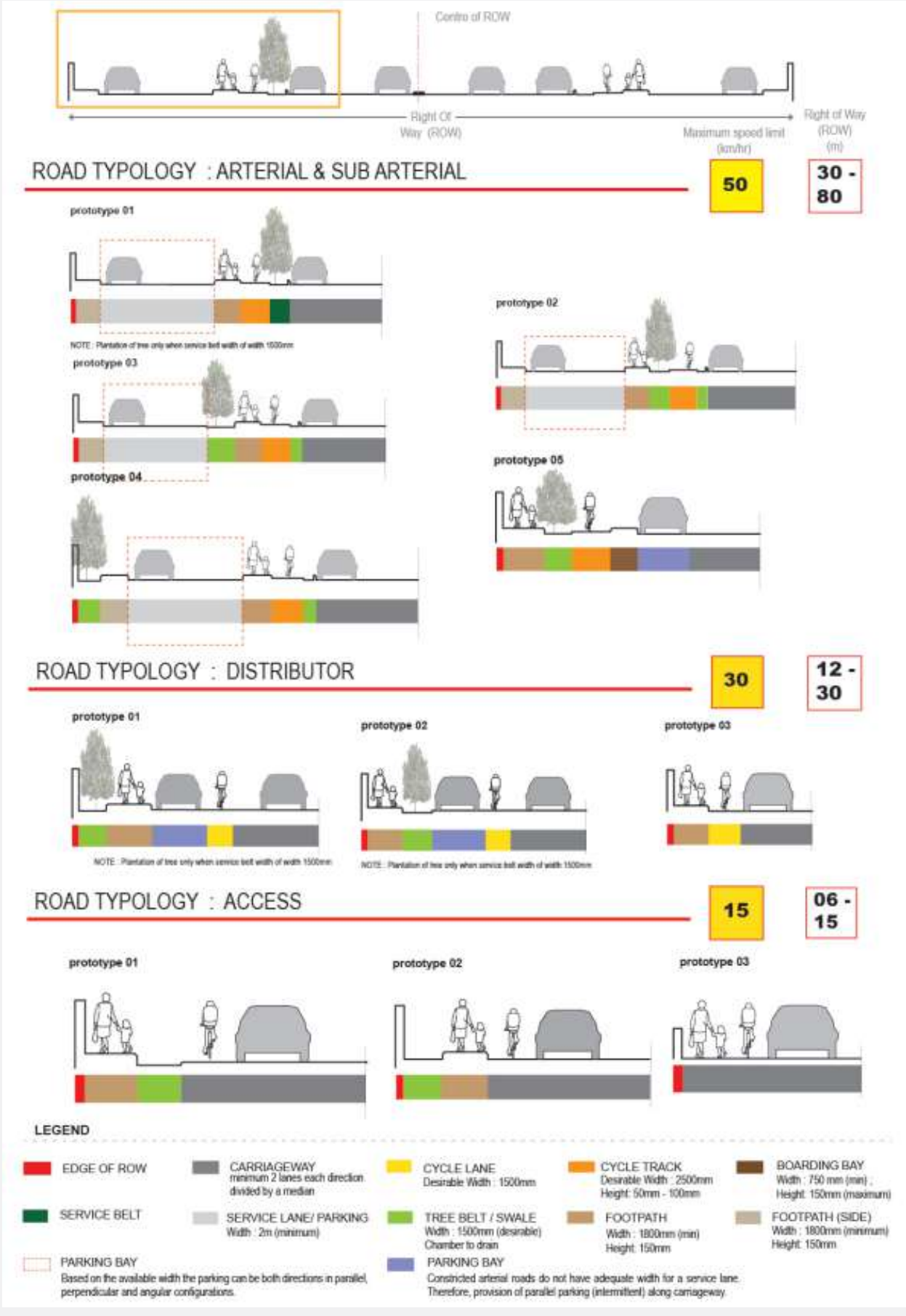
FIGURE 3.81 Schematic section of Eco-corridors



Source: Nature based solution catalogue, World bank.

The eco-corridors connect across the neighbourhoods like the sub-arterial city roads, and the development of the distributor and the collector roads as secondary and tertiary green streets help build a robust green connected network in the city. TRIPP at IIT Delhi and the Shakti Foundation have developed typical street sections in Figure 3-82, for the green streets that prioritise NMT connectivity.

FIGURE 3.82 Schematic road sections developed by TRIPP at IIT Delhi



Source: Planning and Design Guideline for Cycle Infrastructure by TRIPP-IITD & Shakti Foundation

The secondary green streets proposed along the selected distributor roads have mixed-use development alongside. They connect commercial routes with public transport and residential areas with NMT. Image 3 20 is a secondary green street developed, prioritising green streets in the city. The tertiary green streets proposed along the collector roads connect to the neighbourhoods and residences. In Image 3 21, the street is characterised by designated limited parking spaces, lighting, seating and green infrastructure, promoting a pedestrian-friendly environment.

IMAGE 3.20 Secondary green street

IMAGE 3.21 Tertiary green street

Neighbourhood in ward no. 54 from the city of Jaipur, as shown in Figure 3-83, has been selected as a prototype to showcase the connectivity of the proposed eco-trails with eco corridors and green streets. Figure 3-84 shows that the neighbourhood is surrounded by the water trail, Dravyavati on the west and south, Amanishah Nala on the east, arterial road of the city on the north, which has connectivity to both the metro-rail and bus service. The streets are earmarked to be developed as secondary and tertiary green streets to connect to green infrastructure.

FIGURE 3.83 Identification of green streets in the neighbourhood

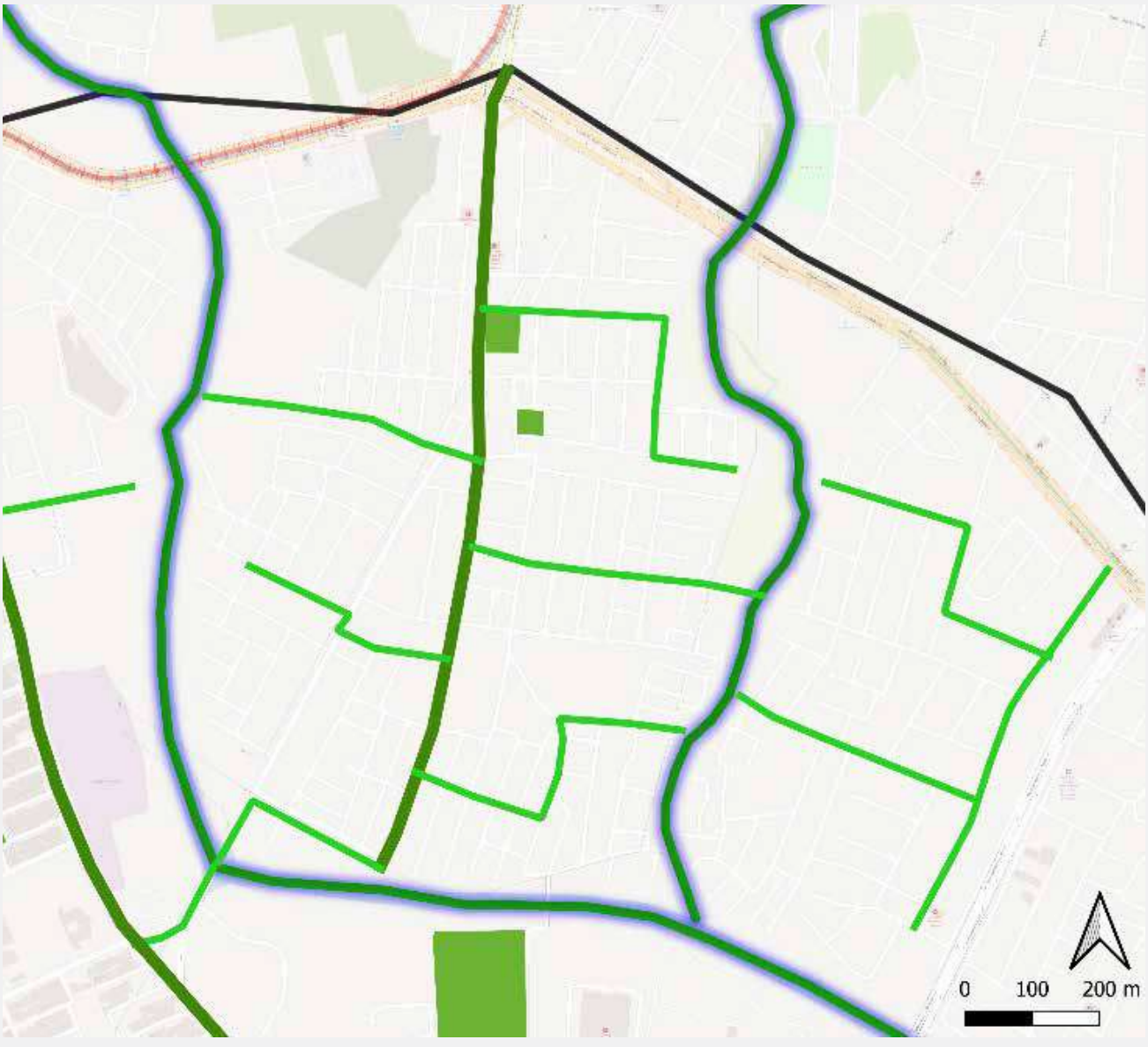
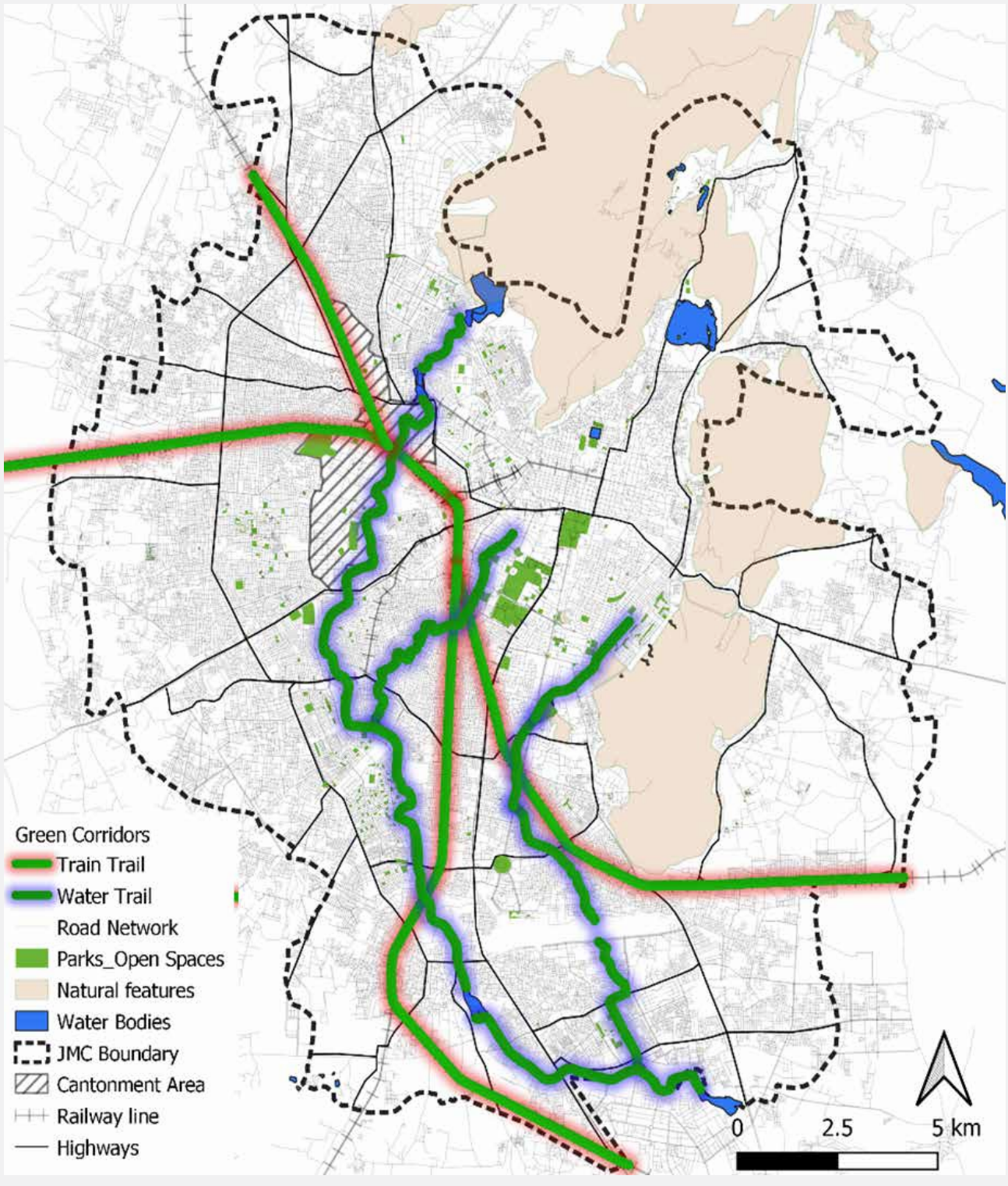


FIGURE 3.84 Selected neighbourhood for demonstration

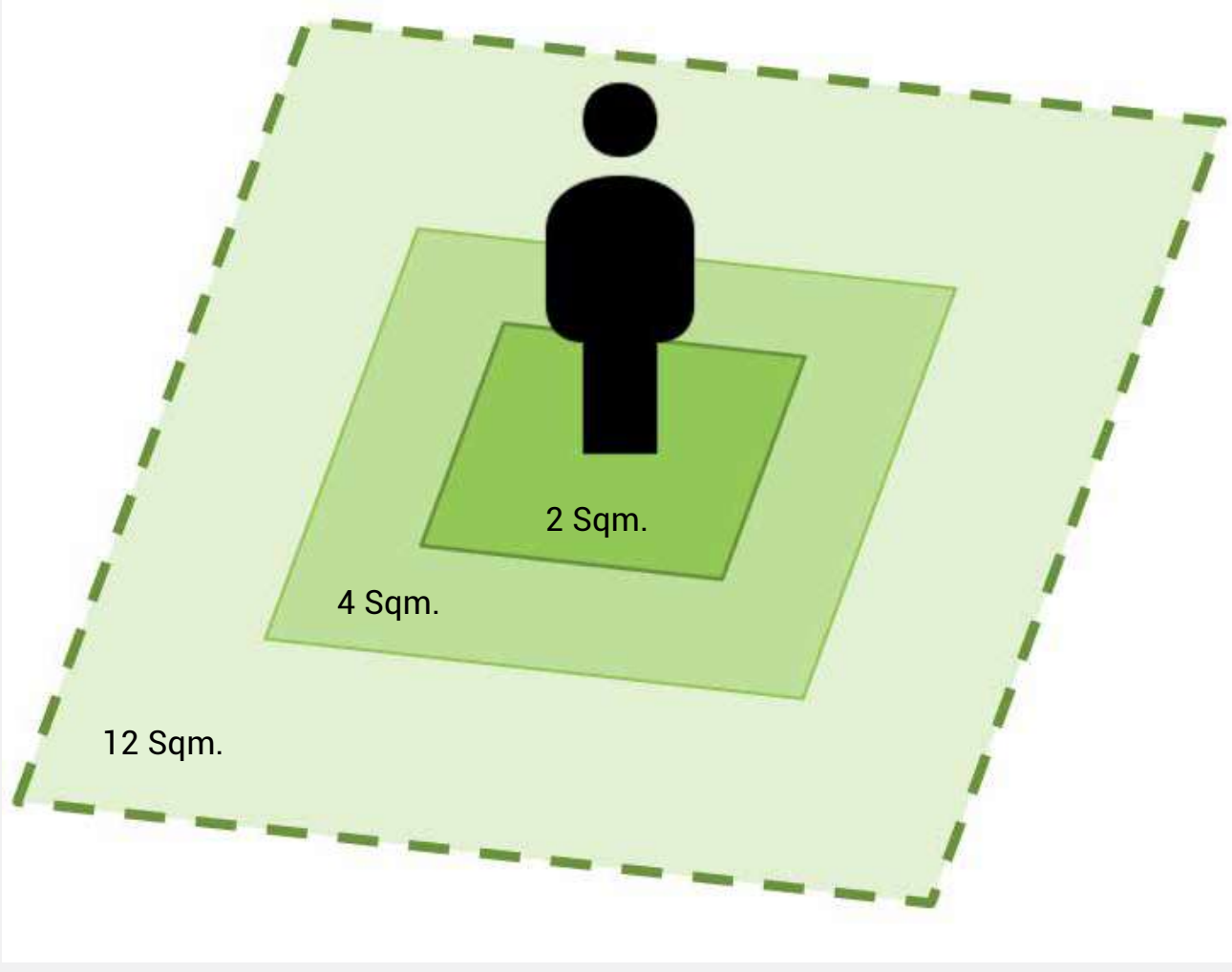


Source: UN-Habitat

Intervention 4.4: Creating new green space in the proposed development

The urban development in the city is proposed as per the Rajasthan Township Policy, which makes it mandatory to provide green open space of 5 per cent for developments proposed on land less than 10 Ha. and 10 per cent when area of proposed developments are more than 10 Ha. Considering an average population of 250 people per hectare, the provision of 5 and 10 per cent of open green spaces amounts to 2 Sqm and 4 sqm. Space per person is marginal compared to the USAF benchmark of 12 Sqm and the URPDFI[45] benchmark of 10-12 Sqm per person. To meet these guidelines, it is important to make provision of 12 per cent and 18 per cent green open space upgrading from the current 5 per cent and 10 per cent provision.

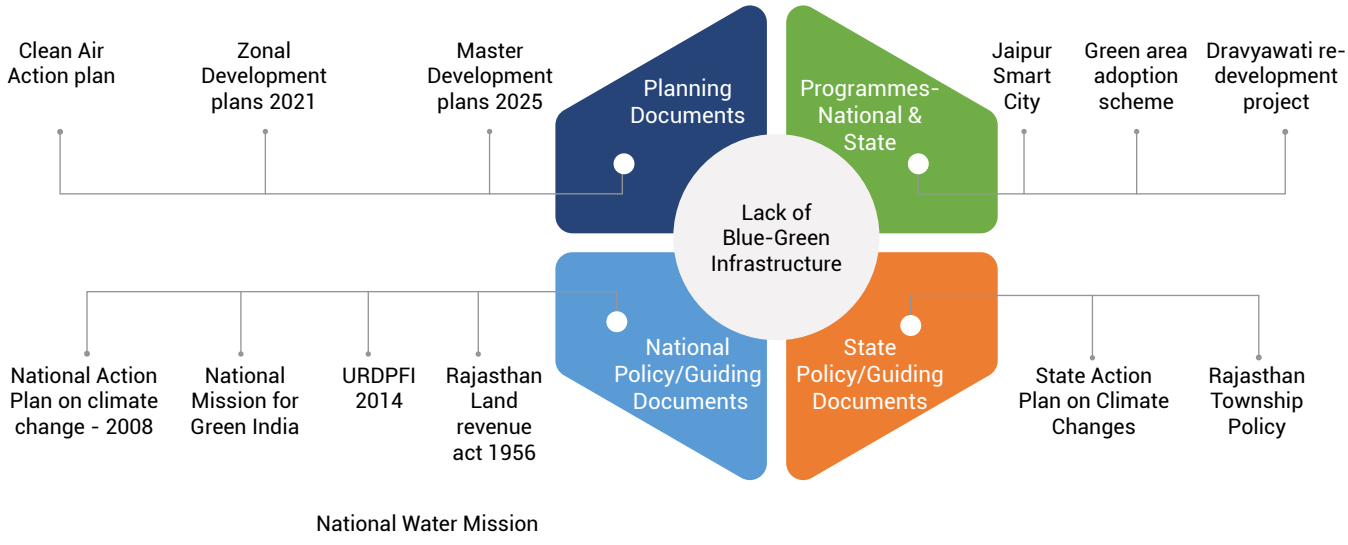
FIGURE 3.85 5, 10 and 30 percent of open spaces



Source: UN-Habitat

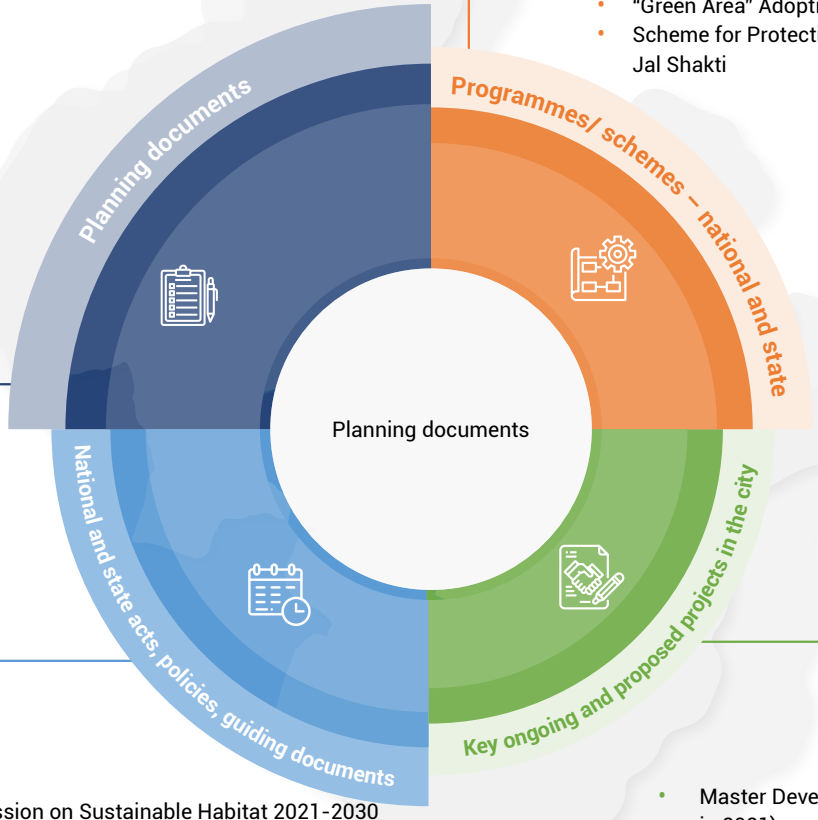
45 Urban and Regional Development Plans Formulation and Implementation

3.5.2 Alignment with national, state policies, programmes and proposed capital projects in the city



- Jaipur Master Development Plan 2025
- Jaipur Zonal Development Plans
- Jaipur District Disaster Management Plan 2014

- AMRUT
- AMRUT 2.0/ Jal Jeevan Mission (Urban)
- Swachh Bharat Mission (Urban) 2.0
- Pradhan Mantri Awas Yojana – Urban
- Mukhya Mantri Jan Awas Yojana – Urban
- Rajasthan Township policy 2010
- "Green Area" Adoption Scheme
- Scheme for Protection of Water Bodies – Ministry of Jal Shakti



- National Mission on Sustainable Habitat 2021-2030
- Urban and Regional Development Plans Formulation and Implementation Guidelines (Volume 1) 2014
- Urban Development Scheme Policy 2015
- State Sewage and Wastewater Policy 2016

- Master Development Plan 2050 (Process started in 2021)
- Development of MLA housing at Jyothi Nagar
- Development of Central Park in Mansarovar
- Rejuvenation of Dravyavati River
- Extension of Jaipur Metro Phase I and Feasibility study for Phase II

3.5.3 Gender and Inclusion

It is recommended that the open space plan be developed by collecting and assessing public space usage and behaviour data, disaggregated by gender, age, income, disability (and religion, where relevant).
The waterfront development plan should consider gender-inclusive strategies, including improving safety of women by design (Annex VI). This could increase women's use of these spaces, improve leisure activity rate of women and strengthen the resident community interactions.

This strategic response of envisioning Jaipur as ecological city would ensure creation of safe and secure public spaces for women and marginalised, and women's improved role in economic, environmental and social aspects. The strategic response offers scope for a gender transformative approach in all its actions. The conservation and preservation of vacant open spaces, connecting blue- green networks with eco corridors and waterfront development provides opportunity for gender inclusive design (recommendations in Annex VI for gender inclusive guidelines for public open spaces).

Enabling ecologically sensitive public spaces in diverse forms, scales and function could be considered as part of this response. The natural water sinks-rain pits /temporary rain playscapes encourage multifunctionality and could aid in creating gender inclusive recreational spaces along with ecological restoration. The promotion of urban farming and urban forestry offers scope for Jaipur to trigger a women led green economy leveraging the rich natural resources and optimize the incidental open spaces.

TABLE 3.16 Recommendations of gender inclusive waterfront redevelopment

S. No.	Components	Recommendations
1.	Amenities	Access to safe and hygienic public toilets (Male, female and universally accessible gender-neutral toilets) private nursing rooms.
2.	Access	Clear multi-modal connectivity to waterfront and universal accessible NMT pathways (with consideration to people with disability)
3.	Streetscape design	• Street furniture in accessible points and furniture design suiting all genders • Seating, mounds as seating, outdoor exercise equipment • Including visual markers and well-defined paths for urban safety
4.	Lighting and shading	• Street lighting to be ensured for safe access at early morning/evening with the height of the poles is preferable from 3.5 to 4.5 meters • Shading: Trees, temporary rain/sun shelters or prefabricated tensile structures suiting the character of the waterfront design to be provided in context sensitive manner • Seasonal tree suitable to the city to be planted for shading, using two types of trees simultaneously equi-distant suggested, one among the two could be a seasonal flowering tree • Suggested to provide shading to some of the seating or gathering areas by gazebos or pavilions
5.	Water-land edge design	• Seamless treatment of water land edge to be followed • In cases not possible use of landscape design ensuring visibility to waterfront for sense of safety for women should be mandatory
6.	Landscape design	Visual transparency should be ensured by avoiding barriers like walls and high bunds along the lake and built-water edge design
7.	Signages	• Provision of legible signage in multiple languages - Hindi and English indicating route and amenity centres • Encourage gender positivity in design and representation of signages

Source: UN-Habitat

3.5.4 Climate Convergence

Development of eco-trails and city parks shall enhance the green-blue infrastructure through the city adding to the city greens and in-turn increasing the city's carbon sequestration potential. With the current number of city parks, developed with native trees can increase the city's potential by upto 3 times from 1283 Mt. C/ annum to 3994 Mt. C/annum, of which trees are the major contributor.

TABLE 3.17 A list of various hierarchies of open spaces in the city

Park	Size of Open space	No of Existing Spaces	Current C-Seq (tCO2/ha/ annum)	Enhanced C-Seq. Potential through NBS (tCO2/ha/annum)
Housing Area Park (384)	<750 Sqm.	77	366.72*	1169.83*
	750-3000 Sqm.	157		
	3000-5000 Sqm.	73		
	5000-10000 Sqm.	77		
Neighbourhood Park	1-5 Ha.	72	304.56	972
Community Park	5-25 Ha.	9	190.17	562.5
District Park	>25Ha.	4	422.52	1,290
Total			**1283.97**	**3994.33**

Nos. Based on spaces marked in the GIS file shared by JDA within the JMC area.

* Calculated for an average park size of 2500 sq. mt.

Eco-trails are proposed to be developed across the city along the water channels of Dravyavati and its tributaries and railway lines within the municipal limit. The development of green belt along the trails shall not just help in increasing the carbon sequestration potential but also boost the urban biodiversity by providing habitat to birds and animals.

3.5.5 Cost Estimates

TABLE 3.18 Cost estimates

S. No	Intervention	Project	Block Cost Estimate (INR in Lakh)	Implementing Agency	Sources of Finance
1.	Activation of Space	Development of activity spaces around the water bodies and in the green spaces in the city.	4351.28	JMC / JDA	AMRUT
2.	Increasing Green cover	Planting of Greens in available parks and open spaces	924	JDA/JMC	AMRUT
3.	Plantation along Train Trails	Promoting development of green corridors along the railway track on the government land to make the space availabe for city residents.	282030	JMC/JDA/ PWD	AMRUT/Carbon Credit
4.	Plantation along water trails	Development of water bodies along the drainage channel.	81090	JMC/JDA/ PWD	AMRUT/Carbon Credit
5.	Proposing Eco Streets	Identified Streets for NMT to be provided with Green infrastructure.	1399270	JMC/JDA/ PWD	AMRUT/Carbon Credit
6.	Amandment of Regulation for making more provision of open spaces	Amandment in the township policy for increased share of green space in neighborhoods.	-	DLB	-

3.5.6 USAF Indicators impacted

USAF indicators impacted are:
Multi hazard velunerability is directly liked to 28 indicators (3 descriptive and 16 scored), the strategic interventions shall result in improvemement of score for 19 indicators.

1.4,1.5,1.7,1.9,3.3,4.4,4.5,5.4,6.2,8.1,8.4,8.3,8.5,8.7,8.10,8.11,8.12,10.2,10.6,

4

ANNEXURES

Annex 1 - Proposed Framework for Developing Sustainable City Strategies

This document outlines the overall methodology for developing Sustainable City Strategies (SCS) with its foundation in the New Urban Agenda. The following five pillars (except Pillar 1, since it is beyond the scope of SCIAP) of the NUA shall be the guiding elements in formulating the SCS:

1. National Urban Policies (NUPs)
2. Rules and Regulations
3. Urban Planning and Design
4. Financing Urbanization
5. Local Implementation

STEP 1 Assess the relevant Rules, Regulations and Policies associated with the Sector

In order to build a complete picture of the planning legal instruments available, as a first step, list all the relevant plans, policies, rules, and regulations that are applicable to the issue and its predominant sector. It is also essential to map the interrelationships between various instruments and regulations to the issue and develop a schematic for better understanding.

Ascertain the gaps in the existing rules that have prevented progress towards the diagnostic issue. In addition, assess if any regulatory changes would be beneficial to the overarching strategy and/or if the strategy is complementing the regulations.

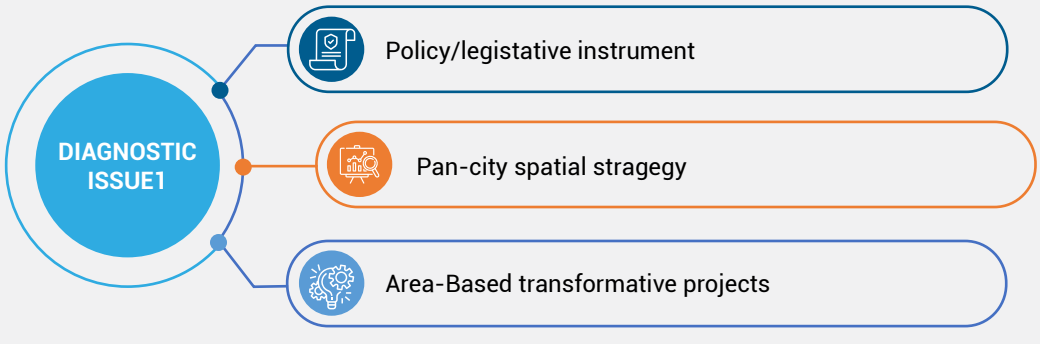
STEP 2 Identify GHG Impact of the Issue and the related sector

Ascertain if the diagnostic issue aligns positively or negatively with GHG emissions and if the climate consequences can be quantified. Identify what kind of factors pertaining to the diagnostic issue have a significant impact on climate mitigation and if any of the rules and regulations assessed in Step 1 can aid in developing the strategic response. Please use UNIDO's study for this step.

STEP 3 Identify an overarching umbrella strategy/concept that addresses the diagnostic issue in a holistic manner

Most diagnostic issues may be addressed by designing an overarching umbrella strategic response, which can be detailed through a series of actions and interventions. For example, a lack of open spaces in a city can be addressed by a strategy that focuses on creating and strengthening an integrated blue-green network, which positively impacts the quality of life of the city residents. In some instances, more than one umbrella strategy may be needed but it needs to be kept in mind that we are building a strategic action plan and only the most critical and impactful actions should be prioritized. In addition, emphasis should be laid on inter-sectoral strategy so that multiple sectors are integrated true to the principles of the project and urban development in general (Please see Figure 1).

FIGURE 0-1 Types of Strategic Responses to Diagnostic Issues



Source: UN-Habitat

The strategy can take the form of the following two types-

1) City -wide or pan-city application
2) Area based development where a few strategic responses may be clubbed together to enhance their impact on the city's urban fabric and it's residents through transformative projects.

STEP 4 Ascertain Actions and Interventions required to implement the overall Strategy

The actions and interventions may be in any of the following formats/types:

1. City Wide Policy or an amendment to an existing policy
2. City Wide Plan/Network or an amendment to the existing plan through a review process
3. Development Guideline (Urban Design, Landscape, Street Design, etc.)
4. Byelaws
5. Detailed Project Report/feasibility Study for an already identified action/project
6. Area-Based Development Plan or a Precinct Design (urban design scale)

For the area based transformative projects, through spatial analyses and consultation with the Tier 1 stakeholders, identify locations for which an urban design scheme can be developed to illustrate the key import of the overarching strategy.

A tabular collation of the actions and interventions as given below may be prepared and the UN-Habitat SCS may detail some of these as part of the strategic planning response to the diagnostic issue (Please see Table 1.1). The work that has already been done by the team such as the Master Plan Reviews, Sanitation Byelaws, UNIDO Investment Projects and projects captured in the CIP need to be integrated into this list and find their place in the overall strategic plan. Similarly, projects from the sustainable city strategy will be integrated into the CIP to complete the loop.

The strategy should clearly articulate that the city managers (municipal commissioners) might use this list to monitor the progress and ensure that these are implemented over the course of five years. Corresponding performance should be mapped using the USAF and captured in the USIR.

STEP 5 Ascertain existing investments in the city and their integration with the overall strategic response

All cities have on-going national or state level investments through the missions or schemes. It is imperative to map those and integrate the investments into the strategic response for the diagnostic issue. In addition, through the identification of under-serviced sections of the city or areas that have multiple deprivations and a higher density of people, areas should be identified for future investments under these missions and schemes.

For example, through spatial diagnosis illustrated above, the strategic response can advise where the next park should be planned so it can be accessed by a greater number of city dwellers. Financial implications for some interventions may be resolved by attaching them with the national and state level schemes, etc.

TABLE 0-1 Sample Actions and Interventions List

Action	Duration (short, medium, long)	Next Steps	Responsibility	Source of Financing/ Mission	USAF Indicator Impacted

Annex 1I – Relevant programmes, plans, legislation at National, State and local level

A. National programmes

Programme	Description
Smart City Mission	Jaipur got included in the first list of smart cities in 2015. The smart city functions as a special purpose vehicle working on infrastructure and development projects in 600 Acres of ABD area including walled city area and albert hall where the focus areas for development include sustainable mobility corridor, Heritage and tourism, Smart civic infrastructure. The Pan city quotient of the project includes multi-modal public transit central operation and management centre, Smart mobility cards, Solid waste management and public information system.
Atal Mission for Rejuvenation and Urban Transformation (AMRUT)	AMRUT launched in 2015 is a national scheme being implemented in the 500 ULBs across India. The components of the AMRUT consist of capacity building, reform implementation, water supply, sewerage and septage management, storm water drainage, urban transport and development of green spaces and parks. Under AMRUT, Jaipur is undertaking various projects including Sewage treatment plant, Building and strengthening sewage network, construction of parks, others.
AMRUT 2.0	AMRUT 2.0 launched on 2nd October 2021 is an extension (second phase) of AMRUT. The second phase aims at making the cities 'water secure' and providing functional water tap connections to all households. This is planned to be achieved through circular economy of water. Mission also targets to provide 100% sewage/ septage management in 500 AMRUT cities. One of the key components, proposed projects in the mission is Rejuvenation of water bodies (including urban wetland) and creation of green spaces.[46]
Jal Jeevan Mission (Urban)	Announced in Union Budget 2021-22, the JJM(U) is applicable for 500 AMRUT ULBs. The mission has a reform agenda focused on financial sustainability and water security of ULBs. Under the mission, the ULBs are proposed to prepare detailed City Water Balance Plans and City Water Action Plan with the focus on improving sustainability and efficiency in water sector which includes Rejuvenation of water bodies and creation of green spaces as one of the components. Application of Sponge Cities concept to reduce floods and enhance amenity value through an Urban Aquifer Management plan is one of key areas of the Mission.[47]
Pradhan Mantri Awas Yojana – Urban	PMAY-U (2015 - 2022) is a flagship Mission of Government of India being implemented by Ministry of Housing and Urban Affairs (MoHUA). The Mission purpose is to address urban housing shortage among the EWS/LIG and MIG categories including the slum dwellers across all the ULBs in the country by ensuring a pucca house to all eligible urban households by the year 2022. The mission is being implemented through States Government, Union Territories (UTs) and Nodal Agencies. [48]

46 Atal Mission for Rejuvenation and Urban Transformation 2.0: Operational Guidelines October 2021
47 https://pib.gov.in/PressReleasePage.aspx?PRID=1694420 (accessed on 2 December 2021)
48 https://pmaymis.gov.in/ (accessed on 2 December 2021)

Programme	Description
Swachh Bharat Mission Urban	SBM-U launched on 2nd October 2014 aims at making urban India free from open defecation and achieving 100% scientific management of municipal solid waste. The objectives of the mission included elimination of open defecation, eradication of manual scavenging, generating awareness and bringing about a behaviour change regarding sanitation practices, and augmentation of capacity at the local level. SBM-U is implemented by MoHUA in all through States/ UTs in all statutory towns in the country.[49]
Swachh Bharat Mission Urban 2.0	SBM-U 2.0 launched on 2nd October 2021 for a period of five years (till 2026) is an extension (second phase) of SBM-U. The mission aims to make all statutory towns in the country 'Garbage Free' in order to contribute to the achievement of the Sustainable Development Goals (SDG) 2030, which will ultimately improve the quality of life and ease of living of urban populations, thus leading to urban transformation. SBM -U 2.0 through the planned activities also aimed at contributing for Clean Air, Clean Water and Clean Land. The mission is aligned with various National Missions and National Priorities such as National Clean Air Program, Namami Gange, Digital India, National Urban Digital Mission, Smart Cities Mission, Start-up India, Make in India, others.[50]
Transport4All Challenge	Jaipur smart city is participating in the Transport4All Challenge, an initiative of the MoHUA, GoI that aims to bring together cities, citizens, and start-ups to develop solutions that improve public transport to better serve the needs of all citizens.[51] A feedback survey was undertaken by JSCL from citizens, stakeholders operating auto-rickshaws, private bus services in the city regarding the requirements for improving urban transport service in the city.
Pradhan Mantri Krishi sinchai yojana	A Scheme to promote water conservation methods of irrigating agriculture fields. The program emphasizes on promoting sprinkler system and drip irrigation system for production of agriculture. The program intends to bring down the water requirement for irrigation.
River interlinking project	The ministry of Jalshakti, the government of India, is undertaking a national-wide project of river interlinking for the management of water resources thought the country. Rajasthan has an ongoing project for the eastern Rajasthan canal project to be completed by 2024, with a total project cost of Rs. 40451 Crore, in which construction of dam and water canal in Jaipur is planned in the third phase with a fund allocation of Rs. 4036 crore.

B. State Government programmes

Programme	Description
Prashasan Shehro ke sang Abhiyaan (PSKS)	A state government led program under the state ministry of urban development, local self-Government and housing department to regularize the residential development on agriculture land within the notified urban areas. The program was launched in August 2021.
Mukhya mantri jan awas yojana	The scheme of mukhya mantri Jan awas yojana is mainly to promote low-cost affordable housing by providing direct incentives to developers and subsidy for the beneficiaries. The main focus of the policy is to create housing stock in general with specific focus on EWS and LIG category.

49 Guidelines for Swachh Bharat Mission – Urban: Revised as on 5th October 2017

50 Swachh Bharat Mission - Urban 2.0: Operational Guidelines October 2021

51 https://smartnet.niua.org/transport4all/ (accessed on 2 December 2021)

C. City level planning documents

Plan / Document	Description
Master Development Plan Jaipur 2025	The master development plan for the city of Jaipur was approved in 2011 for the horizon year 2025. It projects the city's growth and development, delineating the land uses in the peripheral areas for future developments. The master plan proposes zonal development plans for the city's various planning zones, which have been formulated in 2020, delineating road widths and land uses at the parcel level. The exercise for revising the Master plan shall be taken up from 2023-24; JDA is inviting vision statements for the city in 2040.
District Disaster Management Plan	The plan was prepared in 2014 in line with district and state. The plan identified that the city is vulnerable to natural hazards such as Jaipur is vulnerable to hazards, viz. heatwave, urban flooding, and drought. The plan defines the role of the various administrative departments in the city during different stages of managing a disaster.
Clean Air Action Plan (2018)	In 2018, Jaipur was identified as one of the non-attainment cities[52] in India. Rajasthan Pollution Control Board has prepared a Comprehensive Action Plan for Clean Air for Jaipur to curb the increase in pollution levels. The plan recommended various strategies in traffic and transportation, NMT, industries, urban greening, renewable energy, solid waste management, mining, and others. A few strategies proposed in the plan include the introduction of e-auto rickshaws, zero-emission battery-operated vehicles, especially in commercial areas with high footfalls, creating electric charging infrastructure, Expanding the city bus service with an appropriate fleet size of buses, developing pedestrian and cycle-friendly corridors.
Comprehensive Mobility plan, 2010	A comprehensive mobility plan for the city of Jaipur was last formulated alongside the Master development in 2010 by the Jaipur development authority. The plan gave details for the travel pattern and user behaviour in the city. since then, the city has increased both in size and population. UN-ESCAPE has assessed Urban Mobility in Jaipur using the Sustainable Urban Transport Index (SUTI) in 2019.

D. National level Policy / Guiding documents

Policy / Guiding document	Description
National Urban Policy Framework (NURF) 2018	NUPF outlines an integrated and coherent approach towards the future of urban planning in India. The NUPF is structured along two lines. Firstly, at the NUPF's core lie ten sutras or philosophical principles. Secondly, the ten sutras are applied to ten functional areas of urban space and management. Within each functional area, the status quo and its challenges are analyzed, key priorities formulated, and specific possible actions points suggested.[53] Weblink for NUPF.

52 The Central Pollution Control Board (CPCB) has identified 122 towns and cities in India as non-attainment cities for not meeting the National Ambient Air Quality Standards (NAAQ) between 2014-2018.

53 https://smartnet.niua.org/nupf (accessed on 7 December 2021)

Policy / Guiding document	Description
National Urban Housing & Habitat Policy (NUH&HP) 2007	NUH&HP focuses on provision of "Affordable Housing For All" with special emphasis on vulnerable sections of society. The policy promotes urban planning, appropriate fiscal concessions for housing, technical and cost-effective innovations in the area of housing and infrastructure. The policy emphasizes to promote various types of public-private partnerships for realizing the goal of affordable housing for all.[54] Weblink for NUH&HP.
National Urban Transport Policy (NUTP)	NUTP, launched in 2006, aims at providing better mobility and sustainability by focussing on people mobility and not vehicle mobility. The objective of this policy is to ensure safe, affordable, quick, comfortable, reliable and sustainable access for the growing number of city residents to jobs, education, recreation and such other needs within our cities. Weblink for NUTP.
Non-Motorized Transport Guidance Document, 2016	The document presents a compendium of strategies and recommendations for integrating accessibility with land use and infrastructure investment decisions in shaping NMT-friendly street designs. The guidance document provides overview about promoting NMT in Indian cities by analyzing challenges encountered in attempting to invest in pedestrian and cycling infrastructure around the country. Weblink for NMT Guidance Document.
Urban and Regional Development Plans Formulation and Implementation (URDPFI) Guidelines 2014	URDPFI Guidelines - 2014 provides integrated framework for urban and regional plan formulation and implementation. The guidelines provide comprehensive framework, direction for promoting balanced and orderly regional and urban planning and development. The guidelines also provide provisions of the legal and policy guidelines of the line Ministries, best practices of the States and the planning systems in vogue. The URDPFI Guidelines, 2014 comprise two Volumes. Weblink for Volume 1 and Volume II.
National Mission on Sustainable Habitat 2021-2030	The NMSH 2021-2030 document provide roadmap for States / UTs/ULBs to promote low-carbon urban growth and building resilience of cities to 'bounce back better' from climate related extreme events and disaster risks. Broad interventions to be undertaken at local level are listed under five thematic areas: Energy and Green Buildings; Urban Planning, Green Cover and Biodiversity; Mobility and Air Quality; Water Management; and Waste Management.
National Urban Transport policy, 2014	The objective of the policy is to plan for the people rather than vehicles by providing sustainable mobility and accessibility to all citizens to jobs, education, social services and recreation at affordable cost and within reasonable time. it proposes to formulate UMTA (Urban Metropolitan transport Authority) for the metropolitan cities to bring management of all public modes of transport within city managed by a single administrative organization. Weblink to National Urban Transport Policy, 2014

54 National Urban Housing and Habitat Policy 2007; MoHUA, GoI, https://www.nhb.org.in/Urban_Housing/HousingPolicy2007.pdf (accessed on 7 December 2021)

E. State level Policy / Guiding documents

Policy / Guiding document	Description
Unified Building Regulations 2020	Comprehensive Building Rules and other related rules which are applicable to development authorities and ULBs in the State. The Building Rules has distinct rules applicable to regulate the building activities in different categories of ULBs and areas within their jurisdiction. The rules applicable to Municipal Corporations in the state are applicable to all areas under Jaippur Municipal Corporation (JMC), unless specified. Weblink for Unified Building Byelaws 2020 (Published in Hindi only)
State Action Plan on Climate Change (SAPCC) for Rajasthan (RJ)	SAPCC for RJ is prepared in line with National Action Plan on Climate Change (NAPCC) to address existing and future climate risks and vulnerabilities. 11 major sectors that includes urban development, transportation is identified seriously impacted by climate change have been identified for the State. The issues, concerns and specific interventions for these sectors have been discussed. Weblink for SAPCC for Rajasthan.
Jaipur Development Authority Act, 1982	The Act provide a legal framework for the establishment of the Jaipur Development Authority and its Metropolitan Region for the purposes of planning (including the process of preparing /revising development plan (master plan / zonal development plan /area development plan/infrastructure plan, other plans), coordination, execution, supervision, financing, funding and for promoting and securing the planned and sustainable development of the development area and for related matters. Weblink for JDA Act 1982
Rajasthan Street Vendors (Protection of Livelihood and Regulation of Street Vending) Rules, 2017	The rules were enacted to regulate street vendors in public areas and protect their rights. The states rules were prepared considering the Central Act, Street Vendors (Protection of Livelihood and Regulation of Street Vending) Act, 2014. Weblink for RJ Street Vendors Rules 2017.
Rajasthan Electric vehicle policy 2021	To encourage the use of electric vehicles in public transportation, the Government of Rajasthan offers a concession on the SGST for electric vehicles costing up to INR 5 lac. The policy has benefited e-rickshaws and two-wheelers the most. Weblink for Rajasthan EV policy 2021

Annex III - Ongoing and planned projects in the city

Sector	Project	Implementing agency	Convergence	Funding partners / Donors	Status (as on December 2021)
Planning and development	Preparation of Zonal Development Plan for Planning zones in Jaipur	JDA	NA	NA	Ongoing
Re-Development	Development of MLA quarters at Jyoti Nagar (G+8)	JDA	NA	State Government	Ongoing
Urban Transport	Metro Phase IC and ID – Extension of Pink line to 200 Ft. byepass towards West and Transport Nagar on East.	JMRC	NA	State Government / Asian Development Bank	Proposed
Urban Transprt	Metro Phase – II, North South corridor connecting Amba Bari to Sanganer	JMRC	NA	State Funded DPR	Proposed
Re-Development	Re-development of Nehru place district shopping centre.	JDA	NA	PPP	Proposed
Re-Development	Re-Development of Sawai Man Singh Hospital building (22 Floor hospital building)	JDA	Smart city	State Government + JSCL + JDA + RHB + others	Ongoing
Planning and Development	Dravyavati River Re-development project	JDA	NA	NA	Ongoing
Urban Infrastructure	Ramniwas Bagh Underground Parking Project Phase-II, Jaipur	JDA	NA	Smart City	Ongoing
Urban Infrastructure	Integrated Development of Chaugan Stadium, Jaipur	JSCL	NA	Smart city – ABD	Ongoing
Water body Conservation	Conservation, restoration & Rejuvenation of talkatora lake, Jaipur.	RTDC	Jal shakti	Smart city	Ongoing
Urban Infrastructure	Smart Sewerage Manholes, Street Light & on street parking Monitoring & Management System Including 5 years O&M in Jaipur walled city.	JSCL	AMRUT	Smart City	Ongoing
Urban Beautification	Railing, Divider Repair and Beautification Work on Roads in Parkota Area	JMC-H	NA	Smart city	Ongoing
Urban Infrastructure	Hawa sadak Elivated Road.	JDA	AMRUT	State Government	Ongoing
Urban transport	Jaipur Ring Road – North & South	NHAI + JDA	NA	State Government	Proposed
Waste Management	Dehlawas STP expansion	JMC-G	NMCG	JMC + UNIDO	Ongoing
Urban Greenery	Development of Central part at Mansarovar.	RHB – Rajasthan Housing Board.	AMRUT	RHB	Proposed
Urban Transport	Hawa sadak Elevated Road connecting sodala to ambedkar circle.	JDA	NA	State Government	Ongoing
Urban Transport	Civil Lines Rail overbridge	JDA	NA	State Government and Indian Railways	On-going
Urban Transport	Jhotwada Elevated road Project	JDA	NA	JDA	On-Going

Annex IV - Indicative list of elements to be provided in Community Parks

Thematic Areas	Feature examples[55]
Comfort/Safety	• Seating • Lighting • Shade, shelter, pavilions • Mixed-use area • "Open" facades (eyes on the street) • Paved pathways (universal design) • Water features • Bathrooms • Dustbins • Garden clocks
Facilities	Facilities for all ages, times of day, for informal activities and facilities that are integrated (e.g. climate, play and safety), for example: • Urban farming • Outdoor learning centre/library • Playground/recreational area • Sports and wellness facilities • Water drinking taps • Formal or informal vending
Climate/Nature	• Wetlands, green coverage (for rainwater harvesting and filtration) • Conservation areas (part of learning centres) • Integrated green energy technology (solar panels etc.) • Compost beds, planting • Landscape 'identity' areas (beautification, local species)
Maintenance & Management	• Programme management (activity conflict and efficiency) • Community engagement in park design through ward/zone level consultations • Community, Private and Public partnership for construction and maintenance

55 Exemplary features have been taken from both AMRUT (2015) Sector Wise Template for Green and Public Spaces, and UN Habitat (2019) Global Public Space Toolkit. From Global Principles to Local Policies and Practice.

Annex V - Improve public transport and non-motorized transport

It is recommended that the mobility plan collect and report travel behaviour data, disaggregated by gender, age, income (and religion, where relevant). Specifically, the perception and experience of safety and sexual harassment on streets, access to and waiting for public transport (and paratransit), travel inside the vehicles must be measured. The mobility plan should adopt gender-inclusive indicators and benchmarks (Table X).

TABLE X Gender-inclusive mobility indicators

Indicator		Measure
1.	Developed area near transport (DNT)	Developed area within 500m of frequent bus-based public transport (6 schedules per hour) Informal settlements within 500m of frequent bus-based public transport (6 schedules per hour)
2.	Median block perimeter	Median block perimeter (400-600m) bounded by publicly accessible roads on all sides
3.	Mode shares, disaggregated by sex, age and income	Percent of walking, cycling, public transport (buses, train and metro-rail separately), intermediate public transport
4.	Median non-motorized trip time, disaggregated by sex, age and income	Median walking and cycling trip time
5.	Cost on transport per month	Individual monthly expenditure, disaggregated by sex and income; Household monthly expenditure on transport, disaggregated by income groups/ quintiles
6.	Sexual harassment faced and perception of safety	Sexual harassment faced by women, girls, gender and sexual minorities on the streets, waiting for buses and IPT, boarding and alighting and traveling inside the vehicles Women, girls', gender and sexual minorities' perception of safety in public spaces, accessing and using public transport in the day and night

The comprehensive mobility plan should include the following amenities as outlined in Table X. The involvement of more women and gender minorities in the transportation sector can create safer mobility systems and encourage more women to travel for work/leisure.

TABLE X Gender-inclusive amenities

Amenities		Requirements
1.	Nursing rooms	At least 1 nursing room in every bus terminal, ISBT, railway station and metro-rail station located in well-lit and easily accessible areas
2.	Public toilets	Male, female and universally accessible gender-neutral toilets in every bus terminal, ISBT, railway station and metro-rail station, available for use free of cost; located in well-lit and easily accessible areas
3.	Waiting rooms	At least 1 AC waiting room for women, trans persons and families with public toilets at inter-state bus terminals and inter-city railway stations.

Amenities		Requirements
4.	Night shelters	Reserved accommodation for women, trans persons and boys of 15 years and below at inter-state bus terminals and inter-city railway stations at nominal cost, in line with NULM guidelines for night shelters Emergency accommodation for women with boys of 15 years and below and families.
5.	Pedestrian facilities	Universally accessible footpaths of at least 4m width in bus terminals, railway and metro stations, subject to a LOS approach
6.	Bus stops	All bus stops have well lit, shaded, and universally accessible bus shelters with real-time and static information, display help-line, and emergency phone numbers (See Figure 2).
7.	Drinking water	Purified water for drinking to be provided, free of charge, at every bus terminal, ISBT, railway station and metro station
8.	Vending	Street vending areas to be provided within bus terminals for passenger convenience.
9.	Bus depots	Bus depots include at least one day care centre, waiting room, nursing room, and well-maintained universally accessible gender-neutral toilets to encourage women and transgender staff.

Annex VI - Redesign streets to create safer cities for women and girls

This can be done by creating comprehensive street guidelines for the city, with a focus on gender and universal access (as illustrated by those created for the state of Bihar). These can serve as the basis for redesigning streets. The guidelines can include the following structure:

- Street design principles focused on safety, mobility of care, universal access, environment sustainability, behaviour change
- Land-use and transport integration: Street network planning and location of amenities
- Defining a street hierarchy, and typology based on the land-use context
- Street elements such as footpaths, cycling infrastructure, carriageway, traffic calming elements, pedestrian crossings, IPT stands, street vending, lighting, utilities, street furniture, trees and other shading devices
- Street design process and team within urban local bodies.

Annex VII - Improve public transport and reorganize and improve paratransit

Following recommendations for reorganization of para transit suggested.

- Promote e-rickshaws as a green paratransit mode and provide subsidies to unemployed to start e-rickshaws, preferably for people from lower economic groups.
- Encourage women workers in e-rickshaw waste management project initiative of Swachh Bharat Mission as short-term goal and introduce and encourage female e-rickshaw operators-vahinis as in case of Delhi for medium term projects
- Connect paratransit system to surveillance system as pick up point-destination mapping.

Annex VIII - Activities recommended to implement under 'Safer travel in the night programme'

- **Addressing underutilized spaces:** Urban voids should be a priority as they act as unsafe crime zones in cities limiting access along them/ women in turn taking a longer route to destination fearing perceived danger.
- Street lighting can be implemented on priority on public and intermediate public transport corridors and 5-minute walking distance from these. Use of solar streetlights suggested to minimize operating cost.
- **Women led police patrols:** Police patrols along public and intermediate public transport corridors suggested. Unsafe spaces identified through participatory safety audits will enable a sense of safety in the night. ex: Pink police model followed in Kerala. The Mahila Police Volunteers and Community Policing may also be partnered for monitoring and reporting to Police and authorities.
- **Night accommodation for women:** Subsidized night accommodation for women may be provided at intercity and interstate terminals. Rent can be waived, or a nominal amount may be charged and male children up to an age of 12 years may be permitted to stay with their mothers.
- **Request a stop service:** Bus travel often necessitates the need for last mile connectivity, which is often not assured at night, which leads to women having to traverse streets on foot. Women can request the bus driver to stop along the route, in between bus stops after 8/9pm.
- **Street vendors as street marshals:** Citizen monitoring by street vendors may be initiated. be They need to be trained to better respond to harassment they may witness on the street such as alerting relevant authorities.
- Providing a help desk supervised by the Police at transit terminals.

Annex IX - Gender-inclusive development guidelines for affordable housing projects

- Develop a dense street network for walking and cycling and reduce trip distances and accommodate vending spaces.
- Provide safe and frequent public transport connectivity (minimum of 6 schedules per hour), safe and convenient access to well-lit, safe bus and paratransit stops with good visibility and weather protection.
- Conceptualize the housing development as a low-rise, medium density, mixed-use scheme with creche facilities, pharmacies, primary school and health centres, libraries, community centres. The house should be registered in the name of women or as joint ownership. The entrances should be in close proximity of public transportation stops and in combination with pedestrian-oriented uses for greater social control.
- The buildings can be oriented toward outdoor spaces (within visual and voice range, to encourage passive participation in activities within the immediate surrounding).
- Avoid dark corners, blind spots and create direct sight lines.
- Consider housing units as live and workspaces with a height of 14 feet to accommodate a mezzanine.
- Decouple parking from housing units and provide sheltered parking for bicycles and assess the need for cycle-rickshaw, auto-rickshaw parking.

Annex X - Gender-inclusive development guidelines for public open spaces

Components	Recommendations
Urban form	• Planning of urban form, arrangement of built and open space with consideration to visibility, diverse uses • For smaller public open spaces (POS), the proportion of building height to the width of the POS should be at least 1:2 to avoid a sense of cramped feeling among users (ADB, 2022) • Compound walls providing a clear line of sight and in permeable material • Defined edge of parks/open spaces with natural landscape plants
Spatial structure and layout	• Create a network of non-motorized transport pathways (connected to the city-level network) interlinked to smaller sub-spaces • Provide open spaces of different scale to suit diverse uses • Reuse of underutilized spaces in the city for public spaces • Consider adaptability for future needs
Safety, security and universal access	• In the design of pathways, parks, location of toilets ensure a clear line of sight, connected spaces and paths to encourage natural surveillance • Plan for street vending • Provide pedestrian-scale street lighting • Avoid dark corners and blind spots • Universal accessibility design codes should be followed
Age, gender and ability-inclusive activities	**Persons with disabilities** • Playscapes to be provided to cater the needs of children of different physical and developmental disabilities • Suggested to include sensory play areas, silent zone for mentally retarded and children with autism • Natural elements such as lawn, textured stones, trees of different types can be included for sensory stimulation of the differently abled • Universal design standards to be followed in design of benches and equipment **Boys and girls** • Providing spaces for diverse activities that can be enjoyed by both boys and girls, and inclusive of age, ability • New activities can be incorporated through rain shelters, outdoor gymnasium equipment and dance areas, art pavilions, water play areas/interactive fountains, providing spaces for different kinds of sports such as cricket and badminton, mounds etc. **Elderly** • Include space for interaction, age-appropriate physical activity such as jogging, group exercise classes etc.
Nature-based solutions	• Trees can also provide shade, break-up larger areas, designing for environmental sustainability, drainage, in situ rainwater harvesting
Amenities	• Public toilets (men, women, universally accessible), private nursing spaces, drinking water and spaces for women street vendors should be provided
Audio and visual communication	• Communicate zero tolerance to sexual harassment and encourage bystanders and victims to report harassment along with providing contact details. • The POS can also become a place to understand and bring visibility to women and other gender minorities' contribution to the city.

Source: Adapted from (ADB, Fair shared green and recreational spaces guidelines for gender-responsive and inclusive design, 2021; Manual for Gender Mainstreaming in Urban Planning and Urban Development, 2013)

FIGURE X Schematic diagram illustrating activities and design conditions for gender-inclusive public open spaces

Source: UN-Habitat

Annex XI - Gender-inclusive development guidelines for waterfront development

Inserting character zones and activities along the water edge is recommended to address the need of open spaces for the city, increasing women's use of these spaces, and strengthening the resident community interactions.

Components	Recommendations
Amenities	• Safe access to public toilets (men, women, universally accessible), private nursing rooms.
Access	• Clear multi-modal connectivity to waterfront and defined internal non-motorized transport pathways.
Streetscape design	• Street furniture in accessible points and furniture design suiting all genders • Including visual markers and well-defined paths for urban safety
Lighting and shading	• Street lighting to be ensured for safe access at early morning/evening with the height of the poles is preferable from 3.5 to 4.5 meters (m) • Shading: Trees, temporary rain/sun shelters or prefabricated tensile structures suiting the character of the waterfront design to be provided in context sensitive manner • Seasonal tree suitable to the city to be planted for shading, using two types of trees simultaneously equidistance suggested, one among the two could be a seasonal flowering tree • Suggested to provide shading to some of the seating or gathering areas by gazebos or pavilions

Components	Recommendations
Water-land edge design	• Seamless treatment of water land edge to be followed • In cases not possible use of landscape design ensuring visibility to waterfront for sense of safety for women should be mandatory
Landscape design	• Visual transparency should be ensured by avoiding barriers like walls and high bunds along the lake and built-water edge design
Signage	• Provision of legible signage in multiple languages -Telugu, Hindi and English indicating route and amenity centres
Design detail	• Place branding as city of lakes to optimize tourism, allocation of funds and implementation support • The city can use theme-relevant materials in pavements, seating, and signage design. The themes can be developed based on the context and cityscape of Guntur

Annex XII - Guidelines for neighbourhood centres

TABLE X Recommendations of gender inclusive neighbourhood centres

Design element	Recommendations
Amenities	• Provision and safe access to public toilets (men, women and unisex), private nursing rooms, accessible baby/child change facility • Drinking water • Suggested to provide larger toilet compartments for easier access to those with trolleys or parcels, wheelchair users, parents with pushchairs or accompanying small children, those using walking or mobility aids
Access	• Clear multi-modal connectivity from neighbourhood centre • NMT amenities- cycling infrastructure, E-rickshaw stand etc
Spatial structure and layout	Planning of neighbourhood centres-built form and open space with consideration to visibility, diverse uses • Mixed use amenities with clear circulation paths • Site serviced with outdoor seating, landscape, variety of public open spaces (Plaza, OAT etc.) • Avoid dark corners and blind spots • Designated vendor zones to be provided in centre, suggested to include reserved vendor zone for women • Consider adaptability for future needs
Built form	• Built form to be designed with easily distinguishable entryways and internal passages • Entry to be provided with canopies or recessed entrance suiting climate • Universal accessibility design codes should be followed, ex: -providing ramps of slope 1:12 • Provide seating, lockers and rest points inside building
Circulation	• Access routes to be clear of obstructions and away from any projecting columns or return walls • Vertical circulation module to be designed in easily distinguishable points. • Choice of routes suggested to be provided to access different levels, with at least the choice of stairs and lift • Corridors and passageways must be wide enough to allow wheelchair users to approach and gain easy access through doors off the corridor and where necessary turn through 180° • Ramps and routes for easy exit with trolley/grocery bags

Design element	Recommendations
Lighting and shading	• Provide pedestrian-scale street lighting • Street lighting to be ensured for safe access at early morning/evening with the height of the poles is preferable from 3.5 to 4.5 meters (m) • Shading: Trees, temporary rain/sun shelters or prefabricated tensile structures to be provided in context sensitive manner • Seasonal tree suitable to the city to be planted for shading, using two types of trees simultaneously equidistance suggested, one among the two could be a seasonal flowering tree
Landscape design	• Compound walls of shorter height providing a clear line of sight and in permeable material • Suggested to provide shading to some of the seating or gathering areas by gazebos or pavilions • Including visual markers and well-defined paths for safe neighbourhood centre
Street furniture:	• Provide diverse seating options in the site services and in interior for users • Cut-outs for wheelchair users to sit beside non-disabled companions • Seating to be designed with both back and arm rests • Two-way seating suggested to ensure activities at both sides of the paths (if possible, according to site planning)
Signage	• Provision of legible signage in multiple languages - Hindi and English indicating route and amenity centres • Using recognised symbols/pictograms for help differently abled (cognitive difficulties/reading)
Design detail	• The city to use theme-relevant materials in pavements, seating, signage design. The themes can be developed based on the context and cityscape. • Pedestrian friendly surface finishes to be provided in outdoor and indoor (Material to be smooth, firm and slip resistant ensuring that wheels and sticks do not sink into them)

Annex XIII - Gender-inclusive urban development guidelines girls

Social Infrastructure and amenities

Gender-inclusive urban design guidelines can be adopted to create safer neighbourhoods. Additionally, it is recommended to assess the existing shortage in social infrastructure for women, girls, gender and sexual minorities and allocate land for these. These include but are not limited to:

- Shelters for survivors of domestic violence
- Homeless shelters (men, women, families, gender minorities)
- Counselling centres
- Creches
- Primary education facilities
- Primary health care centres, along with skills development and information
- Working women's hostels
- Living facilities for the elderly

The housing development for relocation, redevelopment of brownfield areas or re-densification must consider the following principles:

- Develop a dense street network for walking and cycling and reduce trip distances, and accommodate vending spaces.
- Provide safe and frequent public transport connectivity (minimum of 6 schedules per hour), safe and convenient access to well-lit, safe bus and paratransit stops with good visibility and weather protection.
- Conceptualize the housing development as a low-rise, medium density, mixed-use scheme with creche facilities, pharmacies, primary school and health centres, libraries, community centres. The house should be registered in the name of women or as joint ownership. The entrances should be in close proximity of public transportation stops and in combination with pedestrian-oriented uses for greater social control.

Source: ADB, 2022

- The buildings can be oriented toward outdoor spaces (within visual and voice range, to encourage passive participation in activities within the immediate surrounding).
- Avoid dark corners, blind spots and create direct sight lines.
- Consider housing units as live and workspaces with a height of 14 feet to accommodate a mezzanine.
- Decouple parking from housing units and provide sheltered parking for bicycles and assess the need for cycle-rickshaw, auto-rickshaw parking.

FIGURE 0-2 Charkop housing scheme

Source: Sonal Shah

Annex XIV - Gender-inclusive governance girls

Create a Gender Lab

A Gender Lab is proposed within Municipal corporation to ensure sustained action on gender-inclusive planning, implementation, capacity development and impact assessment. The role of the Lab will be to:

- Become a repository of gender (and where relevant age and income) disaggregated data across different sectors.
- Provide inputs to policies, programmes and projects undertaken by the MC (and other agencies in the city), as well as propose gender-focused initiatives.
- Review, and create a gender budget with short, medium and long-term actions in partnership with respective state -Women and Child Welfare Department, Social Welfare Department, Police, UDA and other agencies; coordinate with departments and agencies to provide support and monitor implementation progress on a quarterly basis.
- Build capacity within Institutions such as Municipal corporation, State development authority etc.
- Create and implement communications and behaviour change programs for MC (and other agencies).
- Consult with and disseminate information to civil society, academic institutes, self-help groups, membership-based and other organizations in the city.
- Create human resource policies for a gender-inclusive work environment in MC. This includes, but is not limited to creating a gender-inclusive workplace policy, and annual sensitization of all staff.

It is recommended that the Gender Lab include a gender-focused policy/ planning expert, communications and behaviour change expert and human resources expert, and support staff. This can be implemented on a pilot basis for a period of 3 years.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