



सत्यमेव जयते
Government of
National Capital Territory of Delhi

DRAFT

Public cycle sharing system for Delhi

Institute for Transportation and Development Policy
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1. Introduction

Delhi, the national capital territory of India, has population of 17.4 million¹ and covers an area of 1,483 sq km. Delhi has been at the forefront of investment in transport infrastructure. It has a Metro network of almost 200 km—one of the largest in the world—and an extensive network of roads and flyovers. Yet the city experiences some of the worst congestion in the country.

Increasingly, planners are acknowledging that massive expansions in car-centric infrastructure have not worked for Delhi because they simply invite more private vehicles onto the roads. This diminishes the potential positive impact of investments like the Delhi Metro. Further, while the Metro system is well used, it serves only a tenth of all trips in the city. While much effort has gone into expanding Metro service, other essential components of the city's transport network continue to languish. In particular, city bus services overseen by the Delhi Transport Corporation (DTC) and Delhi Integrated Multi-Modal Transit System (DIMTS) are overstressed, with many of the city's buses nearing the end of their usable lifetimes. These essential services carry around 45 lakh passengers per day in the Delhi metropolitan area.²

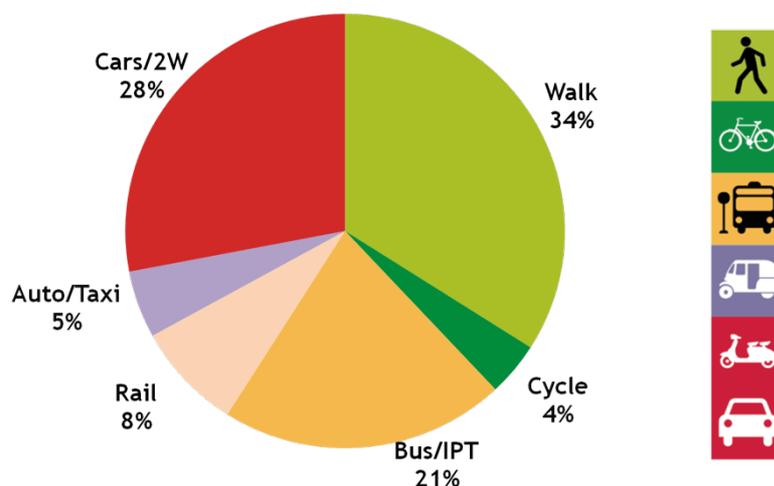


Figure 1: Existing mode share of Delhi.

To address these challenges, the Government of National Capital of Delhi (GNCTD) has launched a number of initiatives to make walking, cycling, and public transport safe, comfortable, and convenient. Cycle sharing is considered a key element among these strategies. Cycle sharing will serve as an alternate mode of public transport in which people have access to cycles that can be used across a network of closely spaced stations. With a smart card or other form of identification, a user can check out a cycle from a station and return it to any other station.

Cycle sharing is expected to boost the use of public transport by providing crucial last-mile connectivity, thereby expanding the catchment areas for the region's rapid transit systems. By

¹ Population for Delhi urban agglomeration

² <http://timesofindia.indiatimes.com/city/delhi/No-new-buses-DTC-struggles-to-carry-45-lakh-Delhiites/articleshow/47044842.cms>

encouraging a shift to sustainable modes, the cycle sharing will reduce dependency on automobiles, particularly for short trips in the city centre, thereby reducing traffic congestion, vehicle emissions, and demand for motor vehicle parking. In addition, the system will expand the health and wellness benefits of bicycle transport to new users. Finally, the system will support the transformation of City streets to become environments where pedestrians and bicyclists feel safe and comfortable. The system will offer the convenience of cycling without the burden of ownership and the flexibility to accommodate one-way trips.

Some existing cycle rental schemes in the city, overseen by Delhi Metro Rail Corporation (DMRC) and DIMTS, provide cycles for hire at a handful of metro stations and bus stops. However, these systems were introduced on a very small scale. The cycle rental schemes have failed to attract users due to limited system coverage, unavailability of cycles, and poor quality equipment. It is essential that new cycle sharing systems in Delhi make use of the lessons learnt from these experimental schemes.

Moving forward, a number of agencies have begun efforts to plan for cycle sharing systems in the city. The Unified Traffic and Transportation Infrastructure (Planning & Engineering) Centre (UTTIPEC) has prepared and adopted a cycle sharing policy, and local-area cycle sharing plans have been developed under the auspices of the Delhi Development Authority (DDA) and the South Delhi Municipal Corporation.

GNCTD has requested the Institute for Transportation and Development Policy (ITDP) to consolidate the existing cycle sharing plans for Delhi and prepare a detailed report, including the system design, proposed station locations, and a financial plan, for implementation of a first phase cycle sharing system. ITDP was also requested to serve as transaction advisor to help with tender the system's Phase 1 and monitor system implementation. The proposed GNCTD Phase 1 cycle sharing system will have approximately 3,800 cycles and an initial coverage area of about 52 sq km.

In implementing the system, Delhi will join over 700 cities in 57 countries that are enjoying the benefits of cycle sharing. Together, these systems comprise over 8 lakh cycles.³ Some of the largest cycles sharing systems are in Chinese cities like Hangzhou and Shanghai. Washington, D.C. (USA), Paris (France), and London (U.K.) have hugely successful systems that have helped re-energise cycling in those cities and encourage more people to use this non-polluting and healthy mode of transport.

2. Cycle sharing features at a glance

The Delhi cycle sharing system will employ the following best practice features⁴:

- A dense network of stations across the coverage area, with spacing of approximately 300 m between stations.
- High quality cycles with specially designed parts and sizes to discourage theft and sale as whole or for parts

³ <https://worldstreets.wordpress.com/2014/09/29/earth-policy-institute-reports-on-public-bicycles/>

⁴ Ministry of Urban Development, Government of India (2012), "Public Cycle Sharing Systems: A Planning Toolkit for Indian Cities," < <https://www.itdp.org/public-cycle-sharing-systems-a-planning-toolkit-for-indian-cities/>>. Institute for Transportation and Development Policy (2013), "The Bike-Share Planning Guide," < <https://www.itdp.org/the-bike-share-planning-guide-2/>>.

- A fully automated locking system at stations that allows users to check cycles in or out without the need for staffing at the station.
- Radio frequency identification devices (RFIDs) to track where a cycle is picked up, where it is returned, and the identity of the user
- Real-time monitoring of station occupancy rates through General Packet Radio Service (GPRS), used to guide the redistribution of cycles
- Real-time user information provided through various platforms, including the web, mobile phones, and/or on-site terminals
- Advertising space on cycles and at stations (provides revenue generation options for system operator or city)
- Pricing structures that incentivise short trips, helping to maximize the number of trips per cycle per day.

These characteristics are described in more detail in the sections below.



Figure 2: Modern cycle sharing systems feature a dense network of stations. A user checks out a cycle using an RFID-enabled smart card and can return it to any other station.

The cycle should be attractive, durable, and theft-proof. The following design standards should be followed:

- Protection against theft and vandalism: unique parts, hidden wiring, RFID tags that allow the system to connect the cycle to the user.

- Universal design: should satisfy all genders and clothing
- Distinctive styling: should project a modern image
- Convenience: basket for carrying and mud guards to protect clothing
- Safety: reflectors, LED lights for night riding
- Longevity: solid frame and puncture resistant tyres



Figure 3: A unique, robust cycle design is critical the branding and reliability of the system. The cycle should be a unisex model with an adjustable seat.



Figure 4: Special parts help deter theft and vandalism.

Cycle sharing station design is a function of the level of demand, the amount of space available, and the nature of the roadside environment. Decisions regarding station design also need to take into account the impact on the city's image. All stations need to accommodate a fully automated smart card check-in and check-out. IT-based management of cycles and users is critical to the delivery of modern cycle sharing systems. It also allows a user to check out a cycle without interacting with an attendant, thus decreasing the time required to take out or return a cycle and limiting the possibility of a station being off-line because an attendant is not present. While fully automated stations may

represent higher capital costs, it will help the city save on operating costs because the stations do not need to be manned all the time.



Figure 5: A typical cycle sharing station includes docking positions, a user terminal, and space for advertising.

Besides incorporating the design features described above, cycle sharing systems should meet basic planning parameters to ensure a successful rollout. Based on the experience in the best-used and most efficient systems across the world, the following are recommended when planning a cycle sharing system⁵:

- At least 10 stations per sq km.
- Sufficient system size to provide access to a critical mass of origins and destinations. Phase 1 systems should have at least 1,000 cycles and aim to provide at least 10 cycles per 1,000 residents in the coverage area after expansion.

Cycle sharing systems that meet the best practice parameters described in this section have the greatest chance of achieving good performance levels, as indicated in the following benchmarks:

- System efficiency: 4-8 rides per day per cycle
- System penetration: 1 daily trip per 20 to 40 residents in the coverage area

Monitoring of these and other performance metrics should be carried out as part of the ongoing operations of the Delhi cycle sharing system.

⁵ Ibid.

3. Existing cycle rental schemes in Delhi

To encourage cycling as last mile transport, Delhi had introduced two cycle rental schemes: Planet Bikes and Rent-a-Bicycle. DIMTS introduced Planet Bikes at eight stations along the BRT corridor from Moolchand to Ambedkar Nagar. Intended to improve last-mile connectivity for BRT passengers, the system offers a total fleet 80 cycles. Planet Bikes is operated by Planet Advertising Private Limited. An attendant is responsible for every cycle that is rented at each station. Planet charges a nominal fee of Rs.10 for 4 hours and Rs. 5 for every additional hour. In order to avail the facility, users need to provide the original copy of an authorised Delhi photo identification card. The identity proof is returned upon the return of the cycle.⁶

Rent-a-Bicycle was introduced by Delhi Metro Rail Corporation (DMRC) as an environmentally friendly form of last mile connectivity to metro stations. While the system initially operated at six stations, at present only three stations operate at Saket, Neb Sarai, and Vishwavidyalaya.⁷ Under this scheme, cycles are available for college students and other commuters for a fee of Rs. 10 for two hours. In order to avail the facility, the commuters need to provide an authorised Delhi photo identity proof.



Figure 6: A Planet Bikes station along BRT corridor (L) and a DMRC Rent-A-Bicycle station (R).

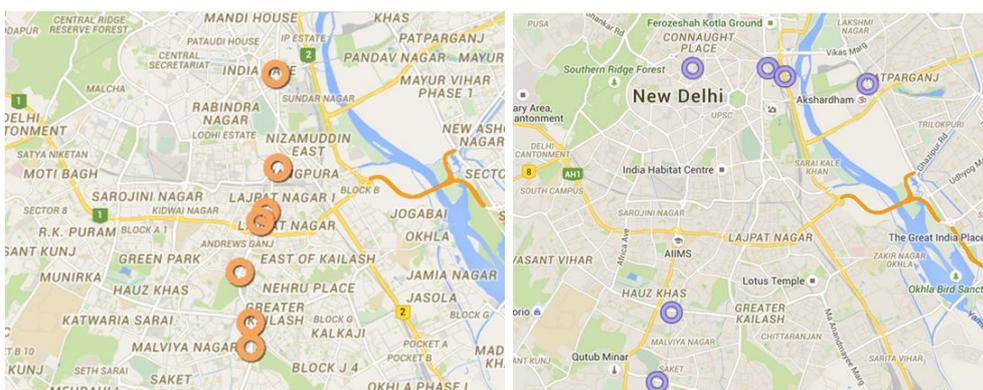


Figure 7: Existing rental schemes: station locations of Planet bikes along the former BRT corridor (L) and DMRC's Rent-A-Bicycle stations (R).

⁶ http://planetgreenbikes.in/rules_an_regulations.html

⁷ <http://www.iamin.in/en/delhi/news/more-stations-added-dmrcs-bicycle-sharing-scheme-50034>

While the systems were launched with good intent, they have not expanded and failed to attract significant ridership due to the following reasons:

- A cycle rented from a station has to be returned to the same station
- Stations are only located adjacent to BRT/metro stations but not in adjoining areas
- Limited coverage with large distances between stations
- Poor quality cycles
- Poor maintenance of cycles and stations
- Renting of cycles restricted to users with authorised Delhi ID documents
- Station attendants deny access to cycles because they are held personally responsible if a user steals a cycle
- No technology used to track status of users and bicycles



Figure 8: Poor maintenance of cycles (L) and locked stations (R) make it difficult to use Delhi's existing cycle rental systems on regular basis.

Table 1: Comparison of cycle sharing features with existing rental system.

	Planet Green Bikes	DMRC Rent-a-cycle	CSS
First half hour free	✗	✗	✓
Dense network of stations	✗	✗	✓
Docking with RFID tag	✗	✗	✓
High quality cycles	✗	✗	✓
Adjustable seat post	✗	✗	✓
Special parts to deter theft and vandalism	✗	✗	✓
Security through IT based system	✗	✗	✓

Unlike the Delhi cycle rentals that promote long-term, round-trip usage of cycles, a cycle sharing system promotes short-term, one-way trips. It is a large, publicly operated service that uses technology to improve system efficiency.

4. Cycle sharing initiatives in Delhi

4.1 Cycle sharing policy

UTTIPEC, a planning body under DDA, recently prepared a cycle sharing policy that was later adopted by the Authority. The policy calls for the government to implement the non-motorised transport (NMT) provisions in Master Plan of Delhi 2021, and focuses on the key components to be addressed in future cycle sharing system:

- Operations Control Centre to be setup with within a local body/DMRC/DIMTS to monitor the operation and management of cycle sharing system.
- An integrated smart card/common mobility card to be introduced for use in all public transport systems including cycle sharing.
- Revenue sharing model between the private operator and public agency:
 1. The private operator will pay for capital and operating expenditure and collects revenue from advertisement and user fees lies.
 2. The private operator will pay for capital expenditure while revenue and operational expenditure shared between private operator and public agency (subsidy provided).
 3. The public agency will pay capital and operational expenditure to the private operator on fixed monthly service charges. Revenue is retained with the public agency.
- All roads under different jurisdictions shall provide NMT infrastructure to include dedicated cycle tracks, cycle parking, retrofitting of intersections and other amenities. All NMT infrastructure shall be designed using UTTIPEC guidelines.
- An NMT Cell in UTTIPEC needs to be formed to act as the management/monitoring cell for all NMT and cycle sharing projects in the city.

4.2 Delhi Decongestion Plan

In late 2014, the Ministry of Urban Development (MOUD) convened a High Powered Committee on How to Decongest Delhi to prepare a detailed action plan for transport improvements in Delhi. As part of the process, the committee came up with a nine-point strategy to prioritise and promote public transport to induce modal shift from private vehicles. In addition, the study recommended other solutions to decongest the city including parking pricing and management, multimodal integration, NMT infrastructure, and paratransit for last mile connectivity.

The committee emphasised cycle sharing and NMT infrastructure as important ways to reduce congestion. The following recommendations were given by the committee:

- Good bicycle infrastructure and a convenient cycle sharing system should be developed to take shorter trips off of arterial roads.
- Cycle tracks should be created on all streets with a right-of-way above 18 m. They should be clearly demarcated with good signage, road marking, lighting, at least one line of tree shade and

frequent bicycle parking areas. Cycle tracks should be provided at a higher level than the carriageway and with protected edges to prevent monsoon flooding or encroachments by parked vehicles.

- Intersections should have cycle queuing arrangement and dedicated bicycle signals.
- Encroachment of cycle tracks and theft or vandalism of cycle sharing infrastructure should be a cognizable offence under the Municipal Act/ Motor Vehicle Act or any other applicable Acts.
- Cycle sharing systems shall include a dense network of stations placed approximately 250-300 m apart. Systems should have 1.2 docks for every cycle.
- The system should be IT-enabled for seamless check-out of cycles and ease of system tracking.
- The cycle sharing system should be accessed by a smart mobility card
- The system should be procured by the government and run on a long-term basis by private operators who will be able to market and expand the system incrementally.

With regards to cycle sharing system, the committee called for the implementation of cycle sharing systems with 20,500 cycles by 2018 (see Table 2).

Table 2: Cycle sharing proposals in the Delhi Decongestion Plan

Phase	Location	Approximate Population	Number of stations	Number of cycles	Estimated costs (Rs.Cr)	Timeframe
1	Dwarka	12,00,000	300	4,000	45	End-2015
2	All arterial roads of Delhi with ROW > 40 m	18,00,000	400	5,000	70	2016
3	Entire West Delhi	20,00,000	400	5,500	80	2017
Future	Entire South Delhi	27,00,000	590	8,000	120	2018

4.3 Dwarka cycle sharing proposal

Delhi Development Authority (DDA), based on work done by the Centre for Green Mobility (CGM), has proposed to implement a cycle sharing scheme in Dwarka with 350 stations and 4,500 cycles covering an area of 50 sq km.⁸

⁸ Source: Unified traffic & transportation infrastructure (plg. & engg.) centre UTTIPEC

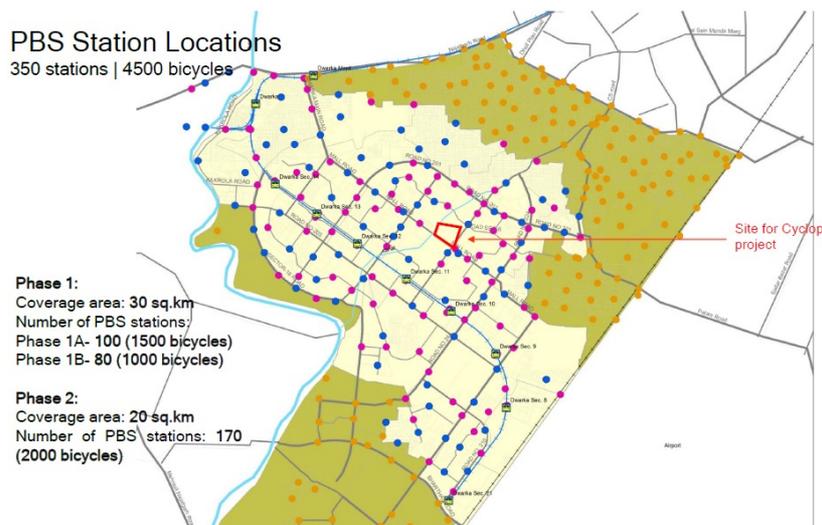


Figure 9: Proposed cycle sharing scheme in Dwarka. (Source: UTTIPEC)

4.4 South Delhi cycle sharing proposal

With technical support from Centre for Green Mobility Ahmedabad (CGM), South Delhi Municipal Corporation has proposed cycle sharing system with 590 stations and 8,000 cycles. A detailed study report on the proposed cycle sharing system design and estimated costs is in progress.

5. Planning the system

5.1 Project goals

Delhi has embarked on several sustainable transport initiatives, including the construction of wider footpaths and cycle tracks on most of the city's arterial streets; expansion of the rapid transit network with metro rail, and BRT. The cycle sharing system will complement these efforts by helping the city achieve the following goals:

- Facilitate the use of the city's public transport system by expanding the reach of popular metro and bus routes.
- Reduce congestion and dependence on private motor vehicles for even shorter trips
- Improve air quality by attracting users from private motor vehicles.
- Increase the mode share of cycling in Delhi.
- Transform the image of cycling, making it a popular means of travel for the middle and upper classes.
- Promote the use of active transport, helping to improve public health.
- Integration with the public transport system

The cycle sharing system is relatively inexpensive, occupies less space and quick to implement compared to other transport modes. It will help improve access to Delhi's rapid transit modes and the city's bus service, providing seamless connectivity between public transit stations, homes and workplaces. The introduction of a cycling option will increase the catchment area of each station,

considering walking radius of approximately 300 m (i.e. a 2- to 3-minute walk). Cycle sharing stations will be strategically placed ensuring physical connectivity and filling in the gaps where public transit stations are missing. Besides physical integration, the same electronic fare collection system should be employed across the cycle sharing system, the city bus service, metro, and BRT in order to simplify the payment process.

Cycle sharing will be faster, cheaper, and more flexible than the existing feeder modes, particularly auto rickshaws. Cycles will be available on demand, so users will not need to wait for a bus or rickshaw to appear. In addition, cycle sharing will be less expensive: most feeder trips will be accomplished within a 30-minute time span for which there is no user fee.

5.2 Target user groups

The cycle sharing system will target a different user group from those who currently own cycles or rent them on a daily basis. The target user will be the commuter who uses public transport, auto rickshaws, or walks long distances to complete some portion of his or her trip. The user will tend to have a higher income than typical cyclists in Delhi, and s/he will place a premium on the quality of the system: the ease of use, the level of upkeep of the cycles and stations, and seamless integration with other modes. Potential user groups include:

- College students of North Delhi University who do not own vehicles and for whom the cycle provides connectivity from metro station to college campus and from hostel to nearby recreational and shopping areas.
- Daily commuters to central areas who use cycling for midday errands
- Commuters who travel on the Metro or BRT for the main leg of a journey but use the cycle sharing to travel between the station and the office.

The placement of stations, system pricing, and marketing campaigns will be tailored to appeal to these key user groups.

5.3 Determination of coverage area

The delineation of a coherent coverage area and the saturation of the coverage area with stations at frequent intervals are critical to the success of the Delhi cycle sharing system. From the day operations begin, the coverage area needs to be sufficiently large to cover a robust set of origins and destinations. It also needs to augment the city's public transport system in a meaningful way. The cycle sharing system in Delhi has been proposed in areas with potential demand, dense, mixed land uses, and access to metro rail corridors and bus systems, and along existing cycling tracks.

Delhi, also called as national capital territory of India, constitutes of interstate regions with the city at the centre. It is one of the largest urban agglomerations comprising of major cities including New Delhi, Dwarka, Ghaziabad, Noida, Gurgaon and Faridabad. Covering an area of 1483 sq km⁹, the state of Delhi is further split into multiple zones of jurisdiction under the Parliament Act of 1957. The largest zones are governed respective municipal corporations of North Delhi (NDMC), South Delhi (SDMC), and East Delhi (EDMC).

⁹ <https://www.ndmc.gov.in/AboutNDMC/NNDMCAct.aspx>

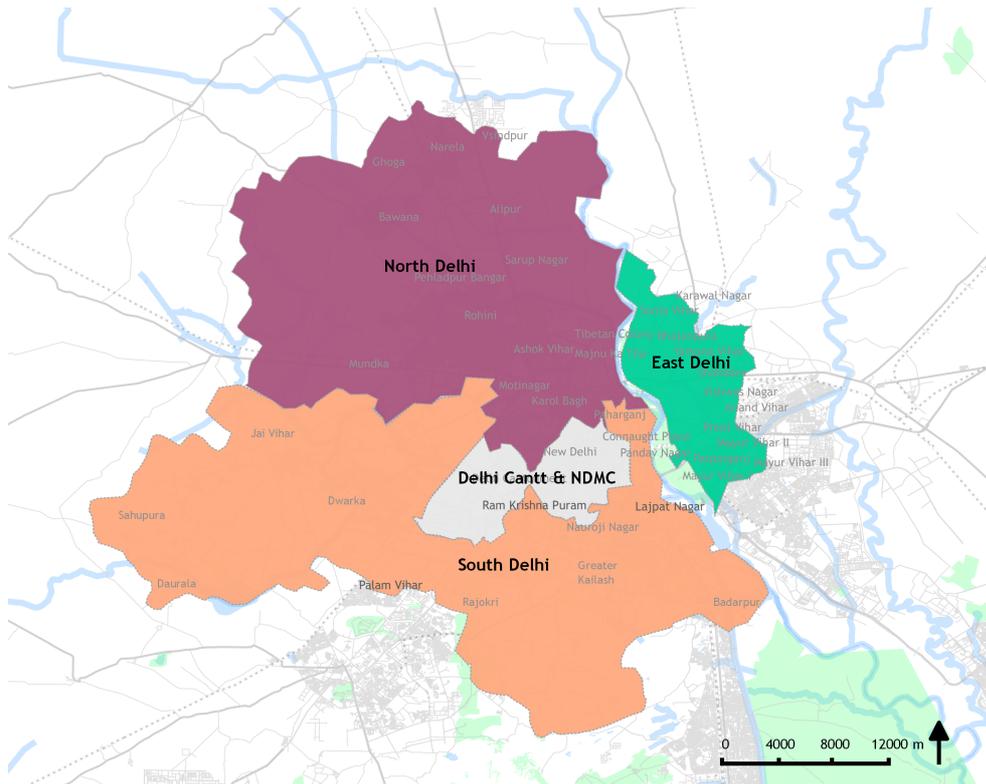


Figure 10: The entire of Delhi is divided into multiple zones but NDMC and SDMC are largest in area and governing jurisdiction¹⁰.

To start off with, this study has identified zones in north and south Delhi with an initial coverage area of 52 sq km. The North zone begins from Vishwavidyalaya metro station, covering University of Delhi- north campus, Kamala Nagar and Ashok Vihar and extends to central Delhi, covering Karol Bagh, Paharganj and Connaught Place. The south zone will cover some parts of Lajpat Nagar, Jangpura and extends up to Ashoka Road in the north.

The proposed system will provide last mile connectivity for commuters residing in the coverage area from home to metro stations as well as local trips. For customers ending their journeys in the coverage area, the system will provide better last-mile access to education institutions, and mixed-use commercial centres such as Connaught place, Khan Market, and Lajpat Nagar. In Phase 2, the system can be extended to further North, South, and East. covering other important areas.

¹⁰ Source: Open street map and www.diva-gis.org/gdata

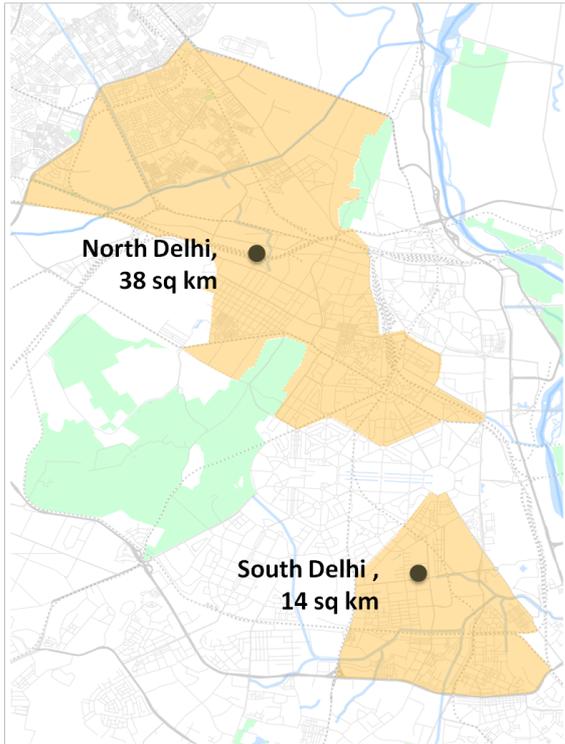


Figure 11: Proposed cycle sharing system coverage in phase-1.

5.4 Identification of station locations

Stations will be placed at frequent intervals, with a typical distance of 300 m between stations. Close station spacing will help make cycle sharing competitive with other modes and will reduce the distance that a user has to walk to the next station, should s/he find a station either completely full or completely empty. To maximise ease-of-use, stations will be placed near important origins and destinations, including:

- Around public spaces and recreation spaces
- Public transport hubs such as Delhi Metro stations and DTC bus stops
- Market areas, and community shopping centres
- Cultural landmarks
- Academic institutions and Libraries
- Retail streets and places
- Government offices
- Easily accessible locations inside residential areas

In the absence of a single important building, stations will be placed at existing nodal points, important public spaces and near intersections to serve origins and destinations in multiple directions.

An innovative resource for locating cycle sharing station is the database of safety information collected by Safetipin, an initiative of Delhi based NGO Jagori. A safety audit study was done to

assess the current situation around 876 bus stops in Delhi using parameters of quality footpath, walkability, crowd, openness, visibility, lighting, transport and sense of security.¹¹ Using a scale of 0 to 3, each bus stop location is rated for each parameter. For instance, quality of footpath was rated where 0 indicates unavailability or unusable, and 3 for poor condition. The overall average of all the parameters is taken to analyse existing condition of the street infrastructure and the scope for improving safety in these locations. Placing cycle sharing stations at locations with poor safety scores can help provide alternate mode of transport for people who feel unsafe walking or taking the bus.

To help identify important landmarks and transport hubs, ITDP mapped a series of elements using geographic information system (GIS) software (Figure 12-Figure 15). The team then carried out field surveys in the north and south zones to confirm the possible stations locations.

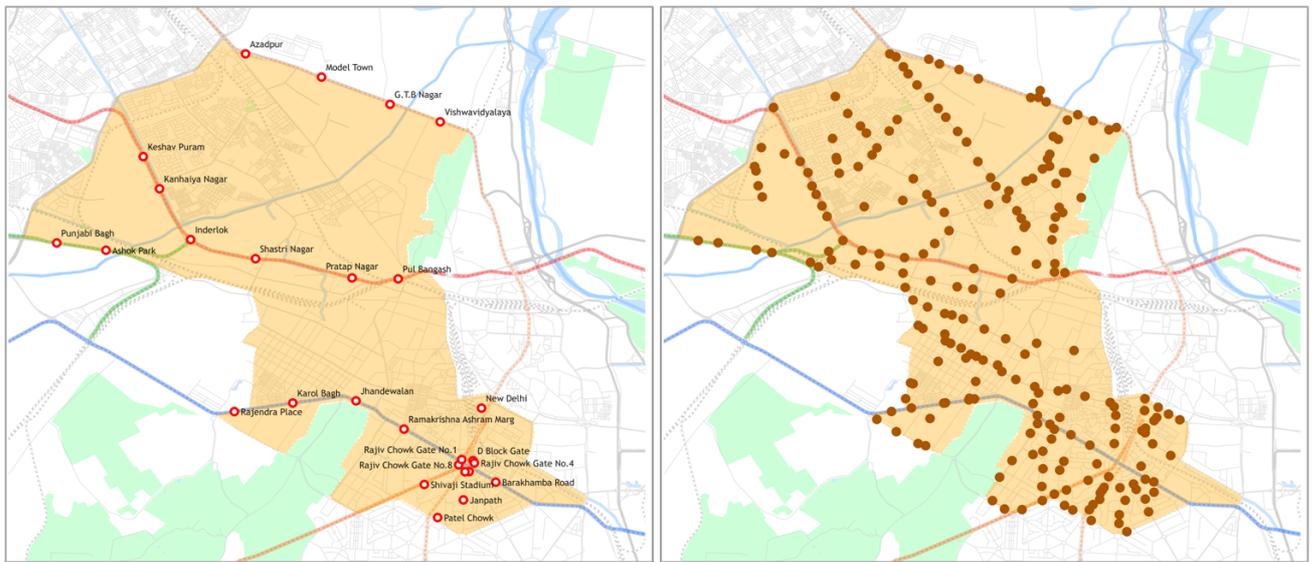


Figure 12: Map of metro stations (L) and bus stops (R) in the coverage area.

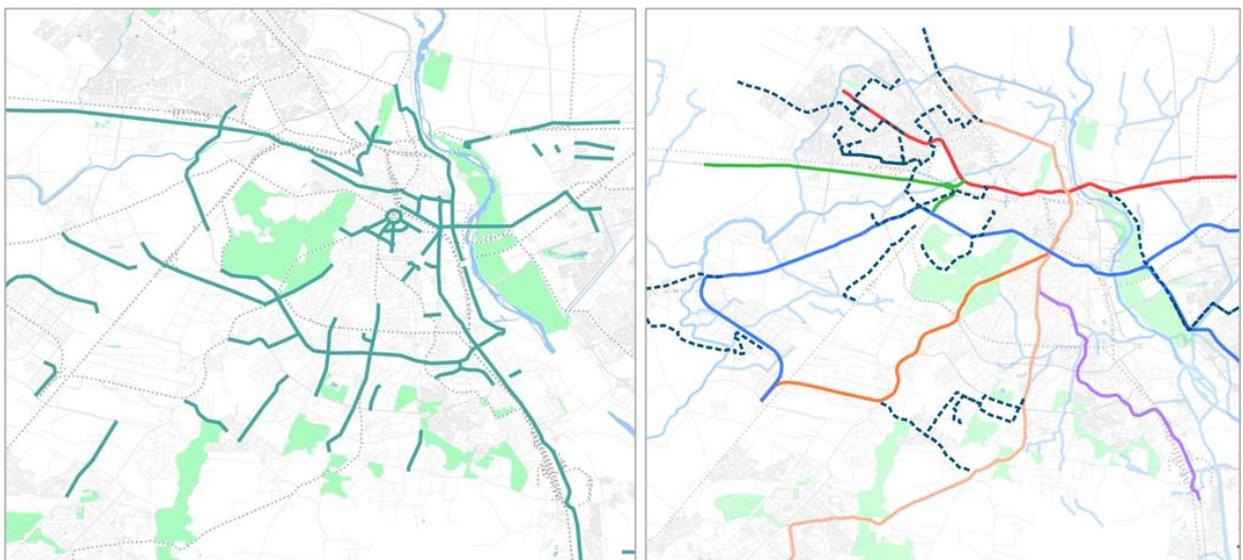


Figure 13: Map of existing and proposed cycle tracks (L) and metro feeder routes (R).

¹¹ Source: Safetipin staff.

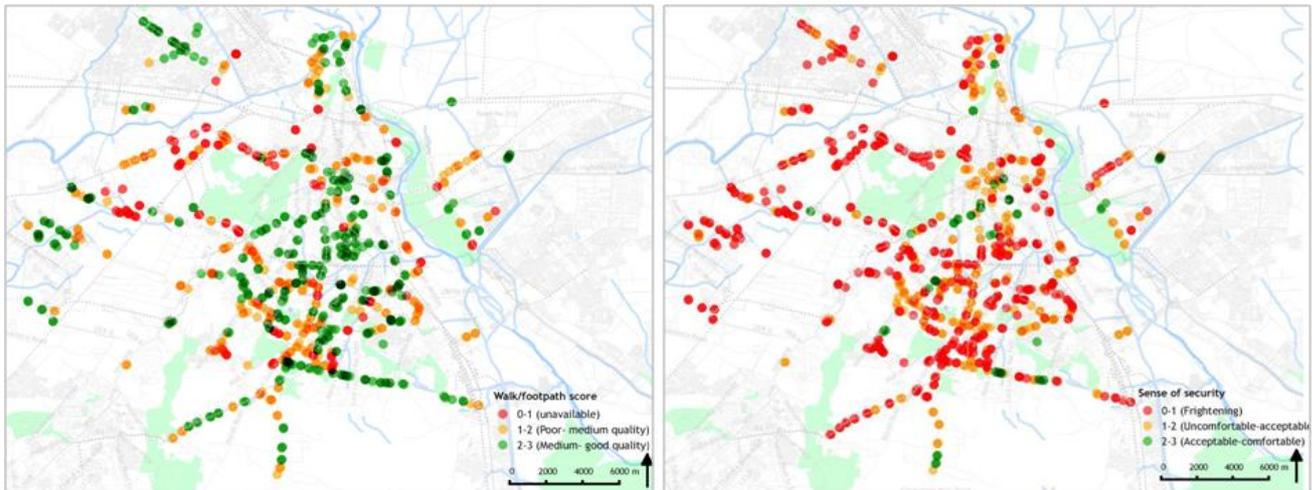


Figure 14: Map showing safety audit at 876 bus stops to rate quality footpath (L) and sense of security (R).

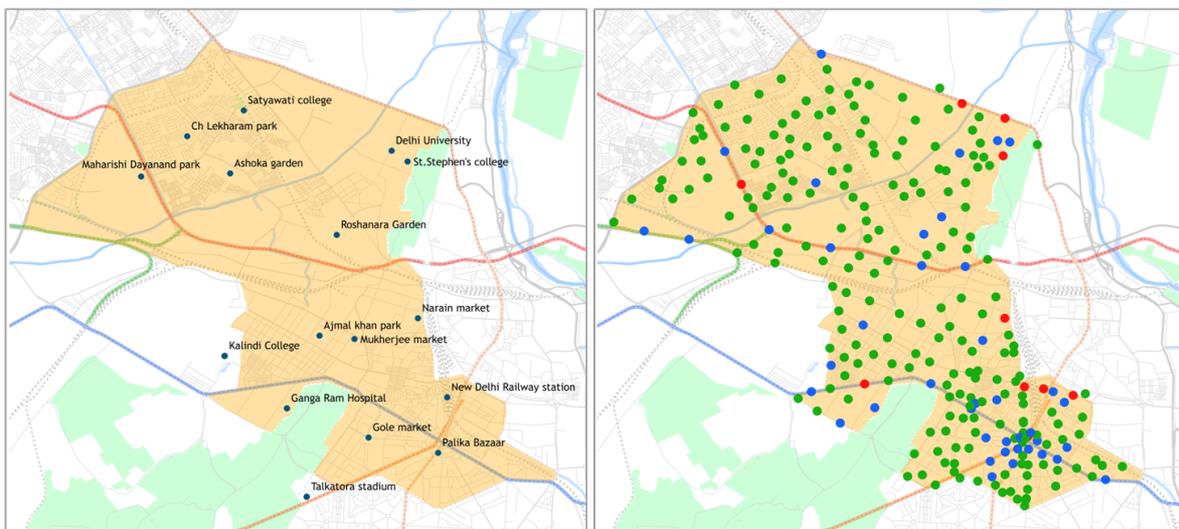


Figure 15. Map of important institutions, cultural landmarks and markets (L) and final locations of proposed stations indicated in green, blue and red colour (R).

For the initial rollout of the system, 276 station locations were identified. These stations provide reasonably good access to major destinations throughout the coverage area **Error! Reference source not found.** After 3 months of operations, new stations will be added, bringing the total number of stations in the system to 377. With these additional stations, the system will achieve a target of around 10 stations per sq km. This density is considered necessary to provide high level of service to the target users, based on the experience of cycle sharing systems around the world.¹² The expansion will involve increasing the size of existing stations as well as the installation of new stations in locations where expansion is not possible or in potential destinations that were not covered in the initial rollout.

¹² Institute for Transportation and Development Policy (2013). The Bike-Share Planning Guide. <https://www.itdp.org/the-bike-share-planning-guide-2/>.



Figure 16: Representative station locations (clockwise from top left): near Hindu College; Main bazaar, Paharganj; Connaught Place and Ramakrishna ashram metro station.

Stations have been sized according to the level of patronage at nearby destinations, using proxies such as observed foot traffic and the number of vehicles parked nearby. Stations have been categorised into three groups: small stations with 12 docks, medium stations with 24 docks, and large stations with 36 docks. Some large stations can be constructed as parking area stations, in which a large number of cycles are retained in a walled parking area. In such stations, a user completes the checkout process by passing through turnstiles with a cycle. Parking areas can reduce implementation costs by reducing the number of docks that need to be installed. The number of cycles was calculated assuming a ratio of approximately 1.5 docks per cycle.

Table 3. Phase 1 system parameters

		Initial rollout	Subsequent expansion*
Number of stations	Small (12 docks)	220	80
	Medium (24 docks)	41	15
	Large (36 docks or parking area)	15	6
	Total	276	101
Number of bicycles		2,776	1,024

* Representative values to be refined based on observed system demand.

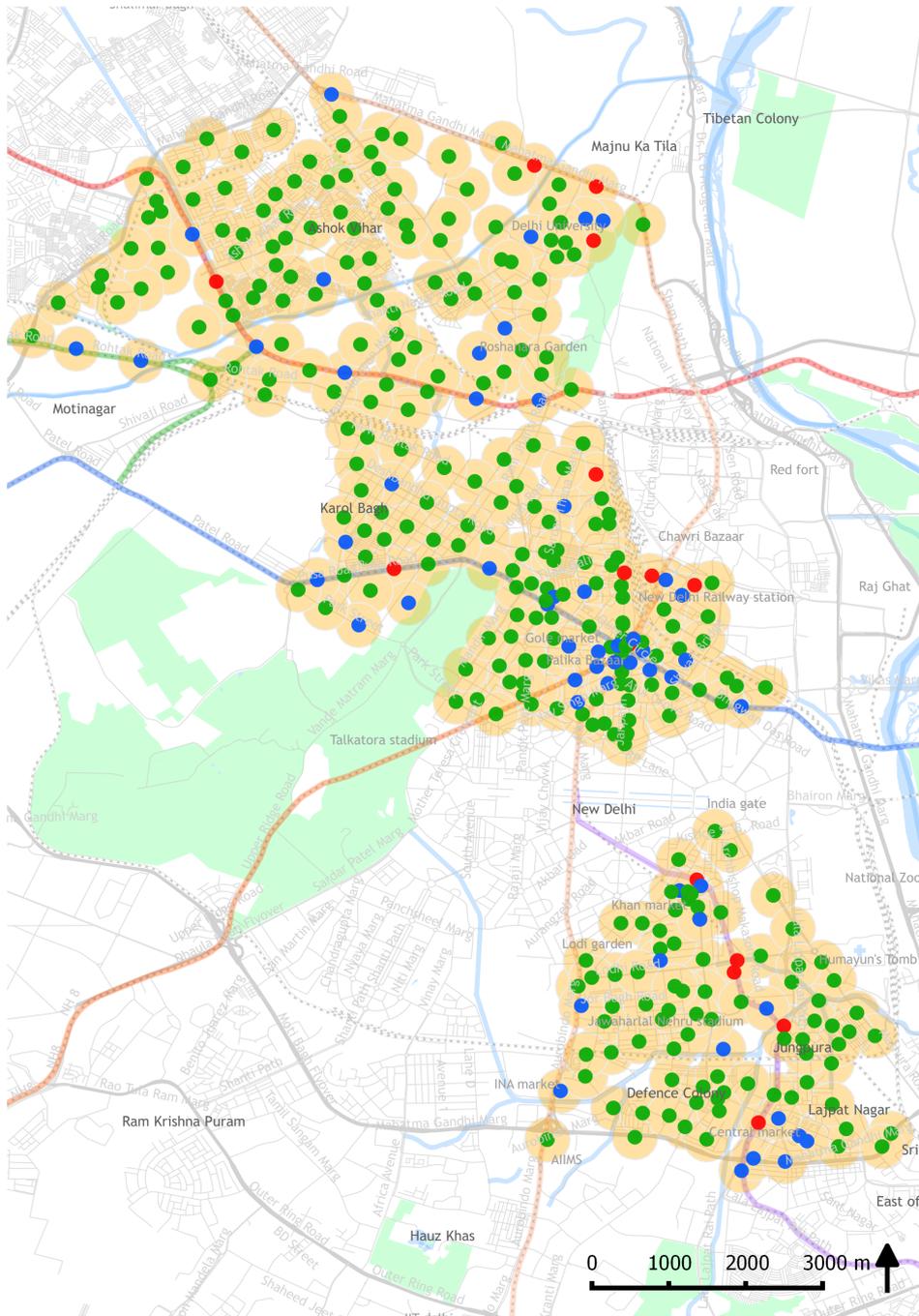


Figure 17: The cycle sharing coverage area, shown as a 300 m radius around each station. Station locations of Delhi cycle sharing system (green = small (12 docks), blue = medium (24 docks), red = large (36 docks)).

While the station locations proposed here can serve as a starting point, it is important to gather community feedback before finalising the locations. GNCTD can use a combination of interactive meetings and online crowdsourcing technology to invite suggestions from the communities on potential station locations. Feedback should be gathered prior to the initial launch as well as the expansion phase.

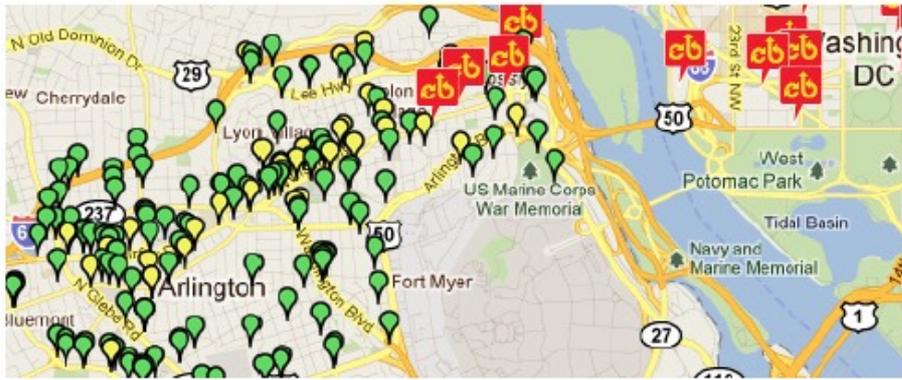


Figure 18. Example: Arlington, USA had used crowd sourcing technology to solicit suggestions on cycle stations. Suggestions from the implementing authority are shown in yellow; community suggestions are in green.

5.5 Station placement

Working from the general station locations identified above, the next step is to identify the placement of the station within the public right-of-way. Stations should be placed so that they are clearly visible to passers-by and should make use of the underutilised and vacant spaces to reduce interference with other activities.

Stations in the Delhi system will have a separate dock for each cycle. The size of stations will depend on the level of demand, ranging from small stations with 12 docks to large stations with 36 docks. A station can fit into a 2 m wide on street parking lane. It should not be placed on footpaths unless there is sufficient clear space for walking beside the station.



Figure 19. A cycle sharing station can fit in a 2 m wide parking lane, as demonstrated in London (L) and Paris (R).

The specific siting of stations will be determined on a case-by-case basis by the cycle sharing service provider. Typical placement options include the following:

- On-street parking spaces
- Vacant space in roadside landscaping strips

- Auto rickshaw stands
- Areas beneath flyovers
- Adjacent to bus stops
- Areas outside metro station entrances
- Private property near large commercial and housing developments
- The furniture zone of pedestrian footpaths (where the furniture zone is wide enough to accommodate the station without compromising clear space for pedestrians)
- Plazas and other public spaces



Figure 20: Potential station locations: beneath a flyover (L) and outside a Metro station entrance (R)



Figure 21: Potential station locations: the furniture zone of footpath (L) and adjacent to bus stop (R)

Since the coverage area is governed by multiple public agencies such as Public works department (PWD), DDA, North and South Delhi Municipal Corporation, there is a need for GNCTD to create a SPV or utilise the services of an existing SPV that brings in the multiple agencies to identify the space for stations in their jurisdictions and operate the system seamlessly.

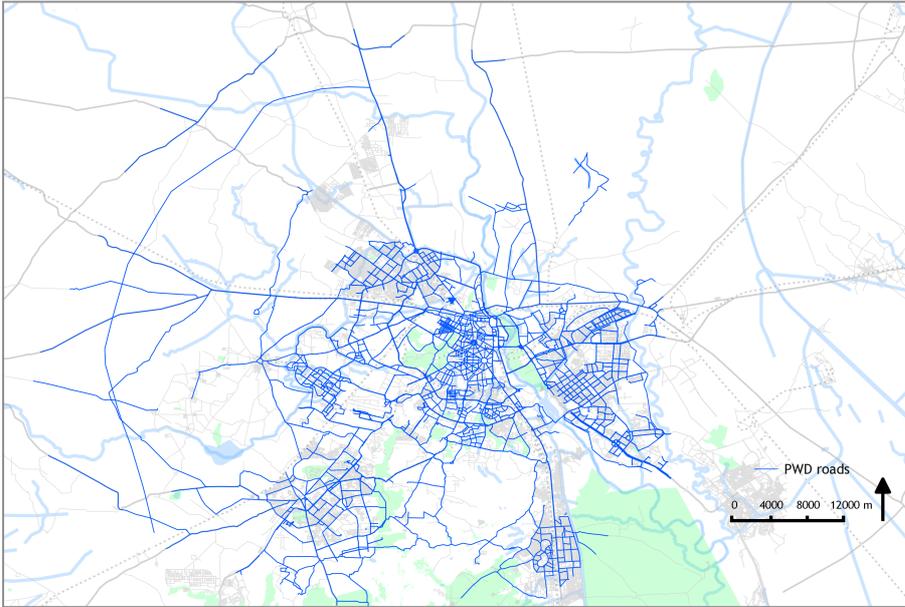


Figure 22. Map showing existing PWD roads (blue colour). Majority of the cycle sharing stations are on this network. However PWD should coordinate with other public agencies and municipal corporations to decide on station placements.

6. Supporting infrastructure

Cycle sharing can achieve greater results when paired with measures to improve safety and convenience for cyclists on city streets. Such cycle infrastructure can take the form of physically separated cycle tracks or traffic calming measures to reduce motor vehicle speeds.



Figure 23: Barcelona, Spain, offers an integrated network of cycle sharing stations and dedicated cycle tracks, helping to improve safety for cycle sharing users and other cyclists alike.

Cycle tracks are typically built on larger streets with right of way more than 18 m and where there is a large differential between the speed of mixed traffic and that of cyclists. Cycle tracks can be placed in the median or at the outer edges of the carriageway, with a minimum width of 2 m for one-way movement and 3 m for two-way movement. The cycle track design should incorporate the following:

- A minimum width of 2 m for one-way movement and 3 m for two-way movement. To accommodate cycle rickshaws, a minimum 2.5 m width for one way, and to accommodate two-way movement 3 m is recommended.
- The cycle tracks should be continuous to allow for reasonable speeds.
- The surface of cycle track should be smooth and clear of obstructions such as man hole covers. The surface material preferred is asphalt or concrete. Paver blocks are to be avoided.
- Continuous shade through tree cover should be ensured along the cycle tracks.
- The cycle track should be elevated by 150 mm from the carriageway to allow for storm water runoff.
- A buffer of 0.5 m between the cycle track and parking areas or the carriageway should be provided to prevent encroachments
- At property access points, the cycle track remains at the same level and vehicle access is provided by a ramp in the buffer of footpath.

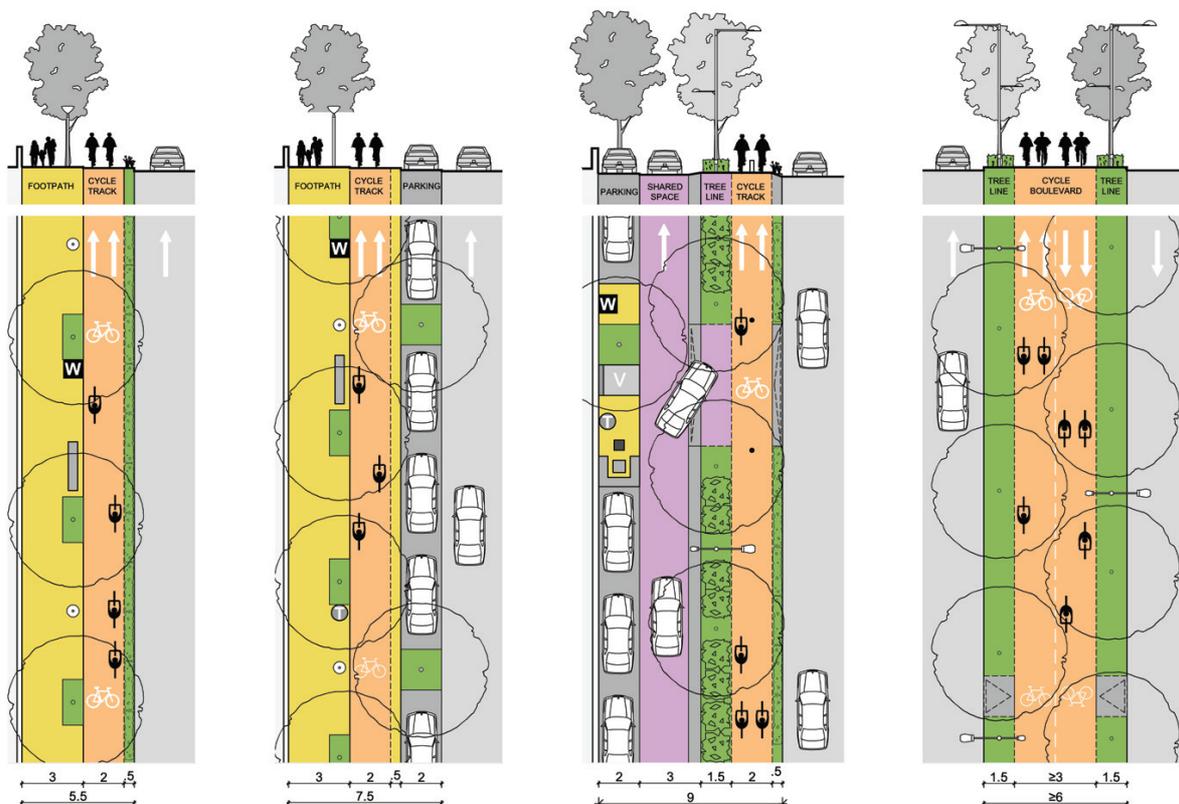


Figure 24: Representative sections and plans showing the placement of cycle tracks: one way side cycle track with buffer (L1, L2 and R1) and median cycle tracks to reduce conflicts with parking and property entrances.

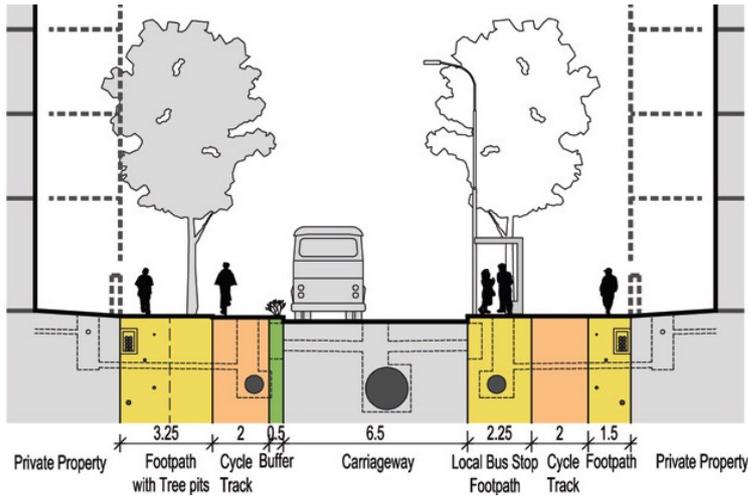


Figure 25: Representative street section showing 2 m side cycle tracks in 18 m ROW. Green cover shades the footpath and cycle track and a buffer is provided between the carriageway and cycle tracks.

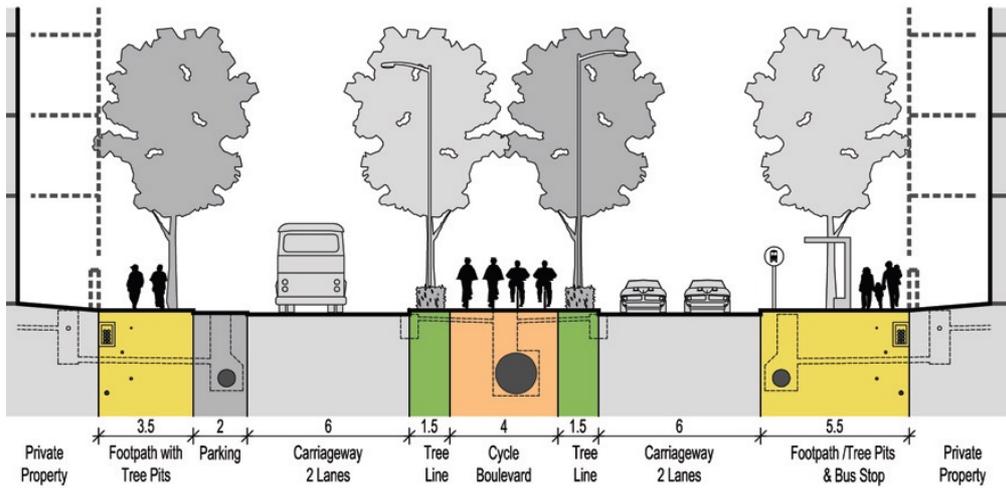


Figure 26: Representative street section on a 30 m ROW with a 4 m wide median cycle track for two way movement.¹³

¹³ Source: ITDP publication, *Better Streets and Better Cities Manual*.



Figure 27: Continuous cycle tracks can enhance safety and convenience for cyclists on major arterial streets in Delhi.

Though Delhi has some good existing cycle tracks, they are limited to small stretches and do not form a complete network. Cycle tracks at some locations are physically separated—raised above the carriageway and separated by a green buffer. At other places, there is no level difference and the delineation is not so clear. In addition, the existing tracks are not continuous and are encroached at numerous locations due to poor enforcement measures.



Figure 28: Discontinuous and poor quality cycle tracks on GTB Road near Model Town Metro Station.

To achieve better results, GNCTD should retrofit/redesign existing stretches to provide continuous tracks. The cycle tracks should be clearly demarcated and separate from carriageway. They should be free of encroachments such as utilities, parking, pedestrian and street vendors. The cycle tracks should have smooth surface material, sufficient shade from trees, and a clear buffer of 0.5 m between the track and carriageway. To ensure smooth and unobstructed flow of cyclists, street vending activities, parking and utilities such as drain covers shall be placed in the furniture/ buffer zones of the footpath. On streets that are too narrow for separate cycle tracks, traffic calming measures should be introduced.

To replicate best practices and create a more comprehensive network of cycle facilities, GNCTD plans to take up four stretches for cycle track implementation, including Vikas Marg, Netaji Subhash Place to Rithala Metro station, Britannia Chowk to Outer Ring Road via Rani Bagh fountain, and Patel Nagar Chowk to Moti Nagar Chowk.¹⁴ This should be expanded to cover the entire city to provide a safe, convenient, and attractive cycling experience.

7. System operations

7.1 User interface

Customer service platforms collect and disseminate information from and to the user through various media, including the web, mobile phones, terminals, and face-to-face interaction. They allow customers to set up accounts and receive information about the system and their account. The web is an ideal platform as it has the advantage of being available 24/7 and offers seamless interaction without the hassle of waiting in long queues. It also reduces operational costs and gives the system a modern, hi-tech image.

While the majority of users may access the system through the website or station terminals, it is important to have a face-to-face platform at the operational headquarters and/or at large stations. ‘Brick and mortar’ kiosks offer the same benefits of the online system to users who do not have access to technology. An optimal location for the customer service centre would be like Rajiv Chowk Metro station, New Delhi railway station and institutions like Delhi University and landmarks on Connaught Place.

Users who want to avail of long-term memberships to the cycle sharing system will be required to complete a registration online or fill out a membership form at the customer service kiosk. Along with a registration form, the prospective user will be required to submit identification proof and pay a registration fee. Besides the registration fee, around Rs 50 shall be paid towards the user’s opening balance to cover initial user fees.

Once the registration is completed, the cycle sharing operator will carry out a background check to verify the information submitted. The operator will mail a smart card within 24 hours to the address listed on the identification document submitted by the user. Upon receipt of the card, the user may begin using the system. For daily subscriptions, users may register online or at specific cycle sharing stations using an active credit card.

¹⁴ <http://timesofindia.indiatimes.com/city/delhi/1260km-of-Delhi-roads-to-be-redesigned/articleshow/48520139.cms>

7.2 Security mechanisms

Cycle sharing systems ensure security by tracking the identity of both users and cycles. On the user side, the system obtains identification details during the registration process (see Section **Error! Reference source not found.**) and the user is issued a smart card with an RFID chip linked to the user's account. RFID chips are also present on the cycles. When a user checks out a cycle using a smart card, the identity of the user is linked that of the cycle that s/he checks out. If the cycle is not returned within a specified time period, say 24 hours, the user's balance is forfeited and his/her smart card is deactivated. In addition, the user will be barred from registering for the system again.

In the case of daily or weekly subscriptions by walk-up users who pay by credit or debit card, the system places a hold on the user's credit card account for the duration of the subscription. If the user is in good standing, the hold is removed at the end of the subscription. However, if a cycle is not returned, then the hold remains on the user's account.

To ensure security for the cycle sharing system, the stations can be located on premises of government facilities and police stations where such facilities are near an optimal location from the standpoint of cycle sharing operations.

7.3 Redistribution and maintenance

Redistribution is broadly defined as the rebalancing of bicycles from stations that are near or at capacity to stations that are nearly empty. The operator will be responsible for redistributing bicycles during peak periods to ensure that bicycles remain available at all stations and that some docking positions remain open at each station. Redistribution is one of the greatest challenges to operating the cycle sharing system, and accounts for a large portion of operating costs.

The day-to-day operations of the cycle sharing system will be run by a private sector operator appointed by GNCTD (see Institutional Structure, below) through a competitive bidding process. The private operator will have several responsibilities, including redistribution, maintenance, and customer service, in addition to setting up the system.

For an experienced operator, redistribution becomes predictive, and is better thought of as the rebalancing of cycles to stations where the operator expects a shortage to occur. The RFID devices on the cycles allow the operator to record all of the trips that are made with the system. After a short period of operation, the IT system generates a full record of the trip patterns and station occupancies. This information can be used to guide the redistribution process. Many operators use logistics software to assign routes and schedules to redistribution crews.

Regular preventative maintenance is necessary to keep the cycles in good working condition. Cycle maintenance teams will be responsible for fixing minor repairs onsite and notifying redistribution teams to collect major repairs that need to be completed at the depot. In addition to cycle maintenance, this team should have basic knowledge of fixing minor problems at cycle docking stations and terminals.

Station and cycle cleanliness is an important aspect of the image of the system. Cycle maintenance teams should wipe down all cycle sat least once a week. They should also clean the station area. The implementing agency will set service level standards to ensure that redistribution and maintenance activities are carried out diligently.

8. Financial analysis

8.1 Pricing structure

This section presents a possible pricing structure for the Delhi cycle sharing system. The annual membership rate should be set at a rate that is high enough to discourage theft of cycles but low enough to encourage broad uptake within the study area. The daily subscription rate would be offered at a lower price for the first month of operations in order to encourage new users, including local residents to try out the system. The usage rates should be calibrated so that the cycle sharing system remains competitive with other modes in Delhi. Annual memberships can be offered in monthly instalments of Rs. 100 to expand access to the system to lower income residents.

Table 4: Proposed subscription rates

Subscription type	Rate (Rs)
Daily subscription	50
Monthly subscription	500
Annual subscription	1,500

The objective of the user fee structure is to incentivise short trips. This increases the number of times that each cycle in the system can be used. Trips with duration under 30 minutes are not charged.

Table 5. Proposed usage fees

Time period	User fee (Rs)
First 30 minutes	Free
30-59 minutes	5
60-119 minutes	10
each additional hour	15

8.2 Ridership scenarios

Some initial estimates of the number of potential subscribers and daily users were prepared using the following demographic data:

- Population density in Delhi: 11,753 persons per sq km¹⁵
- Study area size: 52 km²
- Trip generation rate: 1.8 motorised trips per day

The following table indicates the subscriber base as a fraction of the population residing in the study area (52 km² study area * 11,753 persons / km² = 611,142 persons). It also estimates the number of trips per day assuming that each subscriber makes 1.8 trips on the cycle sharing system. These trips

¹⁵ <http://www.census2011.co.in/census/district/21-Delhi.html>

include users of personal motor vehicles who switch to cycle sharing as well as public transport customers who begin using cycle sharing as a feeder mode.

Table 6: Estimated subscriptions and trips by residents

Uptake rate (% of population residing in the coverage area)	Subscribers	Trips / subscription	Trips / year	Trips / day / cycle
6% of 6,11,000 residents obtained annual subscription	37,000	200	73,34,000	5.3
1% of 6,11,000 residents obtained subscription for 3 months per year	18,000	40	7,33,000	0.5
1% of 6,11,000 residents obtain daily memberships 10 times per year	61,000	6	3,67,000	0.3
			84,34,000	6.1

8.3 Implementation costs

As in most public transport systems, cycle sharing systems generally require supplemental revenue sources to cover operating and investment costs. Revenue streams used in major bicycle sharing systems around the world include advertising, sponsorships, and on-street parking fees. Capital costs, operating costs, and revenue are summarised in the table below.

Table 7: List of costs incurred for implementing cycle sharing system

Capital costs	Operating costs	Revenue streams
<ul style="list-style-type: none"> Stations Bicycles IT equipment Software Redistribution vehicles Control centre Website 	<ul style="list-style-type: none"> Maintenance Stations Bicycles: cleaning + repair IT: software + web Docks Administration: supervisors, managers, call centre, membership process Redistribution of Bicycles: diesel + vehicle repair 	<ul style="list-style-type: none"> Subscriptions (annual and temporary) Advertising System sponsorship On-street parking fees

The following cost estimates have been prepared taking into account the capital cost categories listed in Table 8. The cost per cycle per day is the service cost required for investing in the installation of 3,800 cycles and 377 stations in Delhi. It is inclusive of hardware, software and operational costs of the system and it will vary with the general price of inflation. Capital costs for the system amount to around Rs 88.7 crore, or Rs 106.6 per cycle per day of operations.

Table 8: Capital costs

Items	Quantity	Price per item (Rs)	Total value (Rs Cr)
Stations			
Docks, small stations	3600	41,000	14.8
Docks, medium stations	1344	41,000	5.5
Docks, large stations	756	41,000	3.1
Terminals	377	264,000	10.0
Spare parts, terminals	113.1	462,000	5.2
Cycles			
3-gear cycle	3,800	25,500	9.7
Spare parts/year/cycle	3,800	12,720	4.8
Maintenance & redistribution			
Vans for redistribution	18	800,000	1.4
E-bikes for maintenance personnel	30	100,000	0.3
Office equipment	24	60,000	0.1
Tools	30	25,000	0.1
IT			
Software	1	4,648,000	0.5
Control Centre	1	3,226,000	0.3
Website	1	200,000	0.02
Others			
Company setup			0.003
Shipping: Transport of equipment to India	1	3,856,258	0.4
Subtotal			56.3
Subtotal with customs			72.1
Total cost with interests			88.7
Service cost/cycle/day			106.58

Based on the experience in cycle sharing systems in Asia, operating costs are likely to amount to around Rs 11,400 per cycle per year. This figure includes the on-going cost of cycle redistribution, maintenance, licenses for hardware and software, electricity, staff salaries, and insurance. The total operating cost per year for the pilot is expected to be Rs 4.3 crores.

As per the proposed contracting structure, GNCTD will receive all system revenues, including subscription fees, usage fees, and advertising revenue. GNCTD will in turn compensate the cycle sharing operator on a monthly basis for the services performed, subject to penalties associated with the stipulated service levels.

Subscriptions are estimated to account for the bulk of system revenues, as displayed in Table 9. User fees are not expected to be a significant revenue source because most trips will be under 30 minutes—the period for which there is no charge. Another potential source of revenue is advertising on 94 prime stations mostly comprising large and medium sized stations, which are likely to be in highly

visible locations and forms 25 per cent of the total. In addition to the revenue sources outlined above, GNCTD can allocate an annual reserved fund in the budget as a subsidy for the system. This supplementary funding can be generated through other sources, such as fees for on-street parking. Revenue sources directly related to the cycle sharing system: advertisements on the system, membership fees, and user fees—earn Rs 11.2 crores per year.

Table 9: Annual earnings from revenue sources

Source	Earnings (crore Rs)
Revenue/year from 283 regular stations	0.3
Revenue/ year from 94 prime stations	0.6
Revenue/year from cycles	3.1
Revenue/year from smart cards	0.1
Subtotal: revenue from advertisement	4.1
Annual subscriptions: 37,000 @ Rs 1500 per subscription	5.5
Monthly subscriptions: 18,000 subscriptions @ Rs 500 per subscription	0.9
Daily subscriptions: 61,000 subscriptions @ Rs 50 per subscription	0.3
User fees	0.3
Subtotal: revenue/ year from subscriptions and user fees	7.1
Total revenue/year from all sources	11.2

9. Institutional Structure

The Delhi cycle sharing system will be structured as a public-private partnership in which GNCTD, through an SPV, carries out planning and oversight activities and the private sector handles day-to-day operations. The following table indicates the respective roles of the government and the private sector.

Table 10. Respective responsibilities of the government and the private operator

Government SPV	Private operator
<ul style="list-style-type: none"> • System planning and implementation • Cover system operating costs • Provide space for stations and control centre • Set service level benchmarks • Monitor the operator’s performance • Collect fares and revenues • Market and conduct outreach 	<ul style="list-style-type: none"> • Maintenance of cycles and stations • Redistribution of cycles within stations to maintain optimum number • Customer service • Operate the control centre • Provide information on real time basis

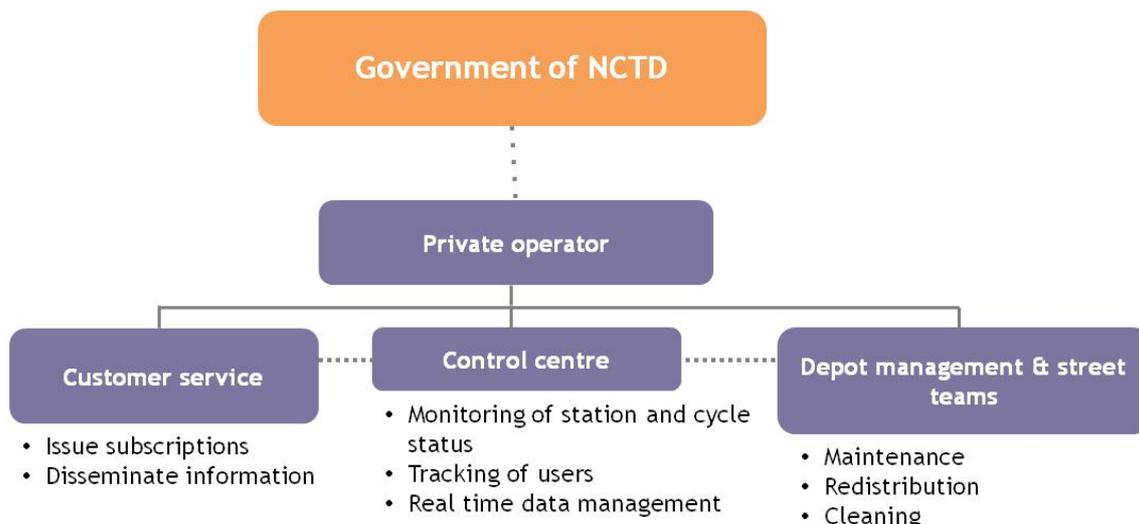


Figure 29. Operating structure for the Delhi cycle sharing system

The cycle sharing operator will be compensated on the basis of the number of cycles operated in the system. Beyond a base payment, the operator will receive an incentive payment that will increase with system usage (i.e., the number of rides per cycle per day). At the same time, penalties will be applied if system performance falls below service levels stipulated in the operator’s contract. Categories of service level standards include the following:

- How many hours per day a station can remain completely full or empty
- How long a damaged cycle can stay in the system before being fixed or taken to a depot
- The fraction of the total fleet that can remain in repair facilities at any particular time
- How often cleaning of cycles and stations should be performed
- How often a terminal can remain out of service

These standards need to be measurable and will be spelled out in detail in the operator contract. The contract will require the operator to deliver the service level statistics to the nodal agency on a real-time basis to enable the nodal agency to monitor the operator’s performance. Compensation will be calculated based on these operational data.

10. Outreach

Marketing of the Delhi cycle sharing system will begin well before the system is up and operational and carry on through the life of the system. Initial marketing efforts include promoting the system name, ‘tag line,’ and logo. A user doesn’t take a cycle—s/he takes “Velib” (Paris) or “Bicing” (Barcelona). A trendy name and logo will be established for the system. Due to cultural barriers, women hesitate to use cycles. Therefore, it is important to actively encourage them to use the system, through media / social campaigns at schools and colleges. Special incentives may also be considered.

The early marketing efforts will focus on information:

- What is cycle sharing?

- The process of checking out a bicycle
- How to register for the system
- Station locations
- Hours of operation
- The pricing system
- Phone numbers and websites for obtaining more information

The marketing campaign needs to establish that a cycle sharing system is a trendy, healthy and environmentally friendly. It is an efficient alternative to crowded buses, uncooperative auto rickshaw drivers, or long walks. GNCTD should bring in celebrities and prominent citizens to project a positive image. The system should be promoted through give-aways and promotional events prior to the launch. GNCTD should retain a professional public relations firm to handle these events.

Even after the launch, an on-going campaign should continue to communicate with existing and potential customers and public at large through newspapers, a website, blogs, smart phone apps, advertisements on cycle sharing stations and bus stops, and other collateral. GNCTD should engage with organisations like health and recreational clubs to actively promote the concept of cycle sharing system. GNCTD should tie up with major hotels in Delhi to lend the cycles to tourists at no cost. (The hotels can pay a subsidised bulk rate to the operator. They are responsible for the cycles and shall ensure that no theft or significant damage is done.)

11. Implementation timeline

Once a detailed project report is completed, GNCTD will need to call for an open tender to invite interested companies for installation and operation of the proposed cycle sharing system. During this time, GNCTD will need to coordinate with multiple governing agencies to identify suitable locations for station placement based on specifications. Once the contract is awarded, the private operator will design the stations and demonstrate few pilot stations and cycles.

The success of the system is not just implementation but way beyond it. To determine the success rate, it is important for the private operator to do an extensive outreach and campaign using various media well ahead of the system launch. During this period, the private operator will perform system testing and initiate the registration process either online or kiosk for accepting user applications.

The proposed timeline for the rollout of Phase 1 is presented below. The total timeframe required for the implementation of the system is approximately one year.

Table 11. Implementation timeline for Phase-1

	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Tendering												
Cycle & station design specifications												
Station location surveys, drawings												

