Project Urban Living Lab

IMAGINE panaji

CYCLES 4 CHANGE

PANAJI

Green Strategic Partnership

ROYAL DANISH EMBASSY
New Delhi

MINISTRY OF FOREIGN AFFAIRS OF DENMARK

This publication has been produced as part of the Project Urban Living Lab in Panaji (PULL), with the financial support of the Danish Ministry of Foreign Affairs, Royal Danish Embassy, New Delhi. Its contents are the sole responsibility of Oxford Policy Management, Transitions Research, and The Energy and Resources Institute (TERI) and do not necessarily reflect the views of the Danish Ministry of Foreign Affairs, Royal Danish Embassy, New Delhi.

PULL is a sandbox to test new approaches and solutions for sustainable and liveable cities in collaboration with residents, policymakers, public bodies, businesses and academia. It has been set up under a Memorandum of Understanding (MoU) between the Royal Danish Embassy in India (RDE) and Imagine Panaji Smart City Development Limited (IPSCDL), drawing on an earlier MoU on Sustainable and Smart Urban Development signed between the governments of Denmark and India in April 2018. It is being implemented by Oxford Policy Management, Transitions Research, and TERI.

Editorial and Design
Oxford Policy Management (India Office)
Transitions Research
The Energy and Resources Institute (TERI)

Authored by
Karthikeyan Kuppu, Silky Jain, Bhavya Bogra, Zaheb Ahmad, Ashali Bhandari and Rishika Das Roy

Published by
Project Urban Living Lab (Oxford Policy Management, Transitions Research and The Energy and Resources Institute), 2021

To Cite This Report:
Kuppu, K., Jain, S., Bogra, B., Ahmad, Z., Bhandari, A., Das Roy, R. (2021). *Cycles 4 Change- Panaji.* Project Urban Living Lab

For More Information

Danish Ministry of Foreign Affairs,
Royal Danish Embassy, New Delhi
Plot number 33 B,
Dr. S Radhakrishna Marg,
Chanakyapuri,
New Delhi 110021, India
Tel.: +91 11 4209 0700
Fax: +91 11 2460 2019
Email: delamb@um.dk
Web: www.indien.um.dk

Oxford Policy Management (India office)
4/6, Sirifort Institutional Area, August Kranti Marg, New Delhi. 110049, India
Tel.: +91 (0)1148 081 111
Email: info.indiaoffice@opml.co.uk
Web: www.opml.co.uk

Transitions Research,
362/B, Coma Vado
Aldona, Bardez - 403508
Goa, India.
Email: hello@transitionsresearch.org
Web: www.transitionsresearch.org

The Energy and Resources Institute,
Centre for Urban Planning and Governance Sustainable Habitat Programme,
Darbari Seth Block, IHC Complex,
Lodhi Road, New Delhi 110003, India
Tel.: +91 11 2468 2100; 2468 2111
Fax: +91 11 2468 2144 or 2145
Email: pmc@teri.res.in
Web: https://www.teriin.org/cities

Executive Summary

India's rapid urbanisation over the last few decades has had a large impact on mobility in the country. There has been an increase in private vehicle ownership in the country and vehicles on the road in urban areas. This has resulted in an increase in emissions and a corresponding negative effect on public health and the environment.

Panaji, the capital city of Goa, is no exception to this - a large increase in private vehicle ownership and a high motorisation rate compared to other cities in the country. Increased private vehicle ownership rates have resulted in parking issues and traffic problems in the city. There is a need to nudge residents to take non-motorised modes of transport such as walking and cycling which will alleviate stress on the city's transportation system and promote a healthy way of commuting, exercising and leisure. However, the city has a severe lack of non-motorised transport infrastructure, especially for cycling.

As a way to raise awareness, test solutions and build infrastructure for cycling, the Project Urban Living Lab (PULL) and Imagine Panaji Smart City Development Ltd. (IPSCDL) have participated in the Ministry of Housing and Urban Affairs' Indiawide initiative called the Cycles 4 Change challenge conducted in 2021. The initiative was aimed at promoting cycling friendly development in Indian cities. It provided a framework for cities to experiment with cycling and to build a foundation for future cycling policy through two phases of the initiative.

This cycling policy report walks through Panaji Cycles 4 Change activities and provides first steps towards introducing a cycling policy in Panaji. Firstly, this report details the activities conducted as a part of the experimentation phase involving surveys, stakeholder involvement, public participation and experimentation of cycling infrastructure through pop-up cycling lanes in October 2021 on four Sundays. Secondly, the report draws from lessons learnt through experimentation and leverages takeaways from Indian and international case studies to propose a set of design recommendations for a cycling connector lane on DB road stretching from Miramar Circle to the Panjim Promenade connecting the endpoints of the Mandovi River promenade in a loop for cyclists. Finally, this report provides the overview of a plan to implement the cycling connector in Panaji.

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Abbreviations

City Corporation of Panaji (CCP)
Imagine Panaji Smart City Development Limited (IPSCDL)
Ministry of Housing and Urban Development (MoHUA)
Non-motorised Transportation (NMT)
Project Urban Living Lab (PULL)
Public Bicycle Sharing (PBS)
Request for Proposal (RFP)
Royal Danish Embassy (RDE)

Figure 1: Families participate in the Cycles 4 Change pilot event

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BACKGROUND

Figure 2: Handlebar survey team riding on DB road

Setting the Context

Rapid growth in India's urbanisation, population, and wealth over the last few decades has a marked effect on the mobility of its citizens. This growth has been positive in many ways, such as promoting the development of a thriving auto industry and allied economic industries. However, it comes with a set of challenges that needs to be addressed including pollution in cities owing to increased traffic on roads in urban areas. A estimated 1.67 million lives were lost in India in 2019, mostly due to high levels of ambient pollution.[1] Cities such as Tokyo, New York, London have well-established central business districts served by effective public transport networks unlike their Indian counterparts. As of 2014, only seven metro cities in India had local rail services and only 65 had organised bus services.[2] Smaller Indian cities lack extensive public transport and bigger cities struggle with affordable last-mile connectivity. These voids are filled by personal vehicles.

The AMRUT assessment of Panaji in 2016 showed that the coverage of public transport in the city is 2% and the extent of coverage of non-motorised transport facilities is 0%.[3] Traffic congestion, parking deficiencies, under-resourced public transport in terms of the extent of routes and level of service are frequently identified by residents as Panaji's most pressing mobility problems. It is necessary to invest in and develop public transport, pedestrian and bicycle infrastructure - which have been identified as key focus mode of transport of the City Corporation of Panaji (CCP) and Imagine Panaji Smart City Development Limited (IPSCDL), being reflected in the Panaji City Development Plan (CDP) for 2041.

>90%

of CO2 emissions from the transport sector in India is caused by road transport[4]

0%

of Panaji households has access to NMT facilities in Panaji[5]

India Cycles 4 Change

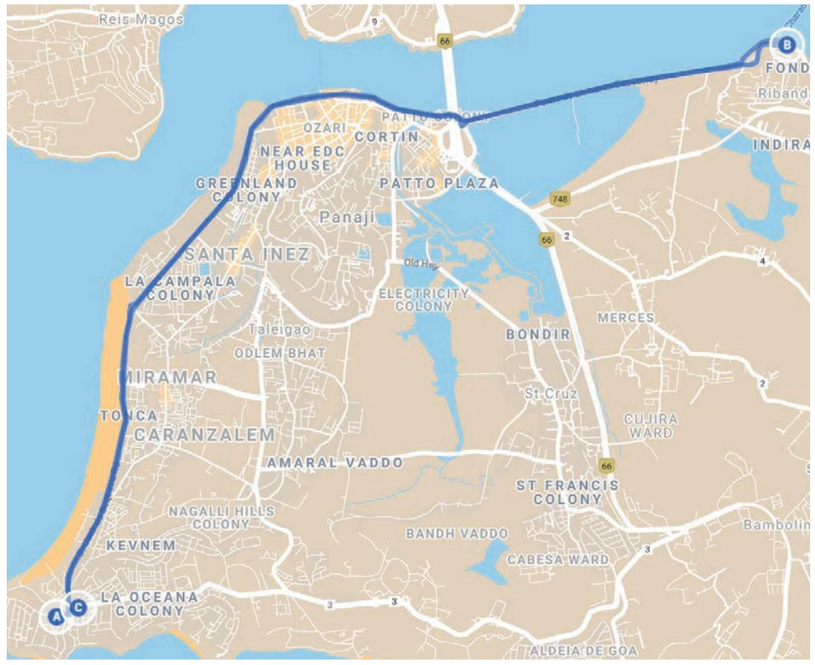
The India Cycles 4 Change challenge is an initiative by the Ministry of Housing and Urban Affairs (MoHUA) to support Indian cities in experimenting with cycling and provide a foundation for scaling-up cycling policy and infrastructure. The initiative was launched in June 2020 to promote cycling-friendly development as a response to challenges posed by the COVID-19 pandemic in India. The initiative was open to cities with a population greater than 5 lakh, Smart Cities and capital cities. The challenge was divided into two phases - Phase 1: Pilot and experimentation of cycling and Phase 2: Scaling up cycling in the city. Panaji was one of 107 cities that participated in the challenge.

The Cycles 4 Change initiative in Panaji was taken up by Imagine Panaji Smart City Ltd. (IPSCDL) and Project Urban Living Lab (PULL). As a part of Phase 1, surveys were conducted in the city, pop-up lanes were piloted and a NMT apex committee was instituted to advance NMT policy and infrastructure.

Objectives

1. Provide an introduction to bicycle infrastructure in the city of Panaji
2. Drive behavioral change towards cycling over private vehicles for commuting, exercise, and leisure
3. Provide equitable access for cycling infrastructure

Phase 1: Cycling Pilot



Left
Map 1: The Panaji Cycles 4 Change Pilot route

A B Dona Paula Circle

C Ribandar

19.2 km

of pop-up cycling lanes and dedicated cycling paths
piloted on four Sundays in October 2020 from Dona Paula to Ribandar

As a part of Phase 1, a handlebar survey, perception survey and key stakeholder engagement meetings were conducted. These initial activities lead to the Cycles 4 Change pilot which used pop-up cycling lanes on four Sundays during the month of October, 2020 starting on October 2 to October 25 to promote cycling among the residents of Panaji.

Based on these Phase I activities, Panaji was selected among 25 finalist cities in the first phase of the challenge.

Phase 2: Cycling Scale-up

Right
Map 2: Proposed cycling connector lanes and the Mandovi River Promenade

Mandovi River Promenade

Proposed Connector (Stage 1)

Proposed Connector (Stage 2)

Learnings from Phase 1 support the scale-up of cycling infrastructure along DB road connecting the ends of the Mandovi River Promenade, which is currently under construction. When completed, the connector will provide a counter-clockwise circuit of 4.7 km for cyclists in tandem with the Mandovi river promenade.

The scale-up plan proposes a cycling lane to be constructed in two stages with cycle parking facilities.

2.1 km

of dedicated cycling paths and segregated cycle lanes
proposed along DB road

Approach

This report details a two-phased approach to develop and implement cycling infrastructure in Panaji. Phase 1 has already been implemented in Panaji. The Phase 2 plan proposes a pathway to introduce permanent cycling infrastructure in Panaji.

Phase 1, which was completed in June 2021, consisted of data gathering, experimentation and establishment of organisational structures to facilitate cycling policy and infrastructure. Phase 1 of the process has been implemented in the city in 2020-21 - lessons learnt from the pilot experimentation will be leveraged along with best practices in Phase 2 to provide a two-stage plan for a cycling connector, which aims to be a start to a network of cycling lanes and facilities in the city. The following are the activities covered in Phase 1 and 2 of this report:

1. Experiment with cycling infrastructure in Panaji through pop-up lanes during cycling pilots
2. Support the effective implementation and adoption of a pilot through public, stakeholders and cyclist surveys
3. Establish a Non-motorised Transportation Apex Committee to speaheard and co-ordinate the development of NMT infrastructure and policy with the public and relevant stakeholders
4. Explore potential corridor and neighbourhood cycling routes for cycling scale-up
5. Identify Indian and international best practices and case studies of implementation of cycling lanes and facilities in cities of comparable population, culture and size
6. Leverage lessons learnt from the Cycles 4 Change pilot to design cycling infrastructure for Panaji that complements city planned NMT infrastructure

Phase 1 (Completed)

1. Cycling Perception Survey
2. Handlebar Survey
3. Cycling Pilot
4. Case Studies and Best Practices
5. NMT Apex Committee Establishment

Phase 2 (Proposed)

1. Cycling Scale-up Plan
   - Stage 1: Dedicated Cycling Lanes
   - Stage 2: Segregated Cycling Lanes
2. Implementation Plan

Report Structure

This report is divided into five chapters:

The first chapter provides a background on the Cycles 4 Change Initiative by introducing the need for NMT and cycling infrastructure in the city of Panaji. It sets the context to the two phases and provides objectives to be achieved through the initiative roll out.

The second chapter examines four case studies of cycling policy in Pune, Bhopal, Bengaluru and Utrecht. Success factors are identified and key takeaways are aggregated from all four cities. These case studies have helped direct Phase 1: experimentation of the initiative and provides a direction to Phase 2: scale-up.

The third chapter outlines activities that took part as a part of Phase 1 of the initiative. Findings from multiple surveys and learning from the Cycles 4 Change pilot events have been identified and taken forward.

The fourth chapter identifies key principles to take cycling policy forward in Panaji. The key principles along with data collected through ground surveys and learnings from experimentation are leveraged to prepare a cycling-scale up plan. A cycling connector of 2.1 km in length along DB road consisting dedicated and segregated cycling lanes with cycling facilities is proposed as a first step in creating permanent cycling infrastructure in Panaji. This report provides conceptual designs for the connector by developing a masterplan and necessary details.

The fifth chapter of the report outlines an implementation pathway for the proposed design over a timeframe of 6 months in two stages. The proposed design along with the implementation process is intended to assist planners, decision-makers and policymakers begin the process of moving towards a cycling friendly Panaji.

The report concludes by highlighting the benefits of scaling-up cycling infrastructure in the city of Panaji.

CASE STUDIES

Figure 3: Dedicated cycle lane and footpath in Utrecht, Netherlands[6]

Summary

This chapter studies implementation of cycling infrastructure and policy in four cities - three in the Indian context and one in an international context. The case studies provides the background of how their cycling infrastructure was initiated, infrastructural and policy interventions proposed, design and policy approaches and methods followed for cycling interventions, level and framework of public engagement and key takeaways that can be leveraged in the Panaji context.

SELECTING CASE STUDIES

Implementation of cycling policy in Indian cities is taken as the primary focus of this chapter due to similarities in cultural context, maturity of NMT networks and congestion issues. Through a study of cycling policy in India, it was found that no Tier II Indian city (comparable to Panaji's population and size) currently has an extensive cycling network. Hence, cities like Pune and Bangalore, who were early adopters of cycling policy are taken as references. Internationally, Utrecht is taken as a case study due its successful and extensive implementation of cycling policy by leveraging best practices and public engagement.

SELECTED CITIES

Indian context:

1. Pune
2. Bhopal
3. Bengaluru

International context:

1. Utrecht, Netherlands

FINDINGS

1. Cycling infrastructure is effective when it does not affect other forms of NMT infrastructure
2. Public participation through user and resident co-determination is key for cycling policy success
3. Strategically located Public Bicycle Sharing (PBS) stations along a cycling network can promote cycling as a mode of transportation
4. Design and implementation of cycling lanes should be sensitive to the needs of cyclists who are not advanced and are not comfortable with high volume traffic

Figure 4: PBS Network and Supporting Cycling Infrastructure in Bhopal[7]

Pune [9]

Population 31,24,458 (2011 city population)[8]

Network Extent 300km (Bicycle Plan), 100km completed

Background Pune Municipal Corporation (PMC) initiated work on a cycling plan in a move that emphasised non-motorised transport in the city after a CMP was created in 2012. The Pune Cycle Plan was drafted in 2017 after several surveys on cycling and the institution of a Bicycle Advisory Committee.

The plan proposed a city-wide network of cycling paths and facilities that suggested integration with public transport, guidelines for design and planning, governance structures, and cycling awareness. Its objective was to increase the modal share of cycling trips from 3% to 25% by 2031. The implementation of the plan would be done through a Bicycle Department at the PMC.

Proposed Interventions

1. Bicycling department at PMC
2. Design guidelines
3. Cycle parking
4. Integration with public transport
5. Regulation and enforcement
6. Outreach and promotion
7. Monitoring and evaluation
8. Implementation schedule

Top Left
Figure 5: Segregated cycle tracks on arterial roads with 1m buffers

Top Right
Figure 6: Shared road use for neighbourhood streets with paved streets or speed bumps to reduce traffic speeds

Please refer to Reference number 9 for photo sources

Design and Policy Approach

The PMC developed Planning and Design Guidelines for Cycle Infrastructure in parallel to the Plan Bicycle Plan in 2017.

Core design ideas:

1. De-motorisation of core city roads
   - The use of inner ring roads to divert motorised traffic around the city core
   - Local circulators and buses for downtown last mile connectivity
2. Controlled motor vehicle parking
3. Dismantling multi-lane one-way streets with three or more lanes
4. Avoid flyover construction
5. Pedestrian friendly redistribution of space

Public Engagement

1. A private public partnership (PPP) named the "Pune Cycle Partnership" was established for promoting cycling in the city
2. The Pune Cycle Plan was created through two stages of public input involving citizen groups, Prabhag Samitis (Ward Committees), cycling groups, cycle shop representatives and corporate cycling groups. The first stage of consultations engaged the public to understand expectations and desired conditions of a modal shift to cycling. The second stage involved incorporating public feedback on the preliminary draft of the cycle plan through a public forum. Nearly 12,000 individuals were engaged through the two rounds of public engagement

Key Takeaways

1. Cycling will be most effective when built without compromising other non-motorised transportation modes
2. A Public Bicycle Sharing (PBS) system can be instrumental in the adoption of cycling in a city but maintenance and coverage of the network is key to its success

Bhopal [10]

Population 19,17,051 (2011 city population)[11]

Network Extent 12km

Background

Based on an understanding of travel behaviour in the city of Bhopal, the Smart City of Bhopal implemented India's first fully automated Public Bike Sharing (PBS) system. The city released a comprehensive mobility plan in 2012, which indicated that the majority of trips were made for work and education and the average trip length was less than 5km. This was indicative that cycling was possible and could promote a more sustainable transportation system in the city.

There are 500 cycles that have been deployed across 50 stations in the city. These locations have been strategically assessed to maximise ridership across the city.

Proposed Interventions

Location of public bicycle sharing stations based on the following factors:

1. Origin destination info from users
2. Travel information (mode/time/distance)
3. Willingness to use a cycle and pay
4. Terrain
5. Land-use
6. Existing public transportation

Top Left
Figure 7: Bike sharing stations installed by Smart City Bhopal

Top Right
Figure 8: Bicycle lane in Bhopal

Please refer to reference number 10 for photo sources

Design and Policy Approach

Along with installing PBS docks and operations for the system, the Smart City of Bhopal also built a 12km long bicycle track which is 5 metres wide.

The PBS system required the installation of docking stations throughout the city. The main design consideration for the docking stations include:

1. Existing civic works (the dock station should not interfere with any other services)
2. Low cost materials
3. Covering for weather conditions (heat, rain)
4. Size: ample space for additional transaction terminals and space for advertising
5. Minimum fixed size for docking based on shape and sizes of bicycles.

Bhopal chose to proceed with a fully automated system with a smart card technology for payment which has resulted in ease of management and encourages use for citizens. Smart card works as a medium for fare payment and therefore each docking station requires transaction terminals, centralised communications, tracking and automated docking stations for smooth operations.

Key Takeaways

1. Public Bike Sharing (PBS) systems are a great way to encourage sustainable transportation, especially when strategically located
2. Efficient operations are essential in uptake of PBS and automated systems allow for easy management so that bicycles can be allocated to in-demand docking stations at the right time so it's easy for people to use.

Bengaluru [12]

Population

84,43,675 (2011 city population)[13]

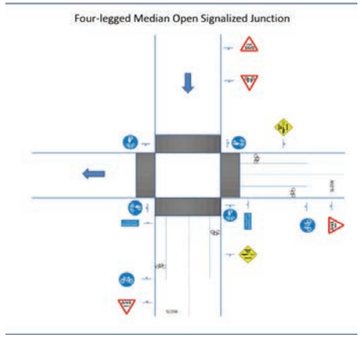
Background

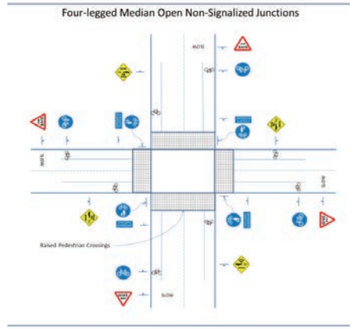
The Directorate of Urban Land Transport (DULT) in Karnataka has been assessing the feasibility of creating bicycle friendly streets in certain localities in Bangalore to promote safe, convenient and sustainable transportation. A proposal for this was developed in 2010 which covers three neighbourhoods in Bangalore that could integrate bicycle tracks in a phased manner: Jayanagar in Phase 1, Basavanagudi in Phase 2 and JP Nagar - BMT Layout in Phase 3.

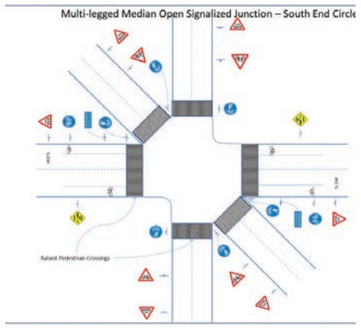
This scoping report prioritises Jayanagar, the community that will implement bicycle tracks in Phase 1 of the project. It focuses on trips to educational institutions and identifies potential networks connecting residential areas to a variety of institutions.

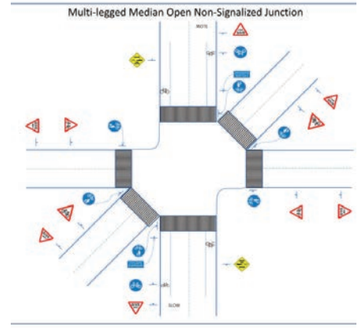
Proposed Interventions

1. Origin-Destination Mapping
2. Streets for Bicycle Tracks
3. Identification of intersections and requirements for safe implementation of bicycle lanes
4. Design guidelines for junctions
5. Regulation and enforcement authorities
6. Implementation schedule (three phases - general)









Top
Figure 9: Interventions at intersections for safer bicycle and pedestrian crossing

Please refer to reference number 12 for figure sources

Design and Policy Approach

The 2010 report included design and policy recommendations to enable safe cycling on routes in Jayanagar:

1. Synchronised traffic signals for pedestrian and cyclist crossings
2. Marking of designated bicycle lanes
3. Installation of traffic signals
4. Construction of raised crossings
5. Installation of bollards
6. Installation of signages to indicate pedestrian and cycling facilities near intersections

Public Engagement

Seven Residential Welfare Associations (RWAs) were consulted to understand popular origins and destinations in the Jayanagar area as part of the planning process for deciding bicycle routes. They were also consulted and engaged with for the awareness campaign about the importance of cycling

Key Takeaways

1. The implementation of cycling lanes should strongly consider the needs of the most basic riders and not assume that cyclists are advanced and comfortable with high traffic volumes.
2. Simplicity in the design of the interventions may result in faster uptake of cycling interventions.

Utrecht [14]

Population 3,57,179 (2019 city population)

Network Extent 245km bicycle path; 90km bicycle strip; 18km bicycle-only street

Background The city of Utrecht in The Netherlands developed a city-wide action plan from 2015 to 2020 to help promote sustainable mobility while growing at a rapid pace. The action plan prioritises accessibility, attractiveness and livability by making cycling the primary means of transportation and is working with diverse stakeholders in the city to realise its ambition of being a world-class cycling city

Proposed Interventions

1. Improving and building new bicycle routes and paths in the city by prioritising bicycle sharing space solutions to ensure that cyclists can navigate busy streets and investing in alternative cycling routes to heavy traffic roads
2. Convenient and free cycling parking spaces. The largest bicycle parking unit has been built in Utrecht
3. Creative circulation management to shorten waiting times and reduce traffic for cyclists
4. Road safety measures such as stricter regulations for contractors doing road maintenance and adequate signage to ensure safe diversions for cyclists

Top Left and Middle

Figure 10: Bicycle parking facilities near major transit hubs including like the Central Station in Utrecht

Top Right

Figure 11: Create bicycle-only streets with adequate signage to improve safety and circulation for cyclists

Bottom Right and Left

Figure 12: Redesigning junctions for easier accessibility and movement of cyclists in Utrecht




Please refer to reference number 14 for photo sources

Design and Policy Approach

1. Reducing car parking to boost the transition from car ownership. The city has set a goal of reducing car space to less than 0.3 car / house.
2. Invest in public space improvements to make cycling a more pleasant experience and also boost the local economy
3. Expand the regional bicycling routes and parking, connecting the larger urban area to transit hubs to increase the percentage of commuters using sustainable mobility
4. Build shared space solutions for busy streets

Public Engagement

Various forms of public engagement were employed to obtain feedback and prepare the action plan:

1. Interviews were conducted with over 8,000 cyclists
2. Town-hall sessions were conducted with residents and organisations
3. Business stakeholders and local communities were engaged for determining local interventions on specific streets.

Key Takeaways

1. Cycling action plans must prioritise the needs of cyclists, therefore interventions on streets and parking facilities must be co-determined with residents and users to determine success
2. Cycling and public realm improvements go hand in hand and can have positive benefits for tourism and the economy

PHASE 1: CYCLING PILOT

Figure 13: Participants use the pop-up lane on DB road near Patto

Summary

For undertanding perception and issues related to cycling in Panaji, PULL and IPSCDL conducted a series of surveys to develop the process of experimentation of cycling infrastructure in Panaji before rolling out the pilot events.

Firstly, with assistance from IPSCDL, an online cycling perception survey and a handlebar survey were conducted between August to November 2020. The cycling perception survey was intended to chart cycling habits of Panaji residents, their perception towards cycling for exercise, leisure and commuting, preferred cycling routes and gauge perceived barriers to cycling. Google Form was used as a medium due to its quick dissemination to residents. A total of 262 responses were received.

Secondly, a handlebar survey was conducted by a team of cyclists who communicated and gathered issues on cycling along the pilot stretch with cyclists, residents and city stakeholders. Several important safety issues were raised through this survey.

Finally, a cycling pilot was conducted during four Sundays in October 2021 using pop-up cycling-only lanes. Traffic cones were used to create lanes on a 19.2km circular route from Dona Paula Circle to Ribandar and back. Several key points on access to cycling, implementation barriers and successes were highlighted through the pilot experiment.

KEY FINDINGS

1. Panaji residents primarily cycle for exercise, followed by leisure and commuting. This will influence the location of scale up infrastructure
2. Fear of being hit by speeding vehicles was the primary barrier to cycling. Cycling lane type and material choice was also guided by this finding
3. Along the DB road stretch, illegally parked cars and bus stop placements proved to be a concern for cycling safety, especially for families as observed during the pilot.

Figure 14: Cyclists use pop-up lanes during the Panaji Cycles 4 Change pilot

Cycling Perception Survey

An online cycling perception survey was conducted between August to October 2020 to capture resident views on cyclist demographics, issues around cycling, preferred cycling routes and the public bicycle sharing system. A total of 262 Panaji residents provided responses to the perception survey through a Google Form.

Survey respondents strongly prioritised cycling for exercise over other purposes. The fear of being hit by vehicles and potholes on roads were identified as the biggest concerns with cycling in Panaji. Wider roads were perceived to be the most unsafe for cycling. A cycling event providing a view of the Mandovi river was the most preferred route among other routes.

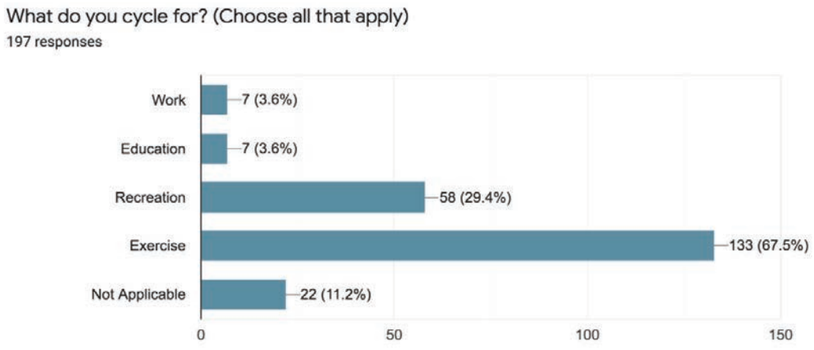


Figure 15: Distribution of cycling trip purpose among respondents

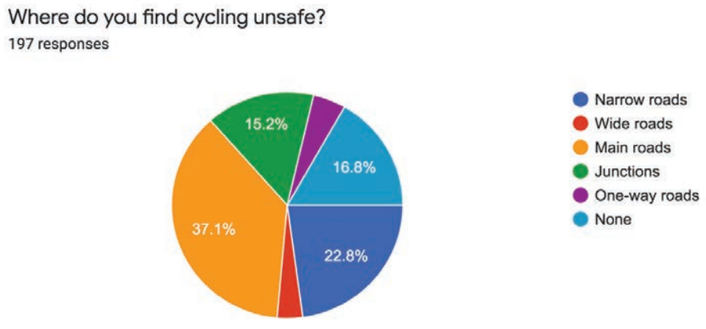
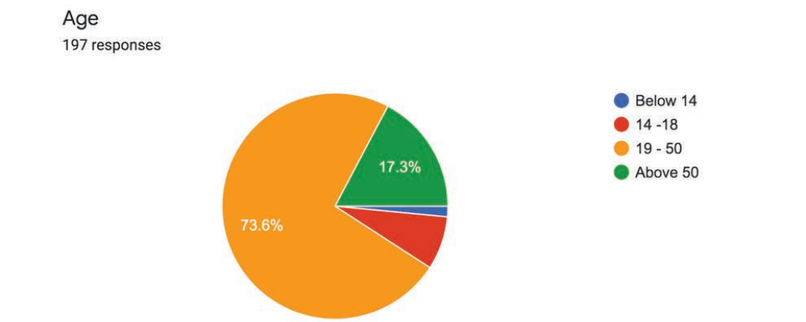
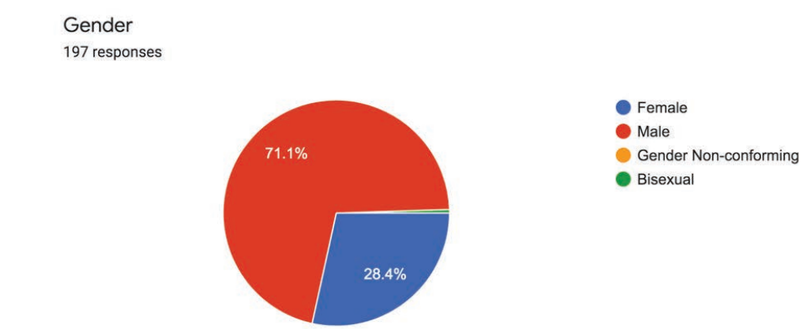


Figure 16: Areas where respondents felt unsafe while cycling

Figure 17: Demographic distribution of the perception survey respondents



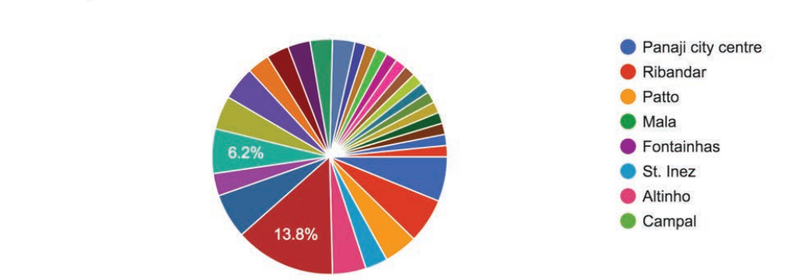


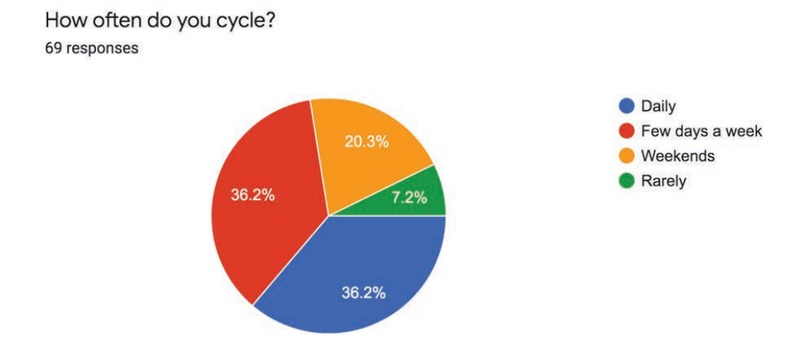
68%

of survey respondants cycled for exercise when compared to 29% for recreation and 4% for work

Cyclists felt most unsafe while riding on main roads when compared to other thoroughfares

Figure 18: Cycling trip frequency distribution among respondents





Cycling Perception Survey

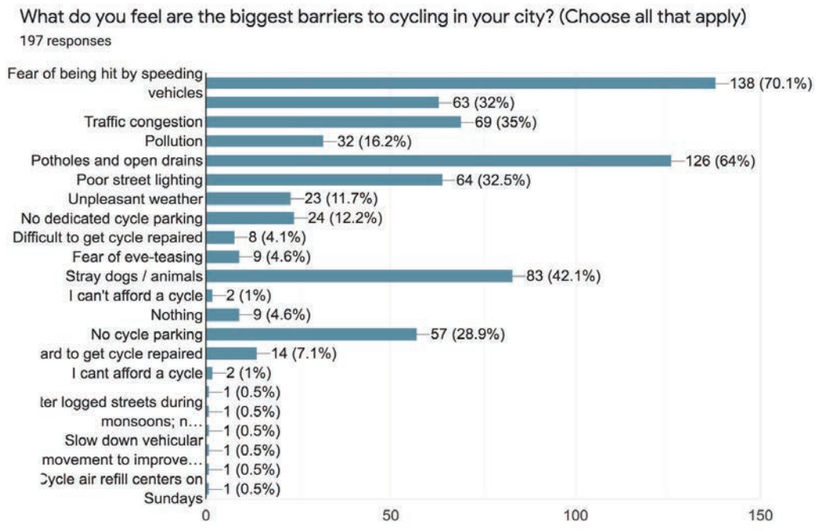


Figure 19: Perceived safety threats to cycling in Panaji among survey respondents

70%

of survey respondents felt that the fear of being hit by speeding vehicles was a barrier to cycling

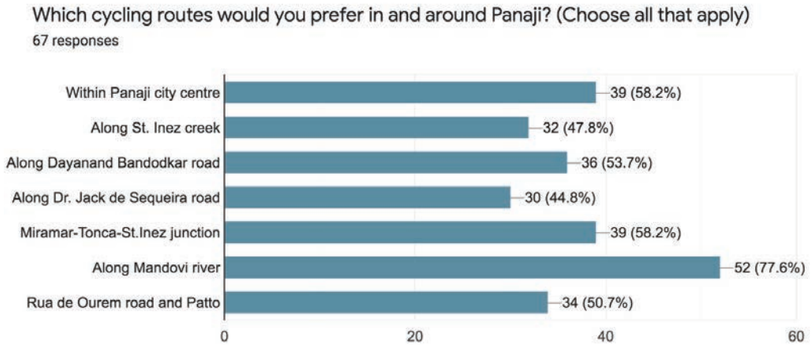


Figure 20: Preferred cycling routes in Panaji among survey respondents

Handlebar Survey

A cycling handlebar survey was conducted between 6.00 pm and 7.30 pm on September 17, 2020 by a team from IPSCDL, resident volunteers and representatives from cycling groups on a 6.4km segment of DB road along the cycling pilot route. The team was composed of 7 men and 3 women.

Bottom Right
Map 3: Handlebar survey points along the Cycles 4 Change Pilot route

Left

Figure 22: The handlebar survey form was distributed among participating cyclists and cycling group members

Did you face any **difficulties while cycling** on this route? **Mark the locations** you faced difficulties with corresponding **alphabetical code** from the list of pain-points described below.

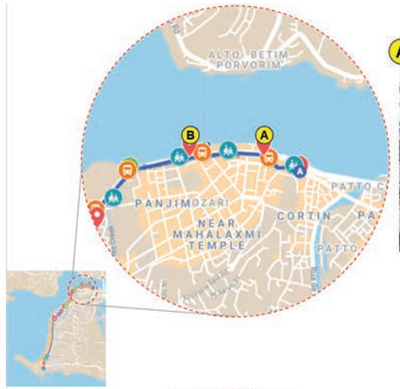
A. Fast-moving vehicles
B. Vehicles coming on the wrong-side
C. Difficulty crossing a road junction/turning right
D. Blind turns/street corners
E. Fear of/Encounter with stray dogs/animals
F. Fear of eve-teasing/mugging/theft
G. Poor lighting
H. Blinding glare from vehicle headlamps
I. Obstructions such as parked vehicles, pedestrians, garbage bins, etc
J. Bad road surface (Uneven/open drains, potholes, unpaved roads, etc)
K. Lack of shade
L. No waiting space at traffic signals
M. Had to stop many times (Signals, Access roads, etc)
N. Steep terrain

Describe other difficulties, if any :

Which of the difficulties you've mapped, if left unresolved, would stop you from cycling on that route again?

Right

Figure 21: Issues along the pilot route identified by the handlebar survey team



A

Lack of cycle parking facilities around the city centre

B

Speeding vehicles on the main traffic corridor of Panaji is perceived as a hindrance for cyclists

C

Cyclists find open drainage channels/ sudden drops at the edge of the road to be unsafe especially during the late hours of the day

D

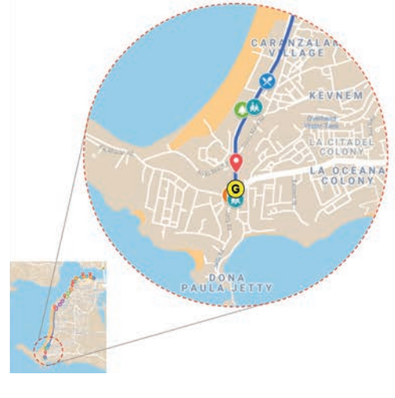
Unmanned traffic junctions make cycling unsafe

E

Maintenance work on one side of the road has reduced available space

F

Uneven roads/ potholes and stray cattle



G

Extremely narrow road/ single lane at an incline just before Dona Paula circle

The Cycling Pilot

In order to test the response to cycling in the city of Panaji, a cycling pilot was launched in the city, stretched over four Sundays in October 2020. The cycling pilot was intended to raise awareness of cycling among residents of Panaji and to learn about the process of creating and scaling up cycling infrastructure in the city of Panaji.

SITE SELECTION

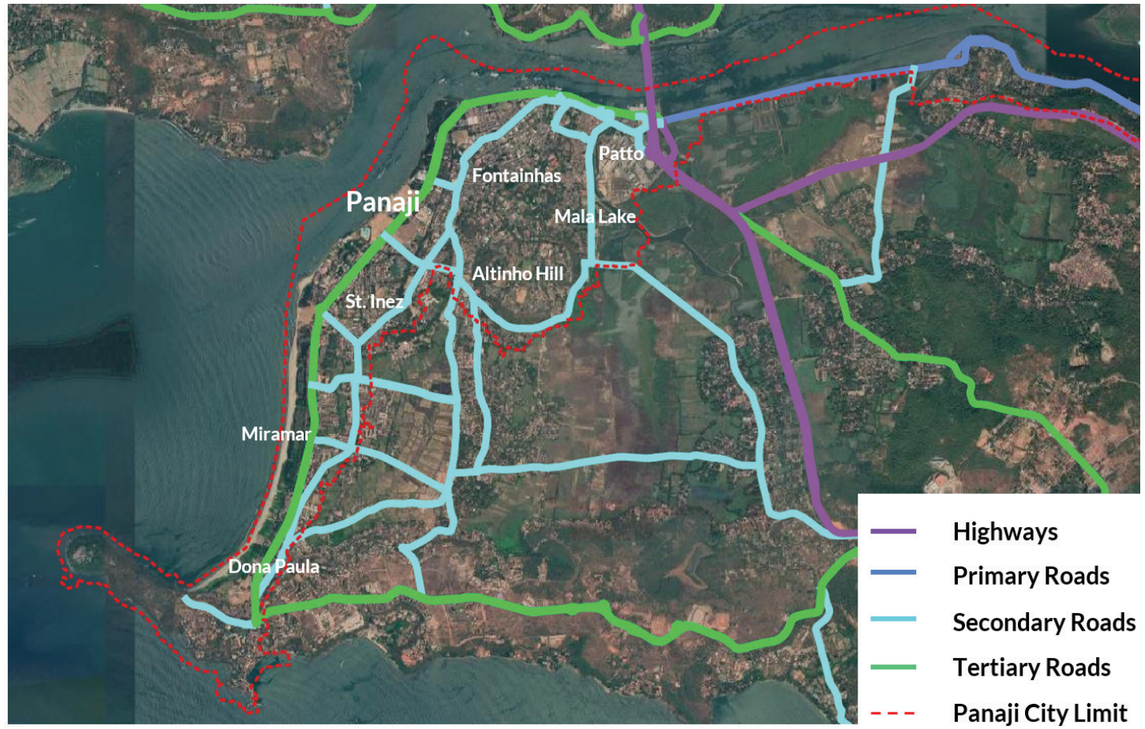
The site selection process was informed by a cycling perception survey, handlebar survey, government and citizen stakeholder input and a ground survey. According to guidelines set by the Cycles4Change initiative, the pilot route passed through a main corridor in the city with priority on the following aspects of the street:

- Visibility - aesthetic views along the route
- Road Width - one lane available to use as cycling lane
- Junctions - low number of vehicle-cycle conflicts
- Connectivity - connection to important Panaji roads

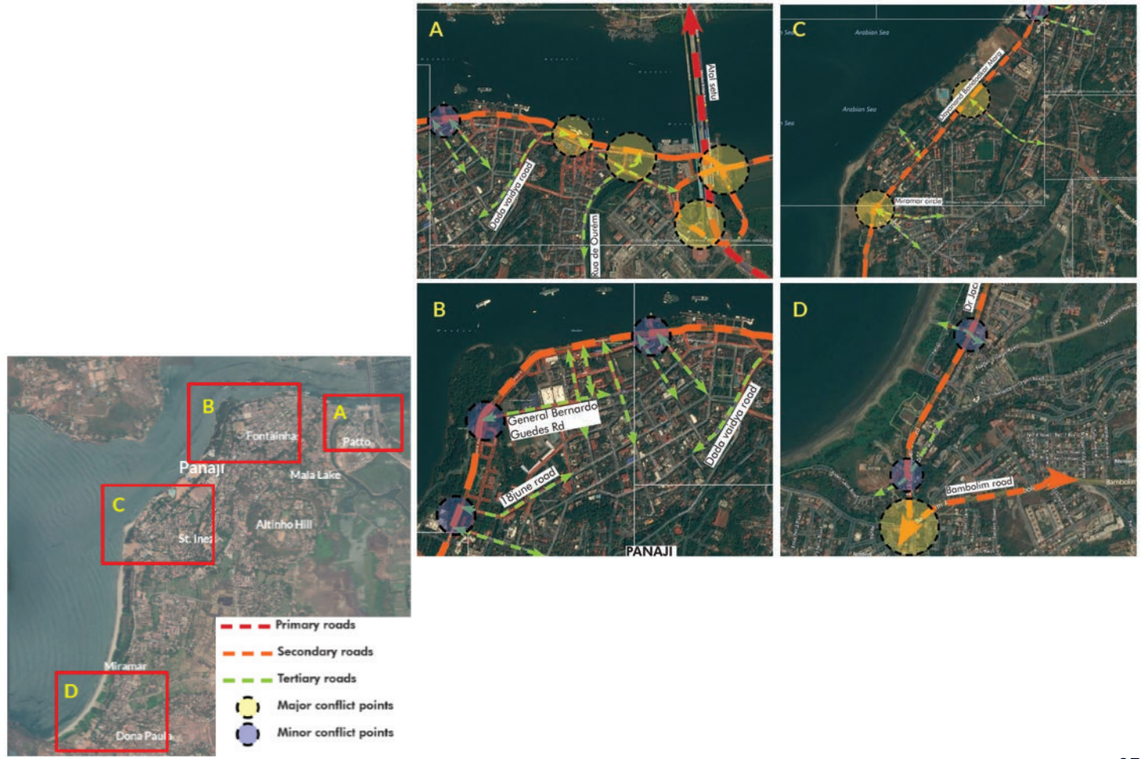
PANAJI FACTS

The City of Panaji covers a total area of 8.27 sq.km.
The city can be accessed through two primary roads from NH66. The main arterial road, DB Marg connects Patto Center to Dona Paula. It connects neighbourhoods of Dona Paula, Miramar, St. Inez, Patto and Fontainhas. Streets within Fontainhas are part of the old Latin Quarter and are often narrow/one-ways.

Top Right
Map 4: Important thoroughfares within and connecting to Panaji



Bottom Right
Map 5: Primary and secondary intersections and conflict points along the pilot route



The Cycling Pilot

SITE CONTEXT

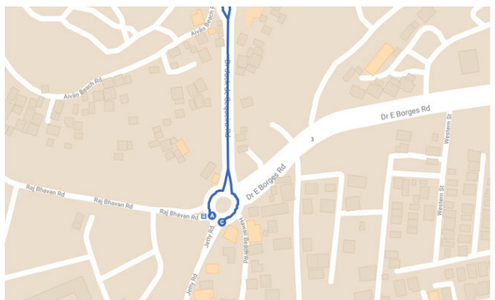
Dayanand Bandodkar Road (DB Road), Dr. Jack de Sequiera Road and Ponte de Linhares Causeway passing through Dona Paula, Miramar, St. Inez, Fontainhas, Patto and Ribandar was chosen as the pilot route. The 19.2km round trip route had a point of return at the Ribandar Ferry in Ribandar returning back to Dona Paula via the same route mentioned above. Along the route, the steepest gradient along the route was a climb of 2%.

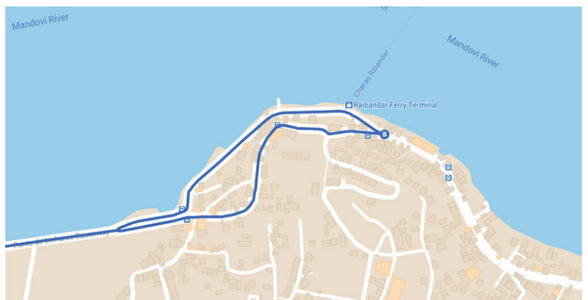
DB Road is one of the widest primary roads in the city of Panaji. It runs along the Mandovi River and the Panjim Promenade with two lanes in each direction along most of its length. During the cycling pilot, one lane (2.5 m width) in each direction was converted into a pop up cycling lane demarcated by traffic cones. Two cyclists could ride side by side in each direction on DB Road. The Ponte de Linhares causeway had been converted to a one-way road for vehicles.

Top Right
Map 6: Map of the pilot route

Center Right
Map 7: Map of end points at Dona Paula Circle and Ribandar Ferry Terminal

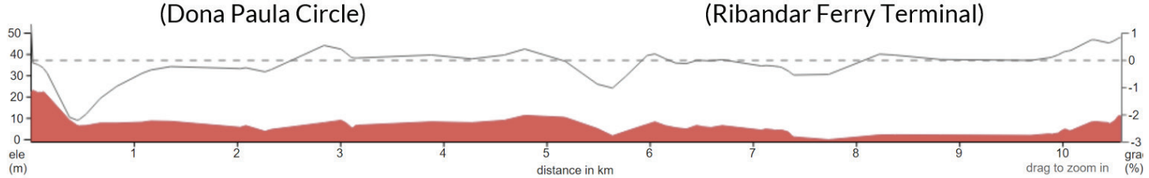
Bottom Right
Figure 23: Elevation profile of the pilot route





A & C
(Dona Paula Circle)

B
(Ribandar Ferry Terminal)



A & C **B**

Elevation Profile

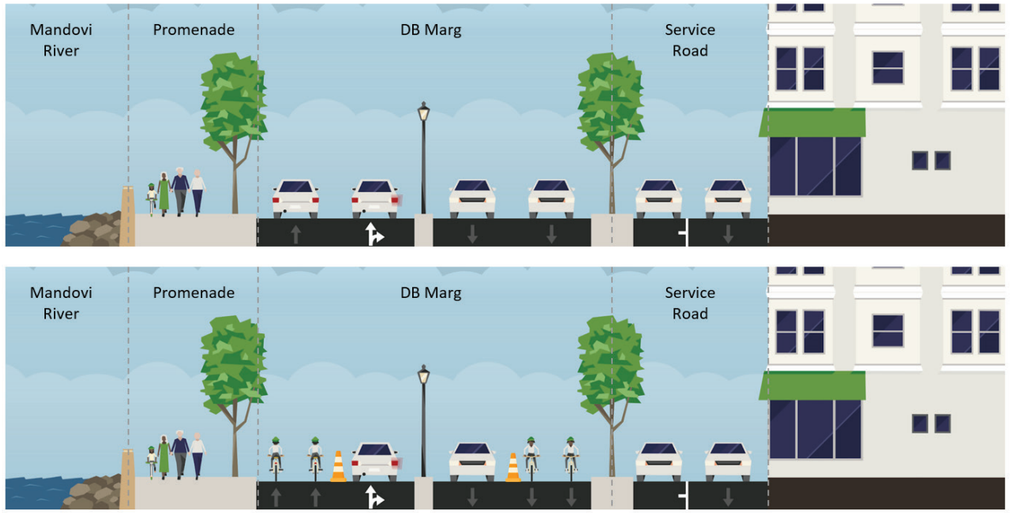
The Cycling Pilot

While conducting a ground survey of the route, several route opportunities and weaknesses to be addressed were identified before the launch of the cycling pilot:

Opportunities	Weaknesses
DB Marg has a very good visibility along the Mandovi River.	Steep slopes near Dona Paula.
Very few cycle-motor vehicle crossings.	Many businesses are closed along the route on Sunday mornings.
Majority of the route as two lanes on each side - pop-up lanes can be set up easily.	Small neighbourhood streets are not included in the route.
Roads are in good condition (no potholes).	Though the majority of the route length has two lanes on each side, certain stretches like the stretch leading up to Dona Paula Circle are narrow single lanes.
Longer route could be implemented with the support of the Traffic Police in Panaji.	Cars parked within the cycle lane and few bus stops along DB Marg reduces the width of lane available for cyclists.
Good access to businesses within a 500m walkshed from the route.	Steep slopes near Dona Paula.

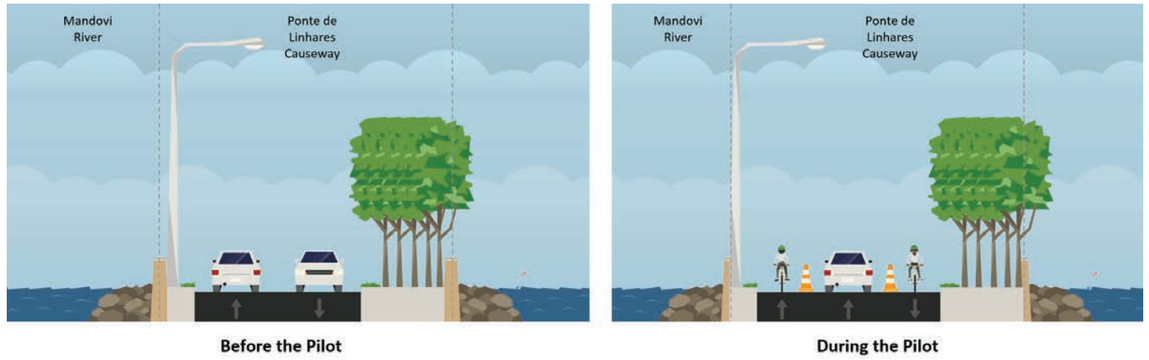
Top Right

Figure 24: Right of way sections of DB Road before and during the cycling pilot



Bottom Right

Figure 25: Right of way sections of the Ponte de Linhares Causeway before and during the cycling pilot



The Cycling Pilot

IMPLEMENTATION

Leading up to the implementation of the cycling pilot, the core committee was formed to steer the initiative and subsequent non-motorised transport apex committee. Stakeholder consultations with the Corporation of the City of Panaji and Panaji Traffic Police were done in September to establish authorisation for the event and traffic police support for vehicular traffic redirection.

The cycling pilot were conducted on four consecutive Sundays starting on October 2, 2020 between 8:00am and 11:00am. Traffic cones were placed demarcating pop-up cycling lanes before every Cycles4Change event. Panaji traffic police were posted along intersections where there might be confusions on routes to be taken by cyclists. A total of three water stations were provided at the route start and along the way. Registered participants were given T-shirts as tokens of participation.

OBSERVATIONS

The first pilot day saw many professional cyclists, however, for the subsequent cycling events more families participated. Though many participants started off in Dona Paula, several cyclists were seen using the lanes starting off at intermediate points as they rode. Some two wheelers were using the cycling lanes despite the traffic cone demarcations.

Top Row
Figure 26:
Families, children and women participate in the Panaji Cycles 4 Change pilot

Bottom Left
Figure 27:
Cycling group volunteers provide water at water stations along the route

Bottom RIght
Figure 28:
Cyclists use pop-up lanes during the Panaji Cycles 4 Change pilot

PHASE 2: CYCLING SCALE-UP

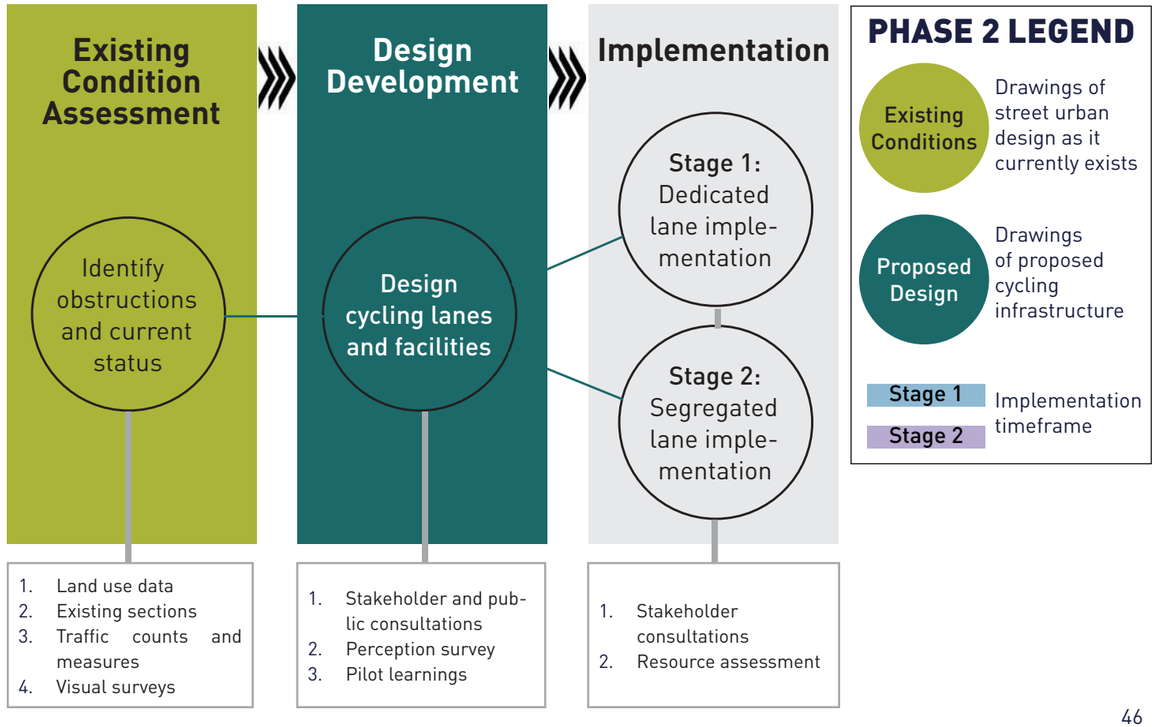
Figure 29: DB Road near the Jawahar Kala Kendra entrance

Methodology

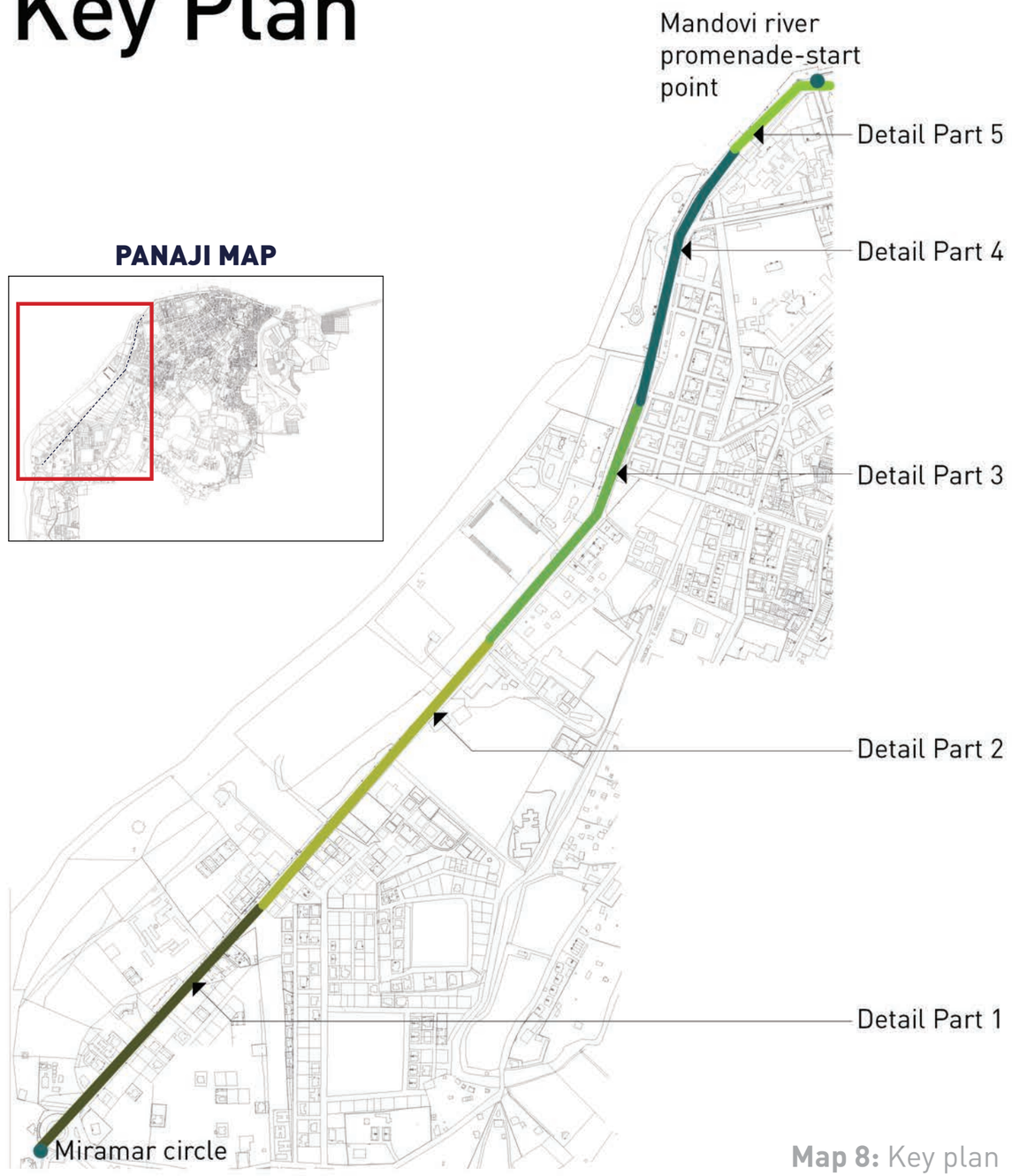
The corridor for scaling-up cycling infrastructure in Panaji was selected after a process of data collection, public perception gathering and stakeholder involvement in Panaji. A neighbourhood recce was conducted to determine the feasibility of a neighbourhood pilot (see Appendix B).

A cycling connector along DB road connecting the Panjim Promenade to the Mandovi River Promenade and providing a circuit for cyclists was selected as the stretch to scale-up cycling infrastructure. The design process is shown below:

Figure 30: Phase 2 methodology



Key Plan



Map 8: Key plan

Proposed Design

Master Plan

PANAJI MAP

Map 9: Master plan

The proposed cycling connector stretches on DB Road from the Mandovi River Promenade to Miramar circle. The cycling lane can help cyclists travel north to south on DB Road.

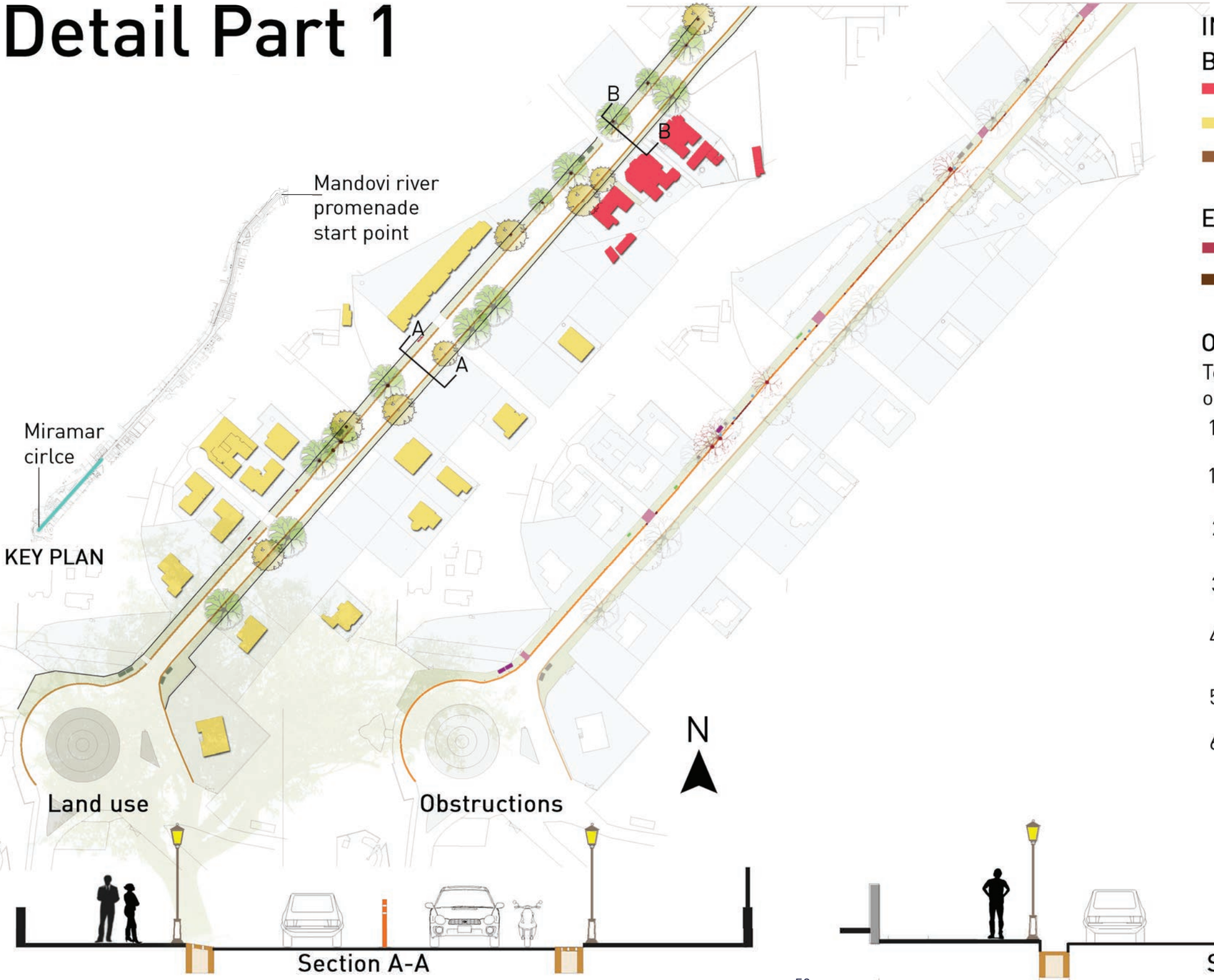
The proposed cycling lanes are of two types:

The 0.6km segment from A to B would be a dedicated and artist painted cycling lane which runs at grade with the footpath along DB Road. The stretch has a wide footpath which can accommodate a cycling lane in the South to North direction. The cycle lane would run on the western side of the road. The AB segment is proposed to be implemented in Stage 1.

The 1.5km road segment from B to C would host a segregated and artist painted cycling lane at grade with the road. A segregated cycling lane was chosen for this stretch due to the inability of the narrow footpath to accommodate a cycling lane. The cycling lane is separated by a rumble strip. The dedicated cycling lane transitions to a segregated lane after Jawahar Kala Kendra at B.

Existing Conditions

Detail Part 1



INDEX

Building use

- Public/semi-public
- Residential
- No record available
- Commercial
- Green spaces

Existing elements

- Electrical box
- Planter/ seating
- Bus stop
- Footpath

Obstructions

Temporary obstructions

- 1a. Electrical boxes (5)
- 1b. light poles (5)
- 2. Bus stops (3)
- 3. Bollards (0)
- 4. Signages (0)
- 5. Column (0)
- 6. Property entrance (5)

Permanent obstructions

- 1. Trees and seatings (5)
- 2. Drainage
  - Road level
  - Below road level
  - Broken/absent

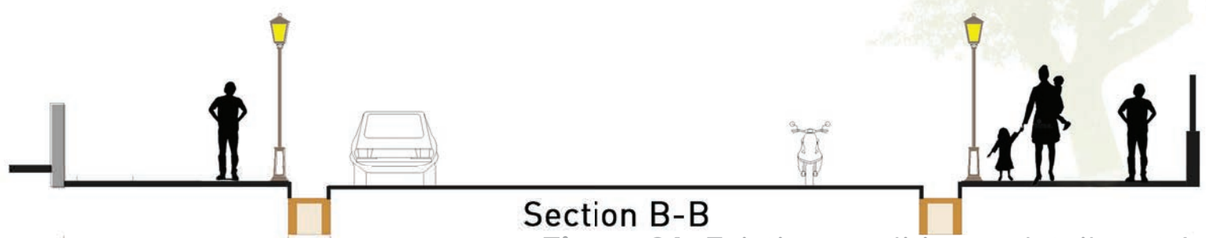
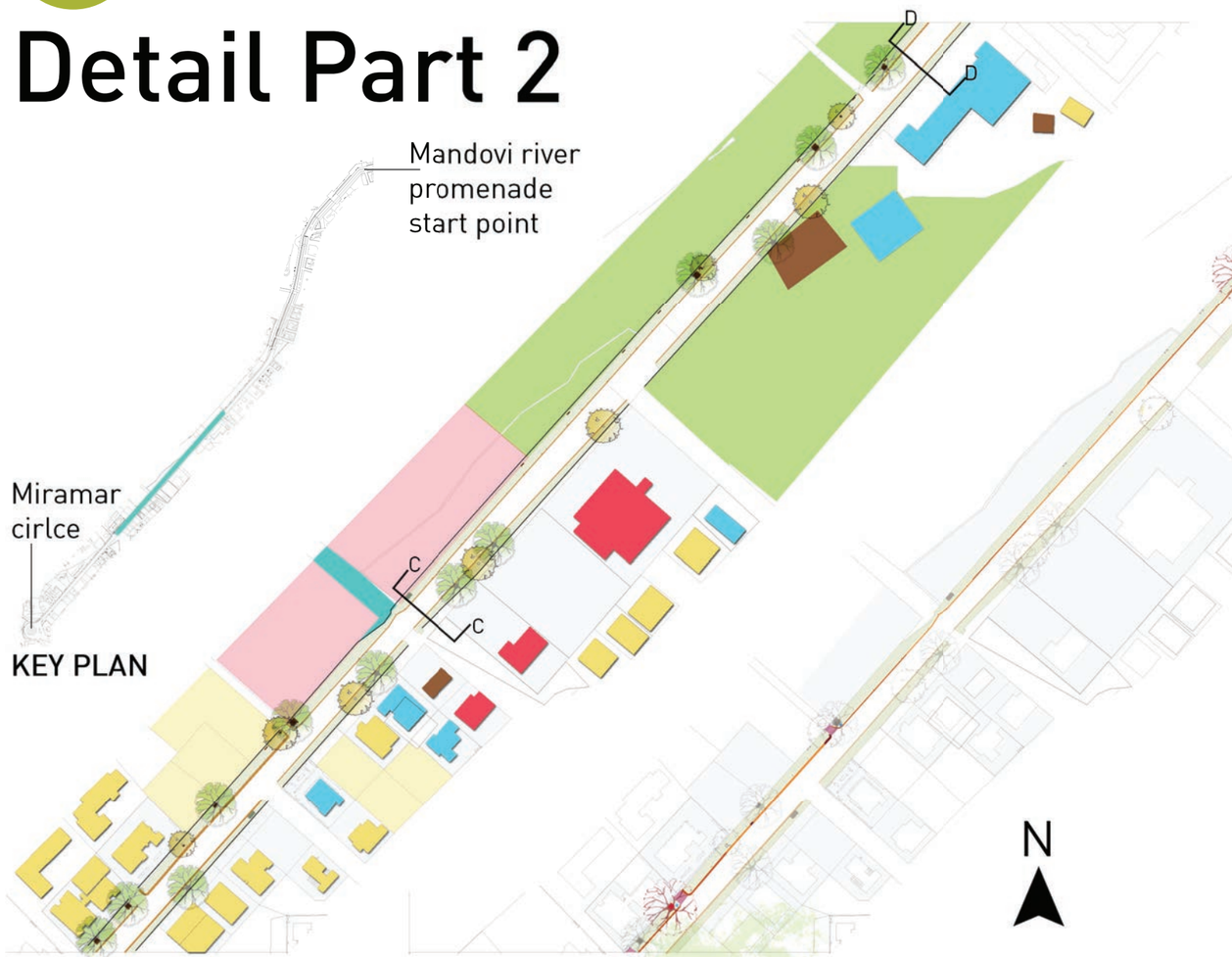


Figure 31: Existing conditions - detail part 1

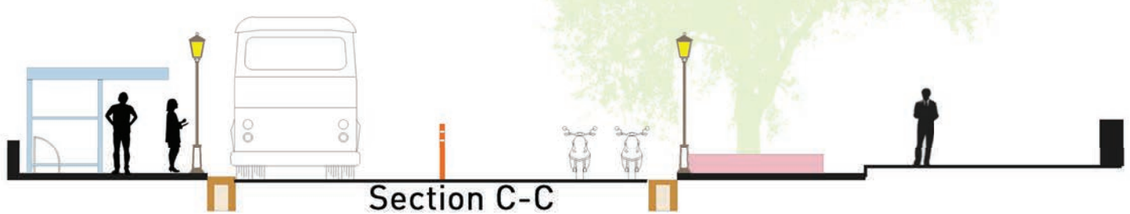
Existing Conditions

Detail Part 2



Land use

Obstructions



INDEX

Building use

- Public/semi-public
- Residential
- No record available
- Commercial
- Green spaces

Existing elements

- Electrical box
- Planter/ seating
- Bus stop
- Footpath

Obstructions

Temporary obstructions

- 1a. Electrical boxes (0)
- 1b. light poles (4)
- 2. Bus stops (0)
- 3. Bollards (0)
- 4. Signages (0)
- 5. Column (0)
- 6. Property entrance (3)

Permanent obstructions

- 1. Trees and seatings (4)
- 2. Drainage
  - Road level
  - Below road level
  - Broken/absent

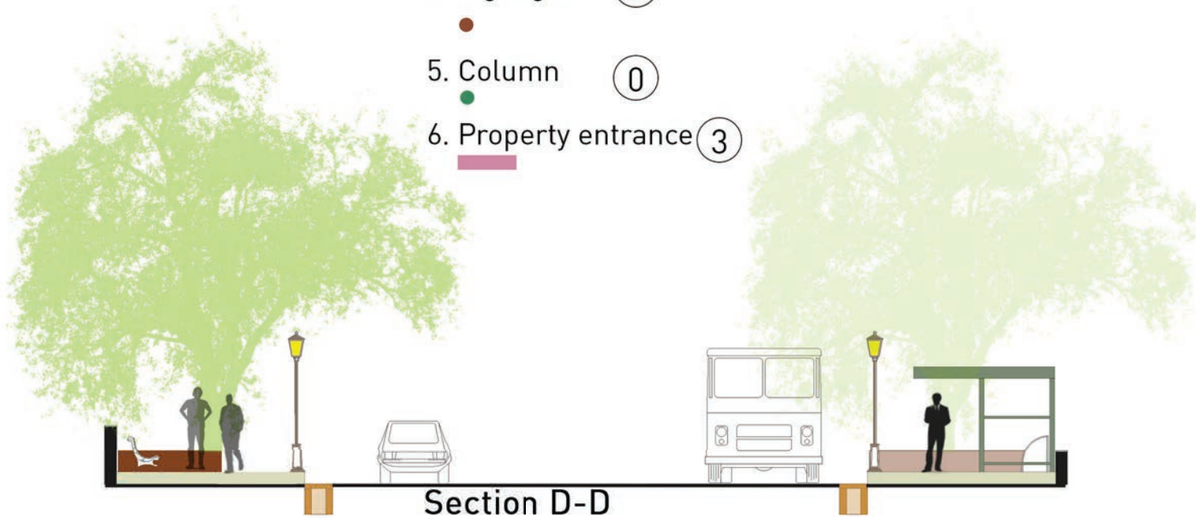


Figure 32: Existing conditions - detail part 1

Existing Conditions

Detail Part 3

KEY PLAN

Land use

Obstructions

INDEX

Building use

- Public/semi-public
- Residential
- No record available
- Commercial
- Green spaces

Existing elements

- Electrical box
- Planter/ seating
- Bus stop
- Footpath

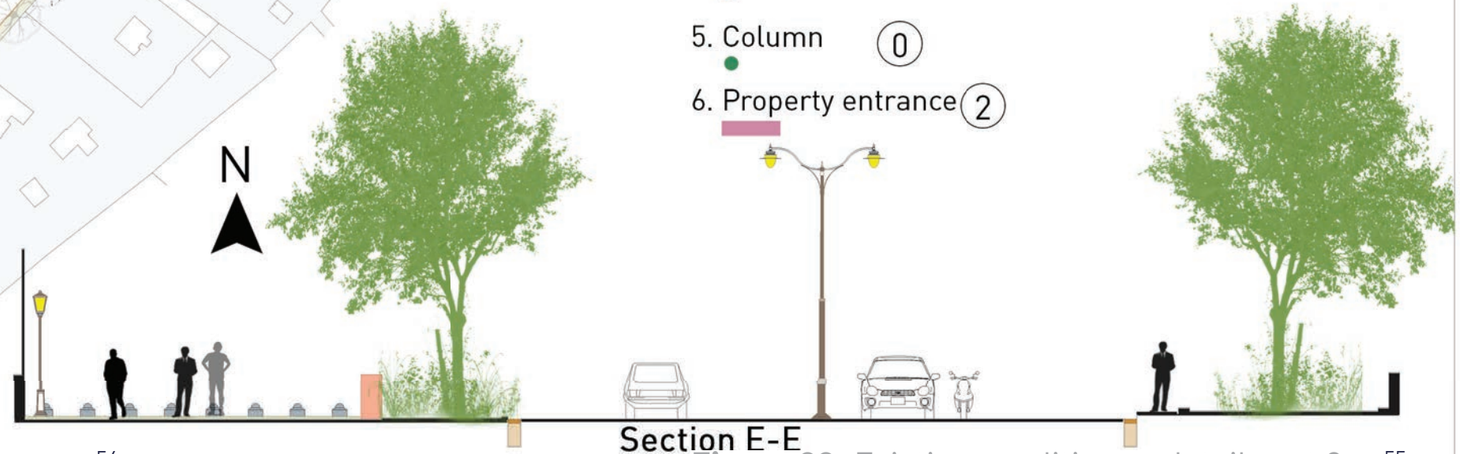
Obstructions

Temporary obstructions

- 1a. Electrical boxes (0)
- 1b. light poles (0)
- 2. Bus stops (0)
- 3. Bollards (3)
- 4. Signages (1)
- 5. Column (0)
- 6. Property entrance (2)

Permanent obstructions

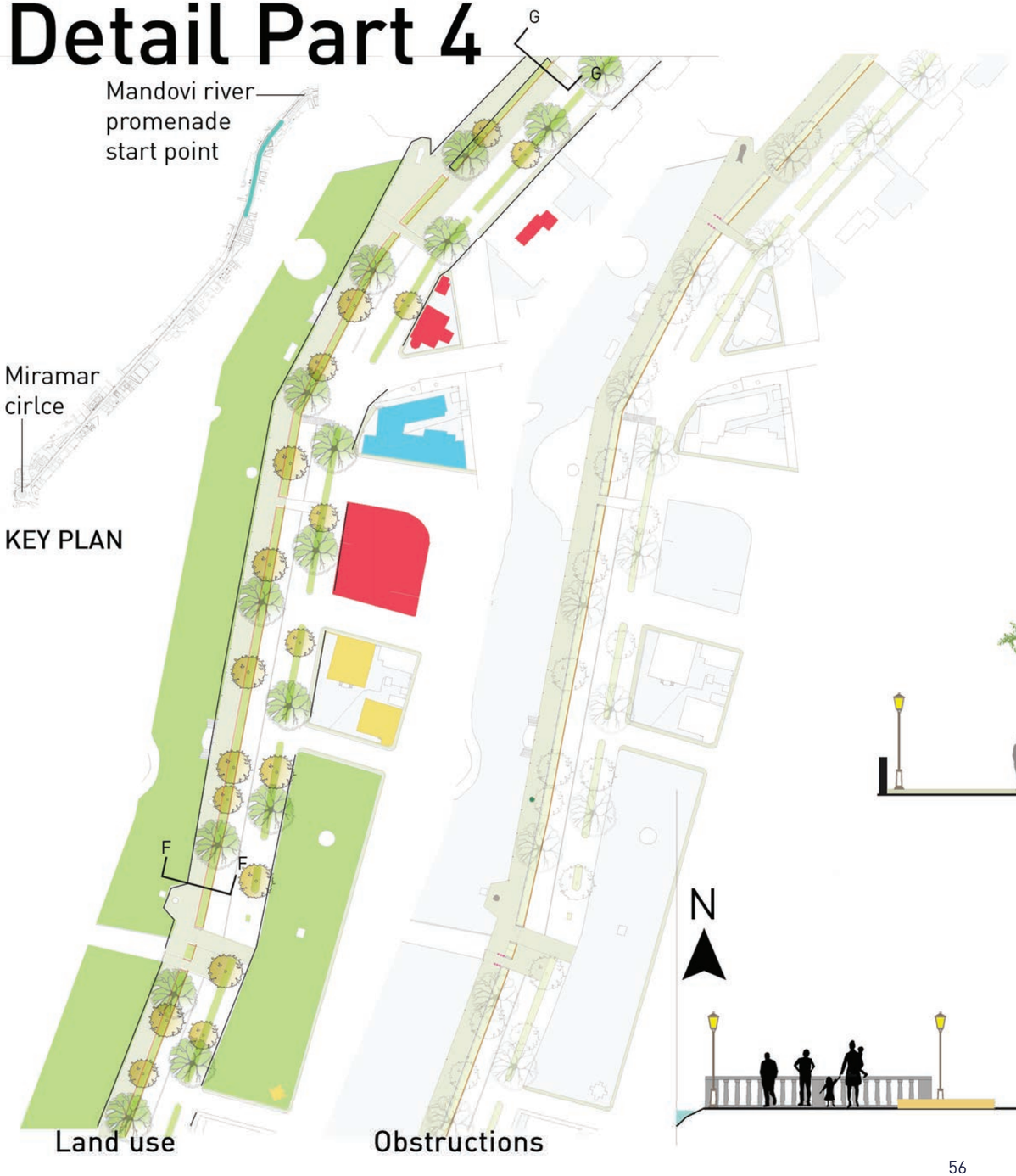
- 1. Trees and seatings (5)
- 2. Drainage
  - Road level
  - Below road level
  - Broken/absent



Section E-E

Figure 33: Existing conditions - detail part 3

Detail Part 4



INDEX

Building use

- Public/semi-public
- Residential
- No record available
- Commercial
- Green spaces

Existing elements

- Electrical box
- Planter/ seating
- Bus stop
- Footpath

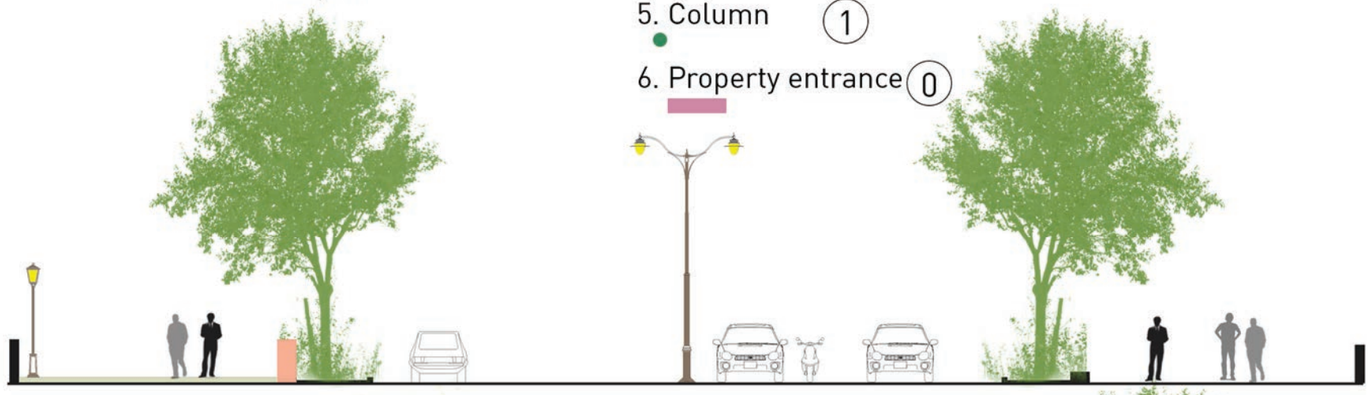
Obstructions

Temporary obstructions

- 1a. Electrical boxes 0
- 1b. light poles 0
- 2. Bus stops 0
- 3. Bollards 4
- 4. Signages 0
- 5. Column 1
- 6. Property entrance 0

Permanent obstructions

- 1. Trees and seatings 0
- 2. Drainage
  - Road level
  - Below road level
  - Broken/absent



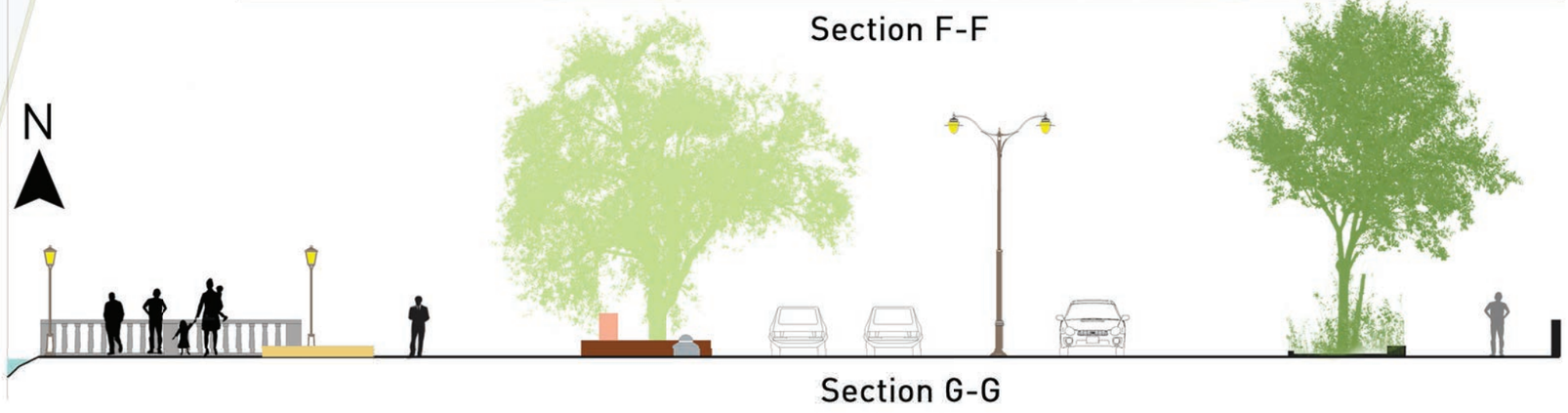
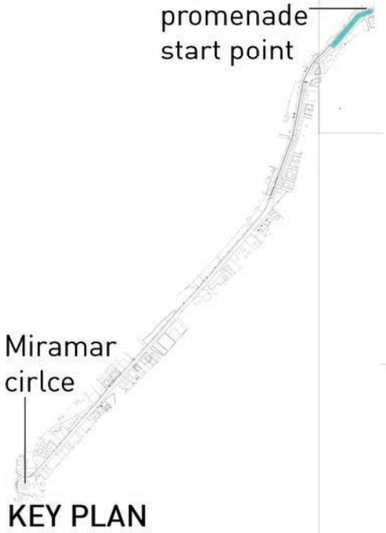
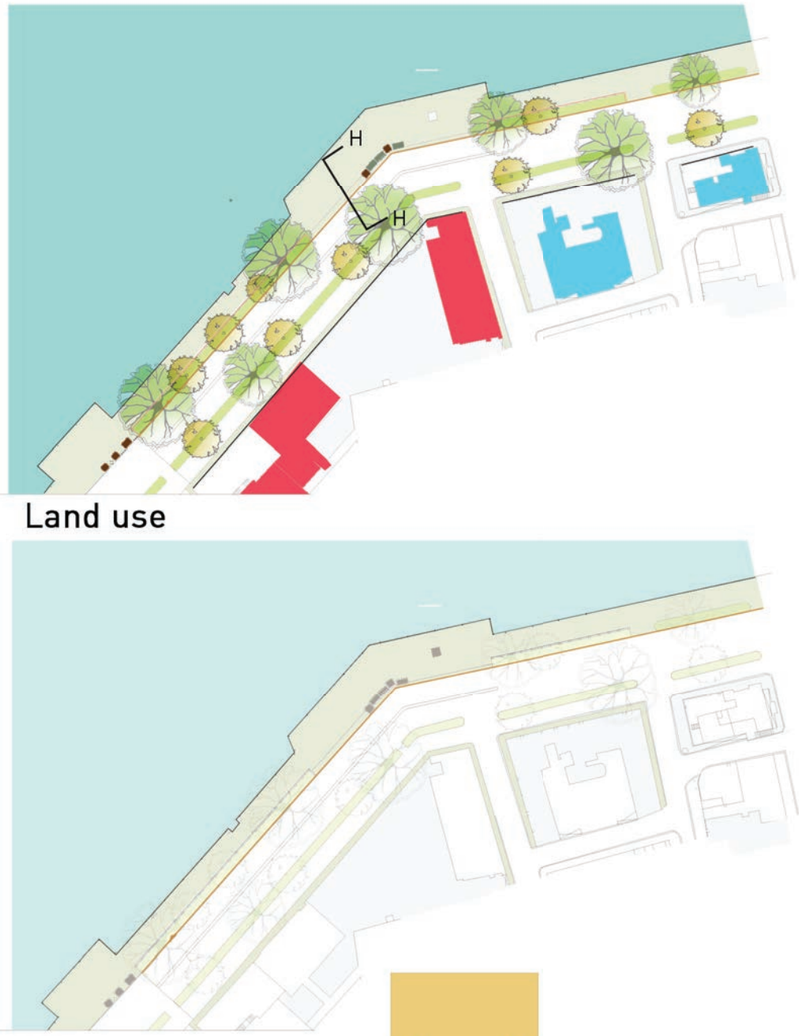


Figure 34: Existing conditions - detail part 4

Existing Conditions

Detail Part 5





INDEX

Building use

- Public/semi-public
- Residential
- No record available
- Commercial
- Green spaces

Existing elements

- Electrical box
- Planter/ seating
- Bus stop
- Footpath

Obstructions

Temporary obstructions

- 1a. Electrical boxes (0)
- 1b. light poles (0)
- 2. Bus stops (0)
- 3. Bollards (0)
- 4. Signages (0)
- 5. Column (0)
- 6. Property entrance (0)

Permanent obstructions

- 1. Trees and seatings (0)
- 2. Drainage
  - Road level
  - Below road level
  - Broken/absent

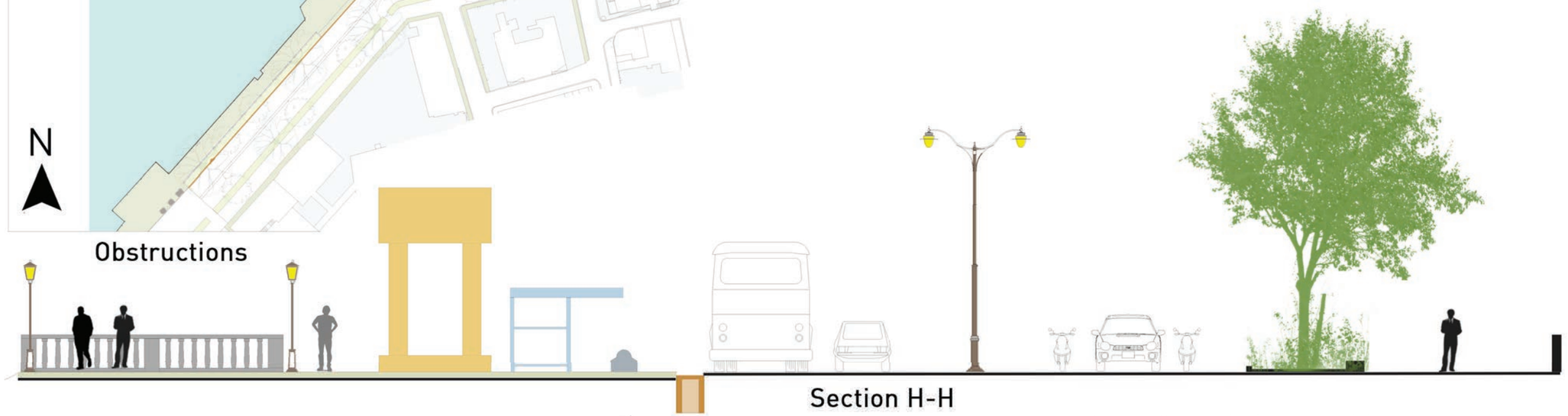


Figure 35: Existing conditions - detail part 5

Proposed Design

Design Guidelines

1 Cycling Lane

- Lane widths of 1m is recommended with buffer where width allows
- Protected cycle lanes should be distinguished by lane markings - A 150mm wide solid white boundary line. Cycle symbols should be marked in white on cycle lanes.
- Green colour can be used to distinguish the cycle lane and points of conflict with motorists, at bus stops, intersections, midblock crossings, property entrances etc.
- Thermoplastic road marking paint is recommended

Sources: IRC: 35-2015, IRC: 11-1962, India Cycles 4 Change Challenge: Design Guidelines

2 Signages

- Signage should be at the edge of the footpath in MUZ (multi-utility zone, refer footpath section) with min. 2.1 m vertical clearance
- Signage should be placed perpendicular to the line of traffic, on the left side of the road with clear visibility

Sources: IRC: 67-2012, India Cycles 4 Change Challenge: Design Guidelines

3 Cycle Parking

- Vandal-proof cycle parking racks which require minimal maintenance should be fixed on the street at frequent intervals (every 100 to 150m)
- Minimum Off Street Parking should be provided - In transit stations, residential, commercial, institutional, and public building premises

Source: India Cycles 4 Change Challenge: Design Guidelines

4 Street Lighting

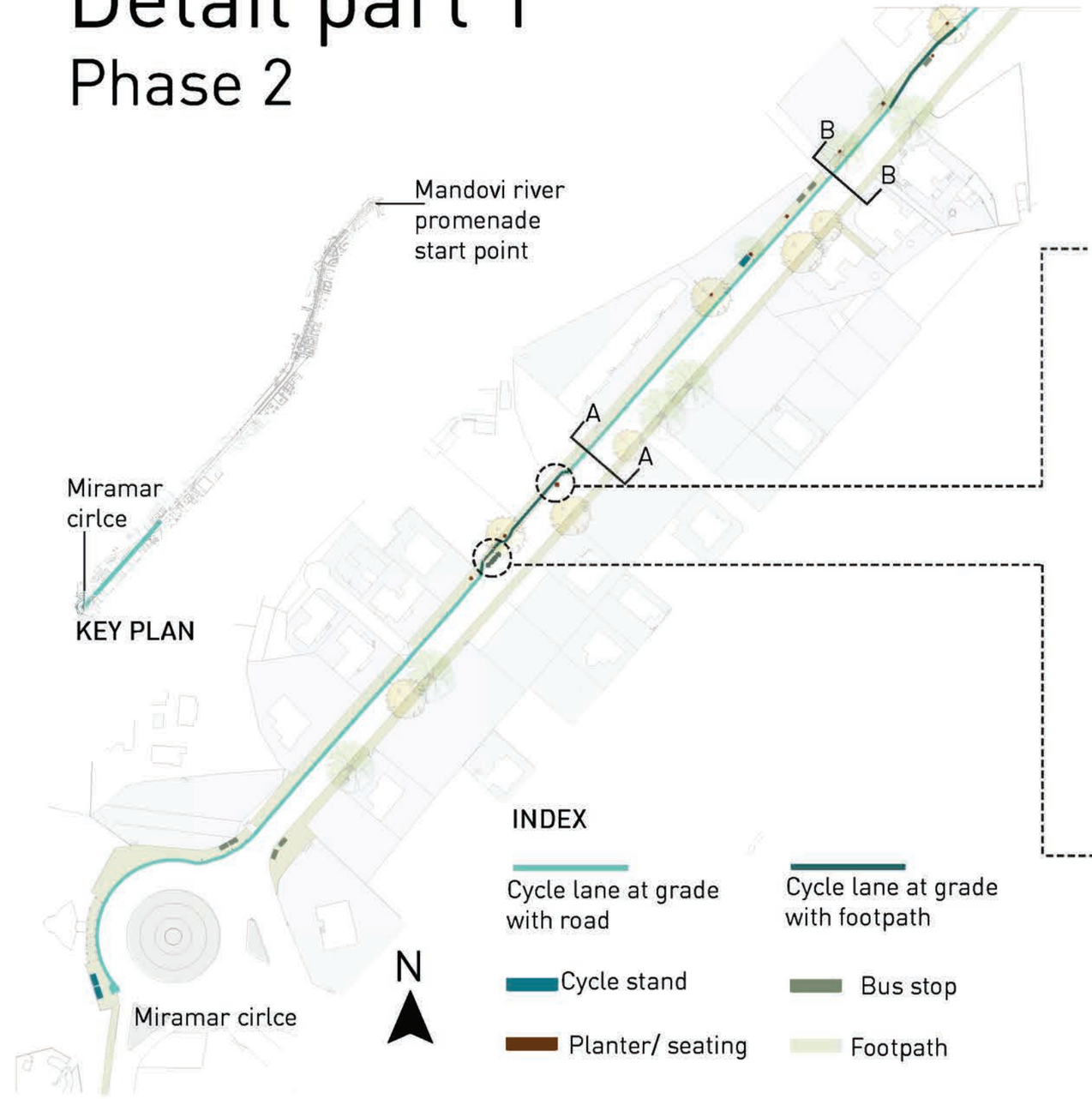
- Good street lighting ensure that all road users can see and be seen. It also increases personal safety especially for women and children
- Street lighting should be placed such that tree foliage does notimpede proper illumination.
- Standards for pedestrian and cycling lighting -
  - Lux - 30 lux
  - Spacing - 12 to 16 m
  - Height - 3 to 6 m

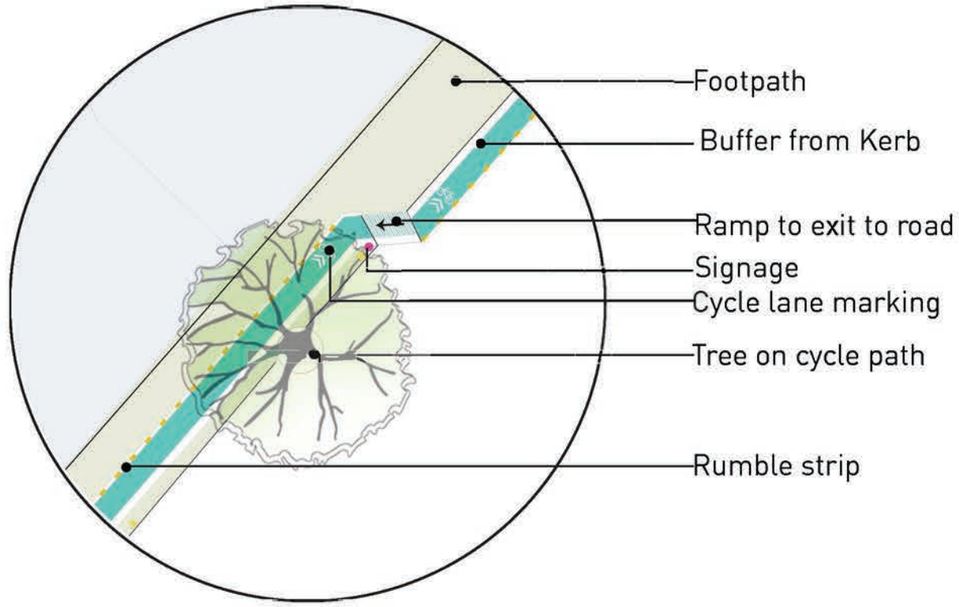
Source: India Cycles 4 Change Challenge: Design Guidelines

Proposed Design

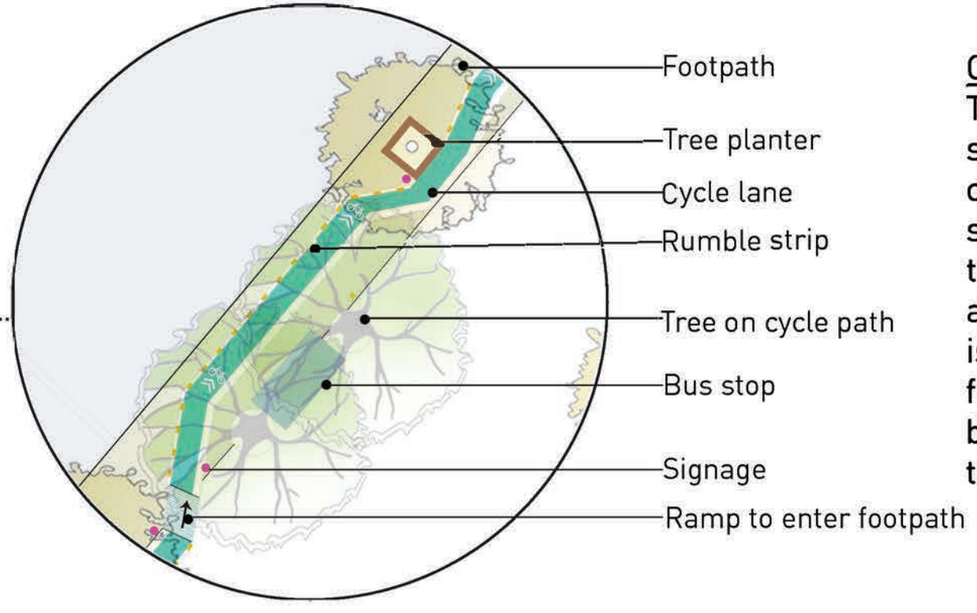
Stage 1

Detail part 1
Phase 2





Condition 1:
Cycle lane on grade with the footpath to avoid the obstruction (tree) on the path



Condition 2:
To avoid bus stopping on cycle lane, bus stop is shifted to road level and cycle lane is turned to footpath behind cycle track.

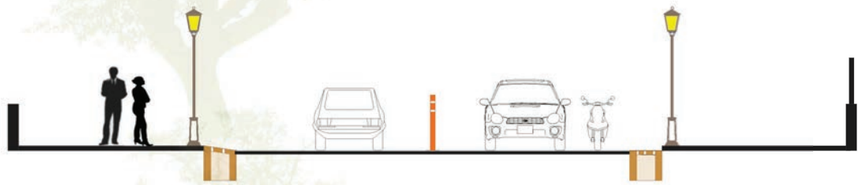
Figure 36: Proposed design - detail part 1 plans

Proposed Design

Stage 1

Detail Part 1
Sections

Before



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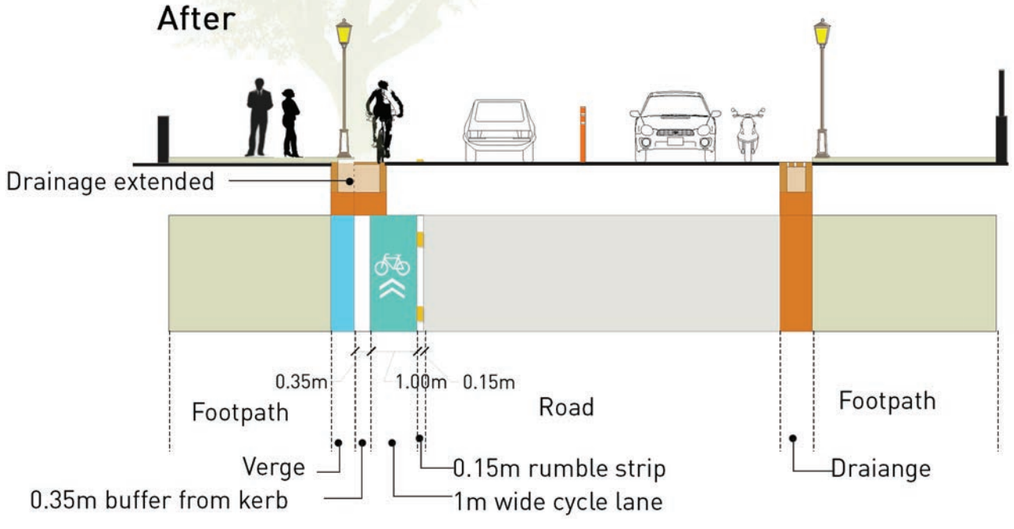
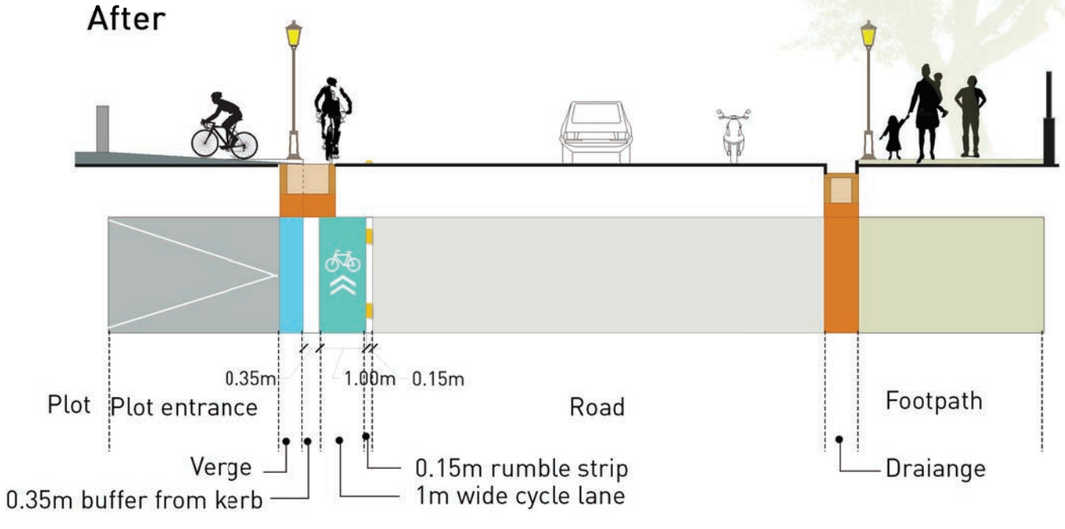


Section A-A

Before

After



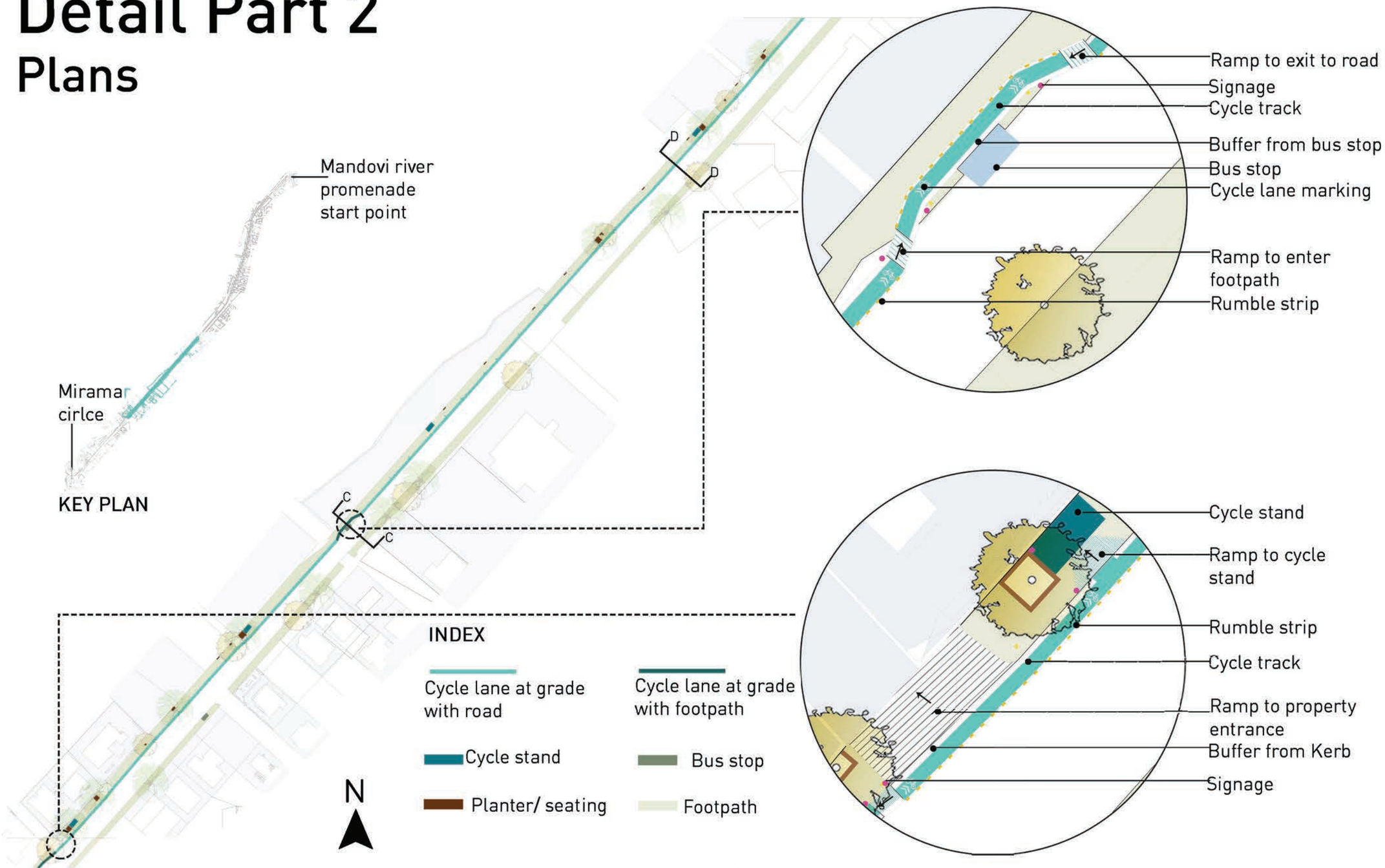
Section B-B

Figure 37: Proposed design - detail part 1 sections

Proposed Design

Stage 1

Detail Part 2
Plans



Condition 3:
Cycle track shifted from 'at grade with the road' to 'at grade with the footpath' to avoid bus stopping on the cycle lane. Bus stop is shifted to road flushed at the same level as the cycle track

Condition 4:
Appropriate gradient and surface material at plot entrances and approaches to cycle stand

Cycle stands are places near the tree planters at appropriate intervals

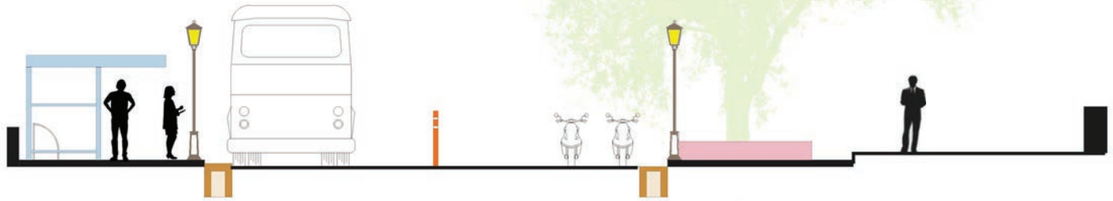
Figure 38: Proposed design - detail part 2 plans

Proposed Design

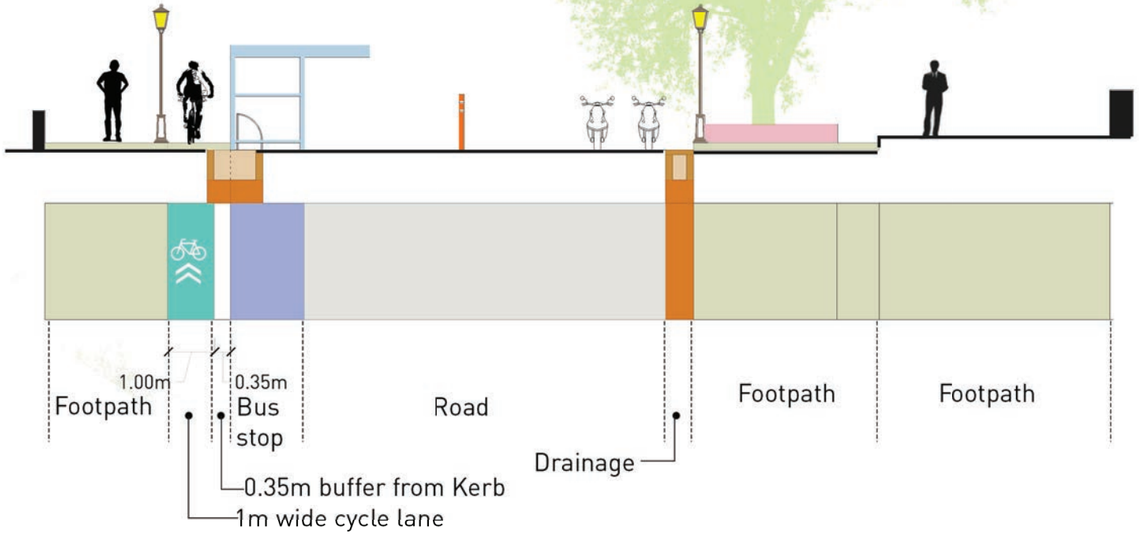
Stage 1

Detail Part 2
Sections

Before



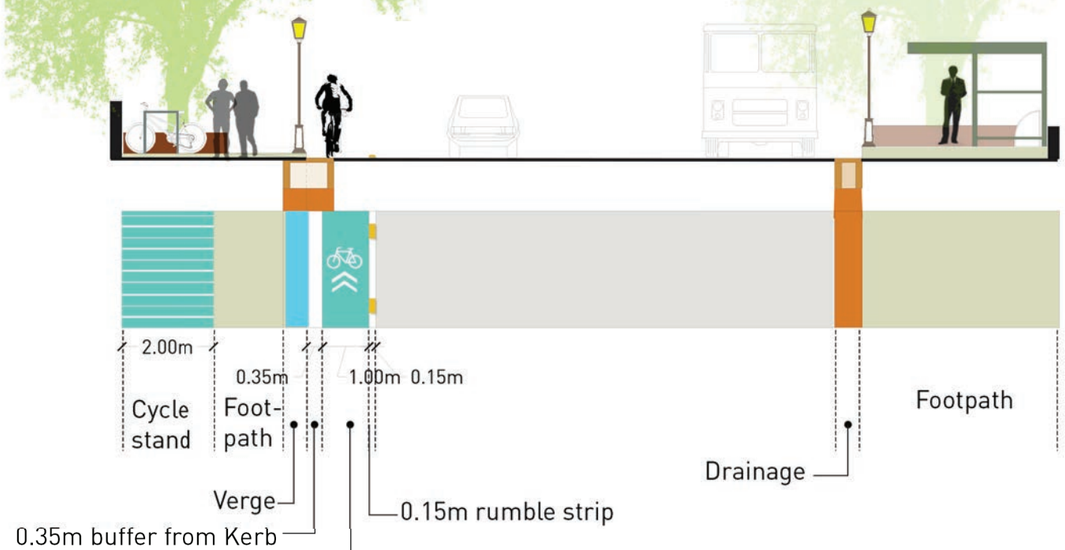
After



Section C-C

Before

After



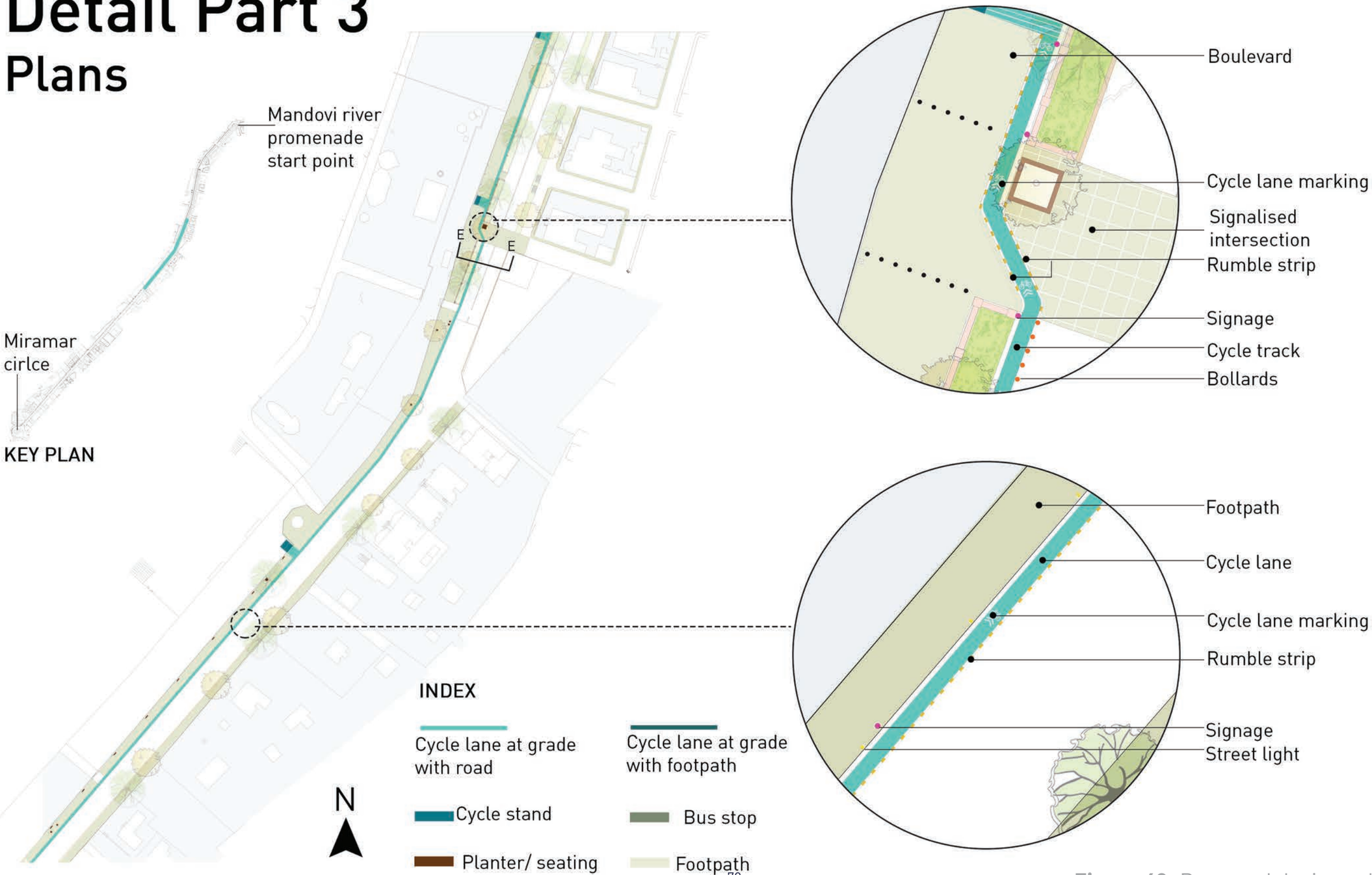
Section D_D

Figure 39: Proposed design - detail part 2 sections

Proposed Design

Stage 1
+
Stage 2

Detail Part 3
Plans



Condition 5:
Change of cycle lane from at grade with the road to at grade with the boulevard at Jawahar Kala Kendra Entrance. Bollards are placed to avoid vehicles encroaching on the cycle lane during stop light.

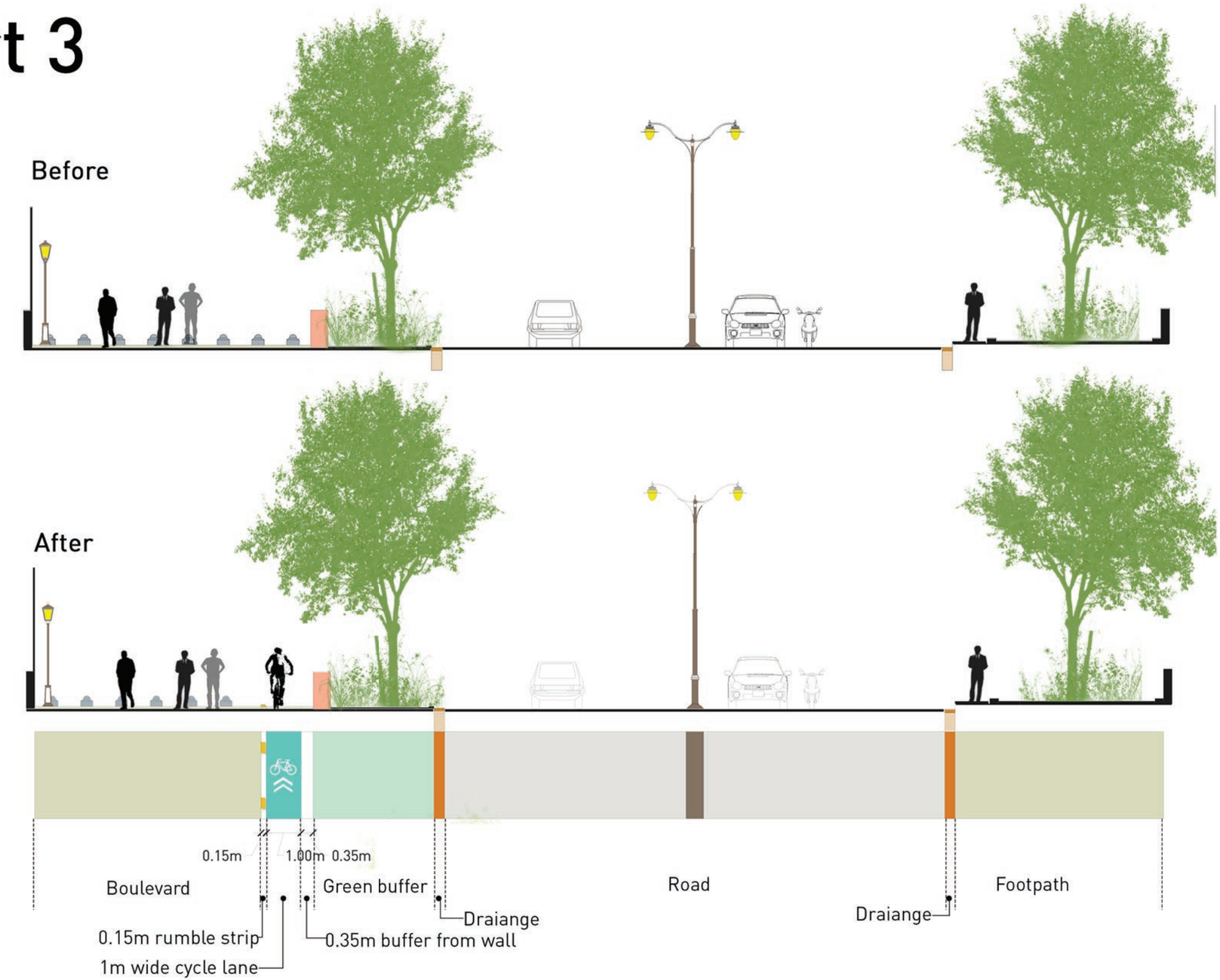
Condition 6:
Shift of street lights from left side of the footpath (boundary wall side) to right side (kerb side) to form a verge/ multi-utility zone and provide light to cycle lane. Signage boards will also be in verge zone

Figure 40: Proposed design - detail part 3 plans

Proposed Design

Stage 1
+
Stage 2

Detail Part 3
Sections



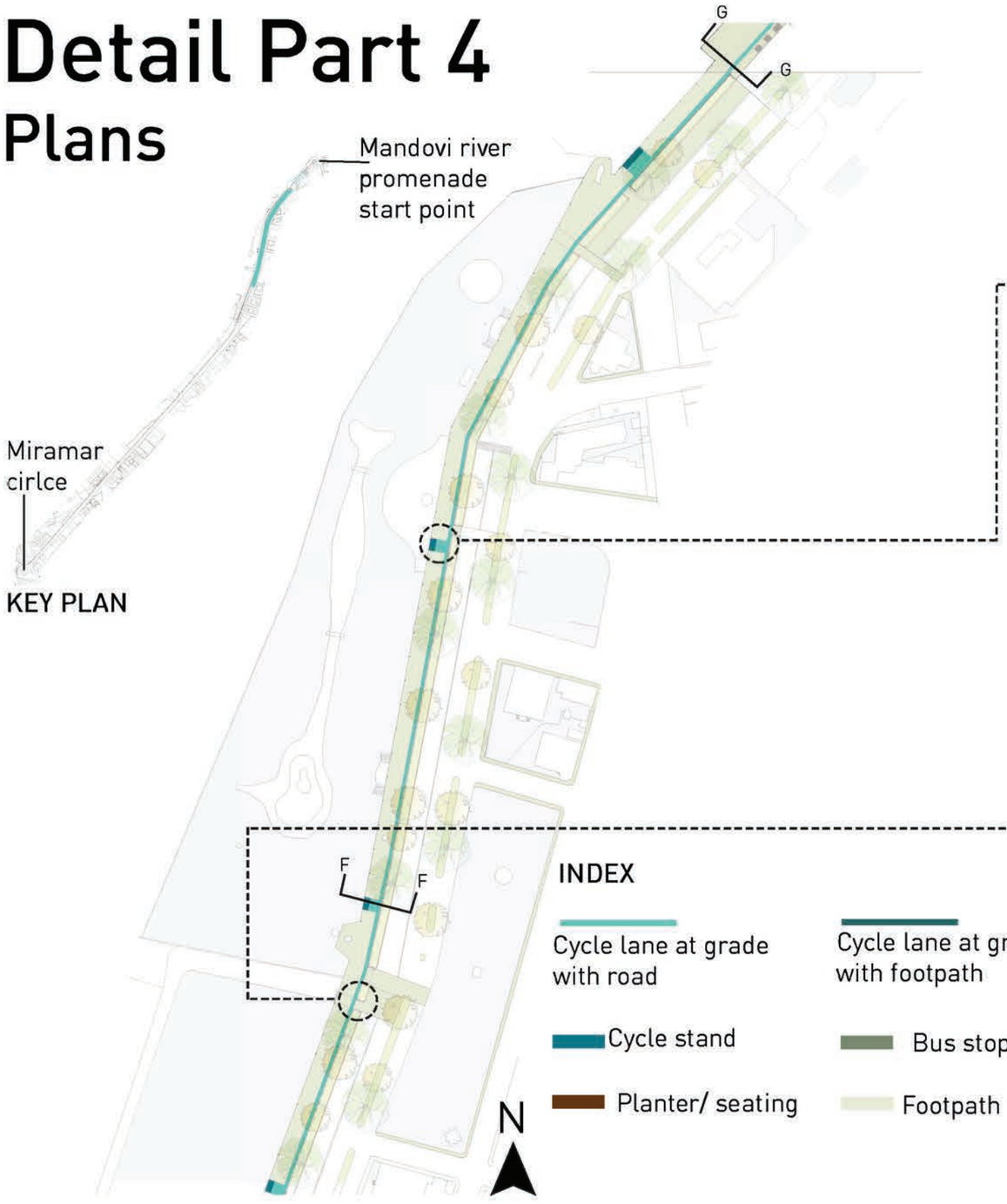
Section E-E

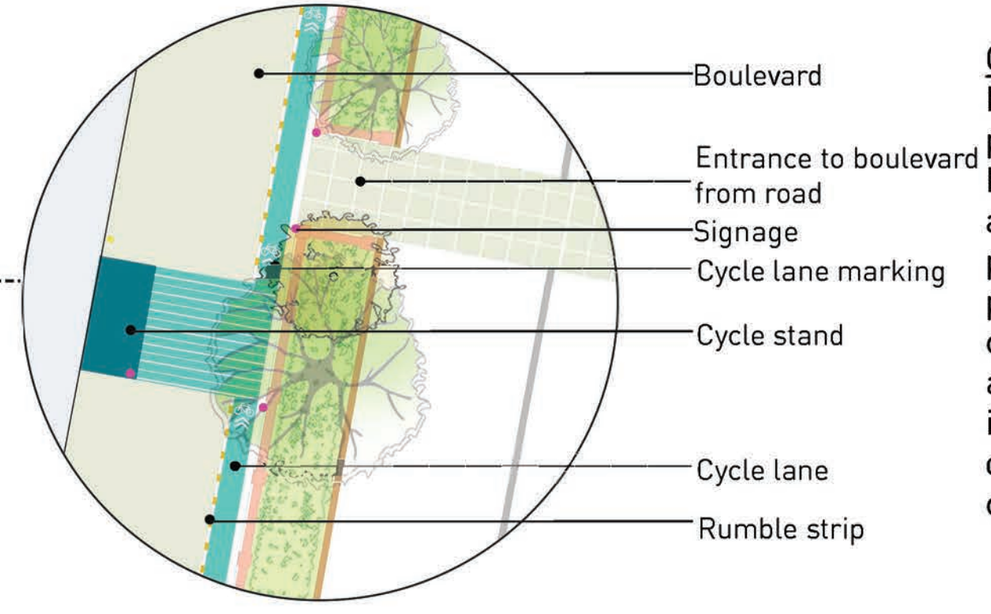
Figure 41: Proposed design - detail part 3 sections

Proposed Design

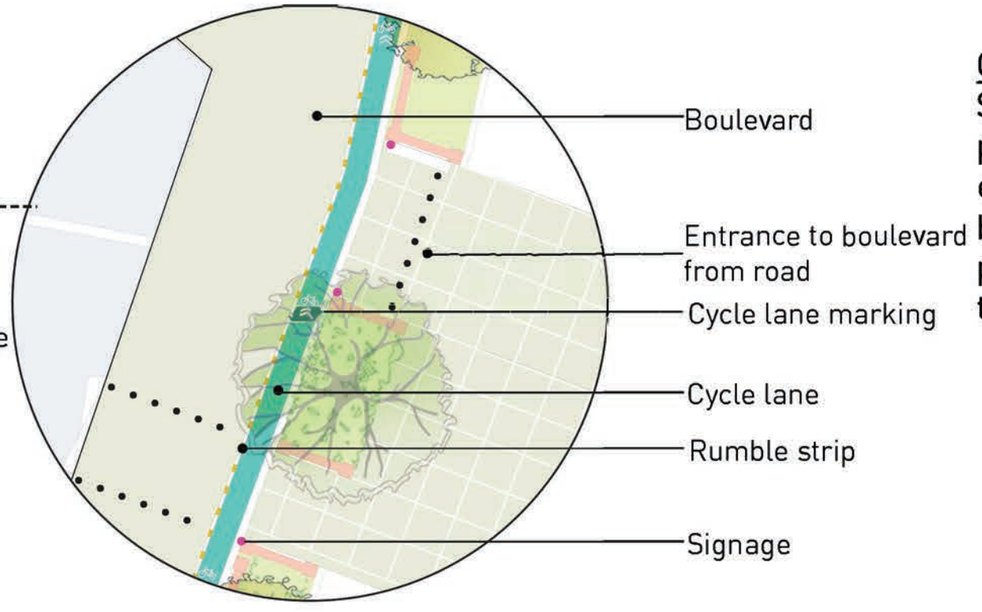
Stage 2

Detail Part 4
Plans





Condition 7:
Footpath painted with bright colour to alert pedestrians of possible cycle crossing. Signs are placed to inform cyclists of upcoming cycle stand



Condition 8:
Signages places at the entrances of boulevard alert pedestrians of the cycle track

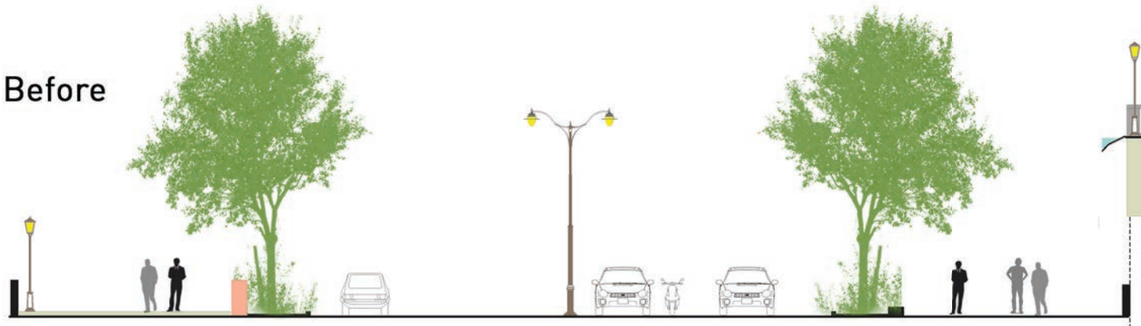
Figure 42: Proposed design - detail part 4 plans

Proposed Design

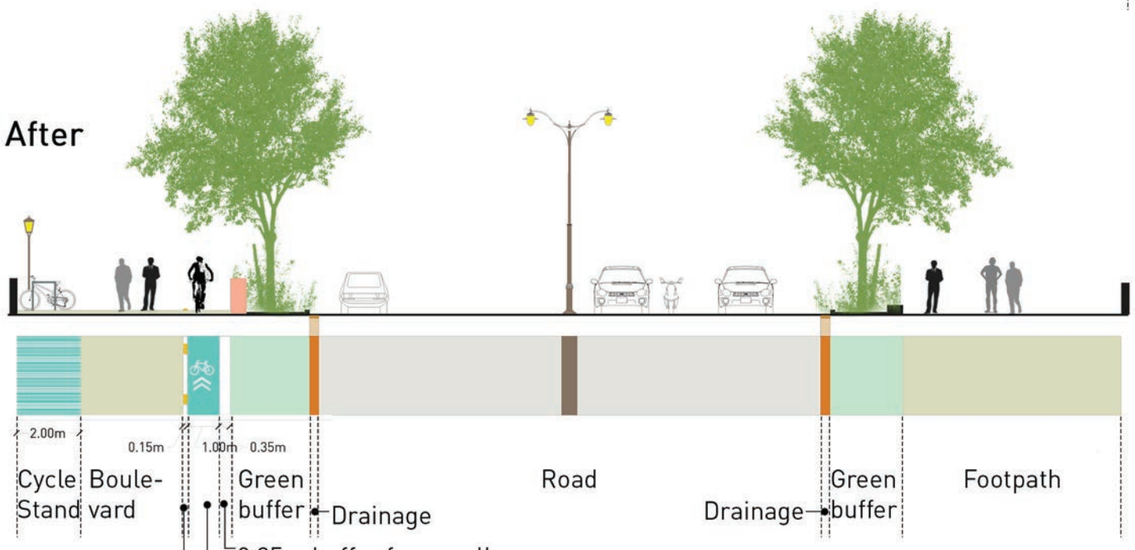
Stage 2

Detail Part 4
Sections

Before



After



Section F-F

Before

After

Section G-G

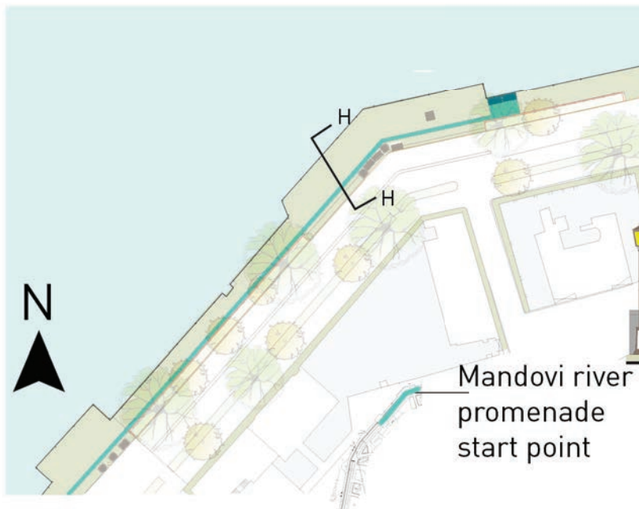
Figure 43: Proposed design - detail part 4 sections

Proposed Design

Stage 2

Detail Part 5

Plan and Sections



KEY PLAN

INDEX

Cycle lane at grade with road

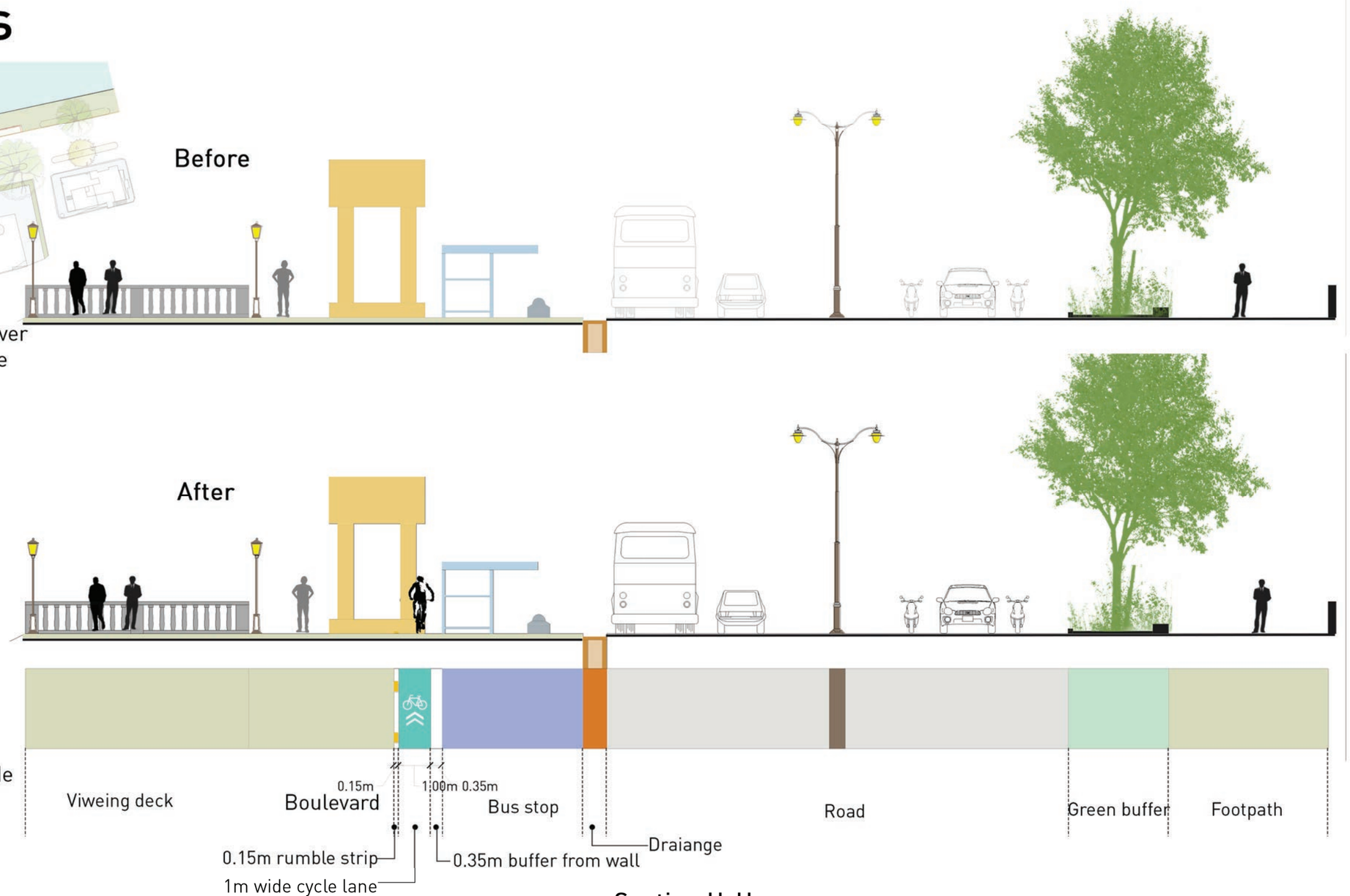
Cycle lane at grade with footpath

Cycle stand

Bus stop

Planter/ seating

Footpath



Section H-H

Figure 44: Proposed design - detail part 5 plans and sections

Proposed Design

Stage 1

Figure 45: Stage 1 proposed dedicated lane near the Panjim Promenade

Proposed Design

Stage 2

Figure 46: Stage 2 proposed segregated lane near Miramar circle

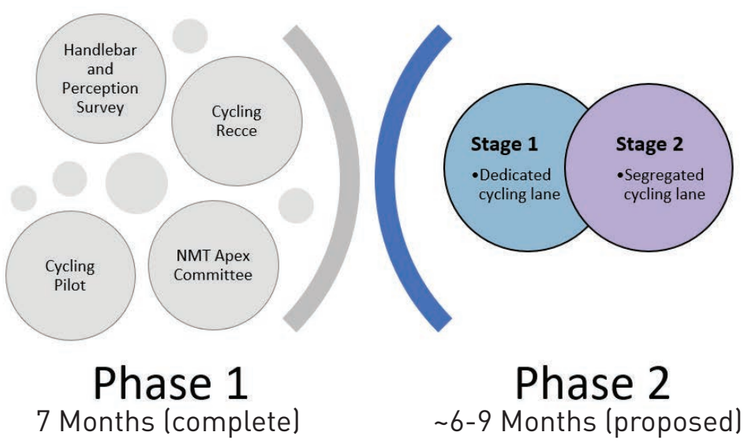
IMPLEMENTATION

Phase 2 Implementation

PROCESS INSPIRATION

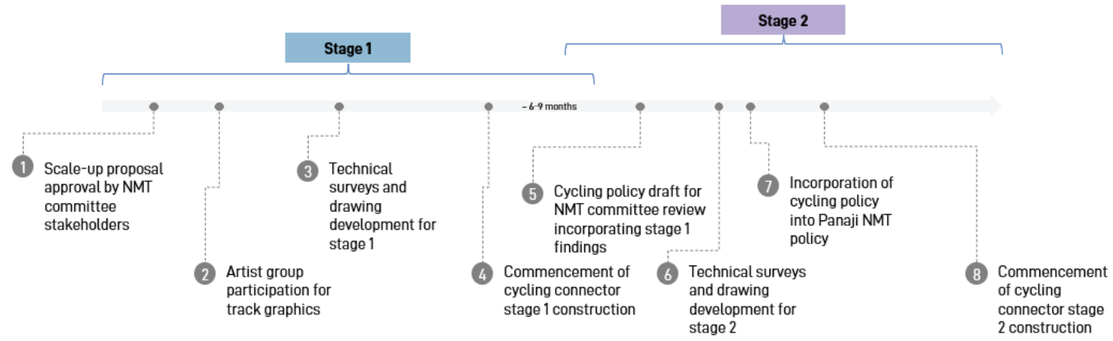
Implementation of the Phase 2 scale-up strategy is split into two steps. The first stage involves the construction of a dedicated cycling lane at grade with the DB road footpath which provides a path of cyclists to travel from Kala Academy to the beginning of Panjim Promenade or join the proposed Mandovi River promenade. The second stage deals with providing a segregated cycling path at grade with the road stretching from Miramar Circle to Kala Academy. Once Stage 1 and Stage 2 are complete, cyclists can ride the counterclockwise route of the Mandovi River promenade and the cycling connector.

Implementation of Phase 2 is split into two parts; to build the easier connector segment first and incorporate learnings and findings to stage 2 design and development. A process overview of the two stages are is provided in Figure 47.



Bottom Left
Figure 48:
Approximate implementation timeframes

Top Right
Figure 47:
Approximate implementation timeline for stage 1 and stage 2



1. The Cycles 4 Change report and scale-up plan is reviewed and approved by NMT apex committee members
2. Local artists engage in the design process for stage 1. Design suggestions are incorporated in cycling lane graphics
3. An RFP and tender are floated for technical consultants to provide working drawings for stage 1 cycling lane and infrastructure
4. Stage 1 cycling lane painting and cycling facility development begins
5. A Panaji citywide cycling scale-up plan is drafted incorporating feedback from stage 1 connector users
6. An RFP and tender are floated for technical consultants to provide working drawings for stage 2 cycling lane and infrastructure
7. The NMT apex committee reviews the draft scale-up plan and approves the addition of the cycling policy as a part of the Panaji NMT policy
8. Stage 2 cycling lane construction, painting and cycling facility development begins

Conclusion

Panaji, the capital of Goa has a high private vehicle ownership rate which has lead to traffic and parking problems in the city. Panaji is in need of permanent NMT infrastructure, with cycling lanes and facilities being some of the most urgently needed. Deriving learnings from the Cycles 4 Change pilot, the first step as outlined in this report is to scale-up through the suggested DB road cycling connector. The cycling connector would aim to create a behavioural change towards cycling and provide an introduction to cycling in the city through permanent infrastructure.

The cycling connector can be implemented through two stages in parallel with the development of the NMT plan for the city of Panaji. The cycling policy would feed into the NMT plan after incorporating public, user and government stakeholder perspectives. Incorporating the cycling plan as a part of the NMT masterplan would help realise goals on the reduction of private vehicle ownership and the decrease of emissions in the city.

The cycling plan will consist of a network of cycling paths that would work with proposed pedestrianization, public transportation and parking plans. A PBS network can be added to accelerating behavioural change towards taking up cycling as a mode for leisure, exercise and commuting. Finally, the NMT plan could contribute towards the Comprehensive Mobility Plan for a safer, resilient and green Panaji.

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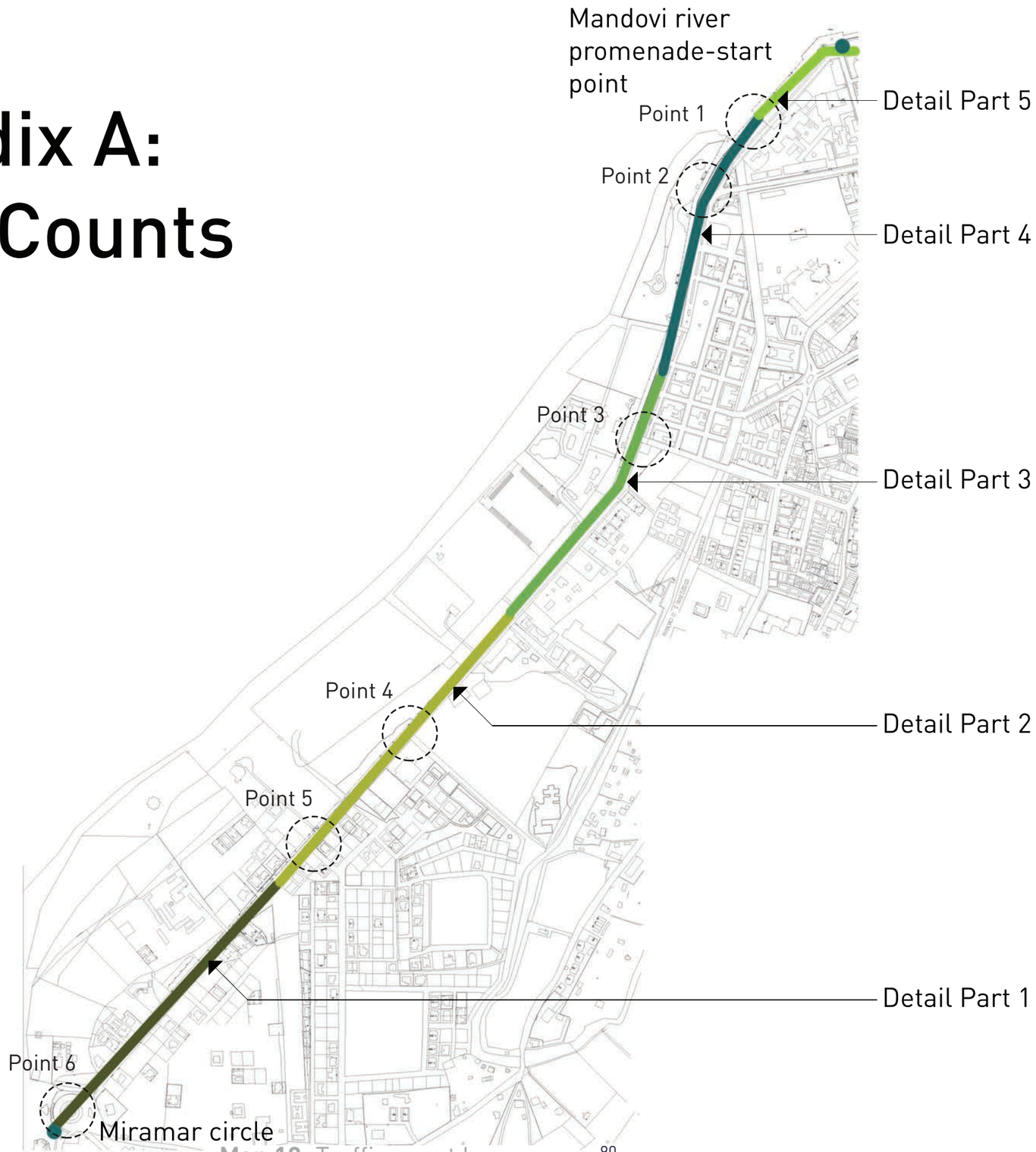
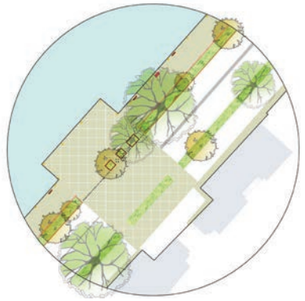
APPENDICES

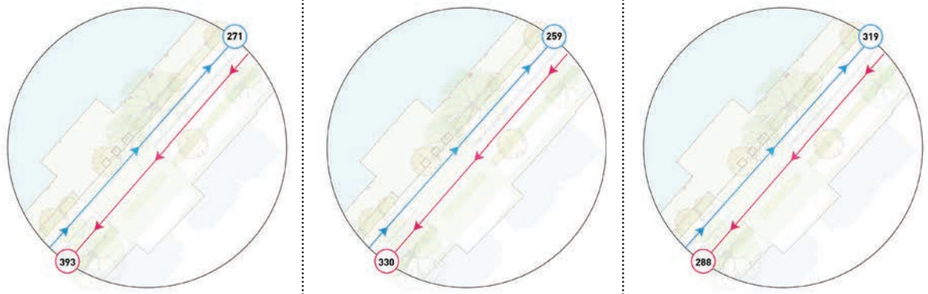
Appendix A: Traffic Counts



Map 10: Traffic count key map



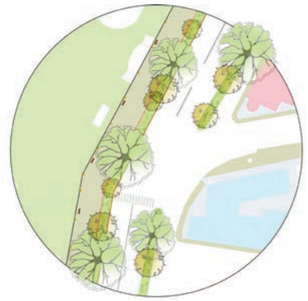
Point 1



Morning | Afternoon | Evening

Vehicle	Morning	Afternoon	Evening
2W	327	245	230
4W	305	311	347
Auto rickshaw	8	3	7
Cycle	1	0	1
Bus	12	8	11
Tempo	2	8	4
Truck	9	14	7
Ambulance	0	0	0
	664	**589**	**607**

Figure 49: Traffic count - point 1



Point 2

Morning | Afternoon | Evening

Vehicle	Morning	Afternoon	Evening
2W	227	259	217
4W	355	292	329
Auto rickshaw	4	3	5
Cycle	4	1	0
Bus	12	8	10
Tempo	8	7	9
Truck	3	11	12
Ambulance	0	0	0
	613	**581**	**582**

Figure 50: Traffic count - point 2

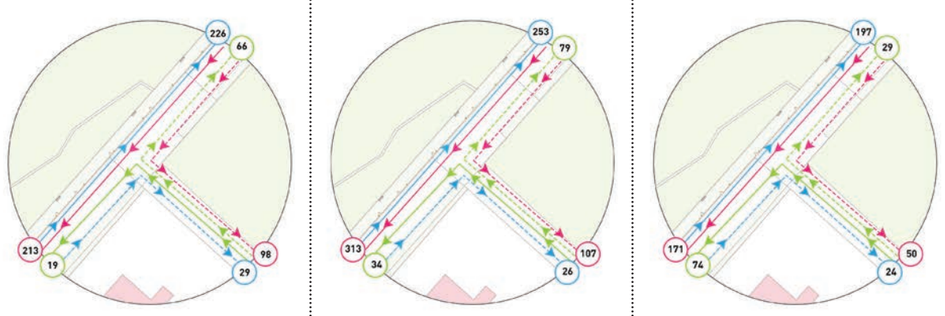
Point 3

Morning | Afternoon | Evening

Vehicle	Morning	Afternoon	Evening
2W	360	398	257
4W	372	401	398
Auto rickshaw	5	3	3
Cycle	1	0	1
Bus	11	10	6
Tempo	9	18	13
Truck	5	10	14
Ambulance	0	0	0
	763	**840**	**692**

Figure 51: Traffic count - point 3

Point 4

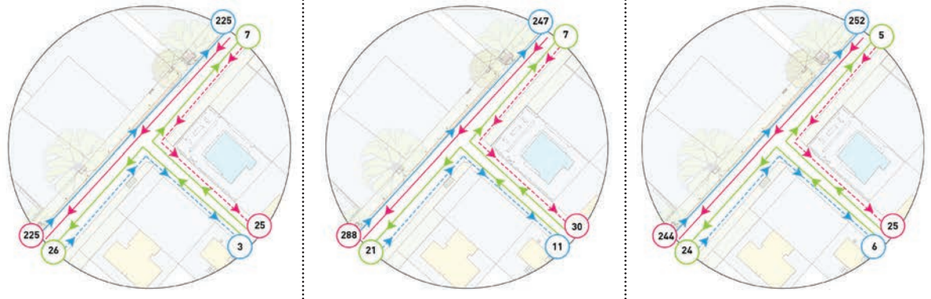


Morning | Afternoon | Evening

Vehicle	Morning	Afternoon	Evening
2W	328	371	212
4W	303	407	300
Auto rickshaw	7	3	3
Cycle	1	1	4
Bus	4	9	7
Tempo	5	13	12
Truck	3	8	7
Ambulance	0	0	0
	651	**812**	**545**

Figure 52: Traffic count - point 4

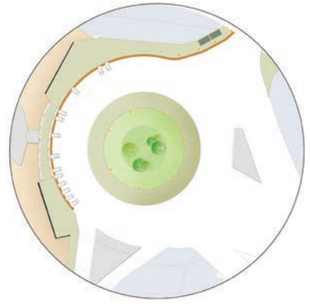
Point 5



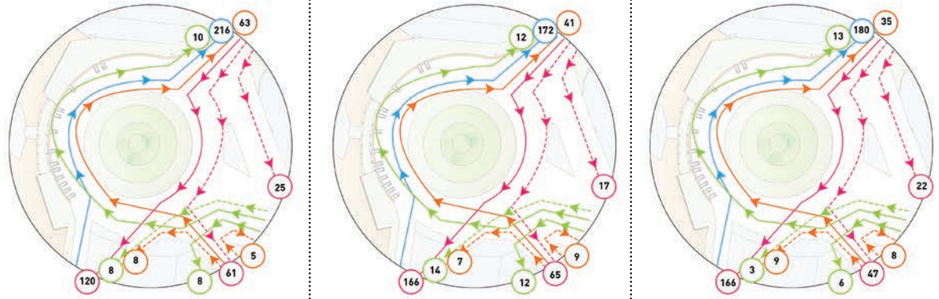
Morning Afternoon Evening

Vehicle			
2W	228	245	233
4W	254	332	295
Auto rickshaw	7	8	4
Cycle	3	0	6
Bus	7	5	9
Tempo	9	6	6
Truck	3	8	3
Ambulance	0	0	0
	511	**604**	**556**

Figure 53: Traffic count - point 5



Point 6



Morning Afternoon Evening

Vehicle			
2W	215	226	203
4W	292	269	271
Auto rickshaw	1	1	2
Cycle	1	3	9
Bus	9	6	6
Tempo	11	11	5
Truck	6	5	4
Ambulance	0	0	0
	535	**521**	**500**

Figure 54: Traffic count - point 6

Appendix B: Neighbourhood Recce

A neighbourhood route starting from Kala Academy on one side and ending at Mandovi Bridge nearby to Dr. Babasaheb Ambedkar Park was considered as a scale-up option along with the DB road corridor. The route passes through neighbourhoods of St. Inez, Fontainhas and Patto colony that have a mixed land use character including residential areas, commercial establishments and the heritage areas of the city.

The Panaji city sub-arterial and collector roads are predominantly one-way because of the traffic movement and its effective management. Therefore, the following route as chosen based on the criteria of road widths and traffic flow. The total length of the round trip would be approximately 7 km and can be easily covered within 45 to 60 mins without any road blockages on the way. The cycling recce survey was done by PULL team members on March 12, 2021. Considering the amount of traffic on this route the whole day, the survey was done in the morning between 7:00 and 8:00 am.

The survey started from Dr. Braganza Pereira Road which is the connector road between the main arterial road (DB Road) and the other sub-arterial/collector roads of the city. This particular stretch had footpath on one side and the rest is concrete surfaced pucca road. It was observed that there were only a few vehicles parked towards the end of this stretch. From this road, the survey team moved towards the Dr. Gama Pinto road (Stretch B) which was wide enough but had parked vehicles on both sides of the road. The road had a mixed character with few commercial establishments running on ground floor and residences on first floor.

Right
Map 11: Scale up intervention corridor

Top Left
Figure 55: View of the Patto Bridge (Stretch F)

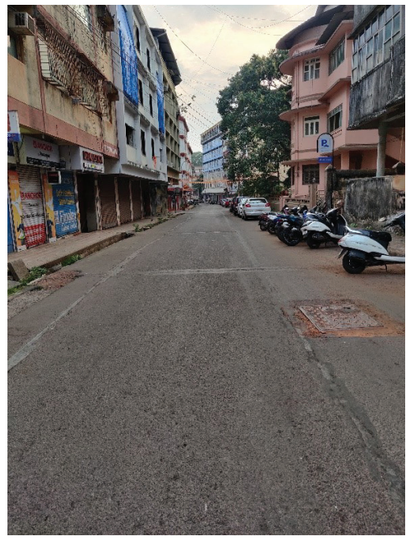
Continuing towards Dr. Dada Vaidya Road from there (stretch C and stretch D), we observed that the character of road has started becoming more commercial with loading and unloading activities happening in the morning and vehicles being parked on both sides for particular Stretch C. The stretch D had shops on one side of the road with the footpath in front and parked vehicles on other side of the road. The vehicles are parked day and night leaving no space for the roads to be redesigned to incorporate cycling/pedestrian activities. Further, to avoid heavy traffic zones and enjoy the Fontainhas heritage lanes the next stretch was the R. Emidio Gracia road that is the road on the side of the famous Immaculate Conception Church.

Moving towards Patto Bridge, a small stretch of Rua de Ourem road (Stretch E) was chosen where a lot of commercial activity is taking place on one side of the road including few hotels owing to flow of Mandovi River on the other side of the road, providing a scenic view of the city. This stretch has the possibility to incorporate a cycling lane on one side as the other is being utilised by the shops/hotels for the parking or loading/unloading activities.

To close the circuit and merge at DB Marg near Mandovi Bridge edge, the Patto bridge on MG Road (Stretch F) has been chosen. The width of the road and the footpaths running on both sides of this stretch provides a good opportunity to transform the road and add a certain part for cycling activities.

Top Left
Figure 56: View of Dr. Braganza Pereira Road (Stretch A)

Top Right
Figure 57: View of Dr. Gama Pinto road (Stretch B)



Bottom Left
Figure 58: View of the junction and street leading towards Dr. Dada Vaidya Road (Stretch C)

Bottom Right
Figure 59: View of Dr. Dada Vaidya Road (Stretch D)

KEY OBSERVATIONS

As the survey was done during morning hours it was possible to cycle on the whole route. However, during the normal working hours of the day it would be difficult for cyclists to follow the trail. Some of the key observations were-

- The sides of the road were being used for parking purposes (particularly stretch B, C and D), leaving no space to modify the streets for cyclists.
- The current lack of parking management strategies within the city necessitate for a dedicated parking zone.
- Some of the narrow roads provide limited opportunity for cycle routes to be designed.
- Cycling infrastructure including dedicated parking spaces for cycles, and cycle services including air pumps are required.

TAKEAWAYS

In consultation with Apex Committee the following points should be considered for designing an efficient cycling network within the city-

- Cycling-friendly roads are those with a posted speed restriction of 30 km/h or less, as the risk of serious accidents is minimal.
- To maintain infrastructure development costs low, existing infrastructure should be integrated into the routes/ networks selected.
- The promotion of trip combinations should be done through the networks.
- The cycling network will aid in the reduction of accident hotspots.
- The roads should be designed in a way that they have a provision to connect different modes of transportation.
- The infrastructure including street lights, weather protection, bike-parking facilities should be supplemented throughout the route.
- In addition, the optical quality of the urban environment influences route selection and may be taken into account.

Left
Figure 60: View of the Rua de Ourem road (Stretch E)

Appendix C:
Existing and Proposed Designs

Detail part 1

Figure 61: Existing and proposed designs - detail part 1

Detail part 2

Before

After

1a. Electrical boxes

1b. light poles

2. Bus stops

3. Bollards

4. Signages

5. Column

6. Property entrance

1. Trees and seatings

2. Drainage
- Road level
- Below road level
- Broken/absent

Cycle lane at grade with road

Cycle stand

Planter/ seating

Cycle lane at grade with footpath

Bus stop

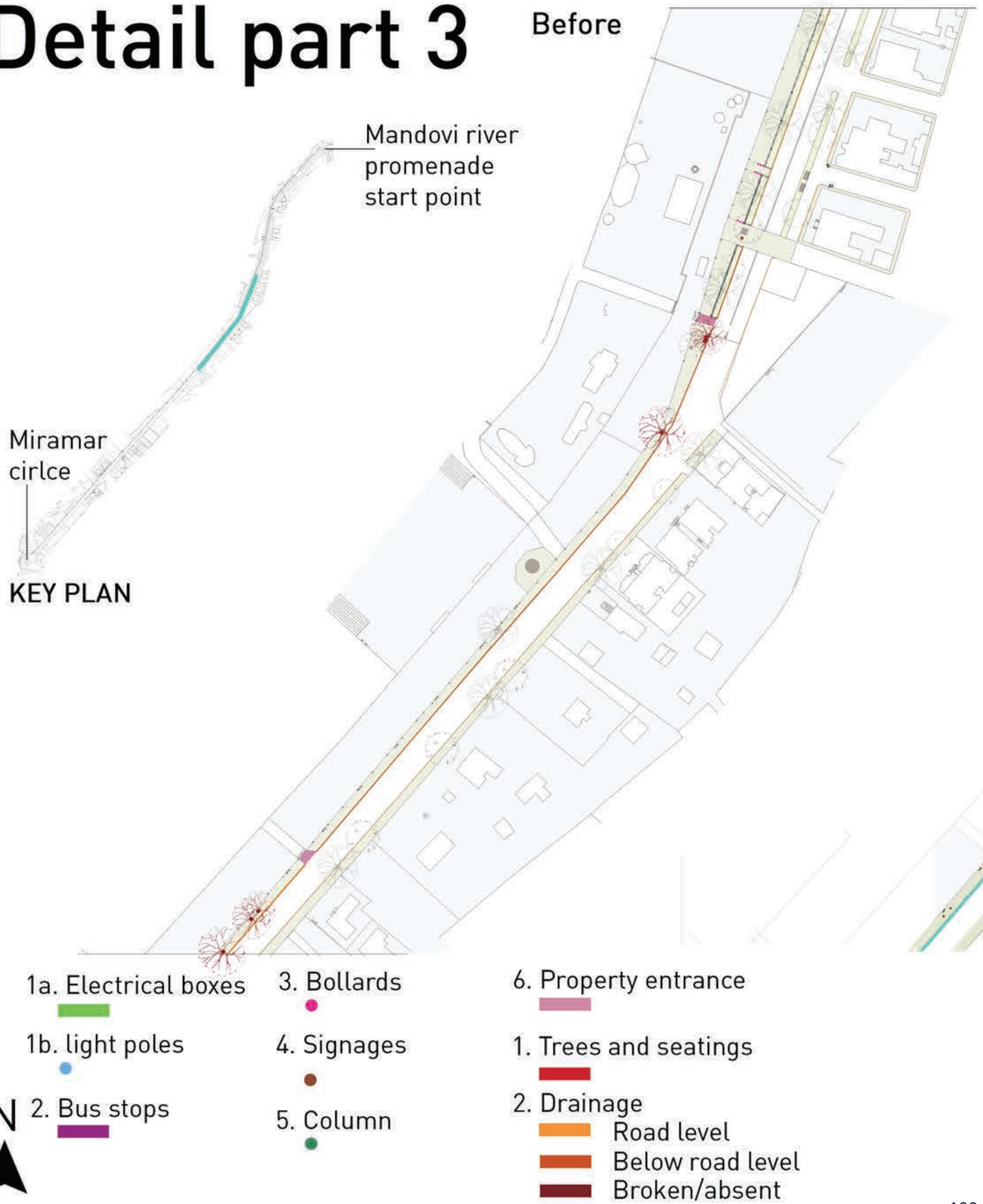
Footpath

N

Figure 62: Existing and proposed designs - detail part 2

Detail part 3

Before



After

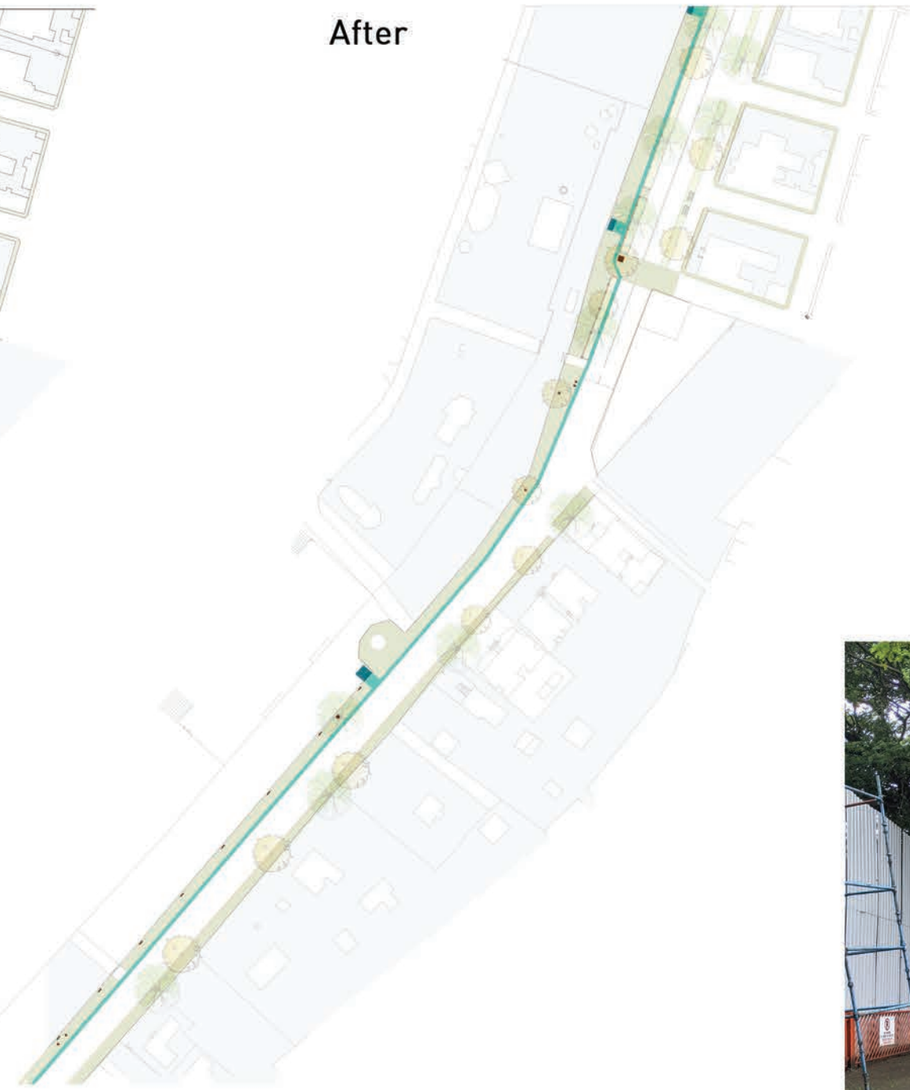
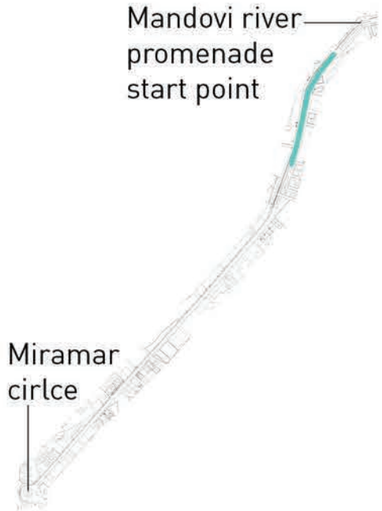


Figure 63: Existing and proposed designs - detail part 3

Detail part 4

Before



KEY PLAN

1a. Electrical boxes

1b. light poles

2. Bus stops

3. Bollards

4. Signages

5. Column

6. Property entrance

1. Trees and seatings

2. Drainage
- Road level
- Below road level
- Broken/absent

N

After

Cycle lane at grade with road

Cycle lane at grade with footpath

Cycle stand

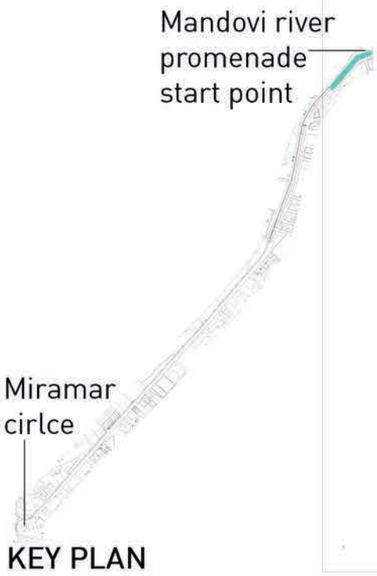
Bus stop

Planter/ seating

Footpath

Figure 64: Existing and proposed designs - detail part 4

Detail part 5



Before

After

1a. Electrical boxes
1b. light poles
2. Bus stops
3. Bollards
4. Signages
5. Column
6. Property entrance
1. Trees and seatings
2. Drainage
Road level
Below road level
Broken/absent

N

Cycle lane at grade with road
Cycle lane at grade with footpath
Cycle stand
Bus stop
Planter/ seating
Footpath

Figure 65: Existing and proposed designs - detail part 5

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