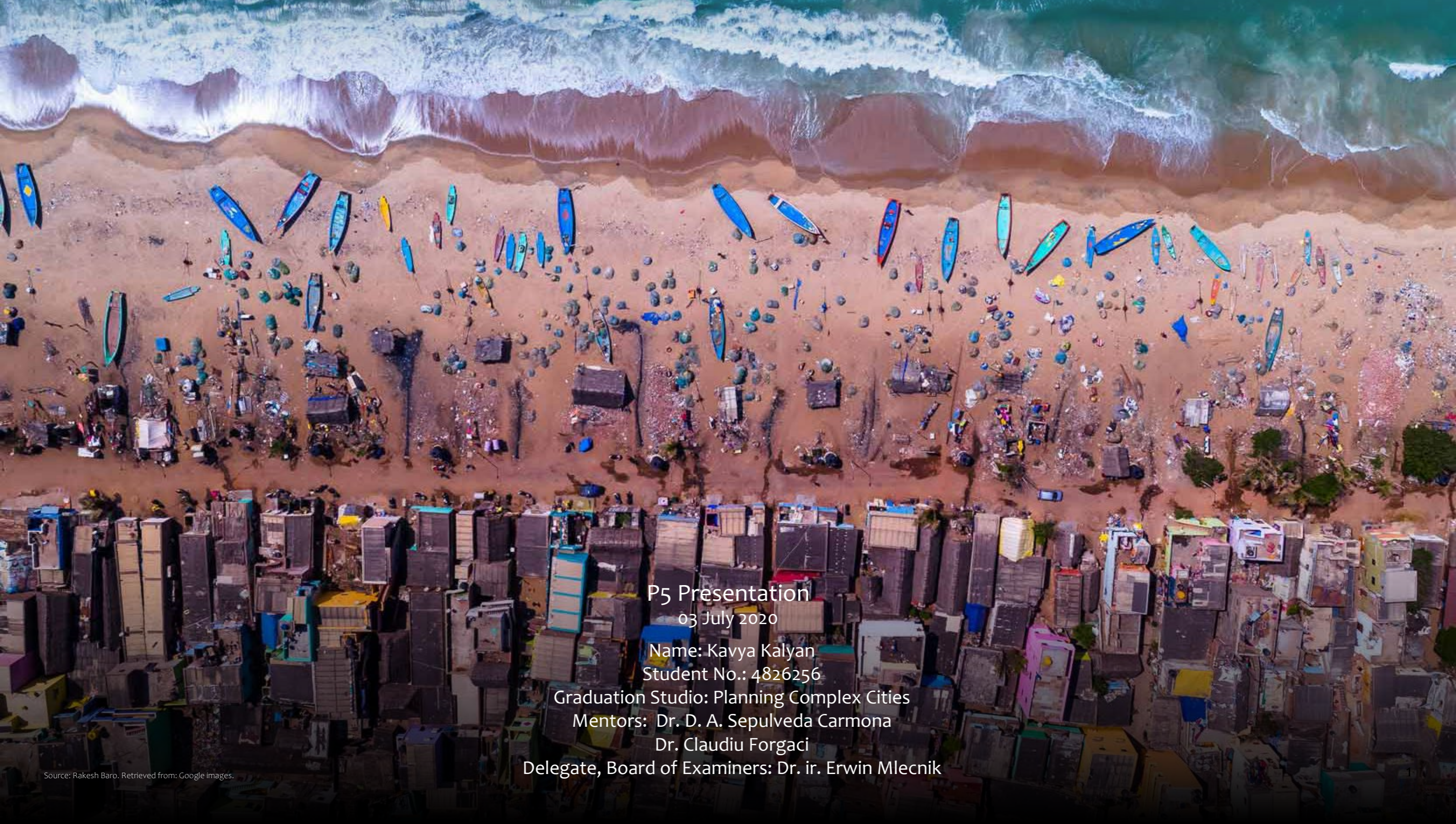


The Humane Metropolis

Towards an integrated socio-ecological planning approach in Chennai



P5 Presentation

03 July 2020

Name: Kavya Kalyan

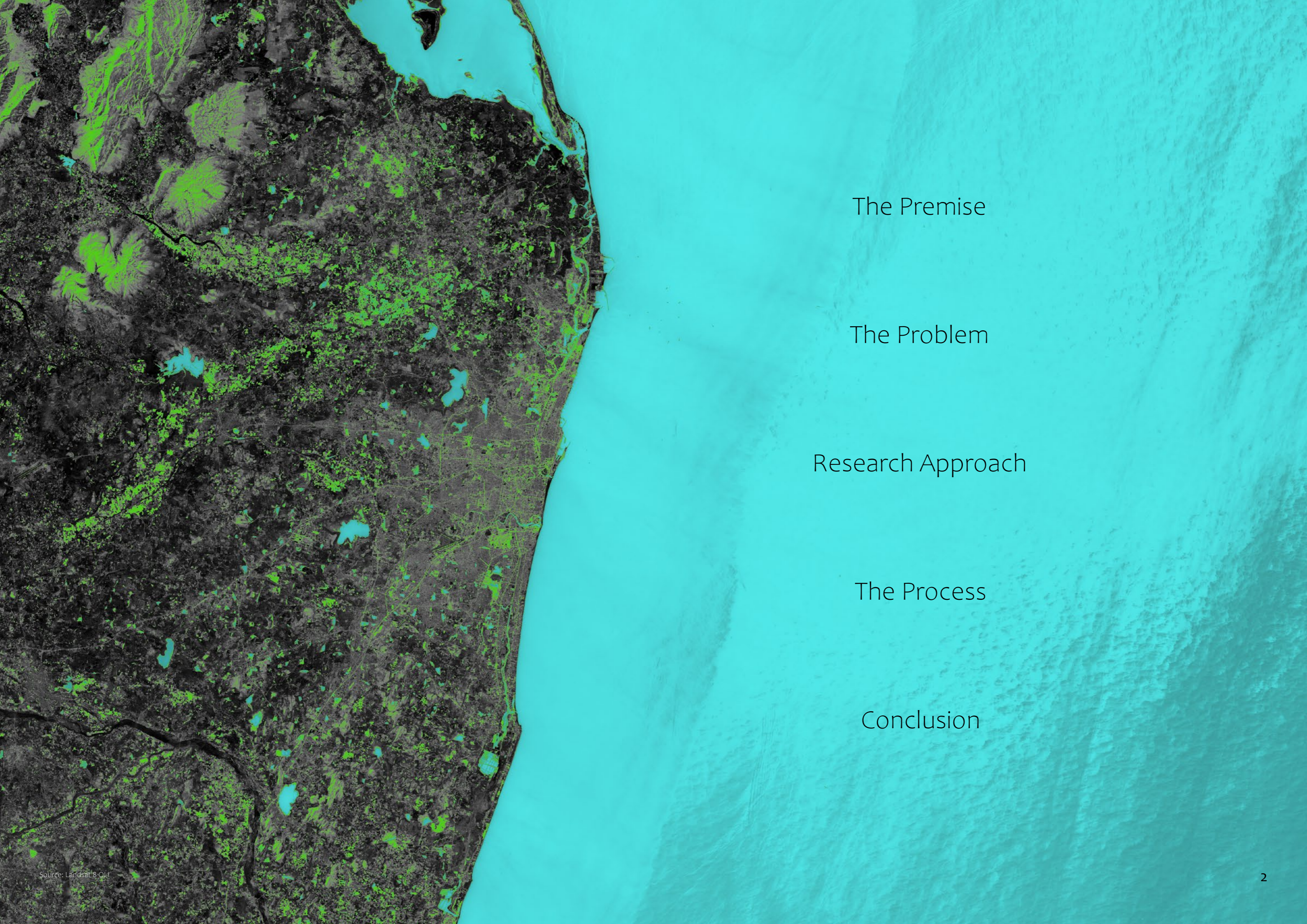
Student No.: 4826256

Graduation Studio: Planning Complex Cities

Mentors: Dr. D. A. Sepulveda Carmona

Dr. Claudiu Forgaci

Delegate, Board of Examiners: Dr. ir. Erwin Mlecnik



The Premise

The Problem

Research Approach

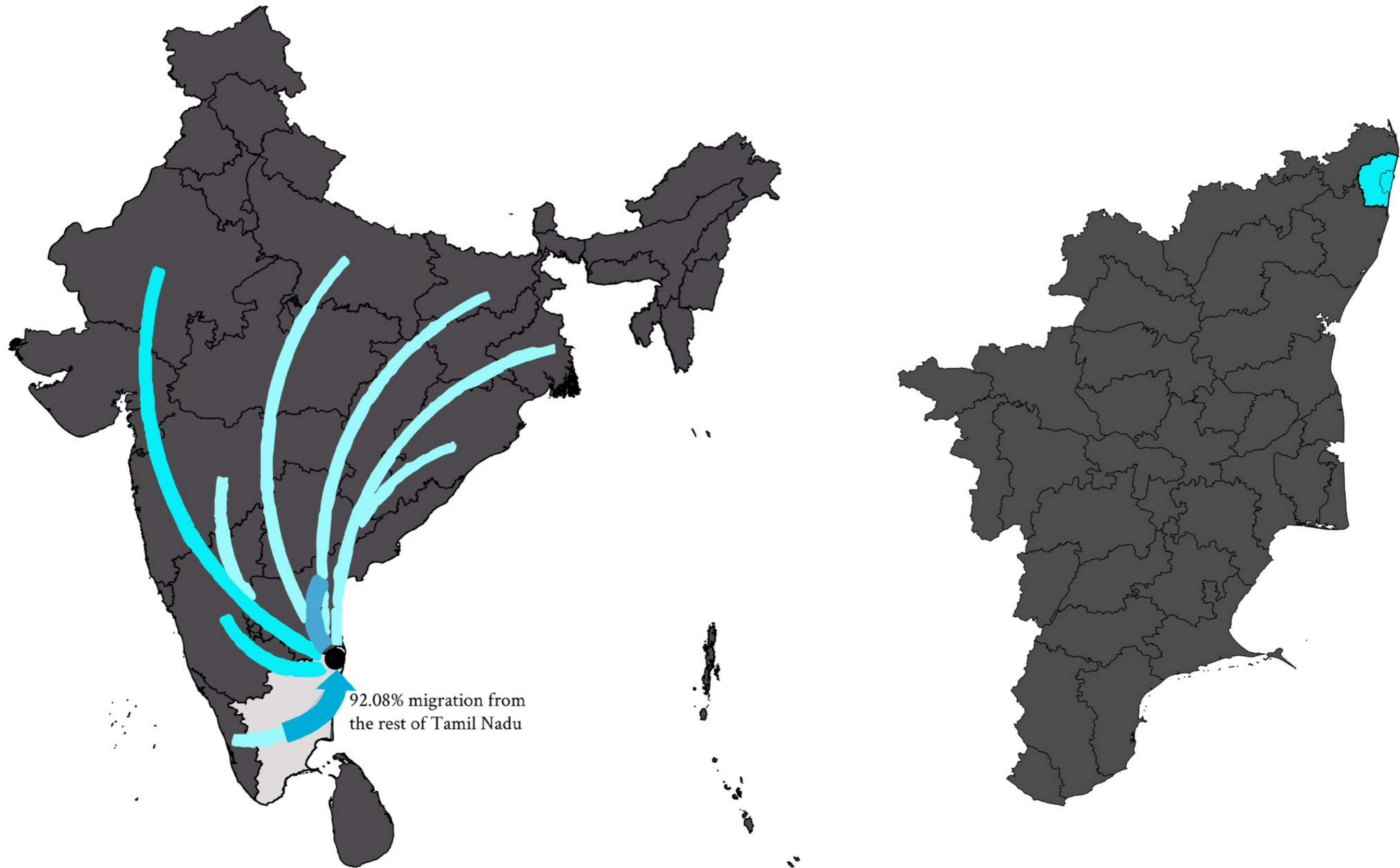
The Process

Conclusion



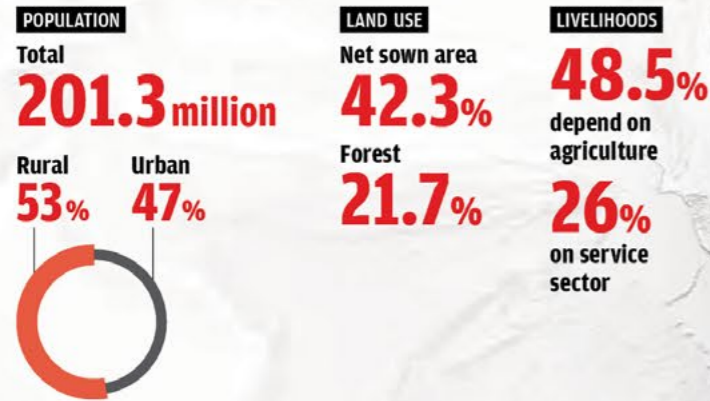
Source: Landsat 8 OLI

Migration to the city

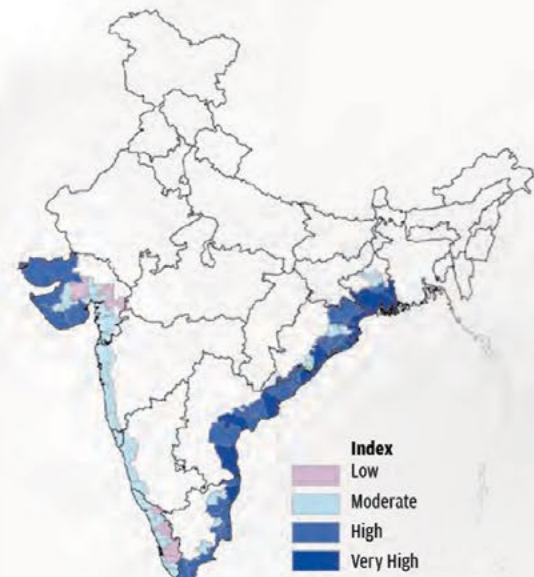


The coast and islands

The 7,517 kilometre Indian coast can be divided into the west coast, the eastern coastal plain and the biodiversity-rich Indian islands. The region is already witnessing climate change impacts like frequent, severe cyclones and sea level rise



CLIMATE CHANGE TRENDS
Cyclone
The Kutch region in Gujarat and the entire eastern coastal region are projected to have the highest incidence of cyclone



Source: Rama Rao C.A., et al., Atlas on Vulnerability of Indian Agriculture to Climate Change, Central Research Institute for Dryland Agriculture, Hyderabad, 2013

DOWN TO EARTH

State-wise projections and impacts

Gujarat



Impact and vulnerabilities:
 ■ Junagadh and Porbandar districts to witness increased intensity and frequency of cyclones
 ■ Rainfall to increase by 6-8% in the western coast by the 2030s

Maharashtra



Impact and vulnerabilities:
 ■ Sea level rise of one metre will inundate 0.18 per cent of the state
 ■ Thane has the highest vulnerability to climate change

Karnataka



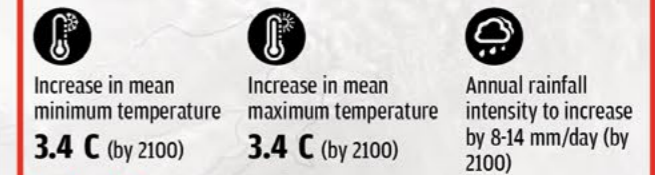
Impact and vulnerabilities:
 ■ In Dakshina Kannada and Udupi, 28% coast has reported erosion
 ■ 10-15% decline in rice yield by 2050

Kerala



Impact and vulnerabilities:
 ■ Coconut yields are projected to increase by 30%

Tamil Nadu



Sea level rise: 0.32 mm/year
Impact and vulnerabilities:
 ■ Sea water intrusion will impact drinking water sources; 13 districts already affected
 ■ Six coastal districts to witness intense cyclones

Andhra Pradesh



Impact and vulnerabilities:
 ■ Reduction of fish catch in coastal areas
 ■ Temperature fluctuation will negatively impact winter crop
 ■ Coconut production to increase by 10%

Odisha



Impact and vulnerabilities:
 Cyclonic intensity to increase during July-October by 2020s

West Bengal



Impact and vulnerabilities:
 ■ Sea surge heights may increase to 7.46 metres
 ■ Kolkata hardest hit by sea level rise, risking one million people and assets worth US \$2 trillion
 ■ Potato production may decline by 4-16% by 2030s

A one-metre rise in sea level will displace **7.1 million** people in India

Andaman & Nicobar Islands

■ There is no projected trend on rainfall and temperature, but a rise in sea surface temperature of approximately 1 C above the normal maximum summer temperature over the past 20 years has led to bleaching events
 ■ The sea level along the islands' coast has been rising at above 1.3 mm/year

Lakshadweep

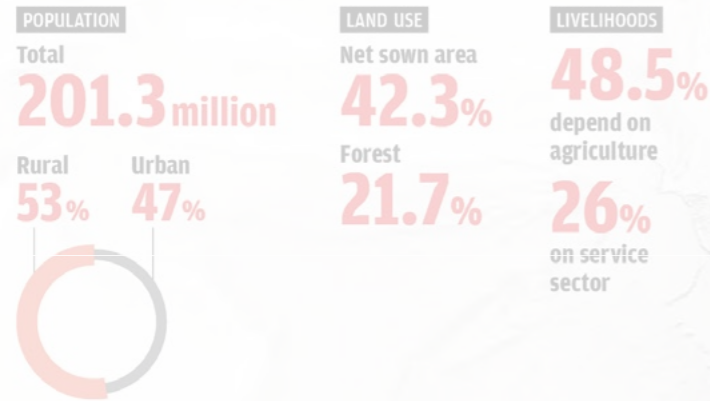
■ No projections for temperature and there is no observed change in rainfall in past 30 years
 ■ But in the past 40 years, the observed sea level rise was 1.06-1.75 mm/year
 ■ Projections indicate an estimated loss of 10-40% in crop production by 2100



www.downtoearth.org.in

The coast and islands

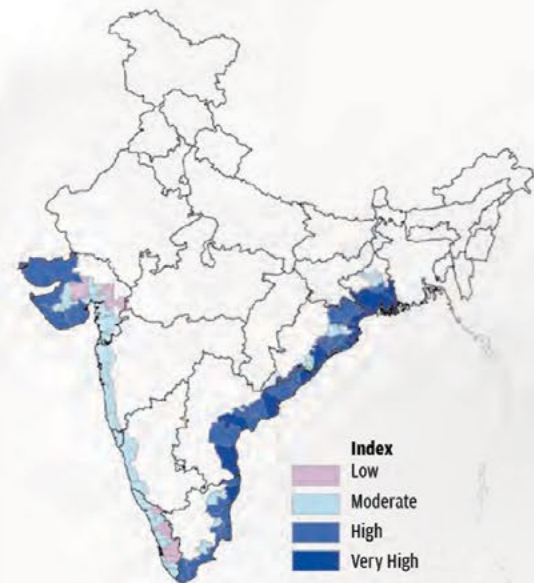
The 7,517 kilometre Indian coast can be divided into the west coast, the eastern coastal plain and the biodiversity-rich Indian islands. The region is already witnessing climate change impacts like frequent, severe cyclones and sea level rise



CLIMATE CHANGE TRENDS

Cyclone

The Kutch region in Gujarat and the entire eastern coastal region are projected to have the highest incidence of cyclone



A one-metre rise in sea level will displace **7.1 million** people in India

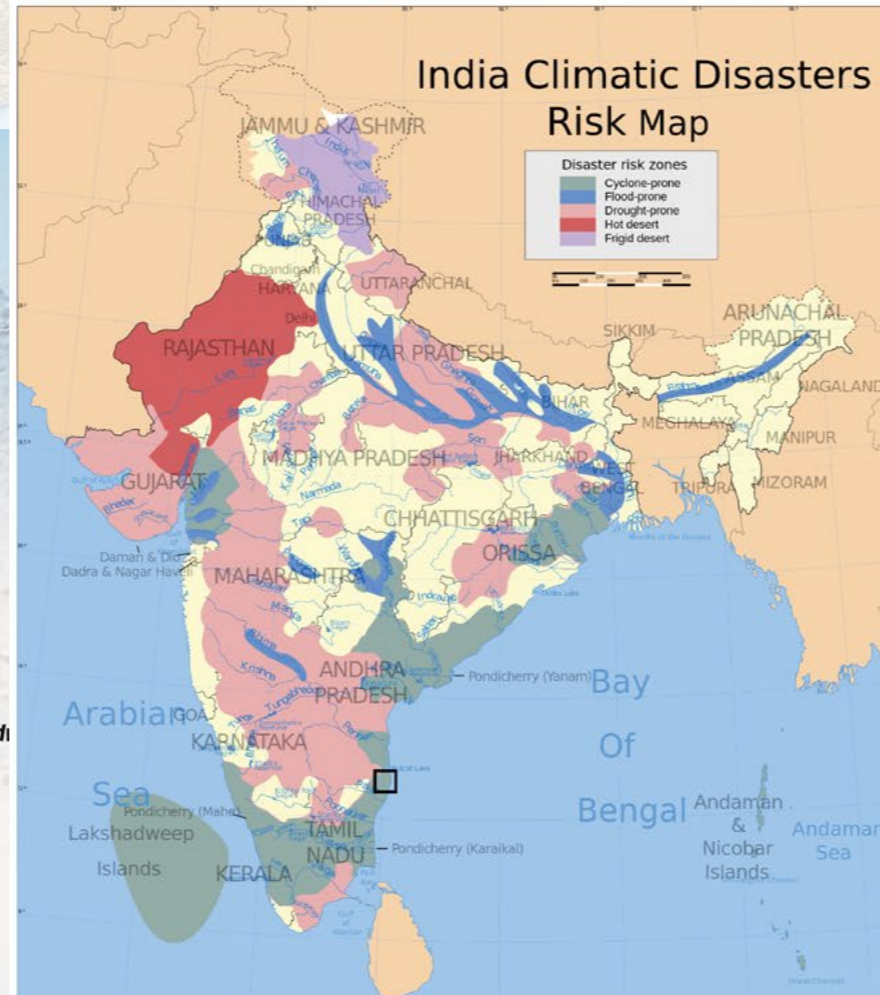
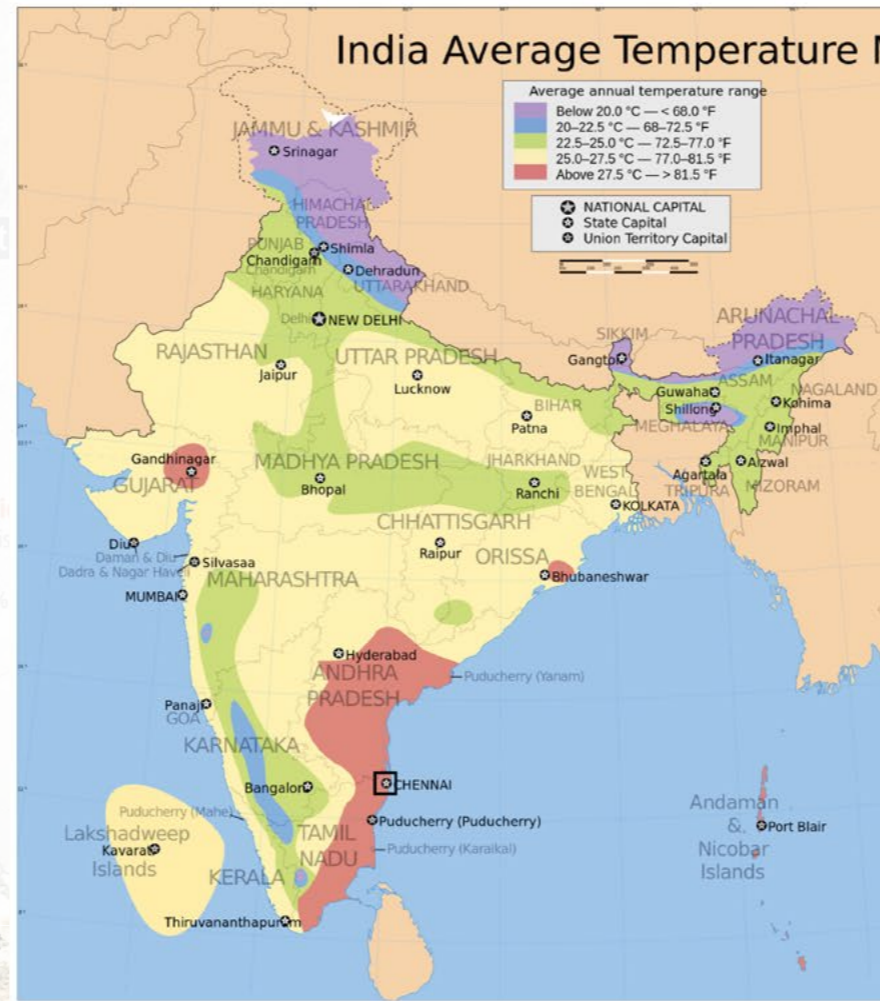
Source: Rama Rao C.A., et al., Atlas on Vulnerability of Indian Agriculture to Climate Change, Central Research Institute for Dryland Agriculture, Hyderabad, 2013

DOWN TO EARTH

State-wise project

Gujarat

Decrease in mean minimum temperature: **0.5 C** (1891-1996)
Impact and vulnerabilities:
■ Junagadh and Porbandar districts face increase in frequency of cyclones
■ Rainfall to increase by 6-8%



Andhra Pradesh

Increase in temperature (for coastal areas): **2.1 C** (by 2030)
No. of rainy days to decrease; intensity of rainfall to rise by 1-4 mm/day
Sea level rise: **1.3 mm ± 0.7 mm/year**

Impact and vulnerabilities:
■ Coconut yields are projected to increase by 30%

Tamil Nadu

Increase in mean minimum temperature: **3.4 C** (by 2100)
Increase in mean maximum temperature: **3.4 C** (by 2100)
Annual rainfall intensity to increase by 8-14 mm/day (by 2100)
Sea level rise: **0.32 mm/year**

Impact and vulnerabilities:
■ Sea water intrusion will impact drinking water sources; 13 districts already affected
■ Six coastal districts to witness intense cyclones

West Bengal

Increase in temperature: **2.5 C** (by 2080s as compared to 2020s)
Modest increase in future

Impact and vulnerabilities:
■ Reduction of fish catch in coastal areas
■ Temperature fluctuation will negatively impact winter crop
■ Coconut production to increase by 10%

Odisha

Increase in temperature (in coastal areas by 2021-50): **1.5 C-2.0 C**
Fewer rainy days with high intensity (by 2020s)

Impact and vulnerabilities:
Cyclonic intensity to increase during July-October by 2020s

Nicobar Islands

Observed trend on rainfall and rise in sea surface temperature over the past 30 years has led to bleaching events along the islands' coast has been 1.3 mm/year

Andaman & Nicobar Islands

Temperature and there is a decrease in rainfall in past 30 years. In the last 10 years, the observed sea level rise is 1.75 mm/year. This rate an estimated loss of production by 2100

West Bengal

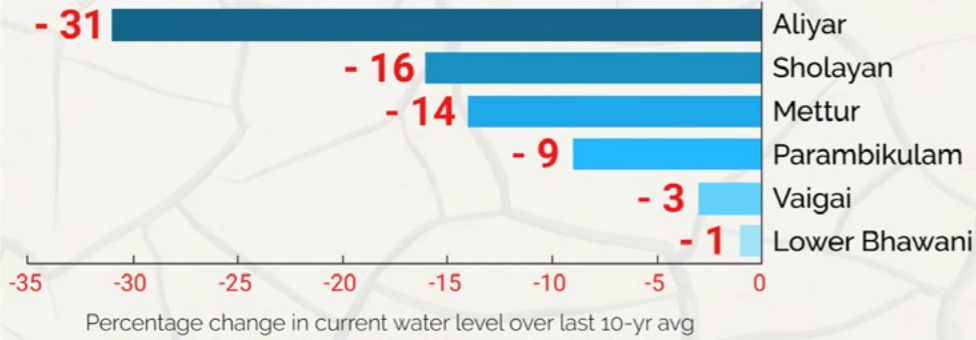
Increase in temperature: **1.8 C-2.4 C** (by 2021-50)
Little or no change expected
Sea level rise: Sea level rise will be higher than global rate

Impact and vulnerabilities:
■ Sea surge heights may increase to 2.46 metres
■ Kolkata hardest hit by sea level rise, risking one million people and assets worth US \$2 trillion
■ Potato production may decline by 4-16% by 2030s

www.downtoearth.org.in

Water Crisis in Tamil Nadu

The situation is critical as the current water level is lower than the 10-year average



A city gone dry: on Chennai water crisis

JUNE 26, 2019 00:02 IST
UPDATED: JUNE 25, 2019 23:46 IST

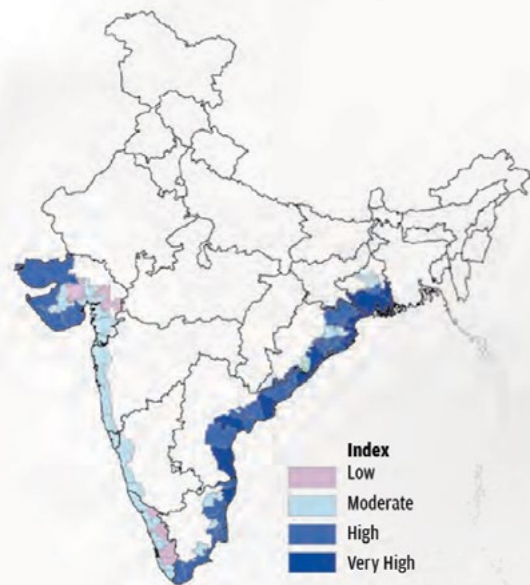
SHARE ARTICLE | f | t | r | w | e | 25 | PRINT | A | A | A

The water crisis in Chennai needs holistic and widely resonant solutions

Chennai's aspirations to grow into a global economic hub appear considerably weakened as it **struggles to find water**. The shadow of drought from 2018 has stretched into the torrid summer this year, evaporating not just the city's reservoirs, but the prosperity of its residents who are forced to hunt for tankers, pay bribes and spend hours even at night waiting for trucks to dispense some water. Ironically, Tamil Nadu's capital, which in a normal year

Cyclone

The Kutch region in Gujarat and the entire eastern coastal region are projected to have the highest incidence of cyclone

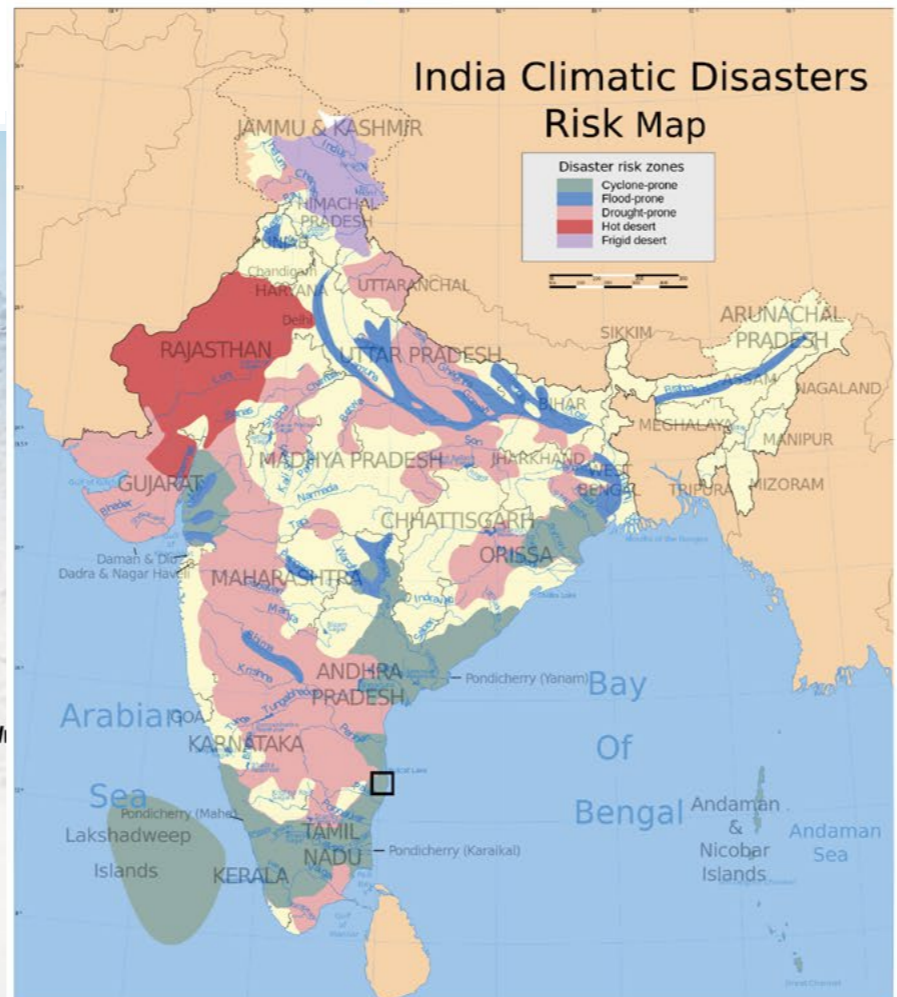
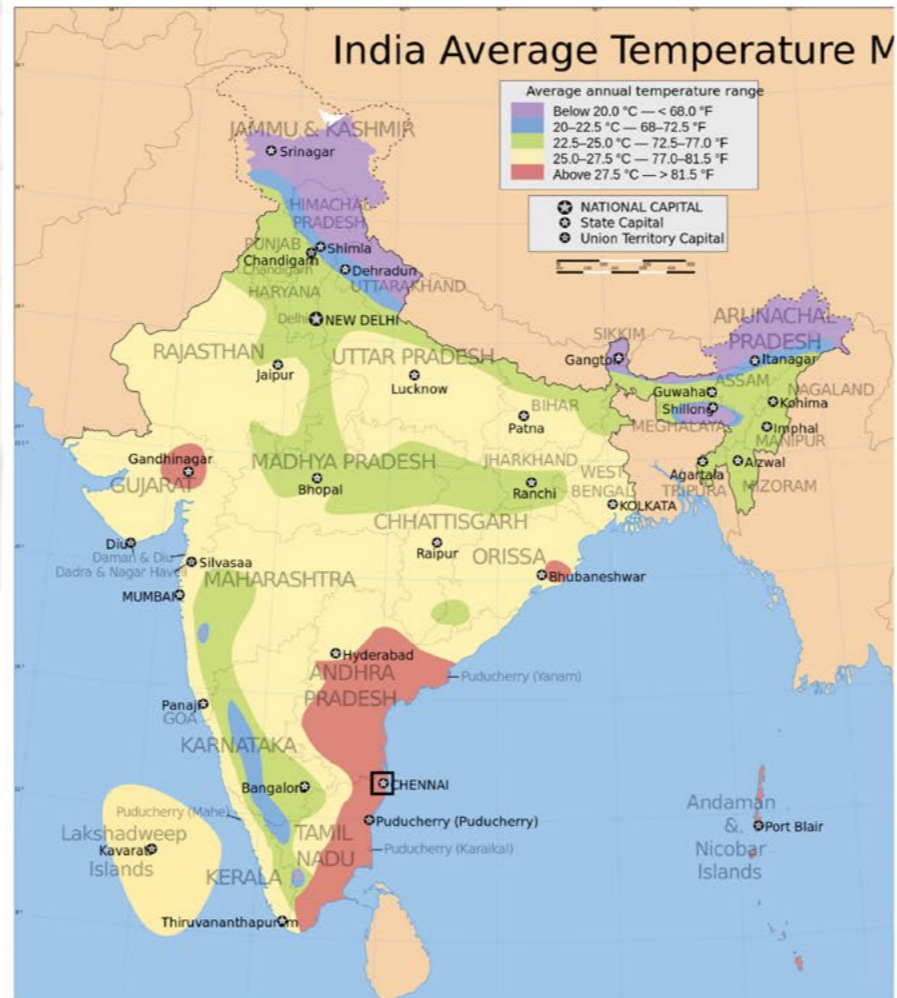


A one-metre rise in sea level will displace **7.1 million** people in India

Source: Rama Rao C.A., et al., Atlas on Vulnerability of Indian Agriculture to Climate Change, Central Research Institute for Dryland Agriculture, Hyderabad, 2013

DOWN TO EARTH

Source: Down To Earth



ENVIRONMENT

Chennai floods due to climate change?

K.S. Rajgopal

DECEMBER 13, 2015 17:00 IST
UPDATED: MARCH 24, 2016 15:35 IST

SHARE ARTICLE | f | t | r | w | e | 3 | PRINT | A | A | A

Tamil Nadu

- Increase in mean minimum temperature: **3.4 C** (by 2100)
- Increase in mean maximum temperature: **3.4 C** (by 2100)
- Annual rainfall intensity to increase by 8-14 mm/day (by 2100)
- Sea level rise: **0.32 mm/year**

Impact and vulnerabilities:

- Sea water intrusion will impact drinking water sources; 13 districts already affected
- Six coastal districts to witness intense cyclones

Coconut yields are projected to increase by 30%

Sea surface temperatures were above normal.

THE HINDU

'Global warming alters rainfall pattern'

Scientists say that a shift in a key weather system is stimulating cyclones in the Bay of Bengal

JACOB KOSHY

NEW DELHI

Global warming has altered a key weather system and that may be whetting cyclones in the Bay of Bengal, decreasing winter rain in north India and altering global rainfall patterns, a study by a team of Indian and U.S. researchers has found.

The Madden-Julian Oscillation (MJO), as it's called, is a moving band of rain clouds that travels around the globe spanning 12,000-20,000 km across the tropical oceans. In its journey, it interacts with surface waters of the Indo-Pacific ocean, the largest pool of warm water in the globe, and due to this - the authors say - the lifecycle of the MJO gets affected.

The MJO clouds on average are spending only 15 days, instead of 19, over the Indian Ocean.

Over the west Pacific, it increased by five days (from an



After the gale: In this photo dated November 19, 2019, men are clearing debris from their damaged house after cyclone Bulbul hit the area in Namkhana, West Bengal.

average 16 days to 23 days). "It is this change in the residence time of MJO clouds that has altered the weather patterns across the globe," according to the research paper that appears in the latest edition of the journal *Nature*.

When the MJO appears in the Indian Ocean during the

monsoon months of June-September, it can increase rains over India. This year, India was poised to receive below normal monsoon rainfall in April but ended up with excessive rain partly due to the MJO.

The study, led by Roxy Mathew Koll, a researcher at the Indian Institute of Tropi-

cal Meteorology, Pune doesn't delve into the impact of the MJO during the monsoon months. However, Mr. Koll told *The Hindu*, the change in the MJO could drift warmer surface water towards the Bay of Bengal and increase cyclones. "The MJOs haven't been as extensively studied as say the El Nino. This study shows that we need better observation of the Indian Ocean and improve forecasts that can warn us about a cyclone."

Ocean temperatures
To compute the reduction in the number of MJO days over the Indian Ocean, the researchers - they included scientists from the U.S. National Oceanic and Atmospheric Administration (NOAA), the University of Washington and the University of Tokyo - compared the ocean temperatures from 1981-2018 to compute the

changes. Global warming has been expanding the size of the warm pool on average by 2,300 sq. km. annually from 1900-2018 and at an accelerated average rate of 4,000 sq. km. per year during 1981-2018.

The changes in MJO behaviour have increased the rainfall over northern Australia, west Pacific, Amazon basin, southwest Africa and southeast Asia (Indonesia, Philippines and Papua New Guinea).

At the same time these changes have brought a decline in rainfall over central Pacific, along the west and east coast of U.S. (e.g., California), north India, east Africa and the Yangtze basin in China. The frequent California fires, droughts in Africa and East Asian floods and cyclones in the Bay of Bengal may be linked to these changes in global weather, the study noted.

Indian Ocean getting warmer, say scientists

Marine heatwaves are affecting monsoon cycle by weakening it, destroying coral reefs, weather condition on land, claim IITM experts

Himanshu Nitwaware

@himanshu_nitwaware

TWEETS @HimanshuNitwaware

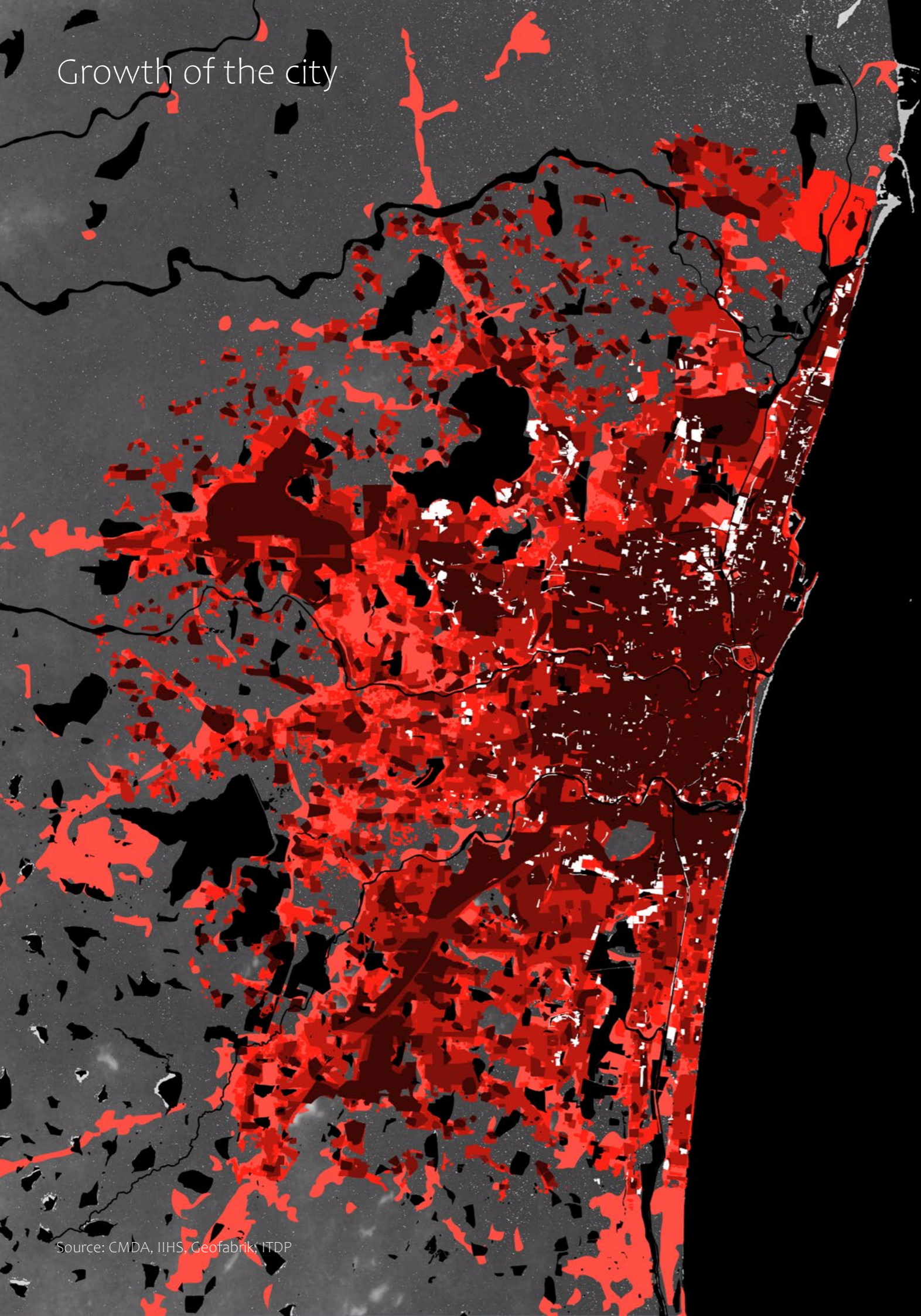
While climate change and global warming have become major talking points across the world, a recent study conducted by scientists of Indian Institute of Tropi-



cal Meteorology, Pune, said. "The Indian Ocean is warmer compared with other oceans. Warming directly affects circulation and flow. The monsoon is weakening, and with fewer rains there is rise in temperature of the ocean and land, thus having reciprocal effects on each other."

Elaborating further, Swapna Parthasarathy, another scientist attached with IITM, said, "The Indian Ocean is warmer compared with other oceans. Warming directly affects circulation and flow. The monsoon is weakening, and with fewer rains there is rise in temperature of the ocean and land, thus having reciprocal effects on each other."

Growth of the city



LEGEND

- Urbanisation - 1973
- Urbanisation - 1980
- Urbanisation - 1991
- Urbanisation - 2006
- Urbanisation - 2006
- Slums
- Water bodies



Source: CMDA, IIHS, Geofabrik, ITDP



Source: Vivek Sundararaman



Source: Seekanpaul Arumainathan



Source: Krishna Narendran

Informal settlements



Source: Wikipedia



Source: Wikipedia



Source: Wikipedia



Source: Citizen Matters

Encroachment



Source: Google Earth



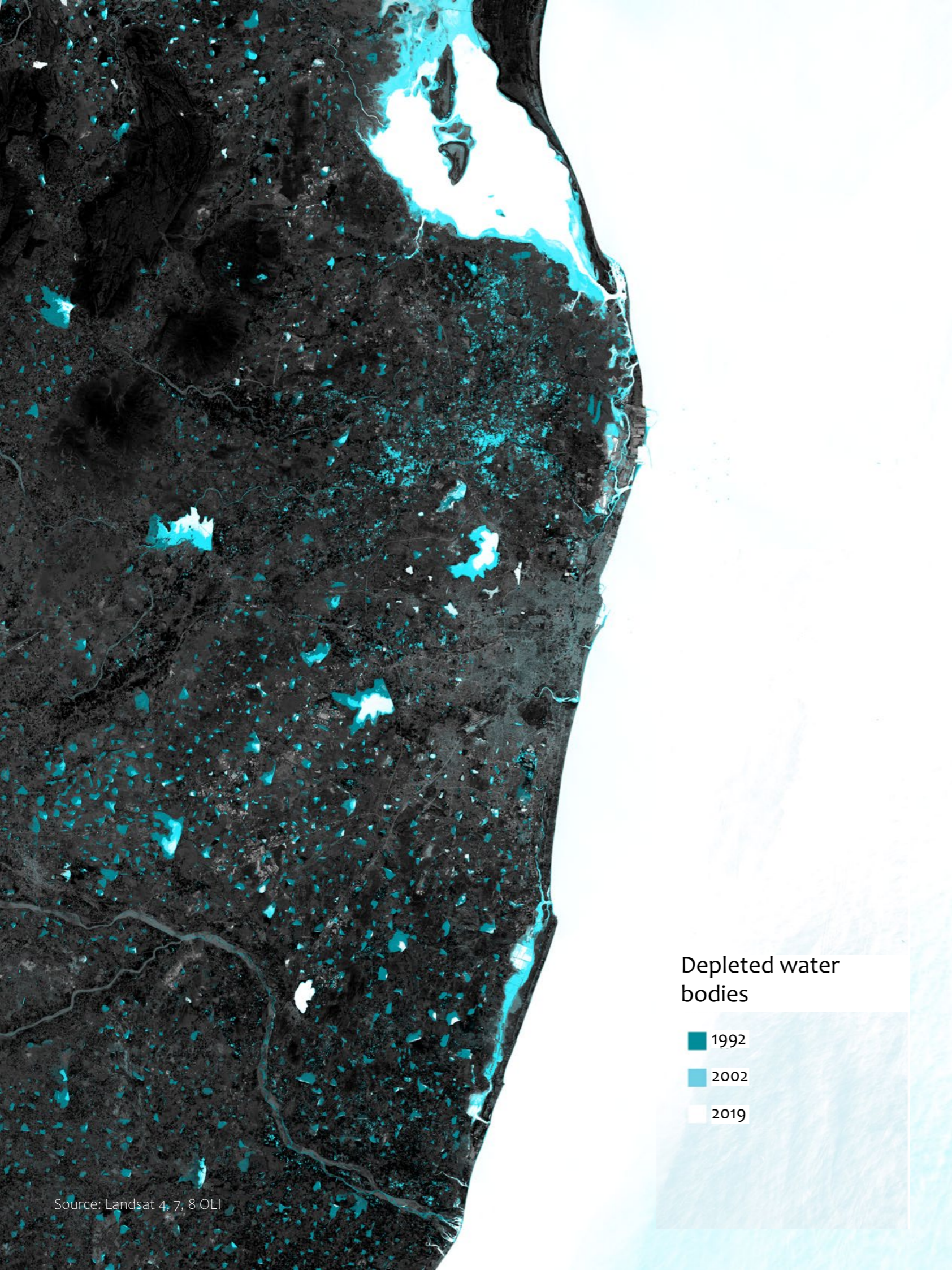
Source: anidiotsraveldiaries.blogspot.in



Source: DT Next



Source: Seekanpaul A



Depleted water bodies

- 1992
- 2002
- 2019

Source: Landsat 4, 7, & OLI

Depleted wetlands



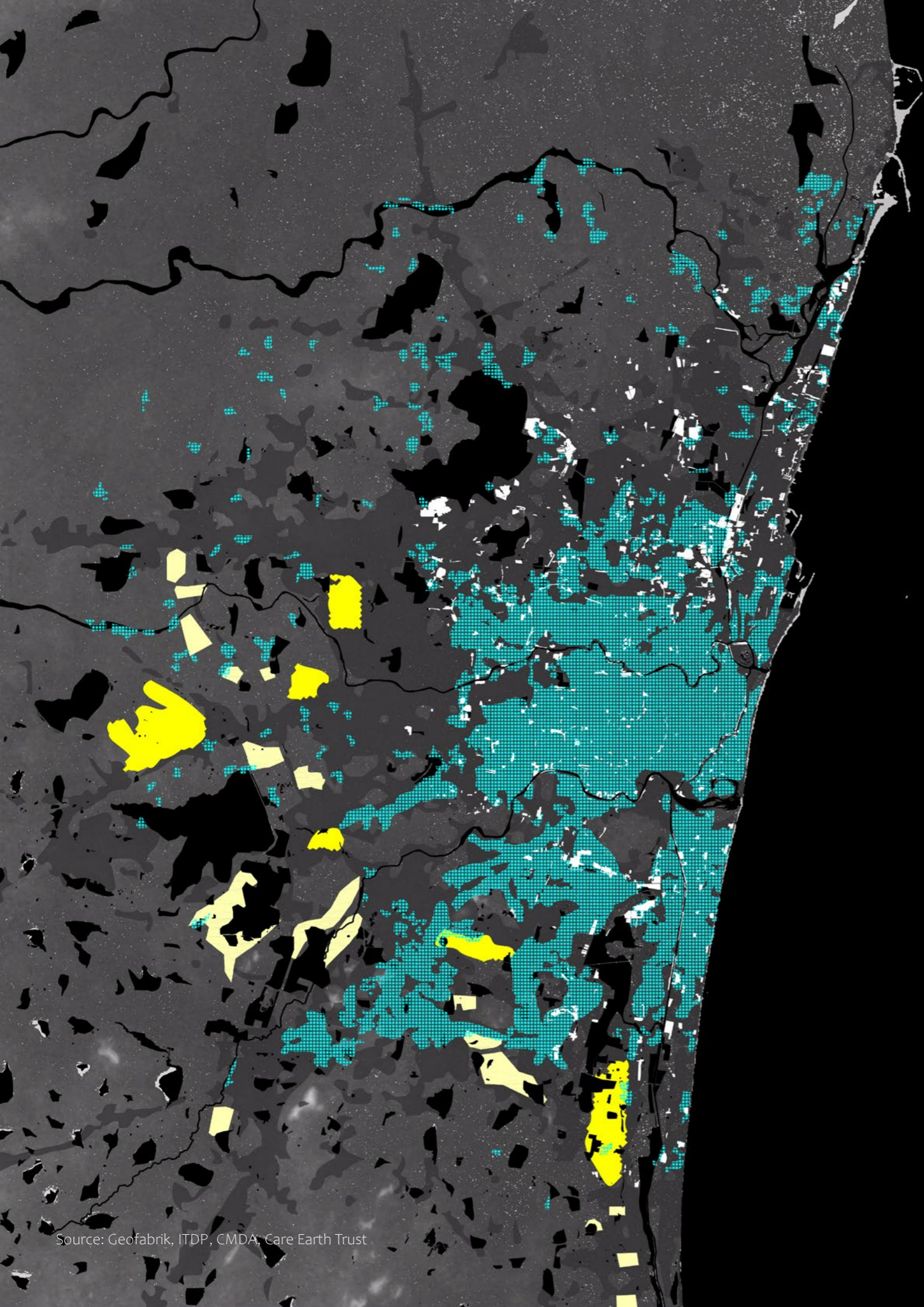
Source: Google Earth

Effects of climate events

Tsunami - 2004

Floods - 2015

Cyclone Vardah - 2016



LEGEND

- Inundated area - 2015 flood (special instance)
- Urbanisation - 2017
- Land proposed for acquisition
- Land identified for future use
- Slums
- Water bodies

0 2.5 5 7.5 km



Source: Daily Mail



Source: The Hindu

Response effects



Source: Geofabrik, ITDP, CRRT



Figure 2: Restoration Plan of Adyar Creek (58 acres). Retrieved from: http://www.chennai-rivers.gov.in/Adyar-Poonca-Phase1/images/location_big.jpg

Source: CRRT

Slums to make way for parks in Chennai

Aloysius Xavier Lopez

CHENNAI, AUGUST 21, 2015 00:00 IST
UPDATED: MARCH 29, 2016 16:31 IST

SHARE ARTICLE | f | t | r | w | e | o | PRINT | A | A | A

Over 14,000 houses along the Cooum to be demolished -Photo: R. Ragu

Source: The Hindu

Basic facilities elude residents of TNSCB tenements

Vivek Narayanan

CHENNAI, SEPTEMBER 02, 2019 00:28 IST
UPDATED: SEPTEMBER 02, 2019 00:57 IST

SHARE ARTICLE | f | t | r | w | e | o | PRINT | A | A | A

Water, sanitation and healthcare are long-pending demands

Source: The Hindu



Slum eviction along Cooum to end before monsoon

SPECIAL CORRESPONDENT

CHENNAI, SEPTEMBER 27, 2019 00:39 IST
UPDATED: SEPTEMBER 27, 2019 04:24 IST

SHARE ARTICLE | f | | | | | | | | | | PRINT | A | A | A



Corporation Commissioner G. Prakash says slum-dwellers will be 'resettled with dignity'. | Photo Credit: M. Karunakaran

Chennai's displacement dilemma: Will 2 lakh residents be resettled?

Vivek Narayanan | Aloysius Xavier Lopez

NOVEMBER 10, 2019 06:34 IST
UPDATED: NOVEMBER 10, 2019 11:25 IST

SHARE ARTICLE | f | | | | | | | | | | PRINT | A | A | A

CHENNAI Evictions along Buckingham Canal soon

Vivek Narayanan

CHENNAI, JANUARY 22, 2019 00:48 IST
UPDATED: JANUARY 22, 2019 00:48 IST



With the Tamil Nadu government expected to make a decision on the eco-restoration of the Buckingham Canal this month, over 2 lakh residents are keeping their fingers crossed.

HC orders eviction of all families from Cooum banks

Mohamed Imranullah S.

CHENNAI, NOVEMBER 29, 2017 00:48 IST
UPDATED: NOVEMBER 29, 2017 00:48 IST

SHARE ARTICLE | f | | | | | | | | | | PRINT | A | A | A



NGO moves HC against eviction of slum-dwellers

SPECIAL CORRESPONDENT

CHENNAI, DECEMBER 28, 2017 07:53 IST
UPDATED: DECEMBER 28, 2017 18:34 IST

SHARE ARTICLE | f | | | | | | | | | | PRINT | A | A | A



For resettled residents of Chennai, distance and poor quality of homes continue to be issues

Vivek Narayanan

CHENNAI, DECEMBER 25, 2019 14:15 IST
UPDATED: DECEMBER 25, 2019 14:15 IST

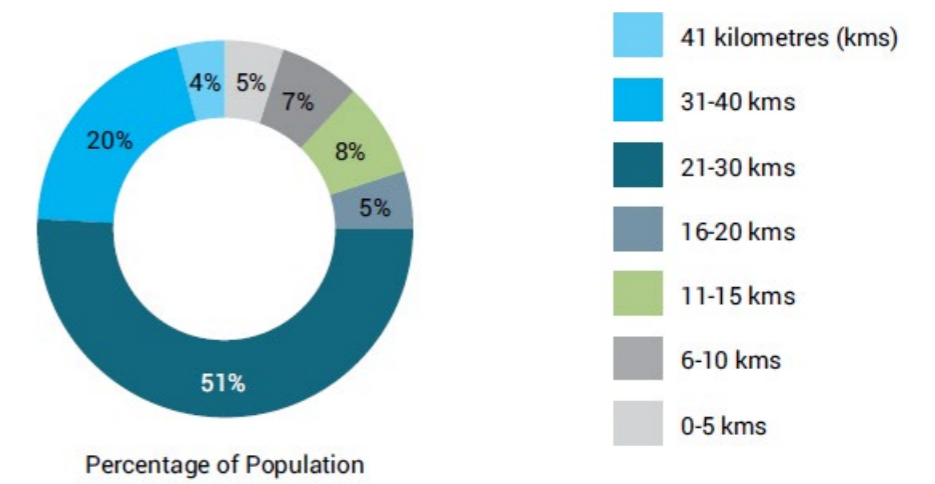
Response effects

Response effects



Source: Divya, Annie. A view of the multistoried Perumbakkam Resettlement Colony built by Tamil Nadu Slum Clearance Board.

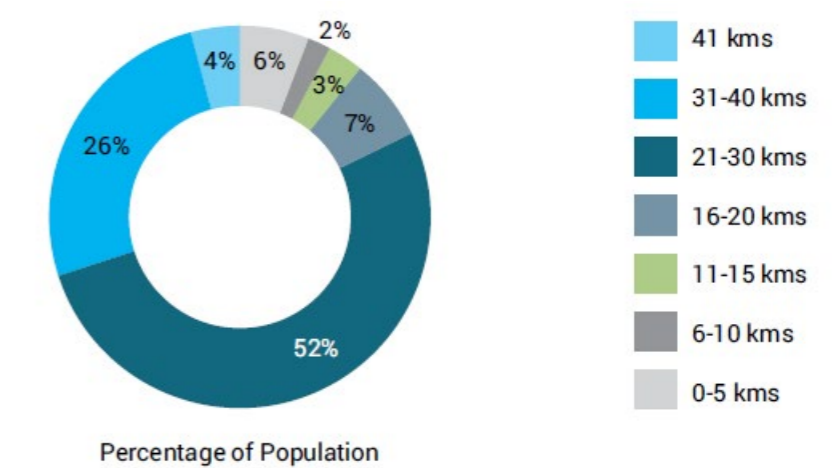
Distance of workplace from tenements



Perumbakkam



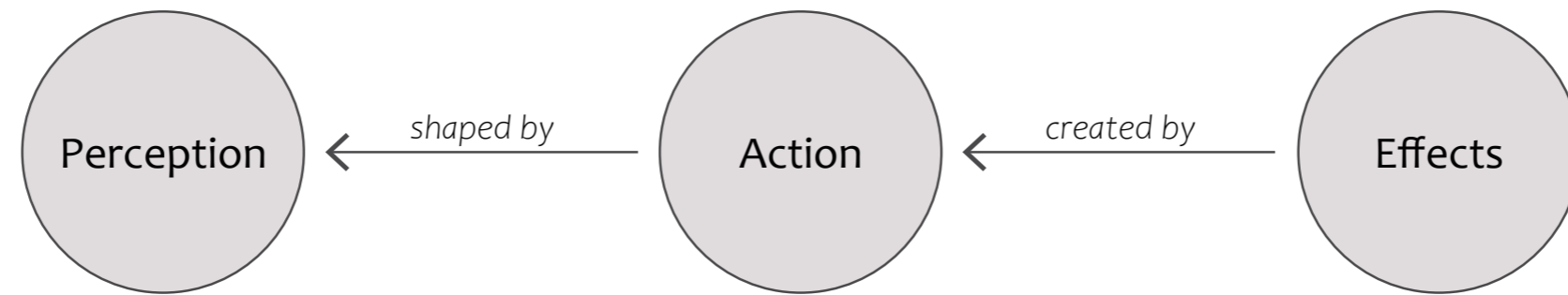
Source: TNSCB resettlement tenements at Ezhil Nagar seen flooded with sewerage water: a sorry state of affairs.



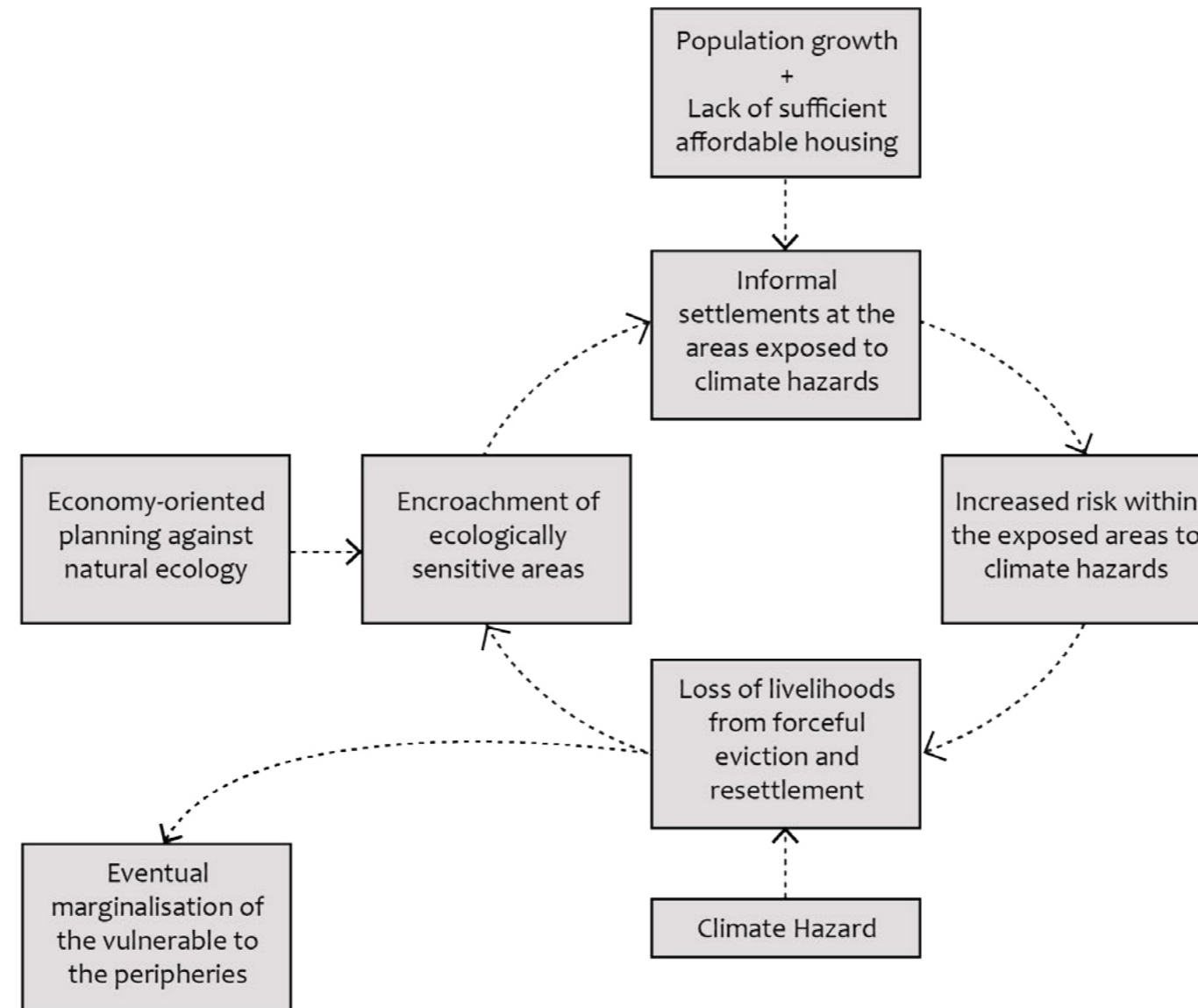
Ezhil Nagar

Source: The Hindu

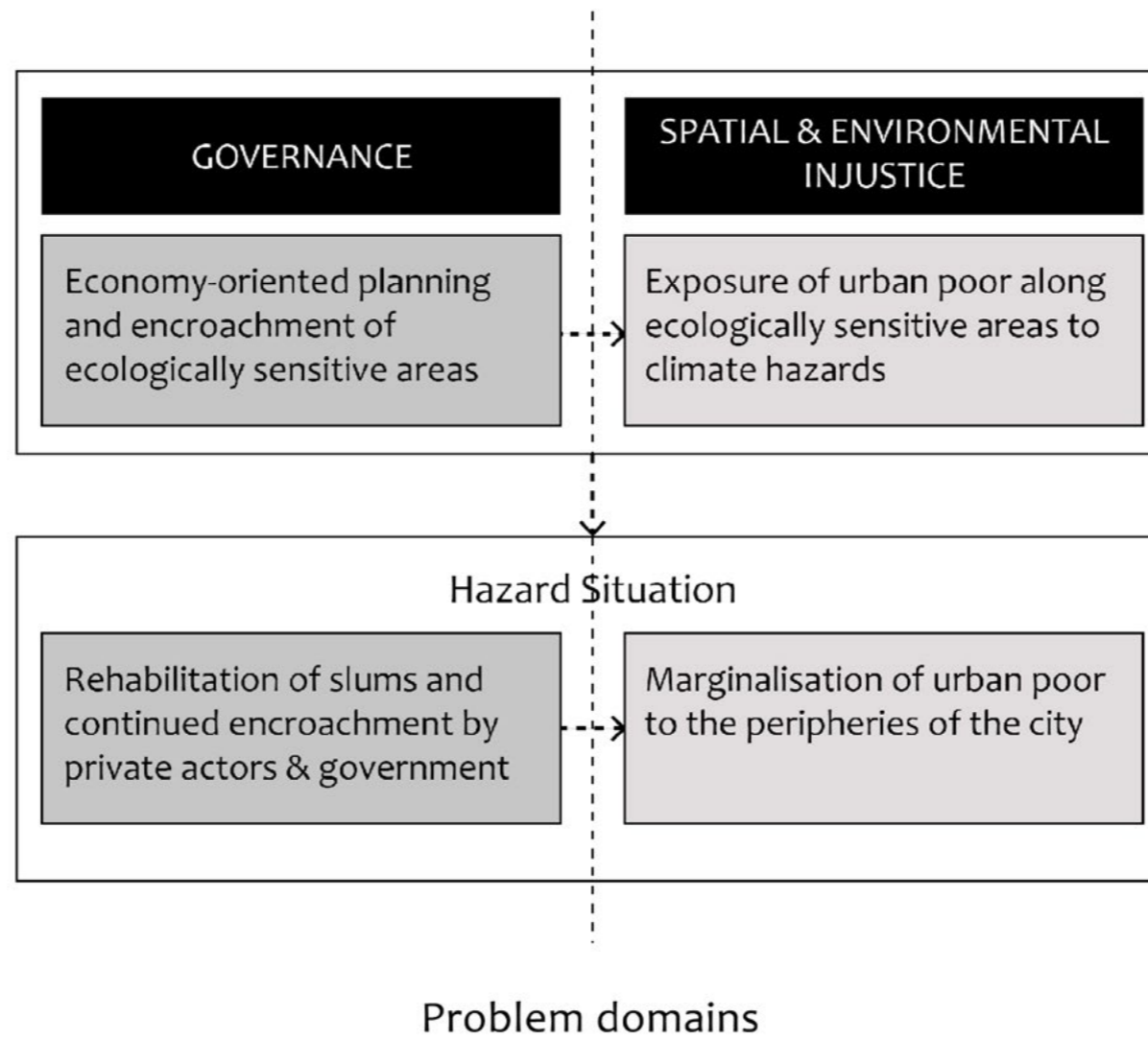
Problem



System at stake



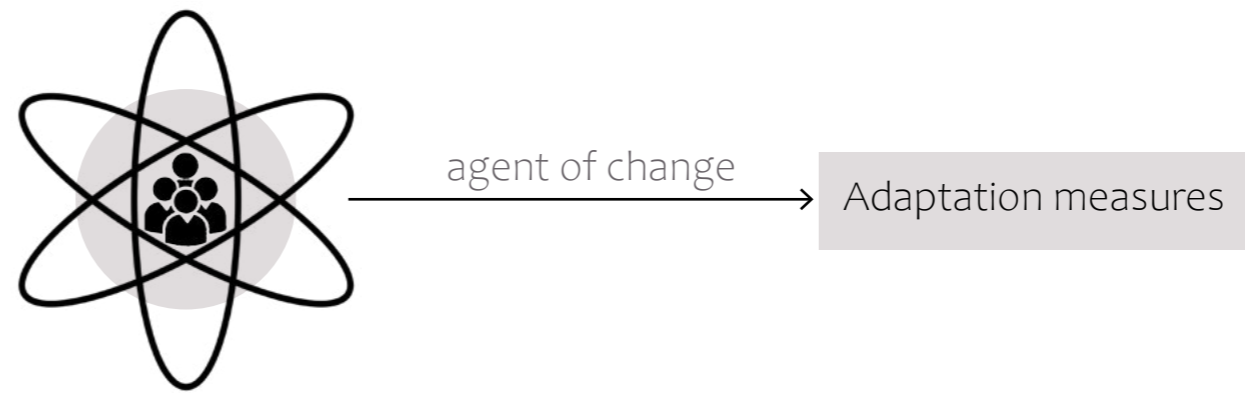
Problem Summary



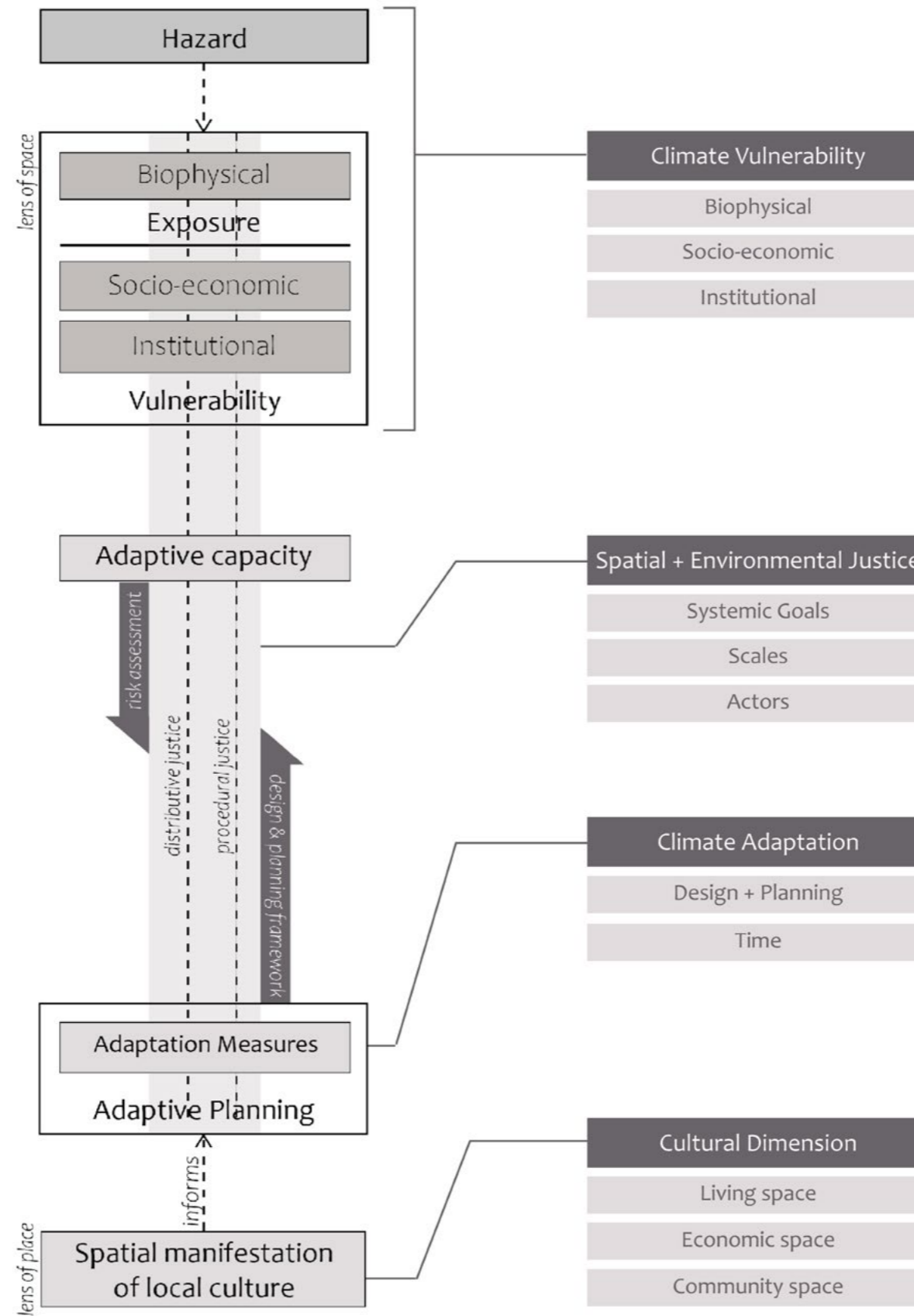
Problem Statement

The measures to rehabilitate the slums in the city lead to further marginalisation of the urban poor, whose voice are not included in the decision-making process, while the current planning processes continue to exacerbate the conditions for climate vulnerability through the encroachment of ecologically-sensitive areas.

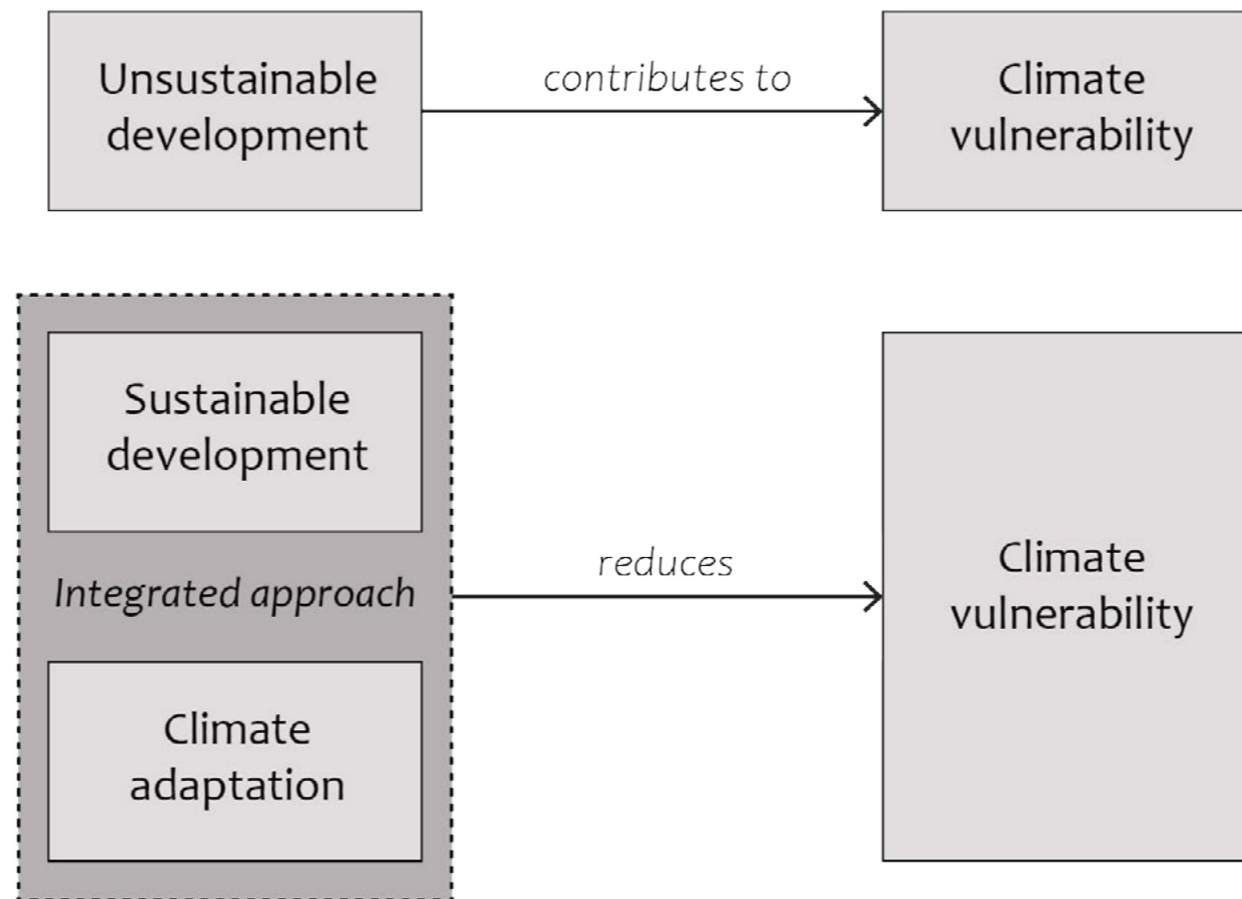
Research Aims



Conceptual Framework



Approach



Research Questions

Main Research Question

How can local adaptation measures in vulnerable areas contribute towards systemic mitigation of climatic effects in order to achieve environmental and spatial justice?

Research Questions

Main Research Question

How can local adaptation measures in vulnerable areas contribute towards systemic mitigation of climatic effects in order to achieve environmental and spatial justice?

Research Sub-Questions

RSQ 1. What are the spatial conditions that contribute to climate vulnerability in Chennai?

RSQ 2. How can local culture inform adaptation measures within CMA?

RSQ 3. How can adaptive planning contribute towards spatial justice?

RSQ 4. What are the spatial adaptation measures required to mitigate climate effects in vulnerable areas within CMA?

RSQ 5. To what extent can the proposed adaptive measures unfold within the current territorial decision-making process?

Process

Spatial Conditions that contribute to Climate vulnerability

Elements of Culture - Framing the challenge

Formulating the Adaptive Framework

Testing the Adaptive Framework

Implementing the Adaptive Framework

Spatial Conditions that contribute to Climate vulnerability

Elements of Culture - Framing the challenge

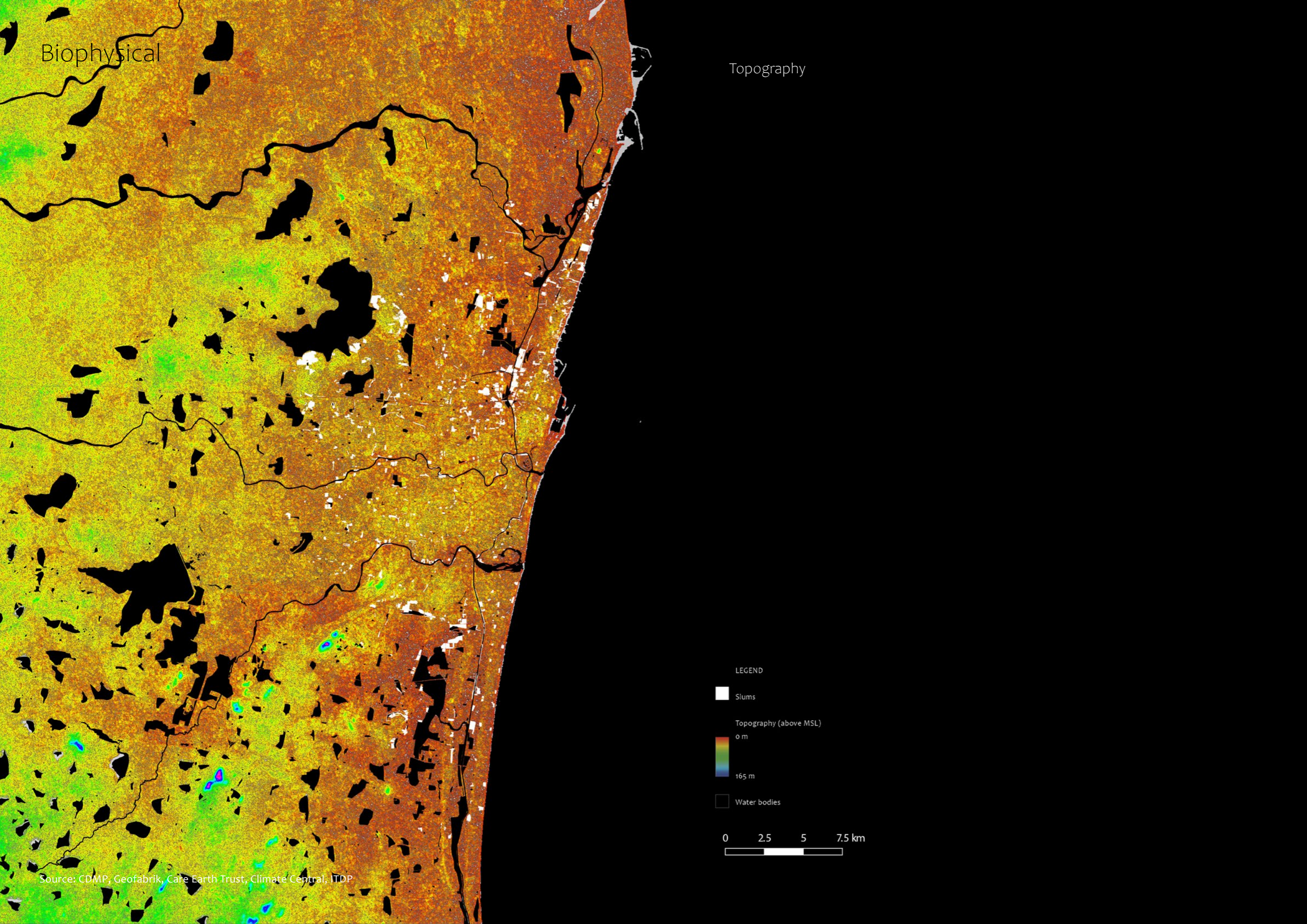
Formulating the Adaptive Framework

Testing the Adaptive Framework

Implementing the Adaptive Framework

Biophysical

Topography



LEGEND

Slums

Topography (above MSL)

0 m

165 m

Water bodies

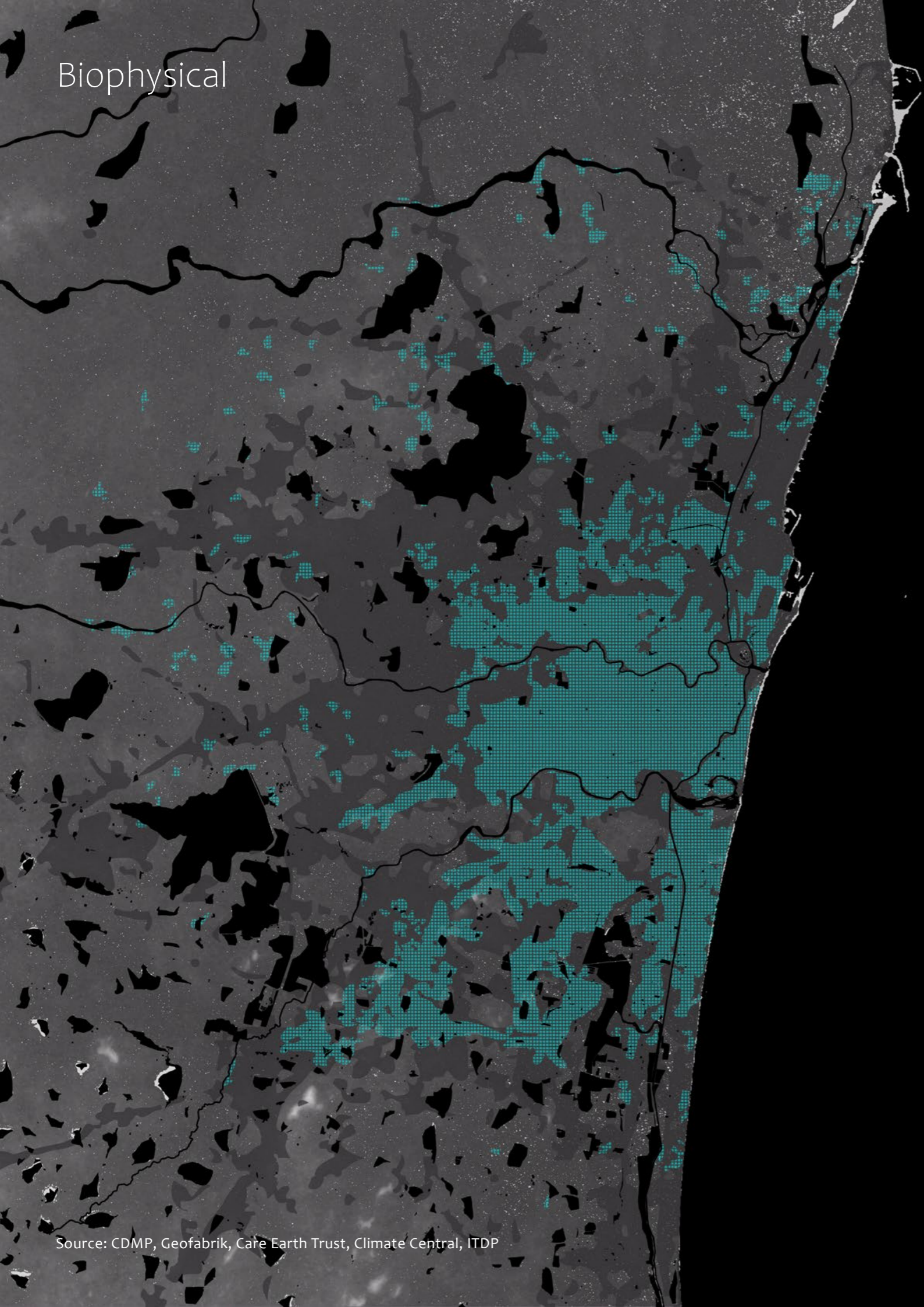
0 2.5 5 7.5 km



Biophysical

Topography

2015 Flooding event



LEGEND

- Buckingham canal - 60% untreated sewage
- Cooum river - 30% untreated sewage
- Adyar river - 10% untreated sewage

Slums

Inundation depth - field points (2015)

- < 0.5 m
- 0.5 - 1 m
- 1 - 1.5 m
- 1.5 - 2 m
- > 2 m

Zone-wise Chronic inundation locations



Coastal flooding due to sea level rise - 2050

2015 flooded areas

Water bodies



Biophysical

Topography

2015 Flooding event

Chronic inundation - 2015

LEGEND

- Buckingham canal - 60% untreated sewage
- Cooum river - 30% untreated sewage
- Adyar river - 10% untreated sewage

Slums

Inundation depth - field points (2015)

- < 0.5 m
- 0.5 - 1 m
- 1 - 1.5 m
- 1.5 - 2 m
- > 2 m

Zone-wise Chronic inundation locations



Coastal flooding due to sea level rise - 2050

2015 flooded areas

Water bodies



Biophysical

Topography

2015 Flooding event

Chronic inundation - 2015

Inundation depth - 2015

LEGEND

— Buckingham canal - 60% untreated sewage

— Cooum river - 30% untreated sewage

— Adyar river - 10% untreated sewage

■ Slums

Inundation depth - field points (2015)

● < 0.5 m

● 0.5 - 1 m

● 1 - 1.5 m

● 1.5 - 2 m

● > 2 m

Zone-wise Chronic inundation locations

80

0

■ Coastal flooding due to sea level rise - 2050

■ 2015 flooded areas

□ Water bodies

0 2.5 5 7.5 km

Biophysical

Topography

2015 Flooding event

Chronic inundation - 2015

Inundation depth - 2015

Projected coastal flooding - 2050

LEGEND

- Buckingham canal - 60% untreated sewage
- Cooum river - 30% untreated sewage
- Adyar river - 10% untreated sewage

Slums

Inundation depth - field points (2015)

- < 0.5 m
- 0.5 - 1 m
- 1 - 1.5 m
- 1.5 - 2 m
- > 2 m

Zone-wise Chronic inundation locations



Coastal flooding due to sea level rise - 2050

2015 flooded areas

Water bodies

0 2.5 5 7.5 km



Biophysical

Topography

2015 Flooding event

Chronic inundation - 2015

Inundation depth - 2015

Projected coastal flooding - 2050

Pollution of rivers/canal

LEGEND

- Buckingham canal - 60% untreated sewage
- Cooum river - 30% untreated sewage
- Adyar river - 10% untreated sewage

Slums

Inundation depth - field points (2015)

- < 0.5 m
- 0.5 - 1 m
- 1 - 1.5 m
- 1.5 - 2 m
- > 2 m

Zone-wise Chronic inundation locations



Coastal flooding due to sea level rise - 2050

2015 flooded areas

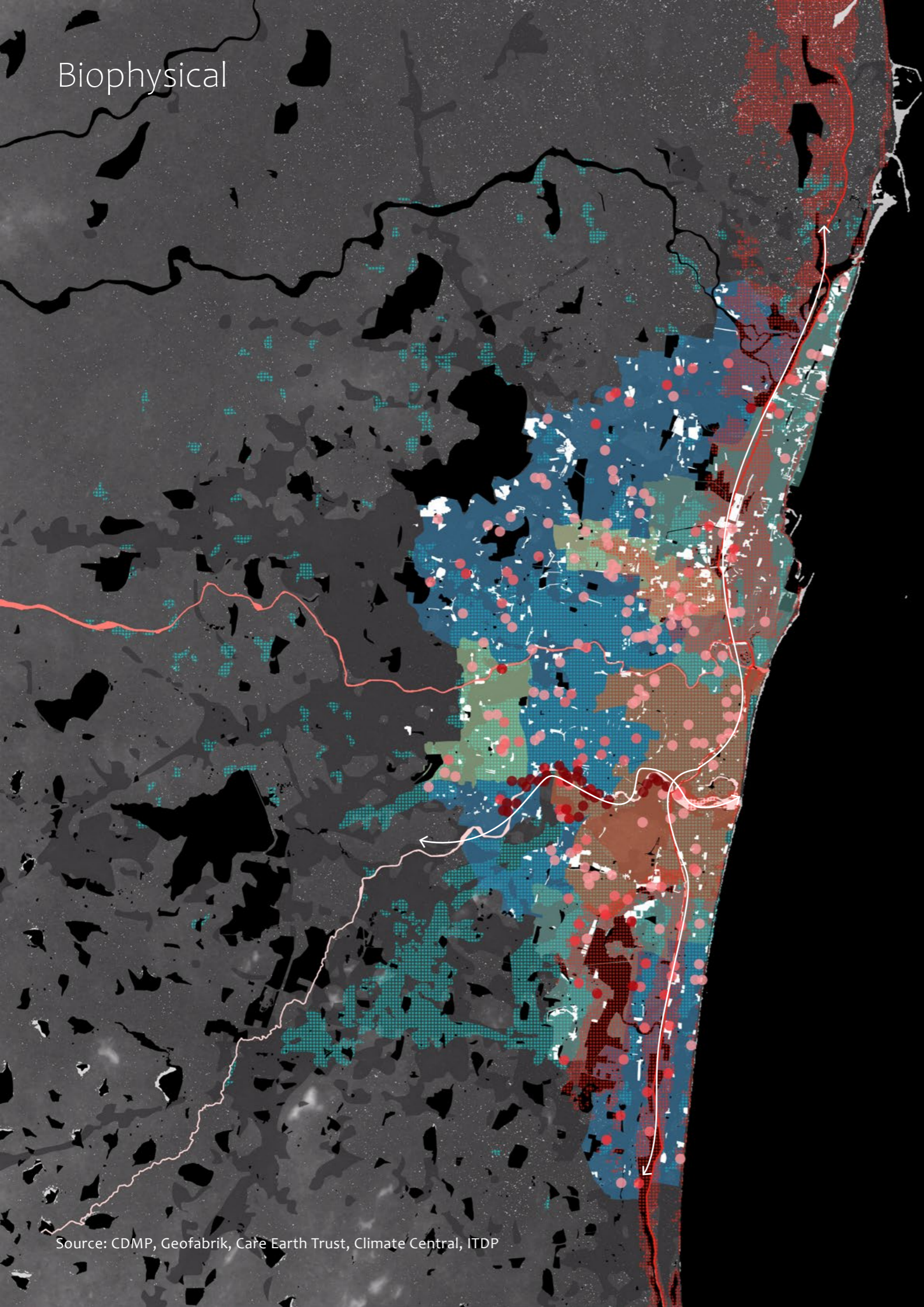
Water bodies

0 2.5 5 7.5 km



Biophysical

Areas with differing exposure to various climatic events - coastal and pluvial



LEGEND

- Buckingham canal - 60% untreated sewage
- Coom river - 30% untreated sewage
- Adyar river - 10% untreated sewage

Slums

Inundation depth - field points (2015)

- < 0.5 m
- 0.5 - 1 m
- 1 - 1.5 m
- 1.5 - 2 m
- > 2 m

Zone-wise Chronic inundation locations

- 80
- 0

Coastal flooding due to sea level rise - 2050

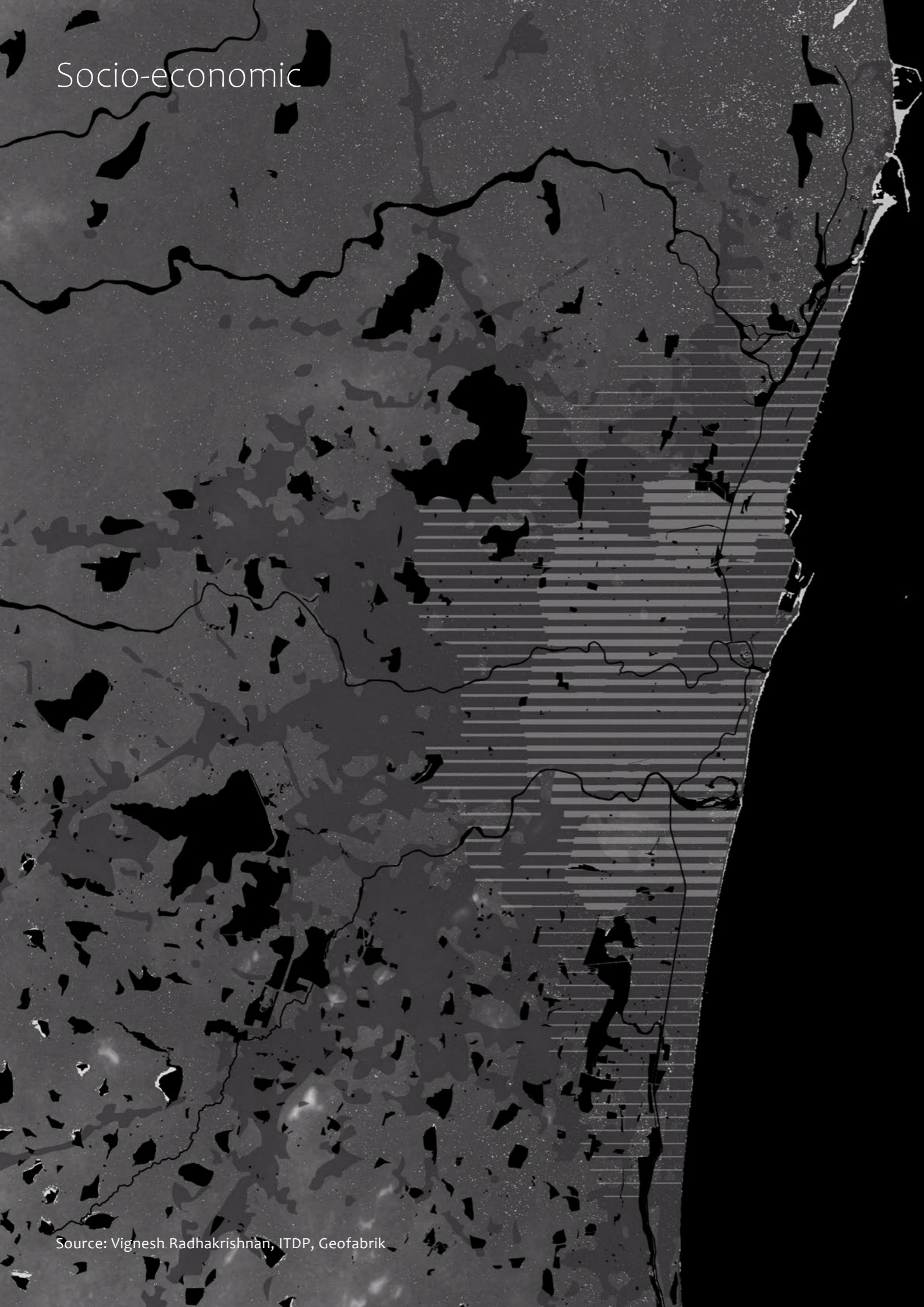
2015 flooded areas

Water bodies



Socio-economic

Slum population - zone



LEGEND

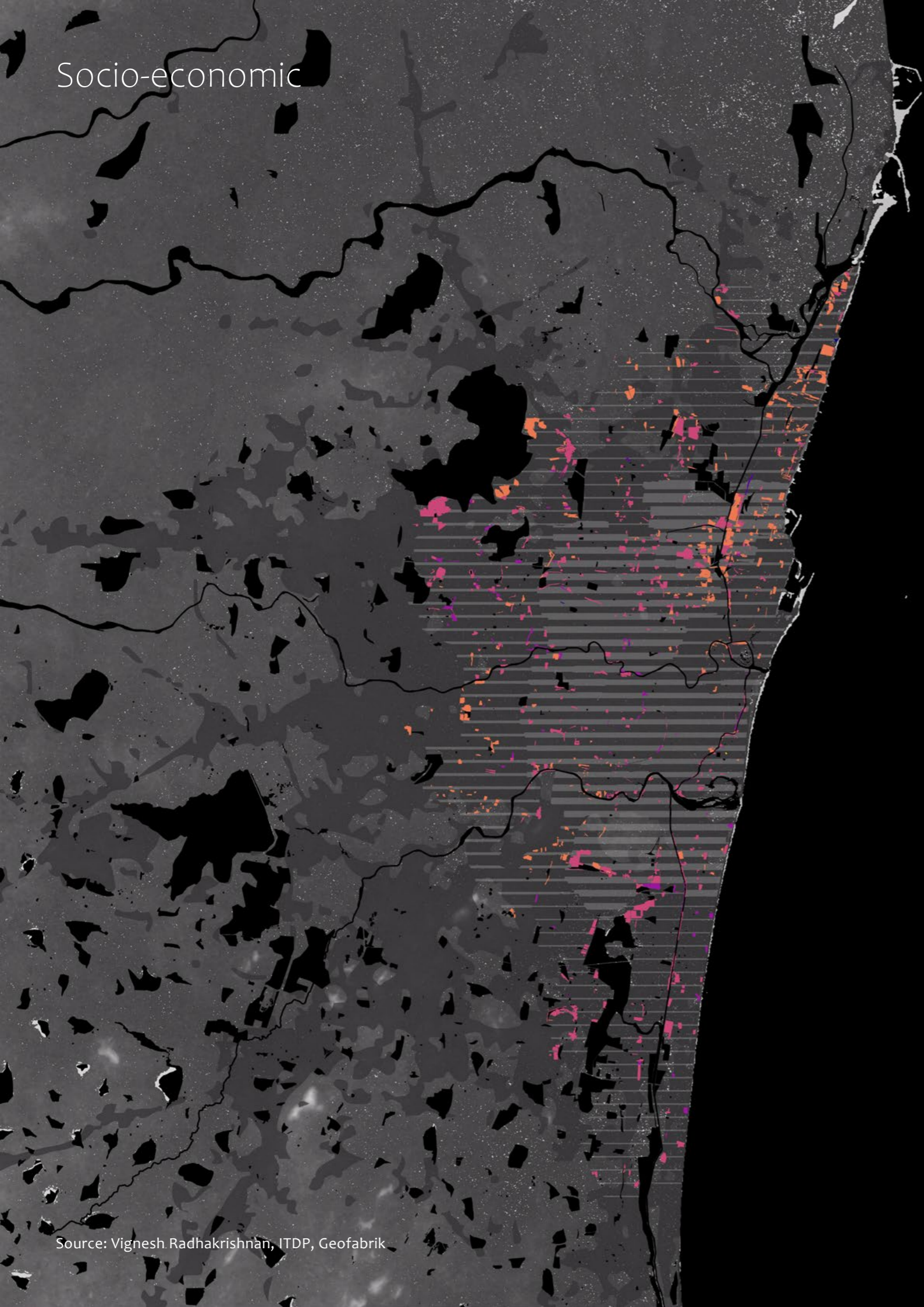
- Slums
- Employment percentage - slums
 - 60 - 70
 - 50 - 60
 - 40 - 50
 - 30 - 40
 - 20 - 30
 - 10 - 20
 - 0 - 10
- Primary, trunk and corridor roads
- Secondary and tertiary roads
- Other roads
- Bus stops
- Suburban rail stops
- Suburban rail
- Metro stops
- Metro line
- Slum population by zone
 - Minimum
 - Maximum
- Water bodies



Socio-economic

Slum population - zone

Employment percentage

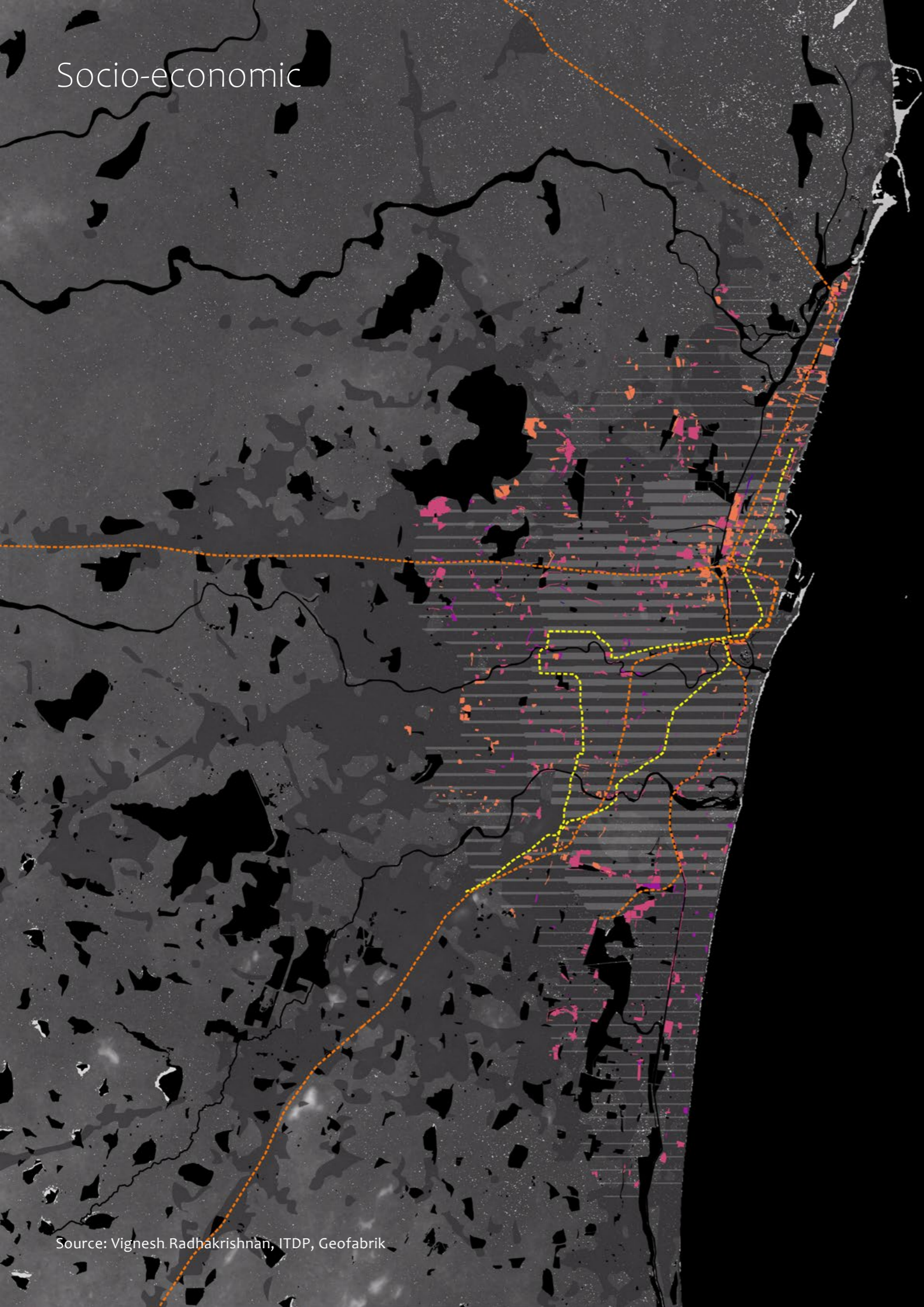


LEGEND

- Slums
- Employment percentage - slums
 - 60 - 70
 - 50 - 60
 - 40 - 50
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 - 20 - 30
 - 10 - 20
 - 0 - 10
- Primary, trunk and corridor roads
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- Suburban rail stops
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- Metro stops
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- Slum population by zone
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Socio-economic



Slum population - zone

Employment percentage

Proximity to metro/suburban railway

LEGEND

- Slums
- Employment percentage - slums
 - 60 - 70
 - 50 - 60
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 - Minimum
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Socio-economic

Slum population - zone

Employment percentage

Proximity to metro/suburban railway

LEGEND

Slums

Employment percentage - slums

60 - 70

50 - 60

40 - 50

30 - 40

20 - 30

10 - 20

0 - 10

Primary, trunk and corridor roads

Secondary and tertiary roads

Other roads

Bus stops

Suburban rail stops

Suburban rail

Metro stops

Metro line

Slum population by zone

Minimum

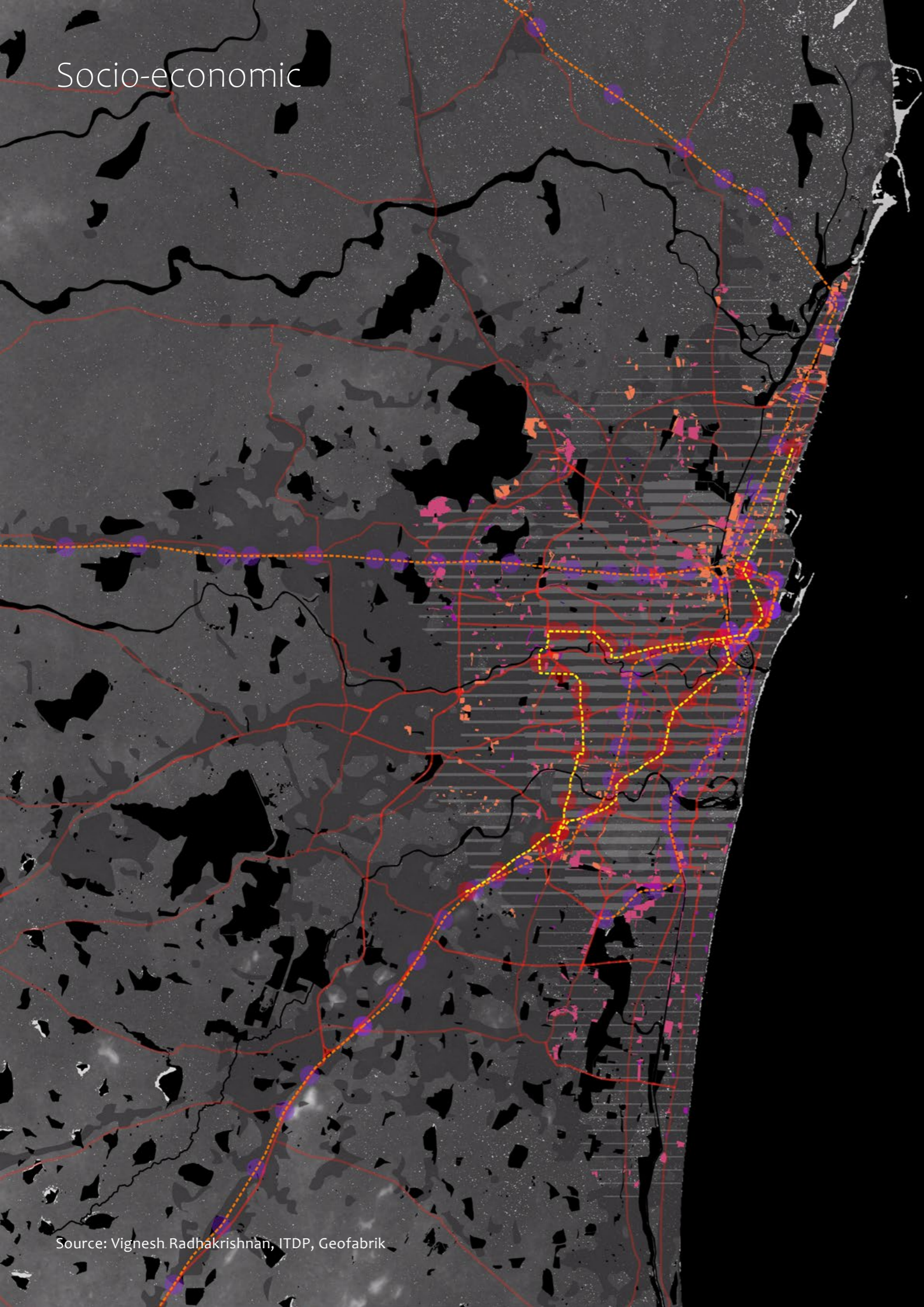
Maximum

Water bodies

0 2.5 5 7.5 km



Socio-economic



- Slum population - zone
- Employment percentage
- Proximity to metro/suburban railway
- Road networks

LEGEND

- Slums
- Employment percentage - slums
 - 60 - 70
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- Metro stops
- Metro line
- Slum population by zone
 - Minimum
 - Maximum
- Water bodies



Source: Vignesh Radhakrishnan, ITDP, Geofabrik

Socio-economic

- Slum population - zone
- Employment percentage
- Proximity to metro/suburban railway
- Road networks
- Proximity to bus routes

LEGEND

Employment percentage - slums

- 60 - 70
- 50 - 60
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- Primary, trunk and corridor roads
- Secondary and tertiary roads
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- Bus stops
- Suburban rail stops
- Suburban rail
- Metro stops
- Metro line

Slum population by zone

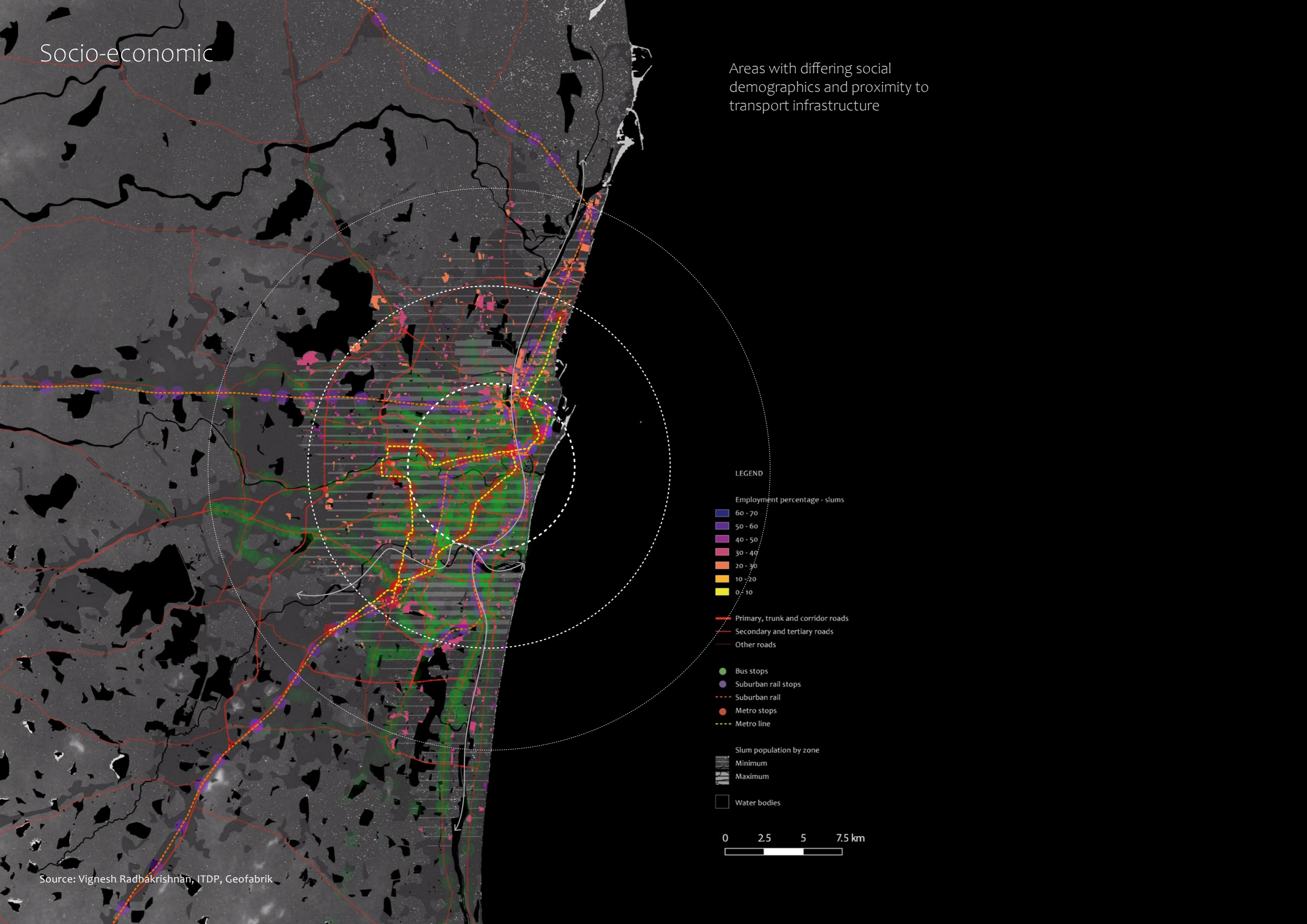
- Minimum
- Maximum

- Water bodies



Socio-economic

Areas with differing social demographics and proximity to transport infrastructure



- LEGEND
- Employment percentage - slums
 - 60 - 70
 - 50 - 60
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 - Slum population by zone
 - Minimum
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Institutional

Administrative boundaries

LEGEND

- Slums
- Industrial use
- Hazardous industries
- Commercial use
- Reservoirs
- Wetlands
- Reserved forest
- Redhills catchment area
- CRZ I
- CRZ II
- CRZ III
- Aquifer recharge area
- Open Space Reservation (OSR)
- Continuous Building Area (CBA)
- Village panchayat
- Town panchayat
- Municipalities
- Chennai Corporation
- Water bodies



Institutional

Administrative boundaries

Land use - developmental

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- Commercial use
- Reservoirs
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- CRZ I
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Institutional

Administrative boundaries

Land use - developmental

Land use - restrictive

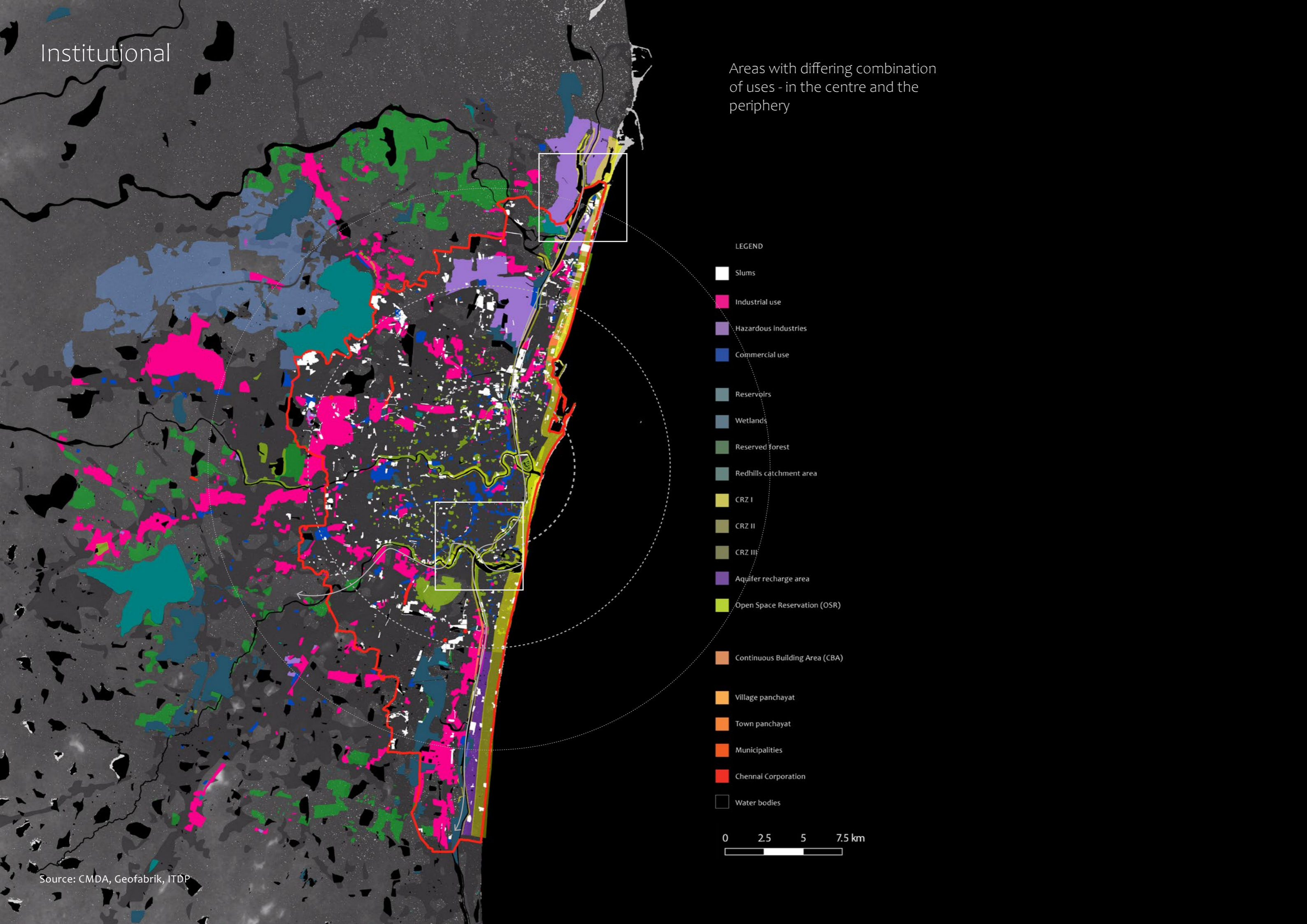
LEGEND

-  Slums
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-  Hazardous industries
-  Commercial use
-  Reservoirs
-  Wetlands
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-  Continuous Building Area (CBA)
-  Village panchayat
-  Town panchayat
-  Municipalities
-  Chennai Corporation
-  Water bodies



Institutional

Areas with differing combination
of uses - in the centre and the
periphery



LEGEND

- Slums
- Industrial use
- Hazardous industries
- Commercial use
- Reservoirs
- Wetlands
- Reserved forest
- Redhills catchment area
- CRZ I
- CRZ II
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- Town panchayat
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- Chennai Corporation
- Water bodies

0 2.5 5 7.5 km

Critical Cases

Ennore



R A Puram



Common Conditions

Located on Coastal Regulation Zone II (CRZ II) under the CRZ Notification

Not well connected to immediate fabric

Critical Cases

Ennore



R A Puram



Common Conditions

Located on Coastal Regulation Zone II (CRZ II) under the CRZ Notification
Not well connected to immediate fabric

Generic Conditions

Low Density Neighbourhoods
Settlements on Continuous Building Area (CBA)
Coastal edge
Creek edge
Vulnerable to coastal flooding - sea level rise
Residents dependent on natural ecology for livelihoods such as fishing activity
Peripheral - far away from many facilities

Generic Conditions

High Density Neighbourhoods
Settlements not on Continuous Building Area (CBA)
River edge
Canal edge
Vulnerable to pluvial flooding
Residents are dependent on proximity to opportunities for livelihoods
Central - proximity to many facilities

Critical Cases



Ennore



R A Puram



Common Conditions

Located on Coastal Regulation Zone II (CRZ II) under the CRZ Notification
 Not well connected to immediate fabric

Generic Conditions

Low Density Neighbourhoods
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 River edge
 Canal edge
 Vulnerable to pluvial flooding
 Residents are dependent on proximity to opportunities for livelihoods
 Central - proximity to many facilities

Specific Conditions

Case area located at the intersection of coastal and creek edges
 Located near heavy (hazardous) industrial area

Specific Conditions

Case area located at the intersection of river and canal edges

Process

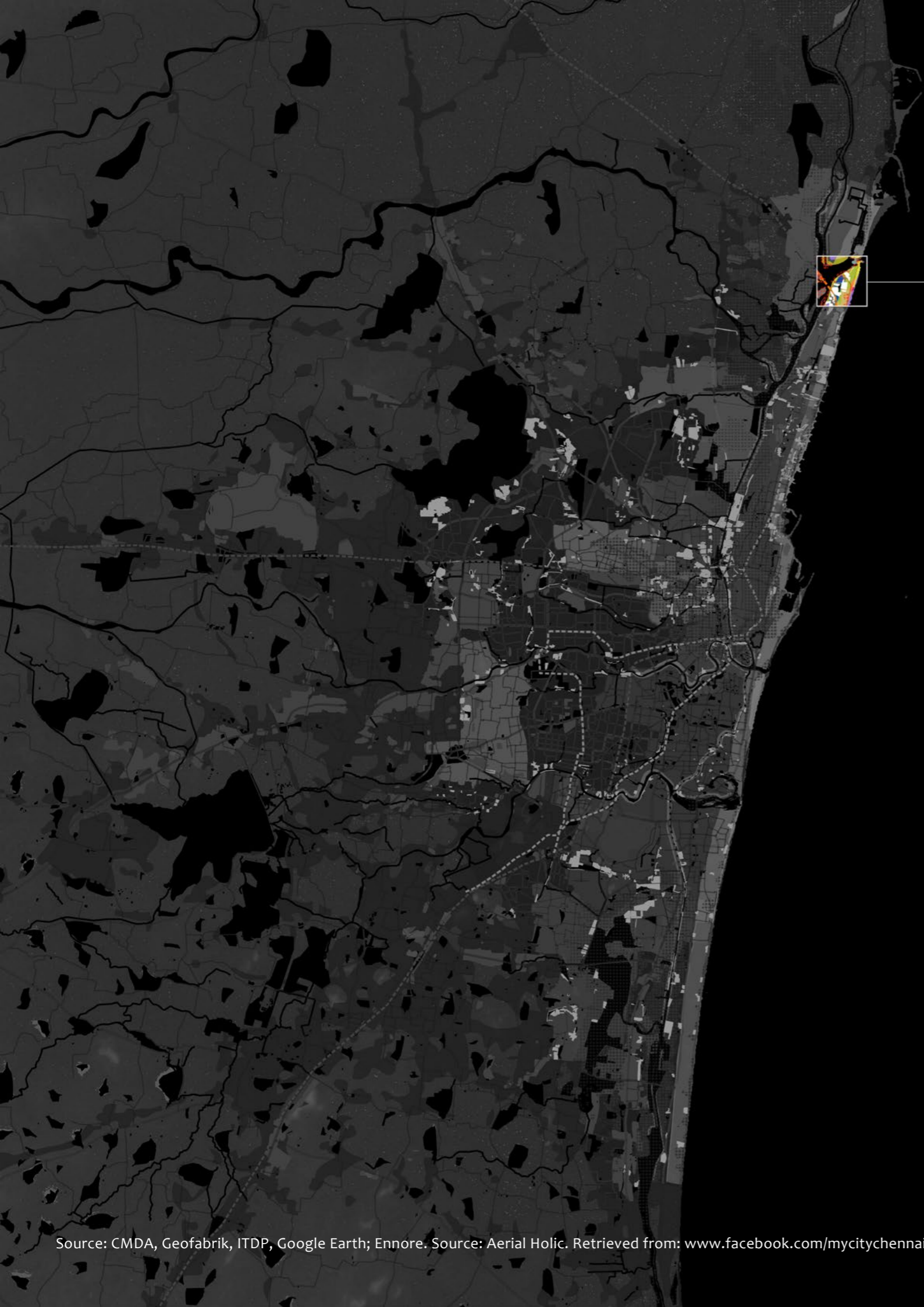
Spatial Conditions that contribute to Climate vulnerability

Elements of Culture - Framing the challenge

Formulating the Adaptive Framework

Testing the Adaptive Framework

Implementing the Adaptive Framework



Industrial encroachment



Industrial encroachment



Industrial encroachment



Industrial encroachment



Industrial encroachment

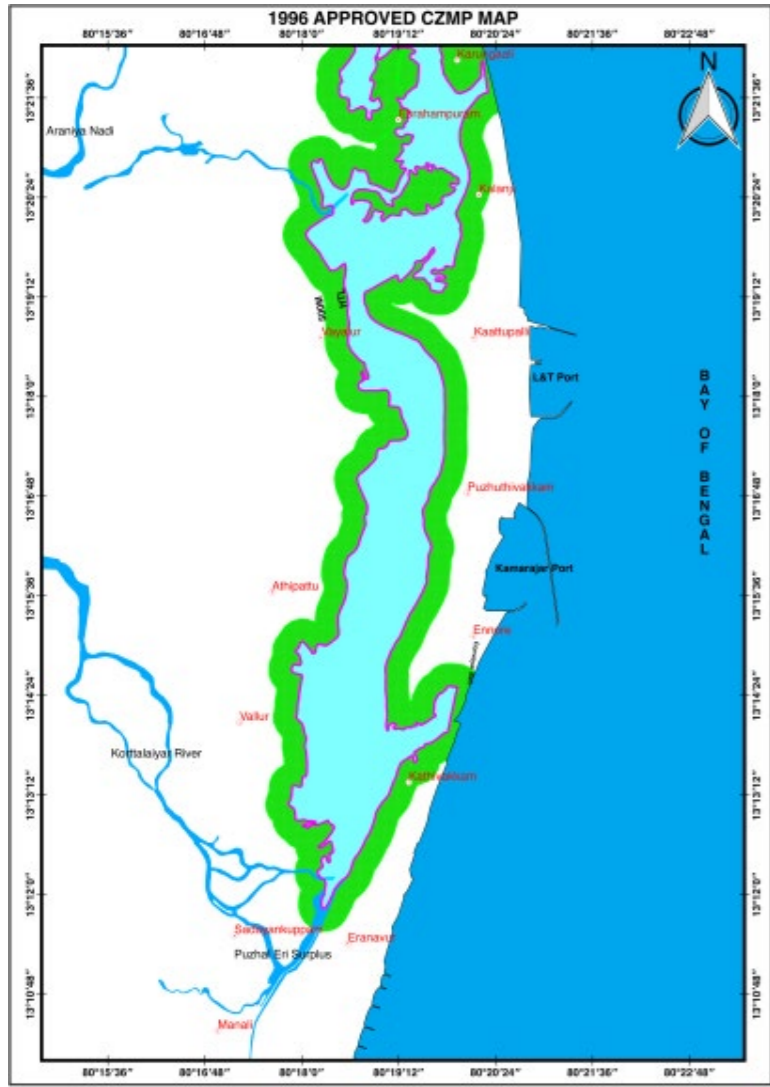


Industrial encroachment

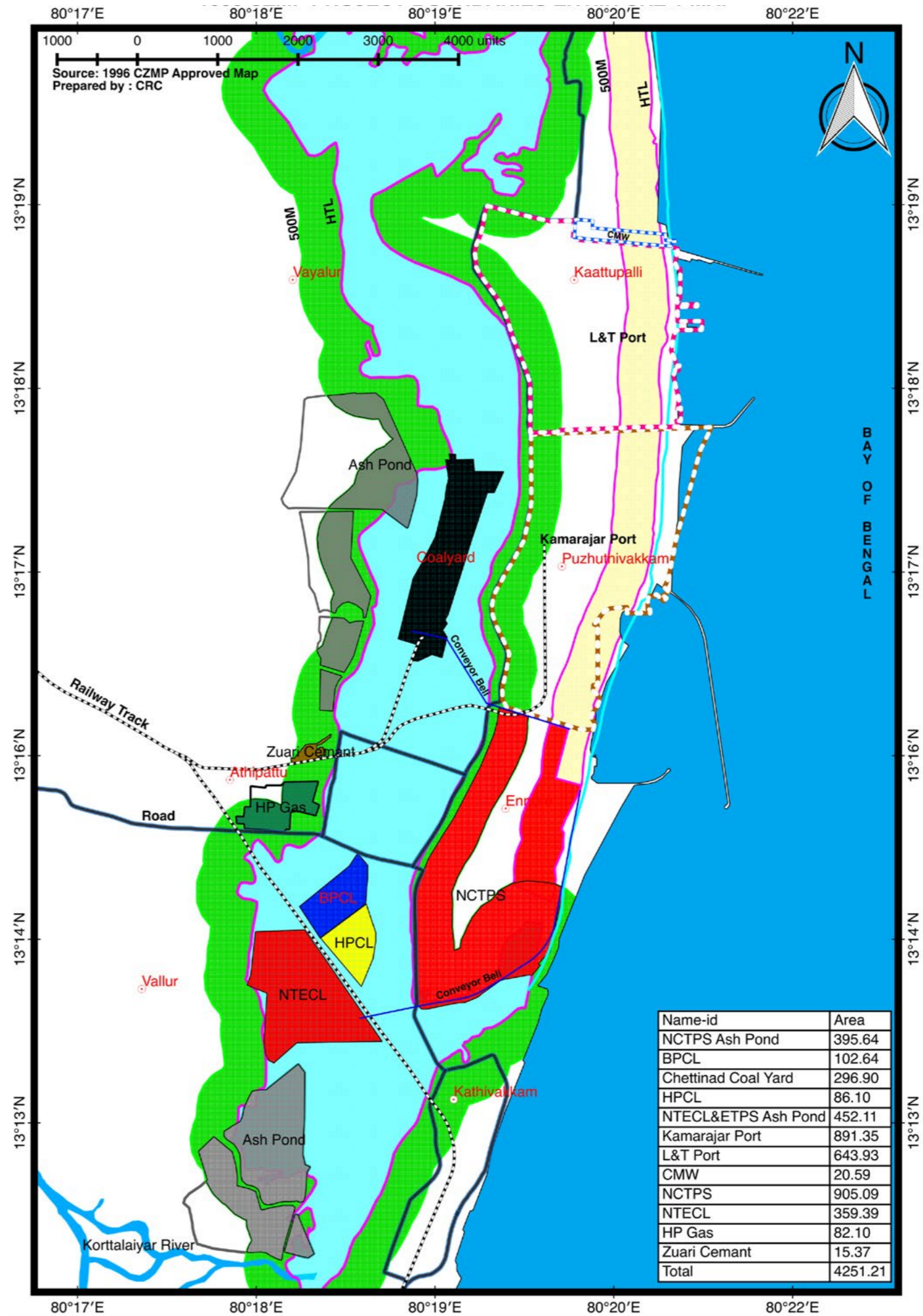


Source: Google Earth

Industrial encroachment



Coastal Regulation Zone (CRZ) violation



Coastal Morphology

2005



Coastal Morphology

2010



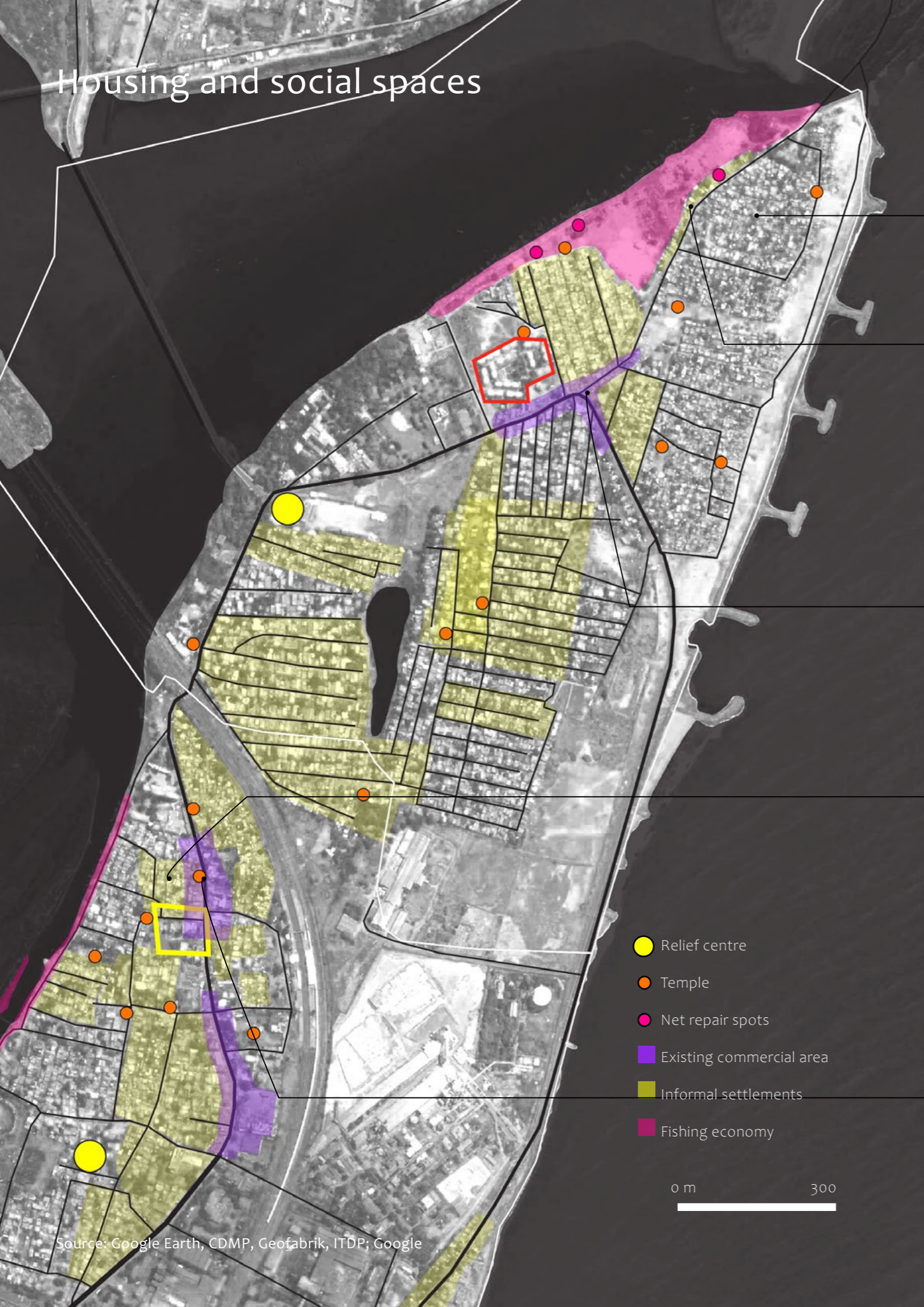
Coastal Morphology

2014





Housing and social spaces



Source: Google Earth, CDMP, Geofabrik, ITDP; Google

- Relief centre
- Temple
- Net repair spots
- Existing commercial area
- Informal settlements
- Fishing economy

0 m 300



Permanent Houses



Temporary Houses



Market area

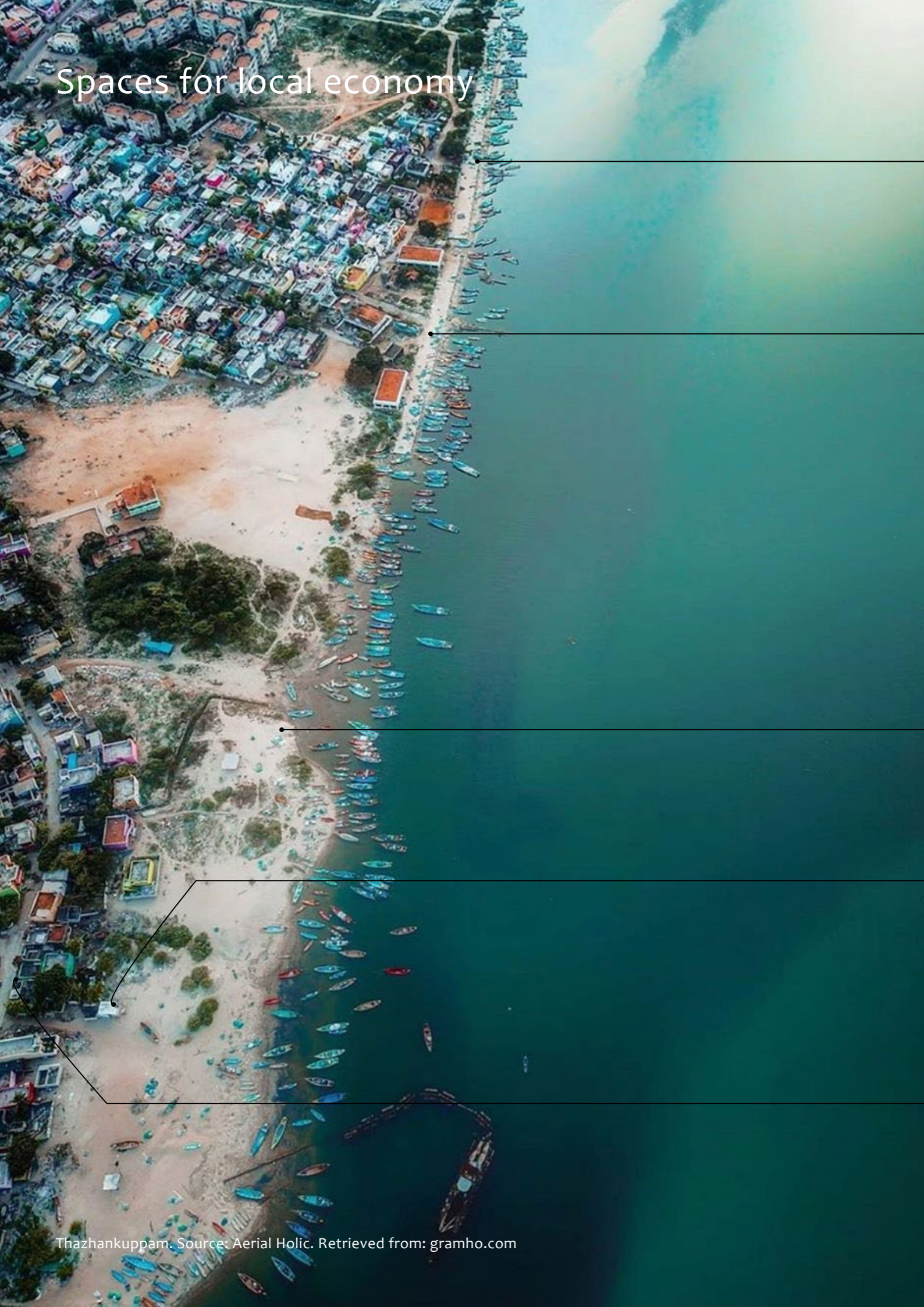


Street character



Temples

Spaces for local economy



Net drying



Designated space



Boat parking

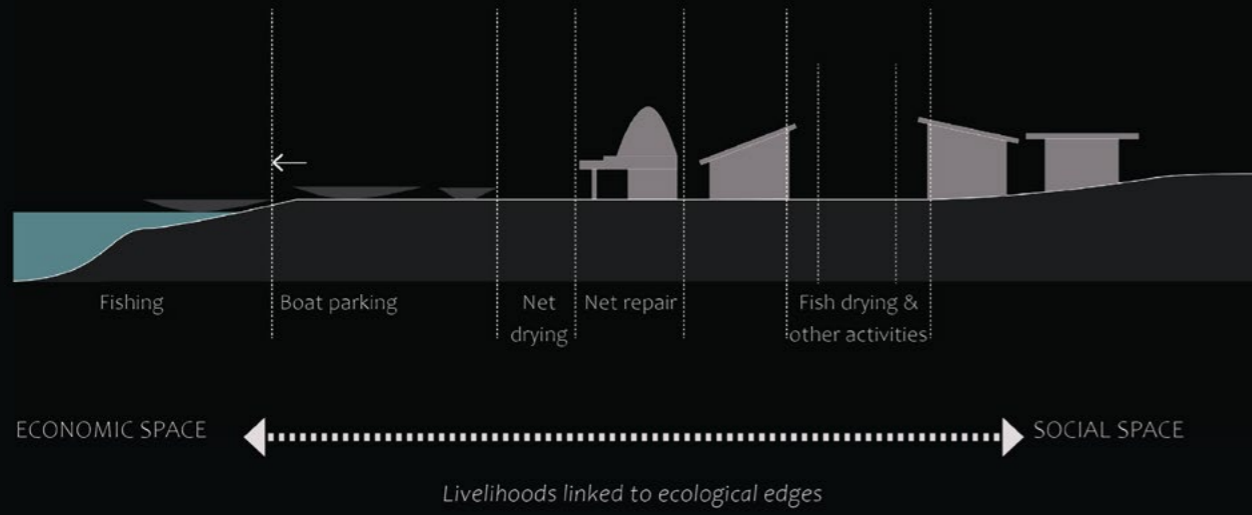


Net repair

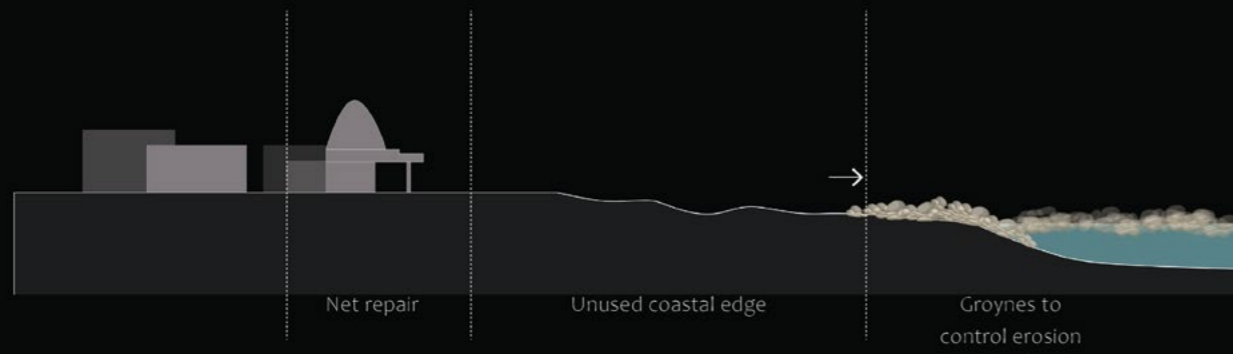


Fish drying

Edges



CREEK SIDE SECTION



SEA SIDE SECTION



Creek edge



Creek edge



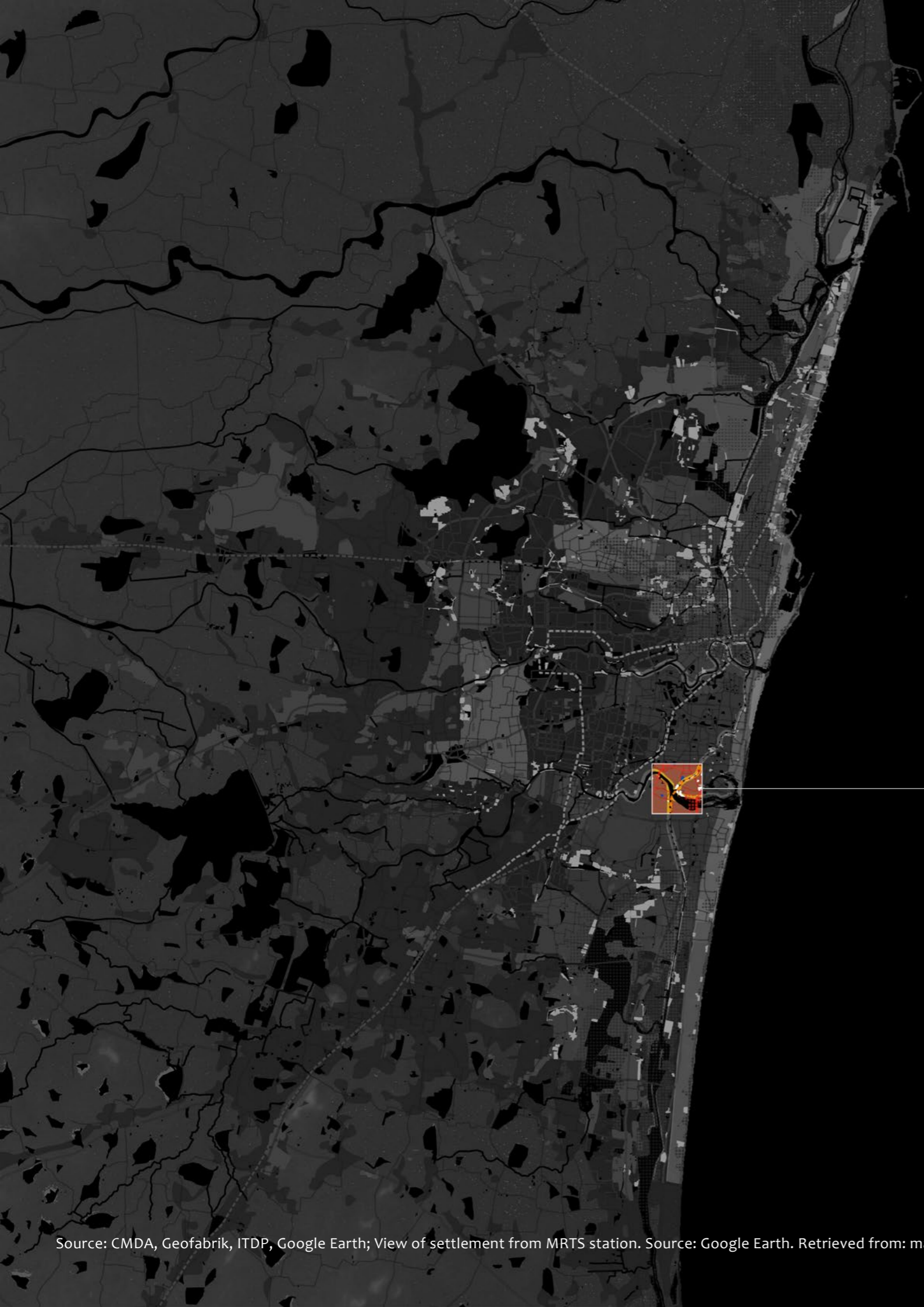
Sea-side edge



Sea-side edge



Canal edge



Ecological conditions

ISSUES

- Encroached canal
- Untreated sewage
- Waste disposal

POLLUTION

- Buckingham canal 60 %
- Cooum river 30 %
- Adyar river 10 %



Source: Author; Buckingham Canal. Source: R. Ragu. Retrieved from: www.thehindu.com



River Dynamics

2001



River Dynamics

2005



River Dynamics

2010

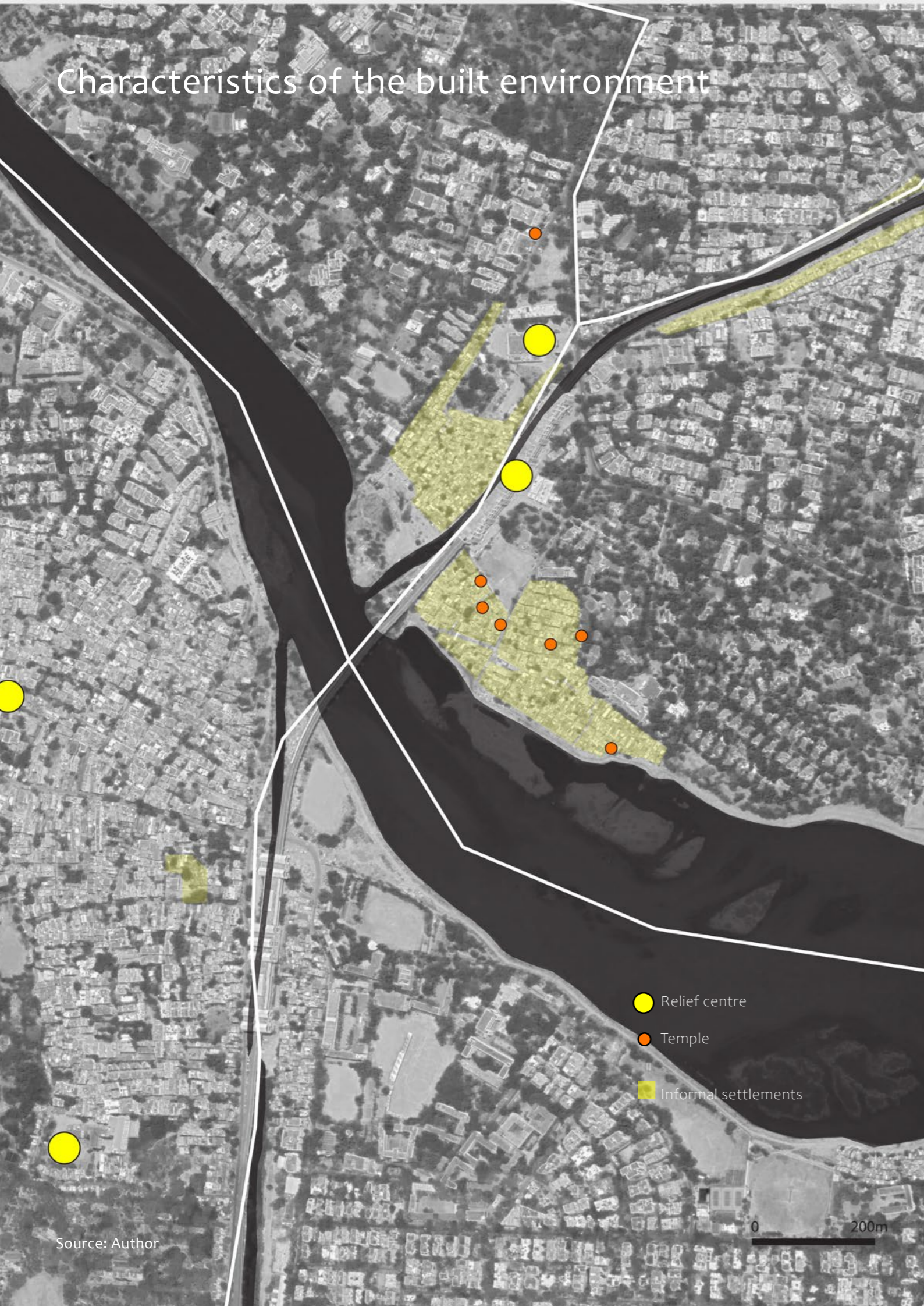


River Dynamics

2019



Characteristics of the built environment



Source: Author



Public-private realm



Streets as social spaces

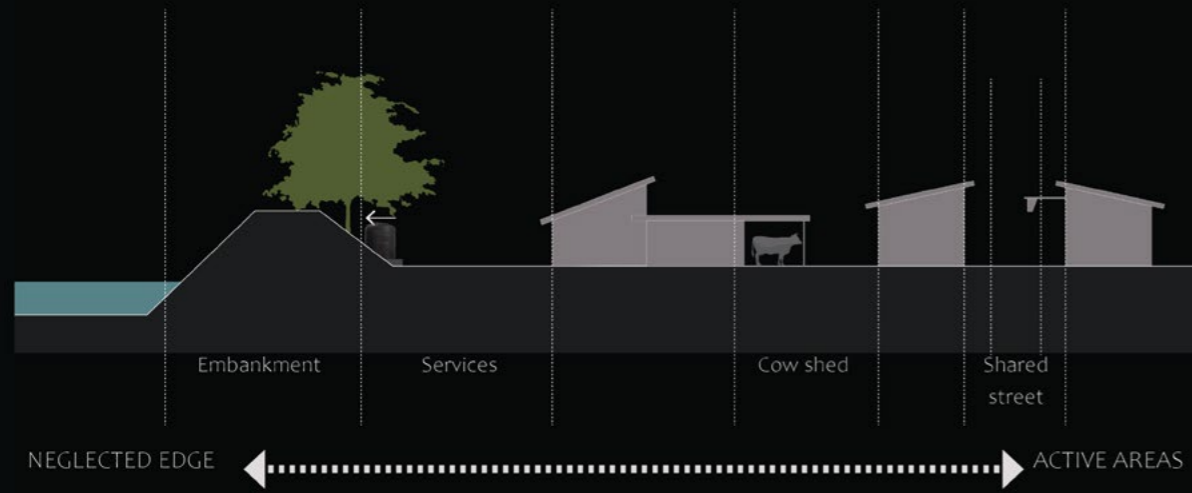


Local economy



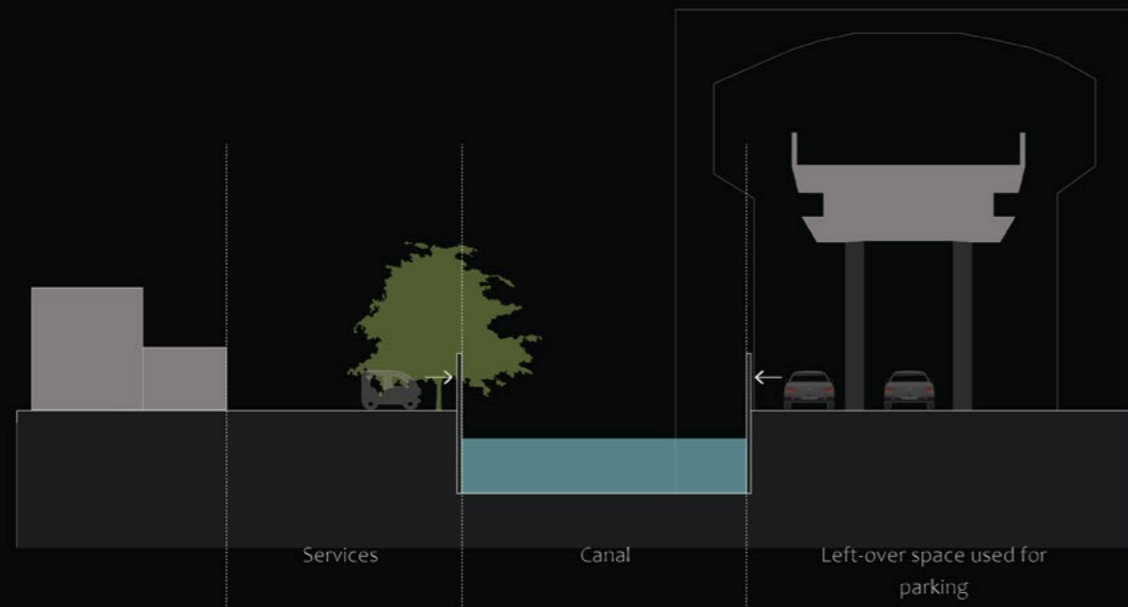
Built environment

Edges



Livelihoods linked to ecological edges

RIVER SIDE SECTION



CANAL SECTION



Canal edge



Canal edge



River edge



Station edge



River edge

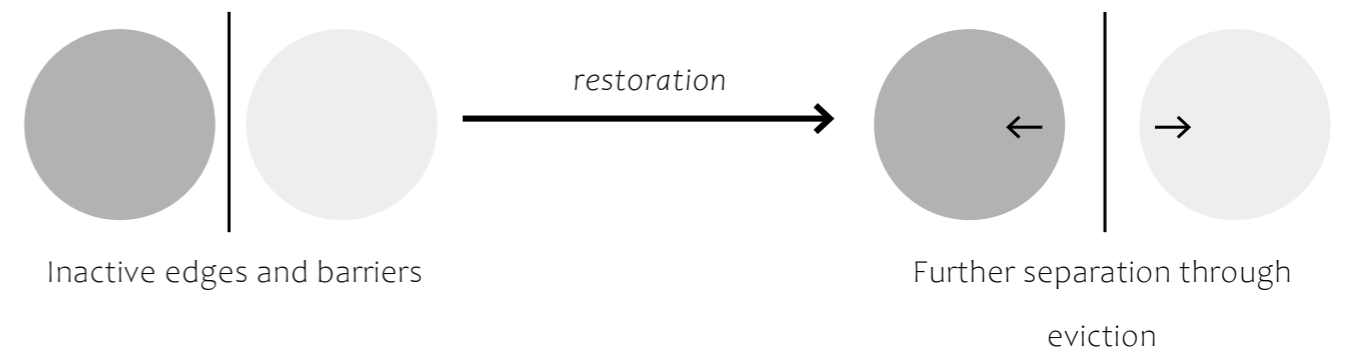
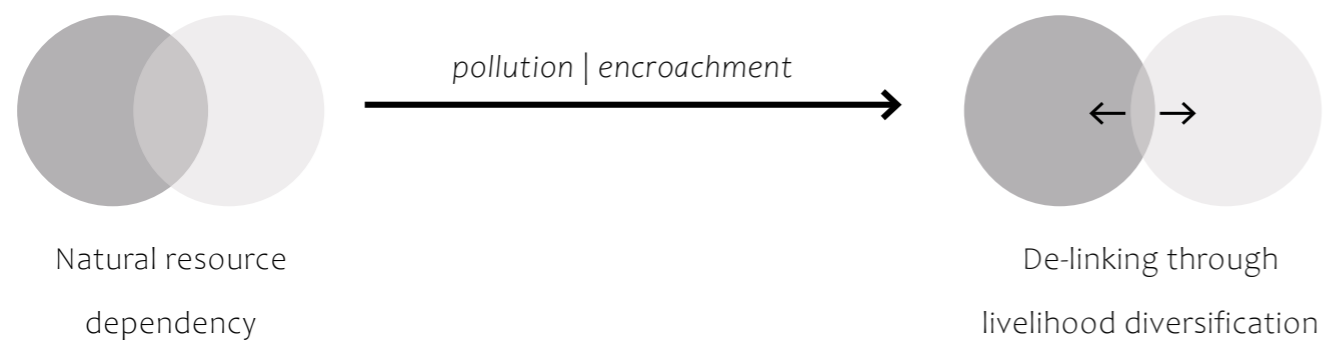
Linking Ecological & Social Challenges



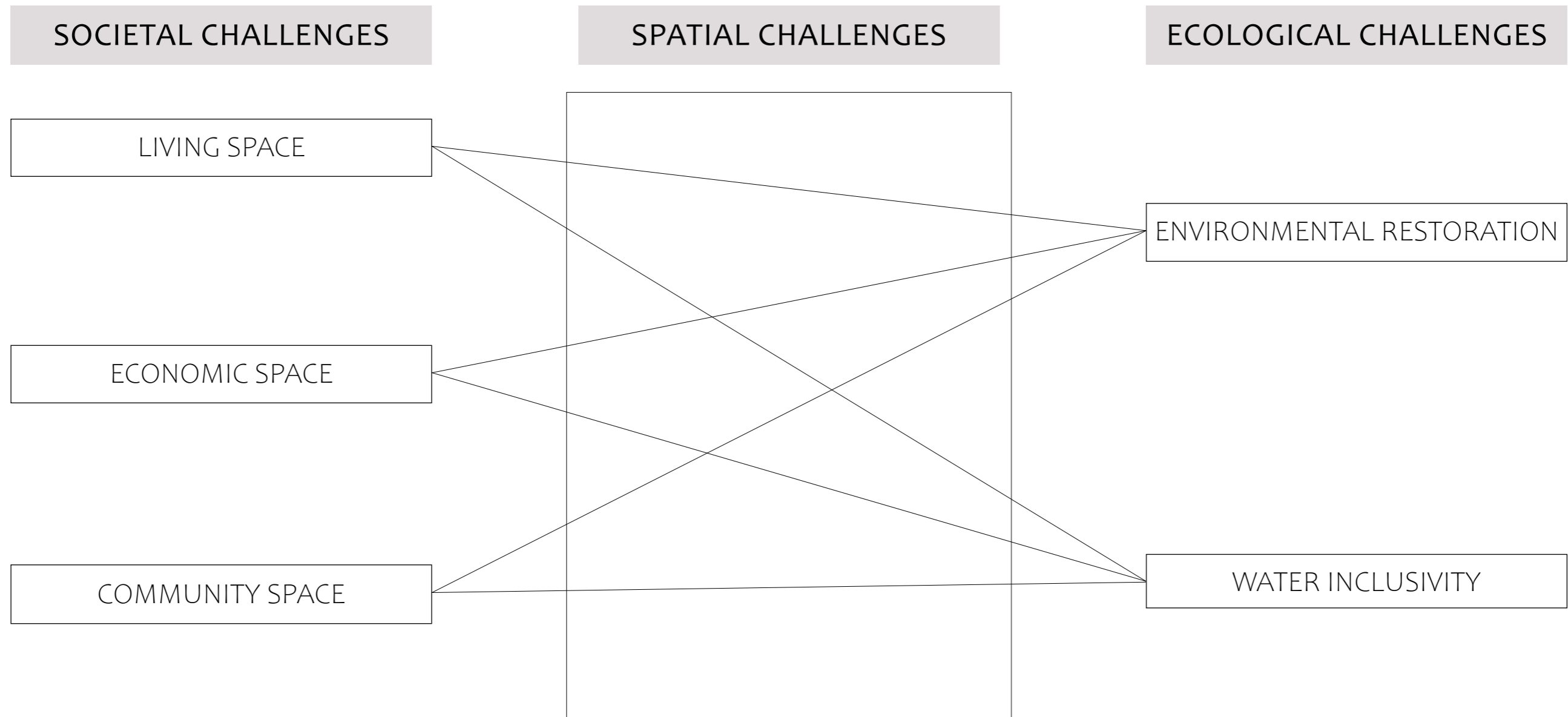
ENNORE



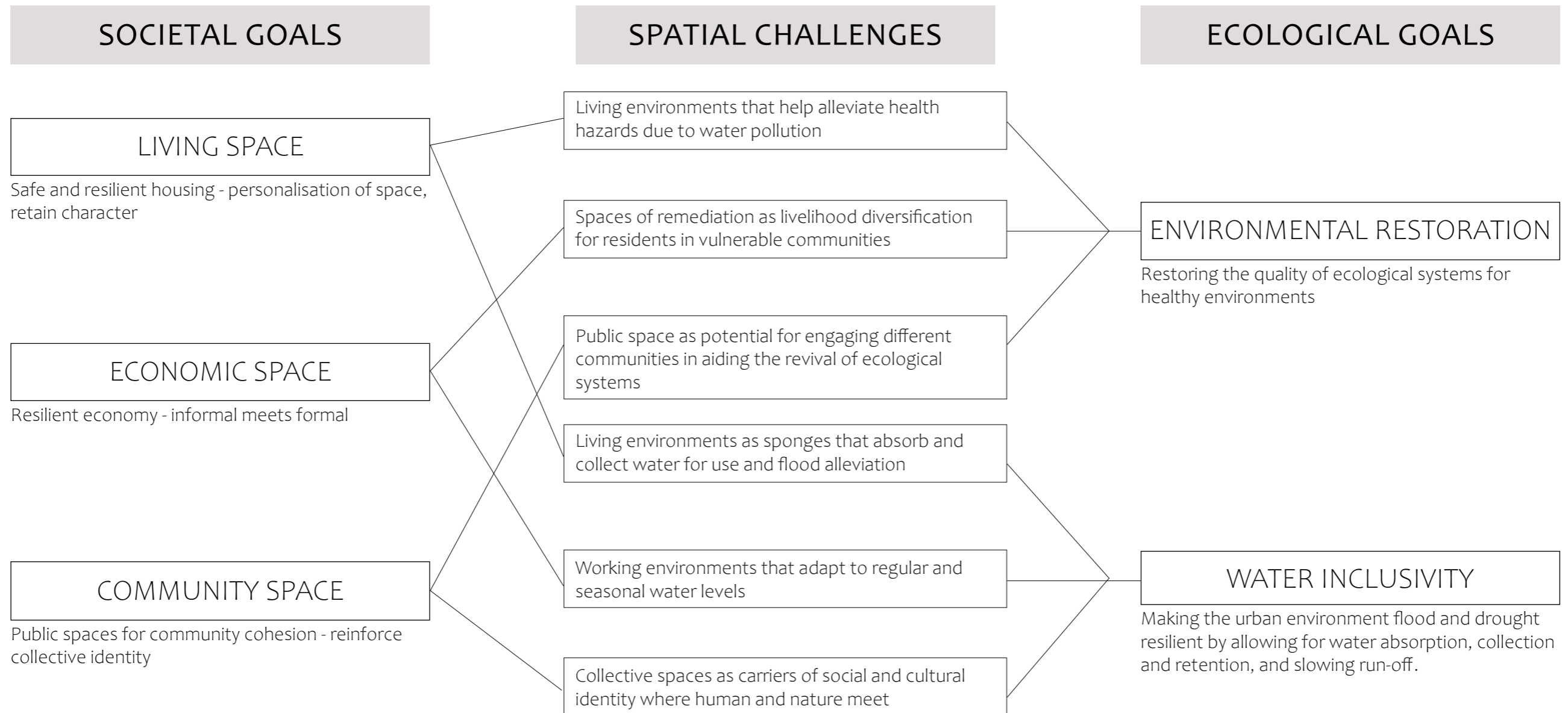
R A PURAM



Linking Ecological & Social Challenges



Linking Ecological & Social Challenges



Process

Spatial Conditions that contribute to Climate vulnerability

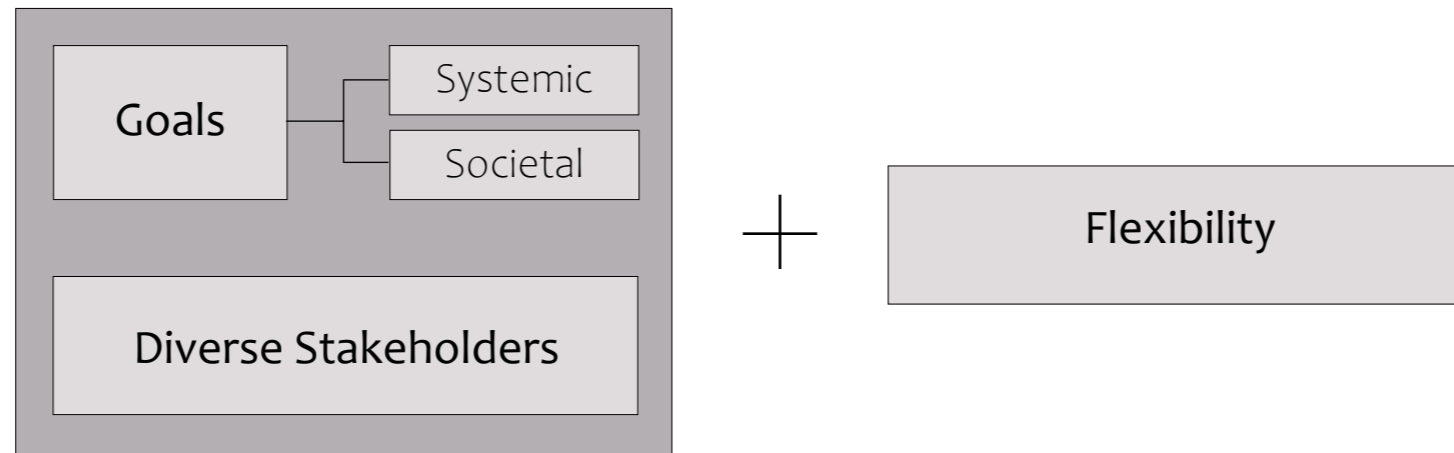
Elements of Culture - Framing the challenge

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Testing the Adaptive Framework

Implementing the Adaptive Framework

Process



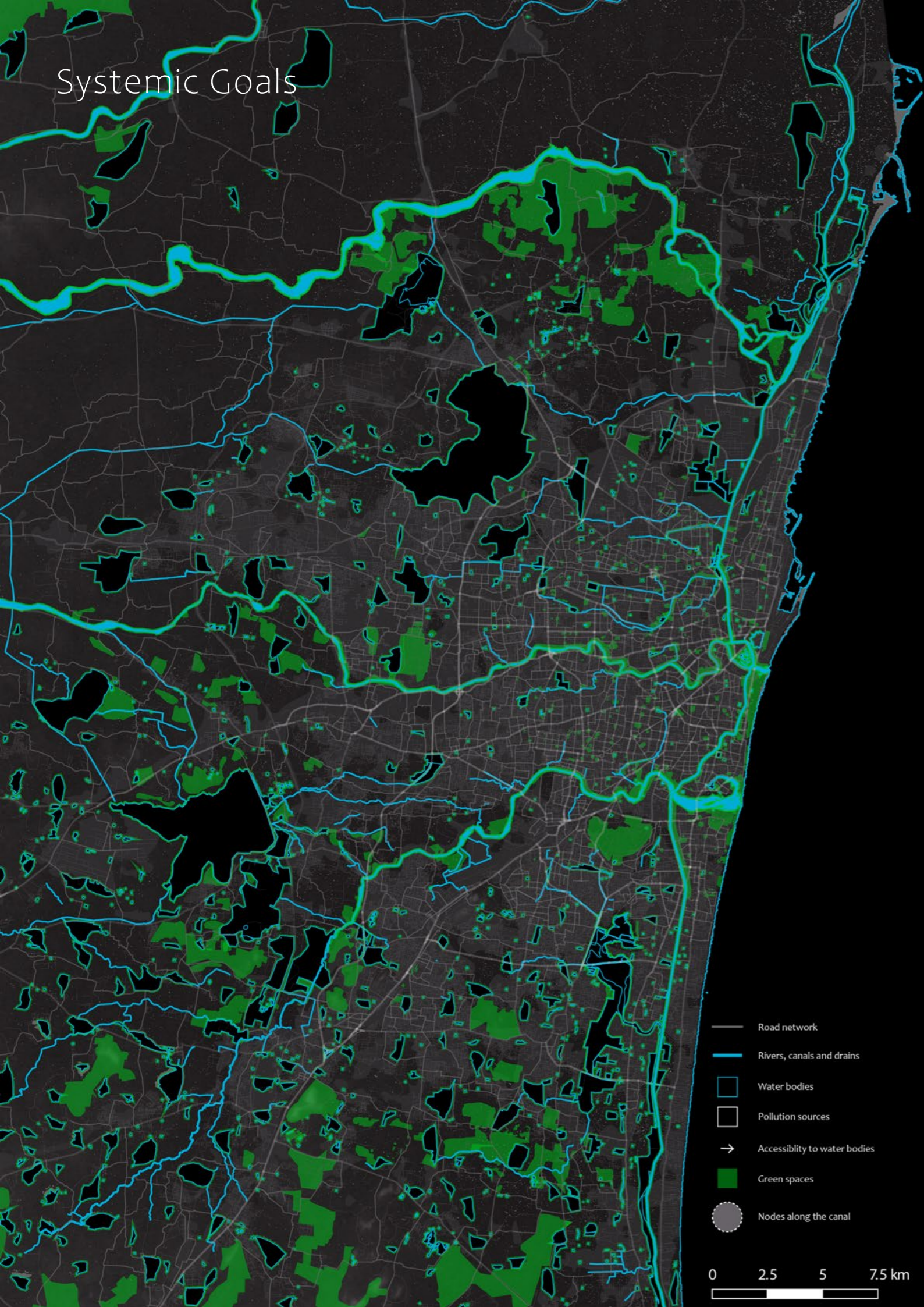
Systemic Goals



CHENNAI SUB-BASIN SCALE

Canal revitalisation as a continuous channel, connecting the city locally, acting as flood alleviator

Systemic Goals



- Road network
- Rivers, canals and drains
- Water bodies
- Pollution sources
- Accessibility to water bodies
- Green spaces
- Nodes along the canal



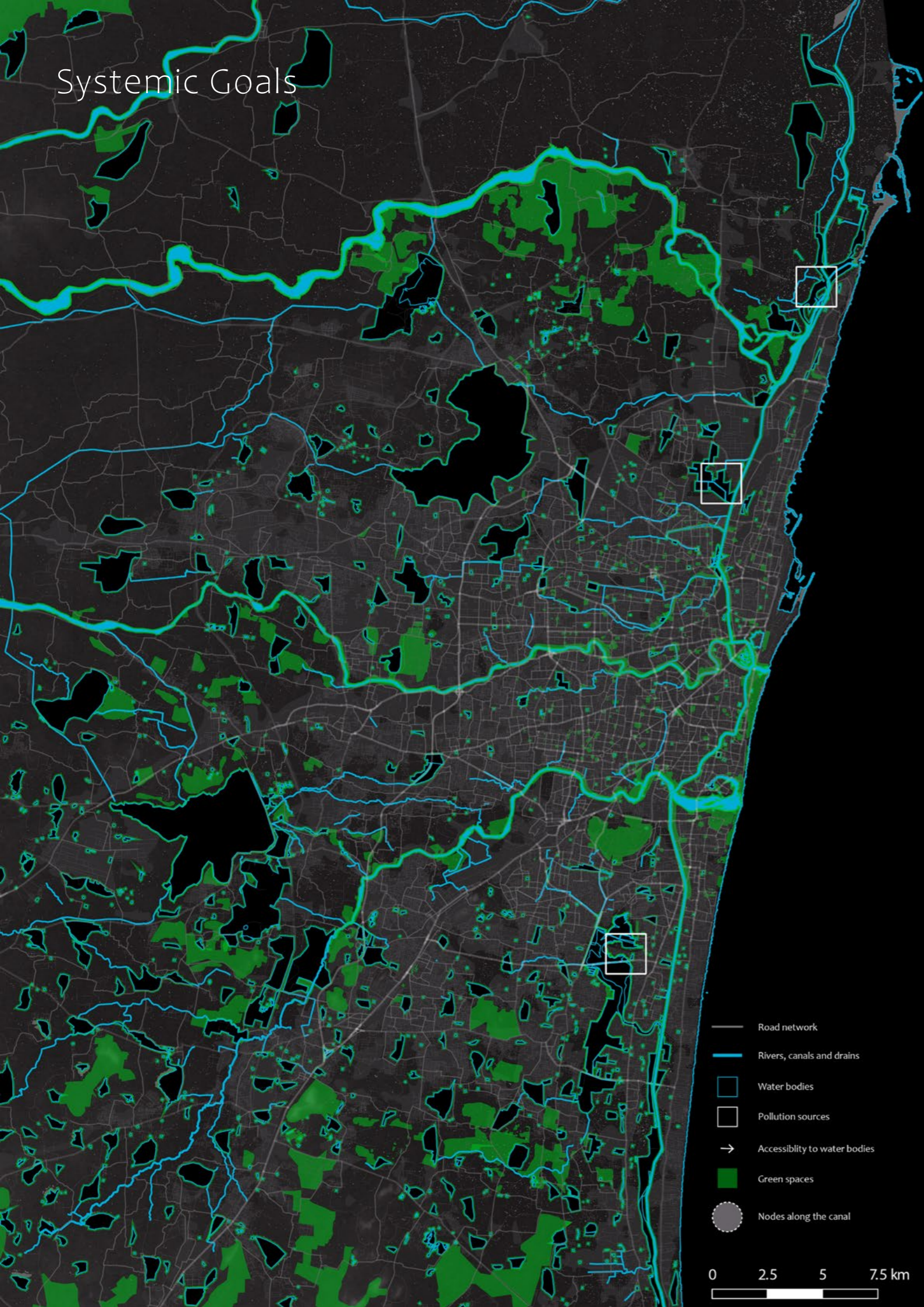
CHENNAI SUB-BASIN SCALE

Canal revitalisation as a continuous channel, connecting the city locally, acting as flood alleviator

Network of green spaces connected to primary waterways in the city, absorbing and recharging ground water, while slowing run off



Systemic Goals

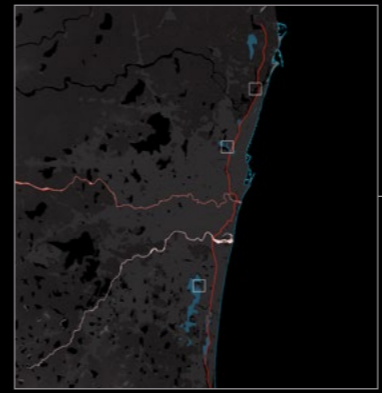


CHENNAI SUB-BASIN SCALE

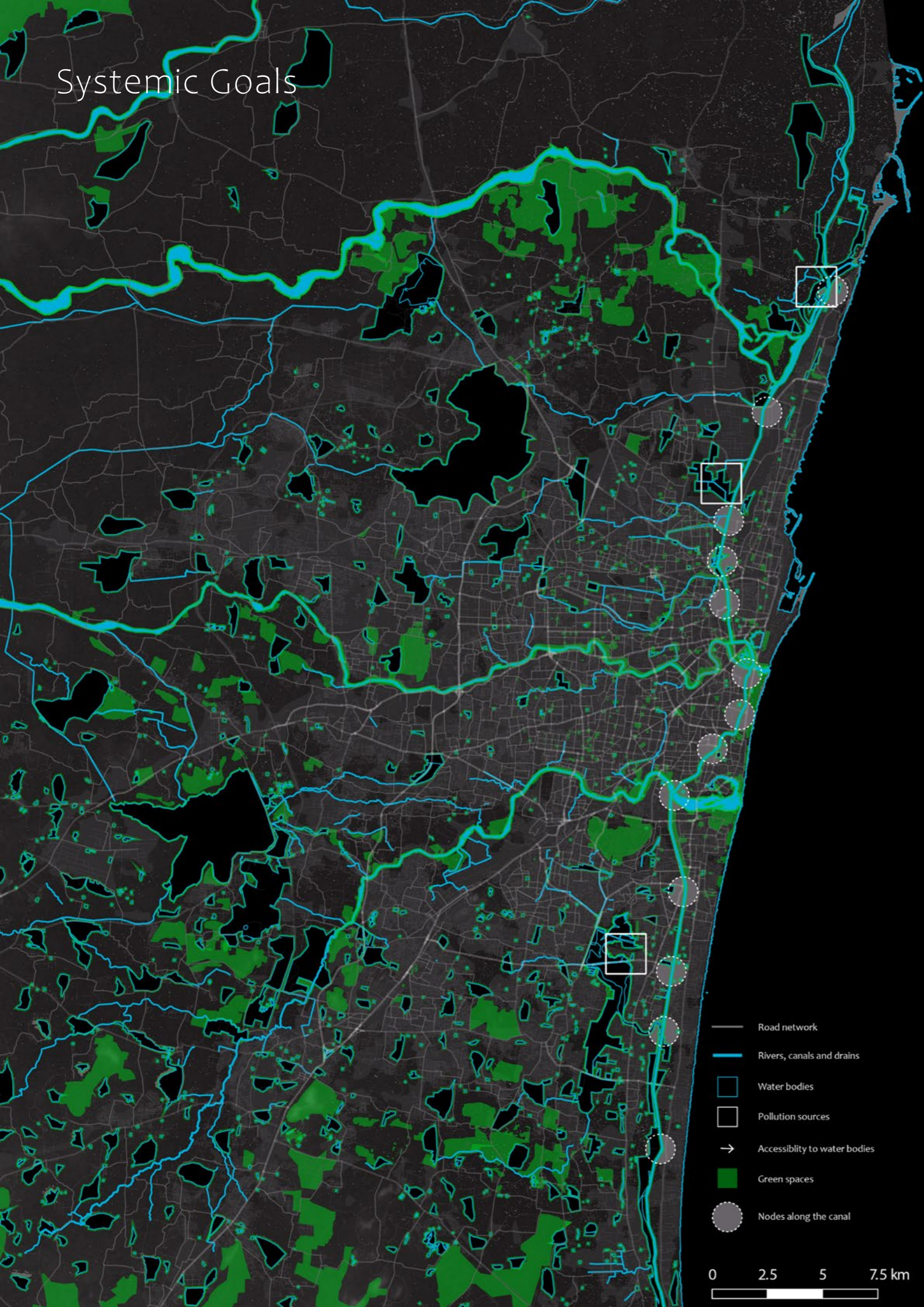
Canal revitalisation as a continuous channel, connecting the city locally, acting as flood alleviator

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Environmental remediation of contaminated areas



Systemic Goals



CHENNAI SUB-BASIN SCALE

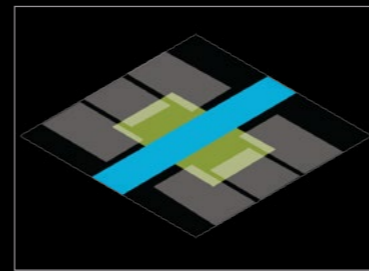
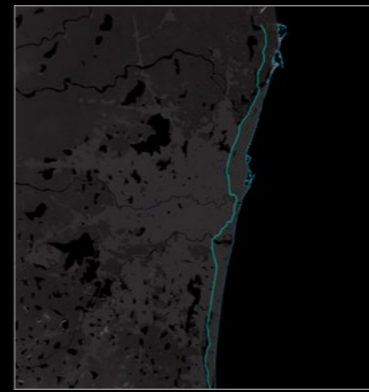
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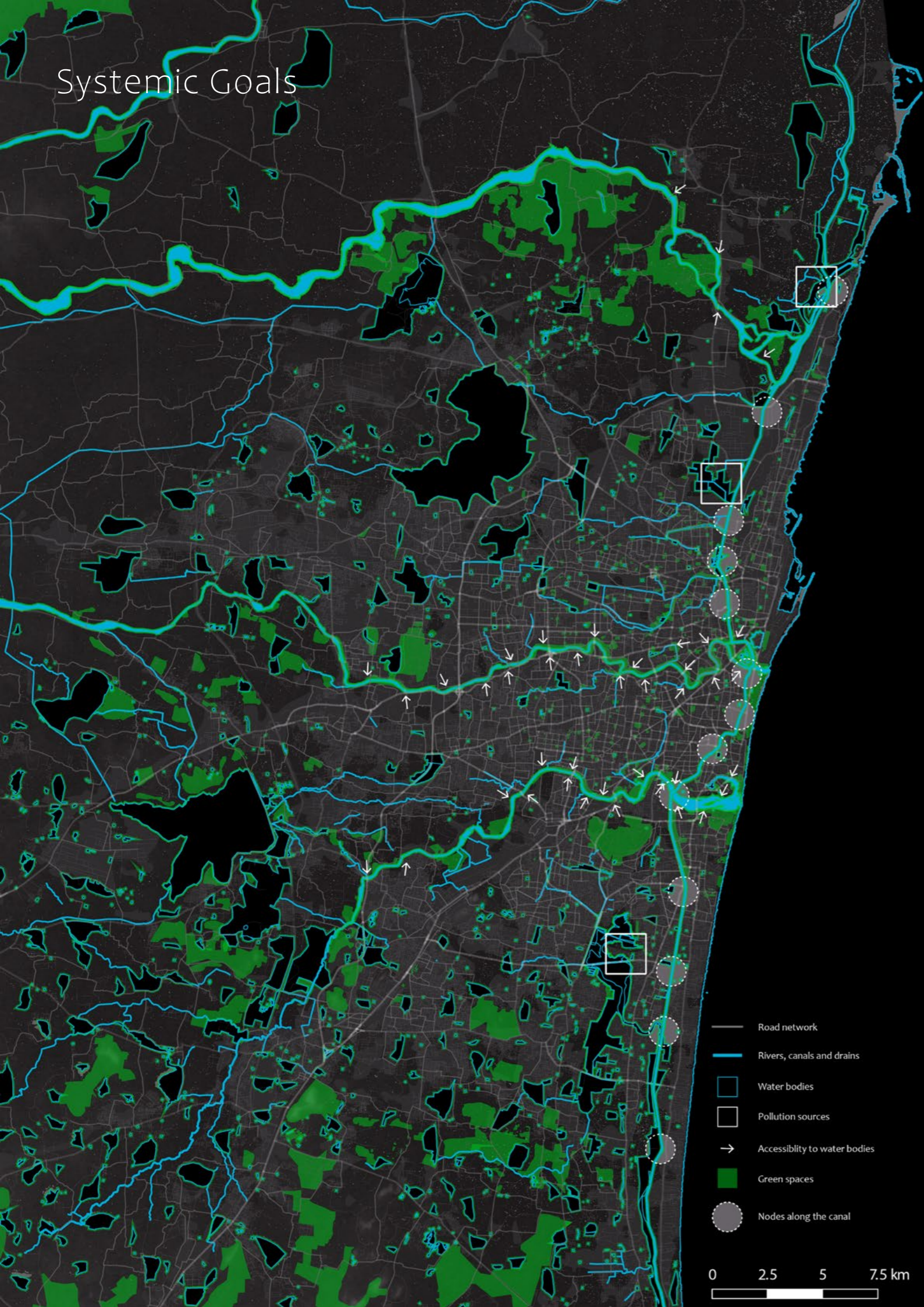
Environmental remediation of contaminated areas

NEIGHBOURHOOD SCALE

Nodes along the canal that have different identities and economies within the informal settlements



Systemic Goals



CHENNAI SUB-BASIN SCALE

Canal revitalisation as a continuous channel, connecting the city locally, acting as flood alleviator

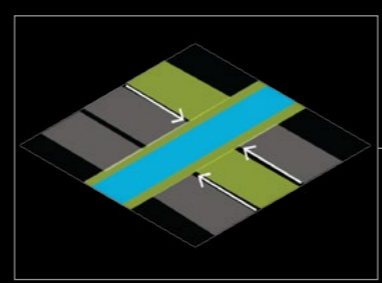
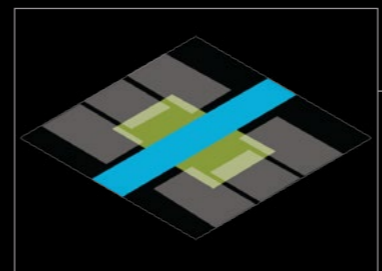
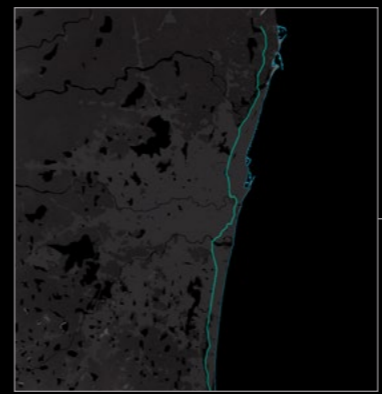
Network of green spaces connected to primary waterways in the city, absorbing and recharging ground water, while slowing run off

Environmental remediation of contaminated areas

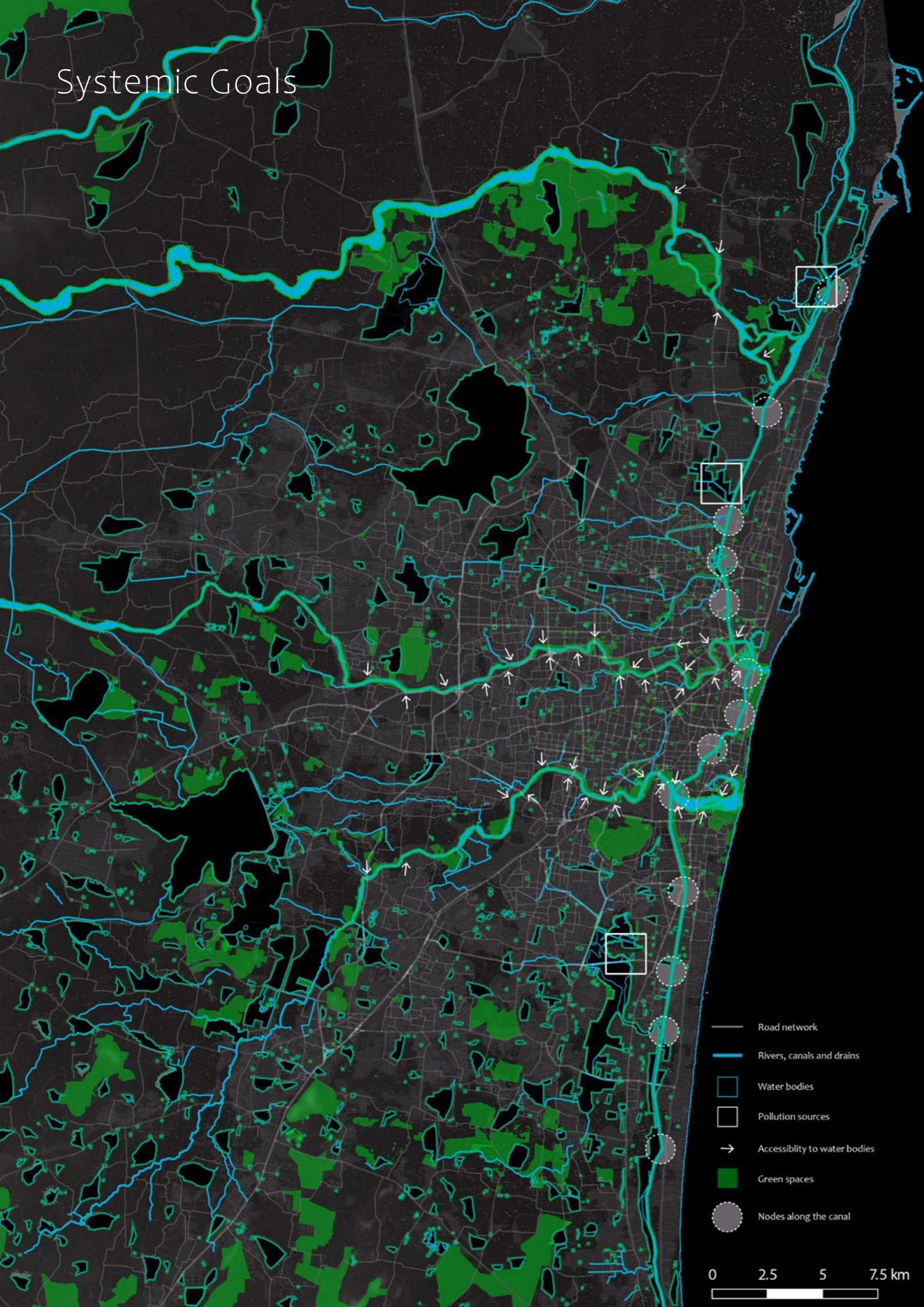
NEIGHBOURHOOD SCALE

Nodes along the canal that have different identities and economies within the informal settlements

Waterways in the city made more accessible to the residents by creating edges that house social, cultural and recreational activities



Systemic Goals



CHENNAI SUB-BASIN SCALE

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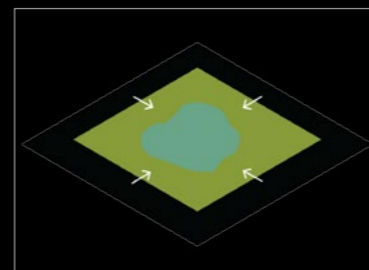
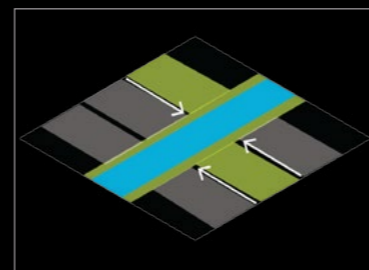
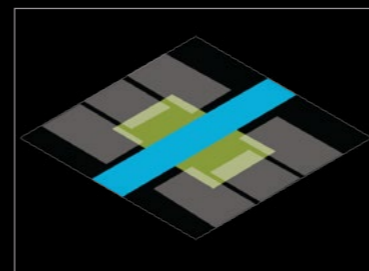
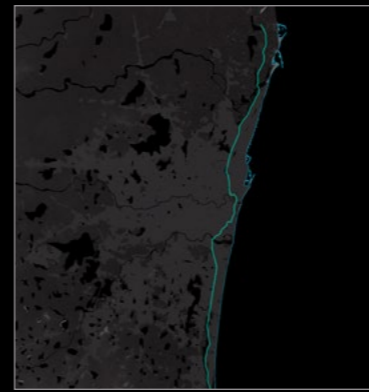
Environmental remediation of contaminated areas

NEIGHBOURHOOD SCALE

Nodes along the canal that have different identities and economies within the informal settlements

Waterways in the city made more accessible to the residents by creating edges that house social, cultural and recreational activities

Smaller green/blue collection/absorption points activated through facilitating social and cultural links



Stakeholder Engagement

Environmental restoration - existing



Water inclusivity - existing



ECOLOGICAL GOALS

REGULATION
Position of control and management

● Public sector

COLLABORATION
Involvement in execution

- Public sector
- NGOs
- Private sector

CONSULTATION
Consulted in the process

- Research institutions
- Communities
- Private sector

Stakeholder Engagement

Environmental restoration - proposed



Water inclusivity - proposed



ECOLOGICAL GOALS

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Stakeholder Engagement

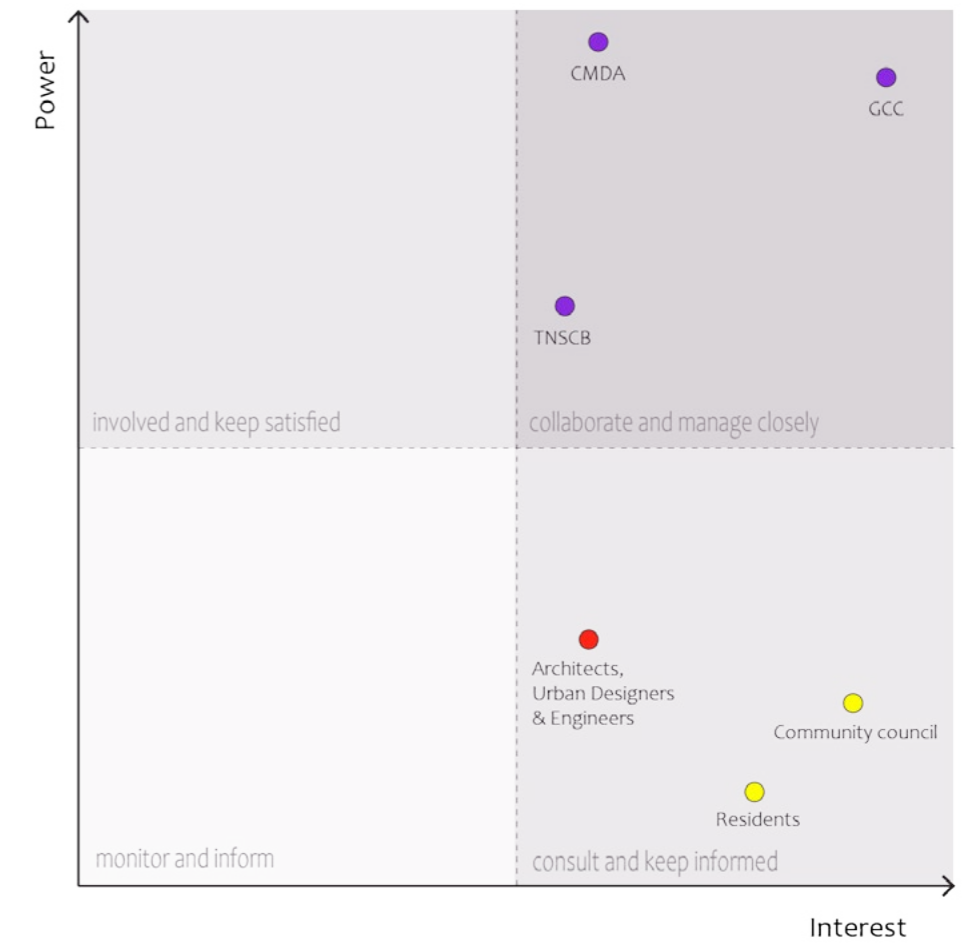
Living space - existing



Economic space - existing



Community space - existing



SOCIETAL GOALS

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Position of control and management

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COLLABORATION
Involvement in execution

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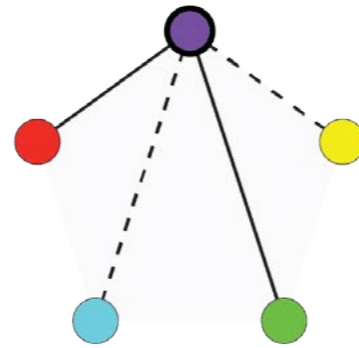
Stakeholder Engagement

Current

ECOLOGICAL GOALS

Environmental Restoration

Water Inclusivity

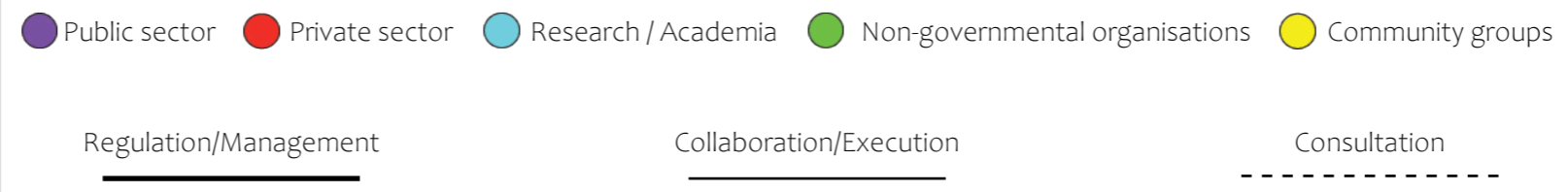
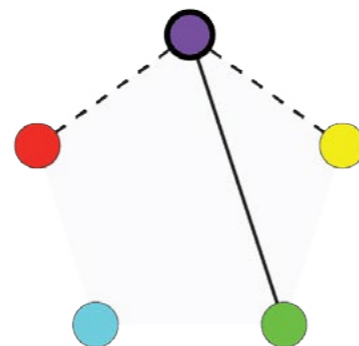


SOCIETAL GOALS

Living Space

Economic Space

Community Space



Stakeholder Engagement

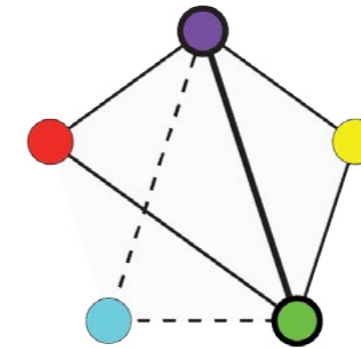
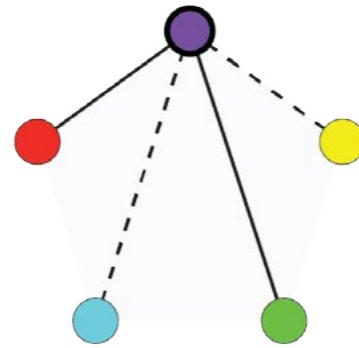
Current

Proposed / Desired

ECOLOGICAL GOALS

Environmental Restoration

Water Inclusivity

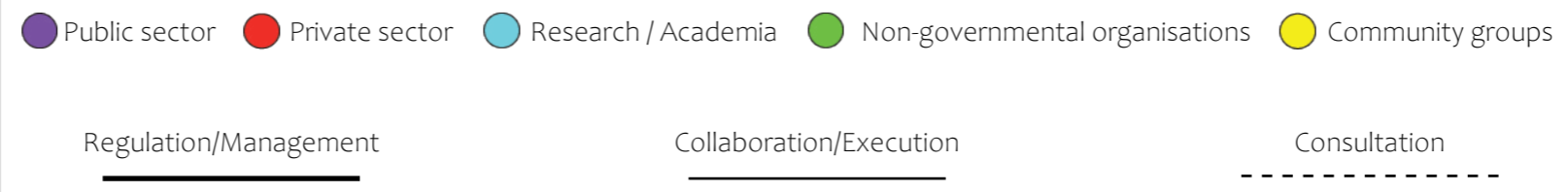
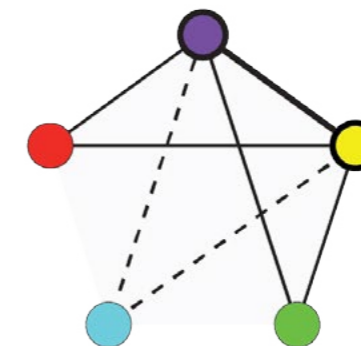
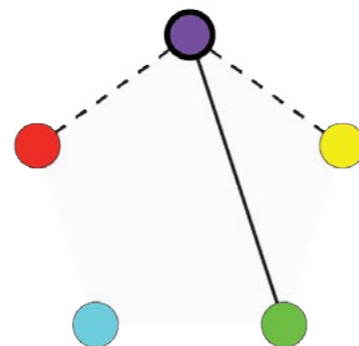


SOCIETAL GOALS

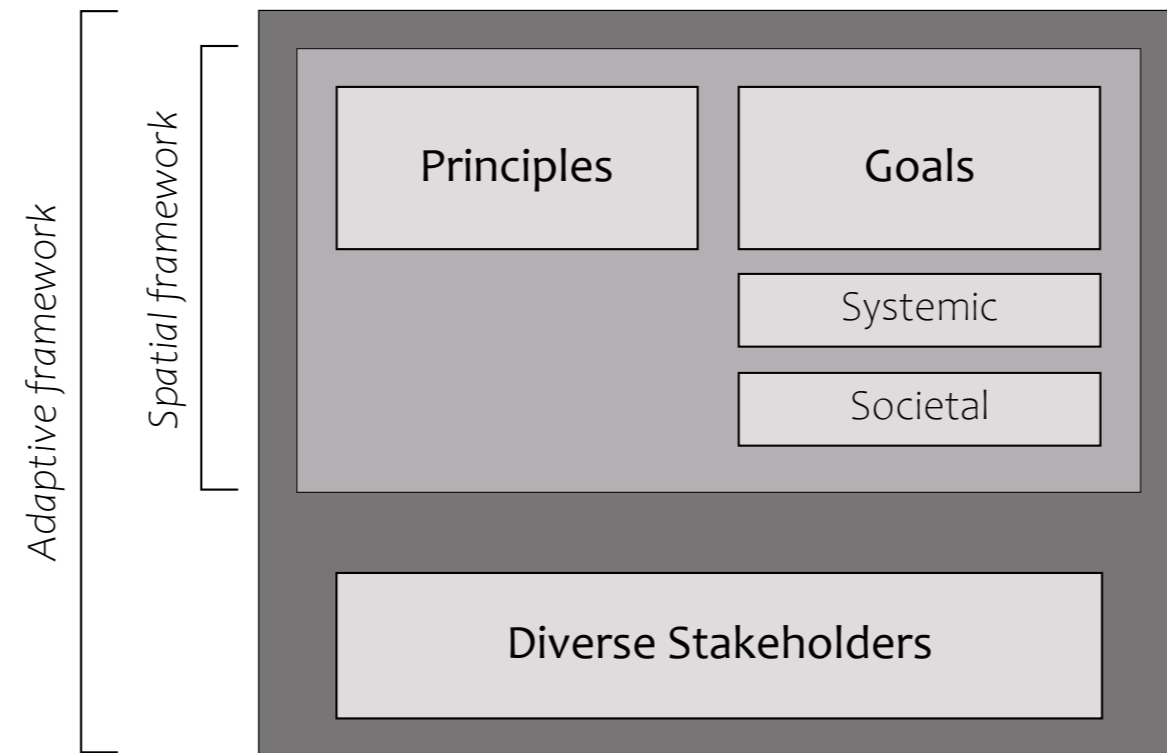
Living Space

Economic Space

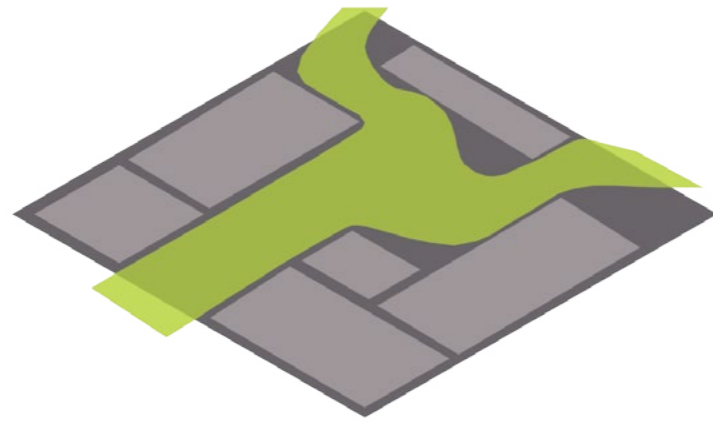
Community Space



Spatial Framework

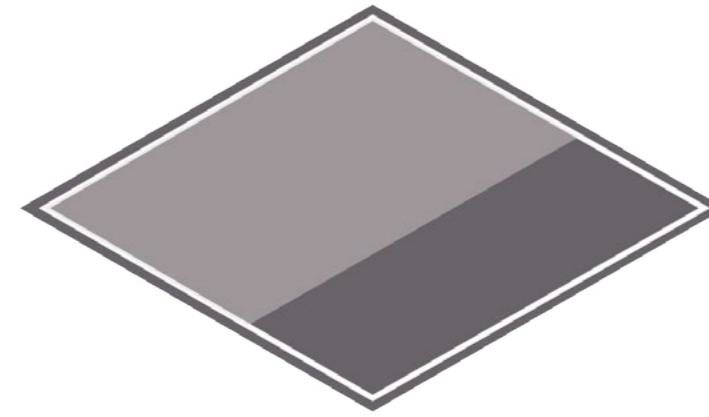


Principles of Resilience of Urban Form



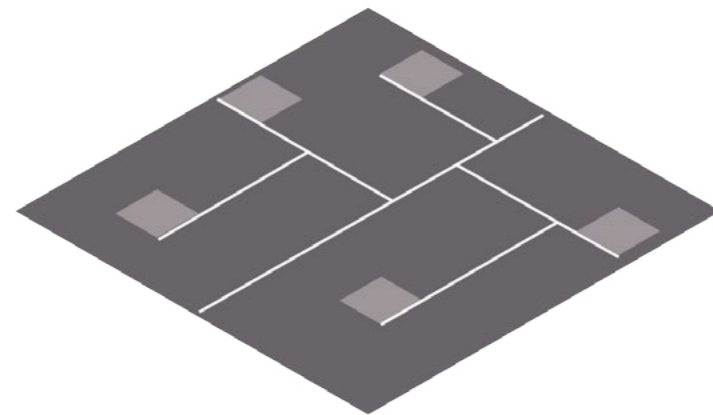
Nature-Inclusivity

Space that is in harmony with nature, inclusive spaces



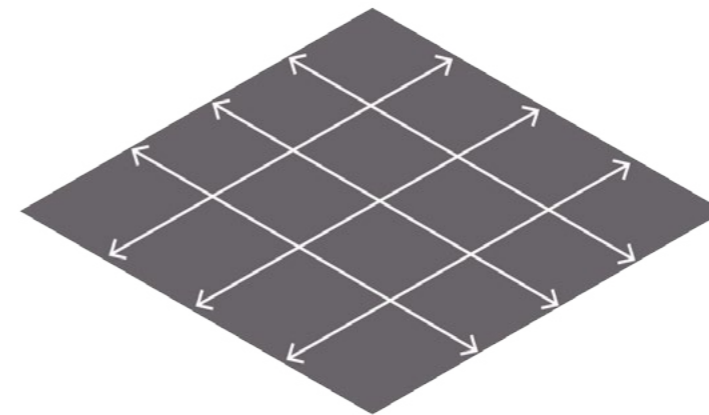
Indeterminacy

The unexplored space or components that are not-determined so as to afford unforeseen functions and flexibility



Modularity

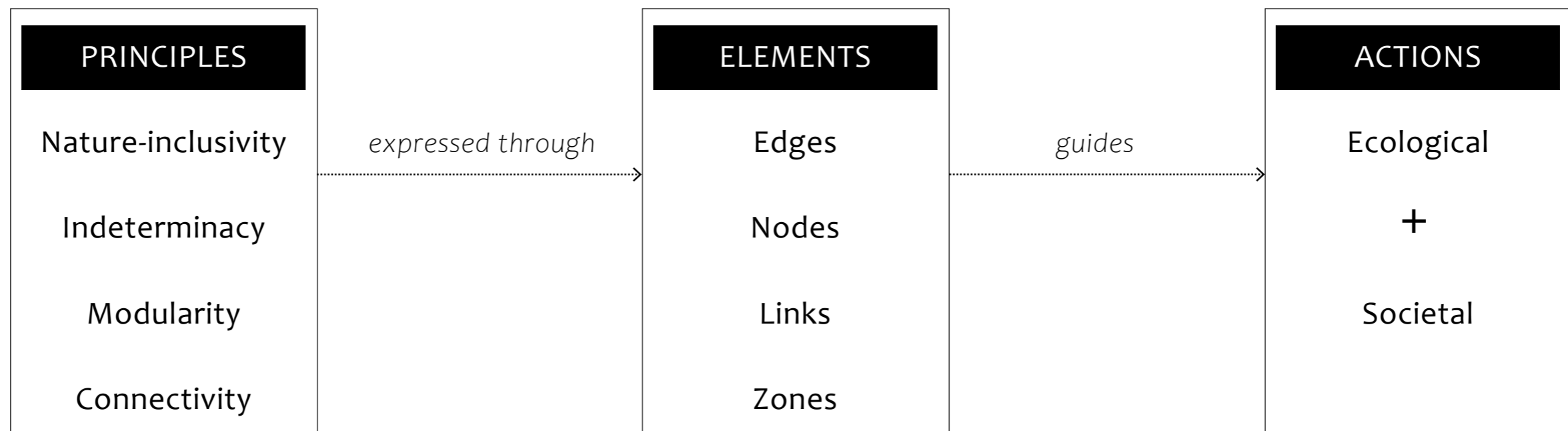
Decentralised spaces - safe to fail
Clustering hierarchical components



Connectivity

Networks between streets and blocks

Spatial translation of principles



Spatial Framework

Elements of Spatial Framework

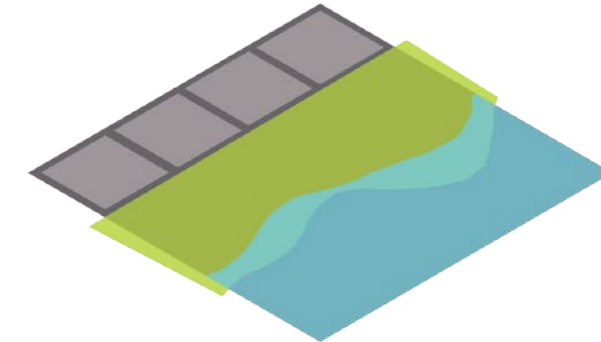
Function

EDGES

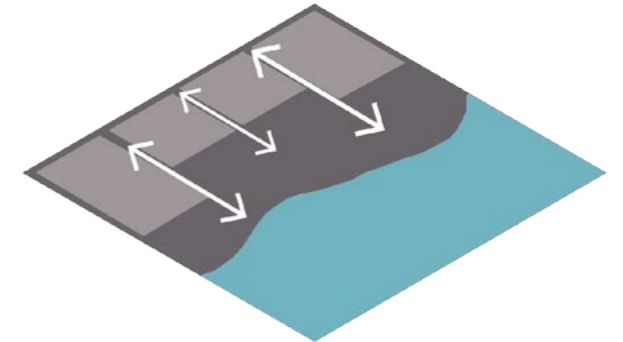


Buffer areas along ecological boundaries, respecting natural processes and conditions

Principles translated through spatial elements



Nature-Inclusivity



Connectivity

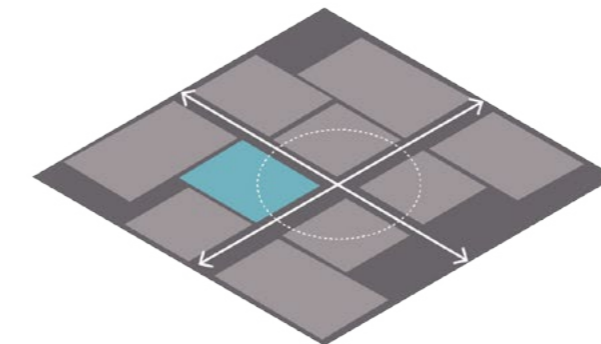
NODES



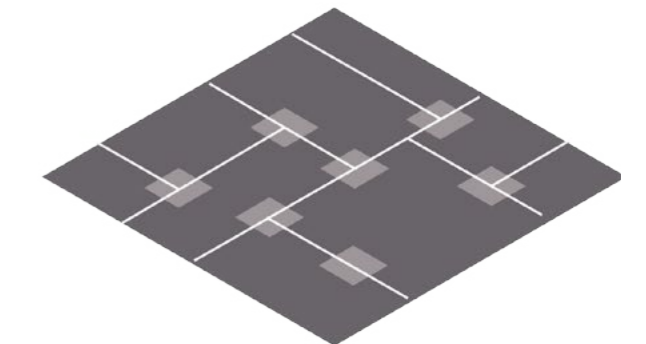
Nodes of integration with ecology



Nodes of integration with the surrounding context



Nature-Inclusivity

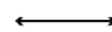


Modularity / Connectivity

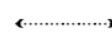
LINKS



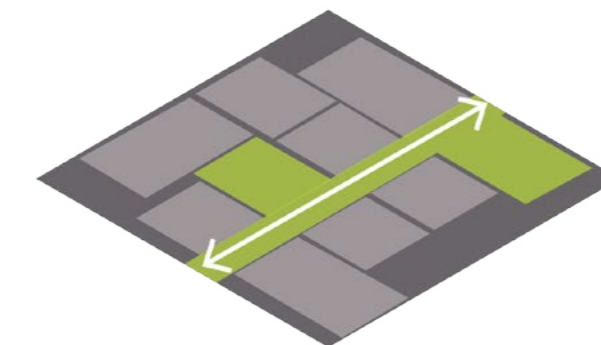
Primary corridors with existing commercial activity



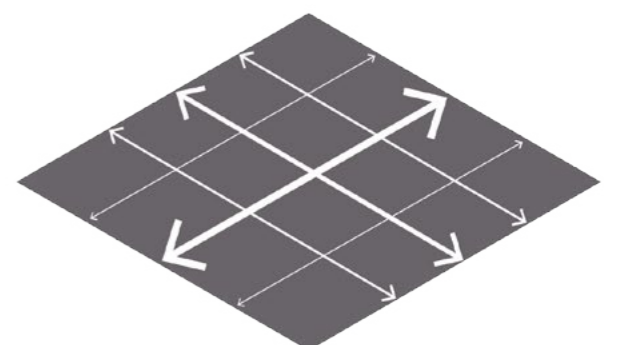
Strengthen existing roads - link interactive spaces connecting nodes within and between settlements



Proposed links within and between settlements



Nature-Inclusivity



Modularity

ZONES



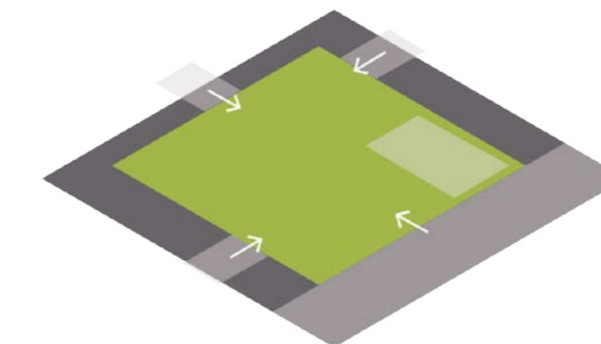
Areas that can house different functions - not predefined



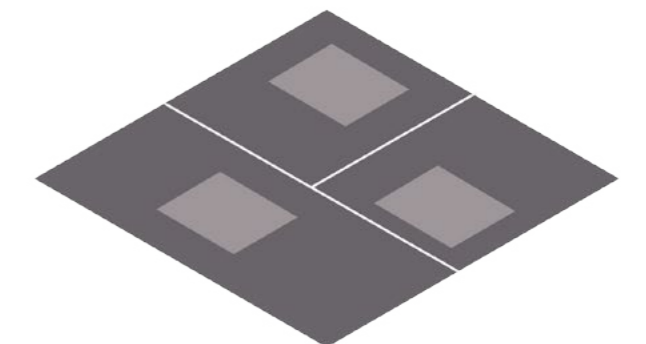
Existing zones of informal settlements



Existing zones of commercial areas



Nature-Inclusivity / Indeterminacy



Modularity

Process

Spatial Conditions that contribute to Climate vulnerability

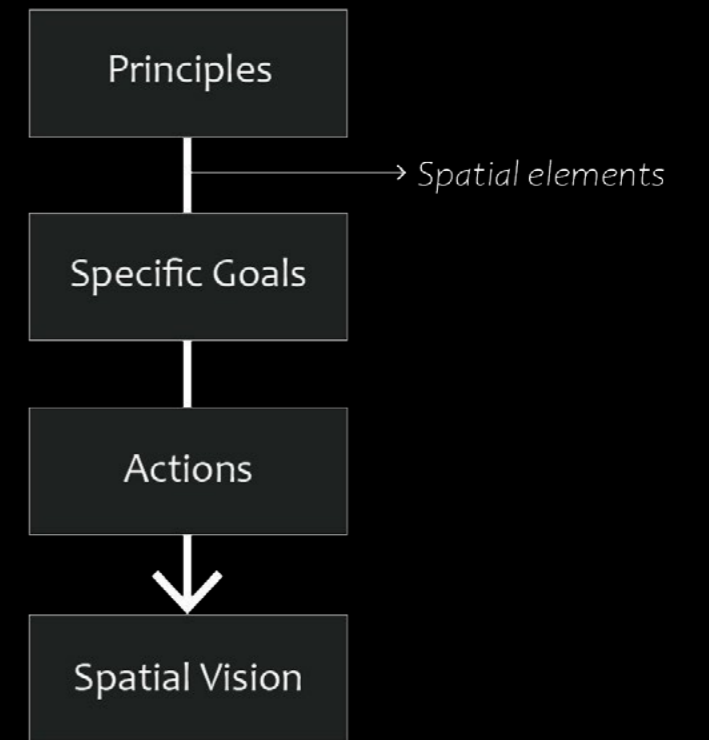
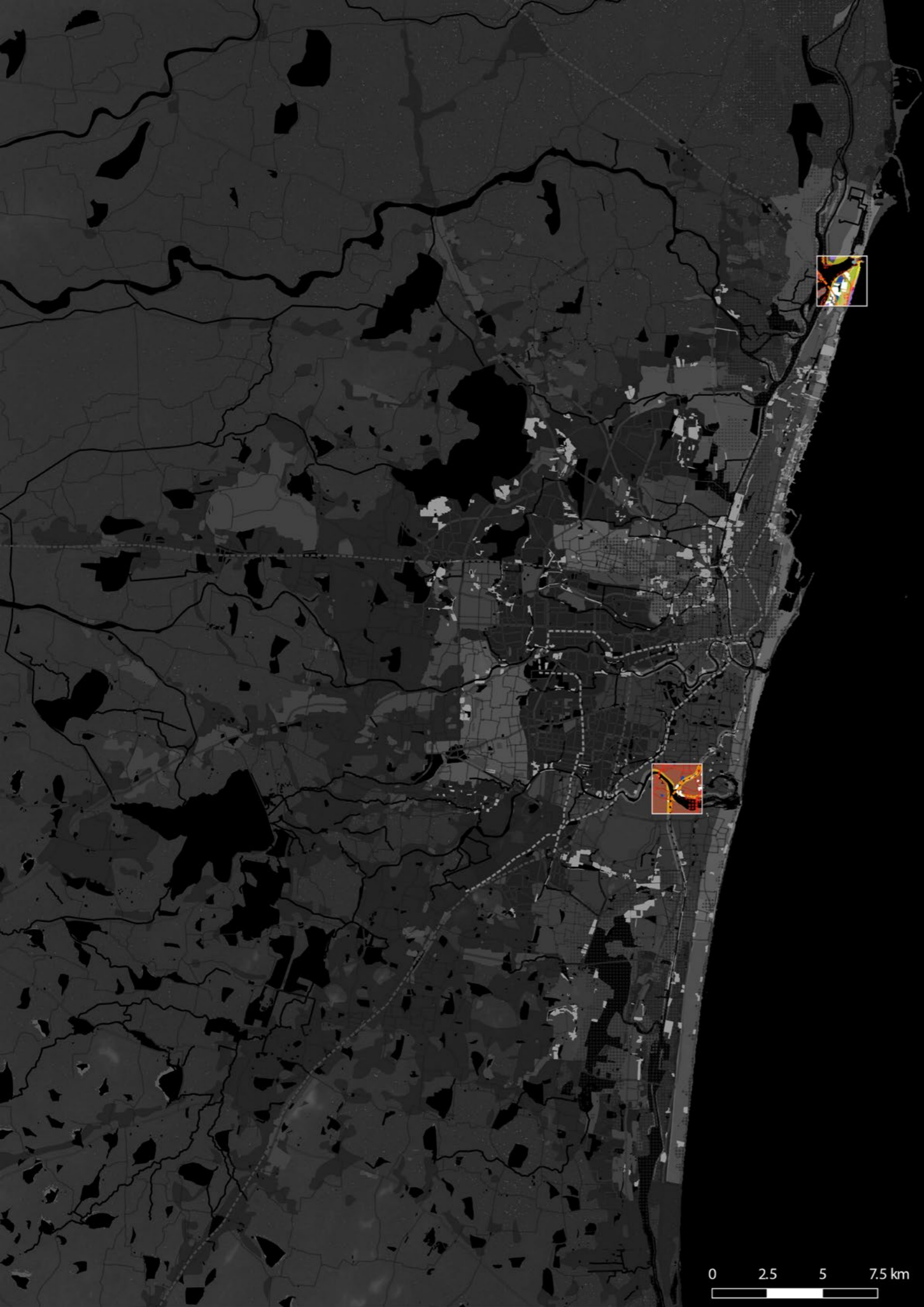
Elements of Culture - Framing the challenge

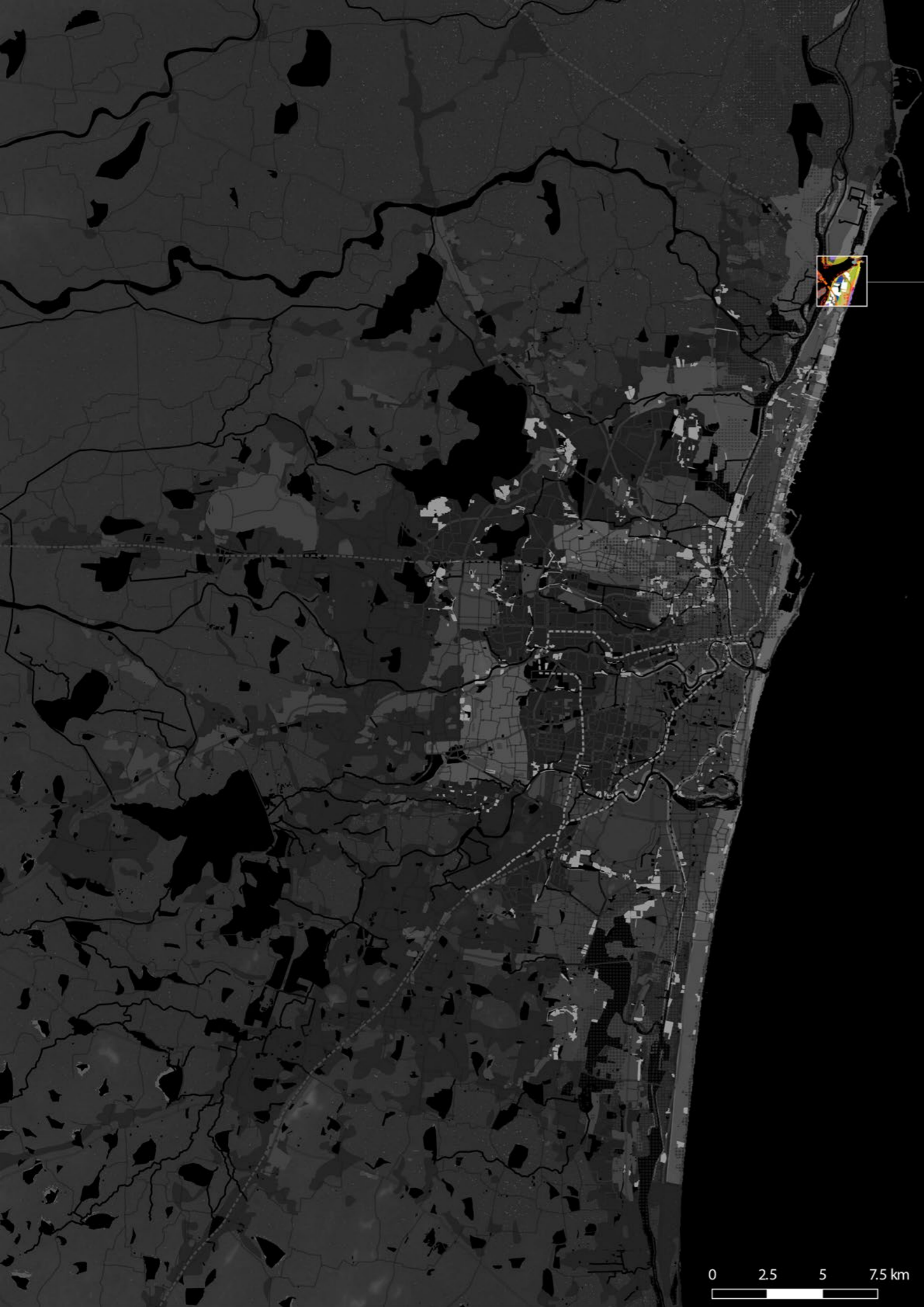
Formulating the Adaptive Framework

Testing the Adaptive Framework

Implementing the Adaptive Framework

Testing the Adaptive Framework





Goals

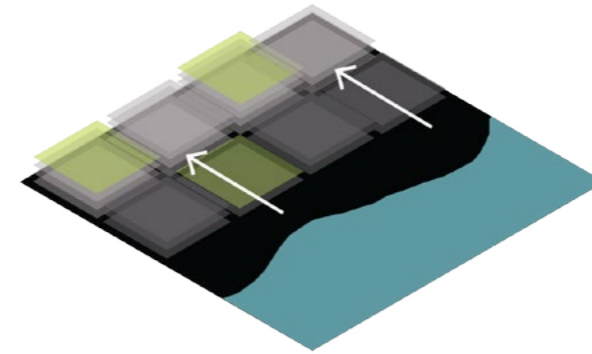
ENVIRONMENTAL REMEDIATION



Re-mediate water resources and remove heavy metal contamination of water and soil



Revive aquatic ecosystem and biodiversity of Ennore creek



LIVING SPACE

Create resilient but flexible housing spaces, to retain relationship with ecology within living environments

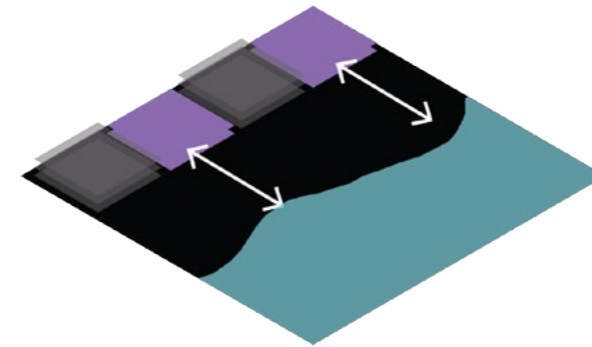
WATER INCLUSIVITY



Increase perviousness of ground in order to recharge ground water and alleviate flooding



Facilitate ecological edges as flood buffer zones and promote development on higher ground



ECONOMIC SPACE

Enhance relationship with the edge through strengthening local economy

LIVING SPACE

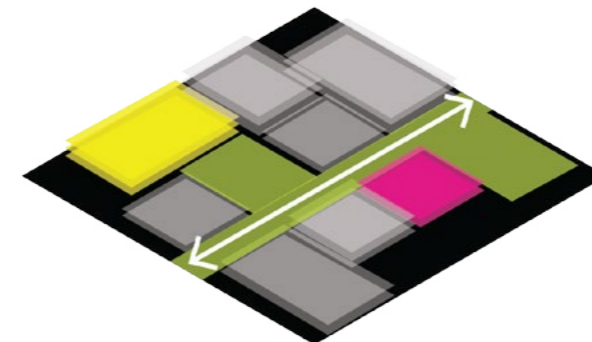


Create safer and resilient living spaces, with possibilities for future transformation and personalisation of space

ECONOMIC SPACE



Delineate edges for local economy to flourish, adapt and transform by enhancing the interaction between formal and informal market



COMMUNITY SPACE

Enhance relationship within the community and with the context through networks of public spaces

COMMUNITY SPACE

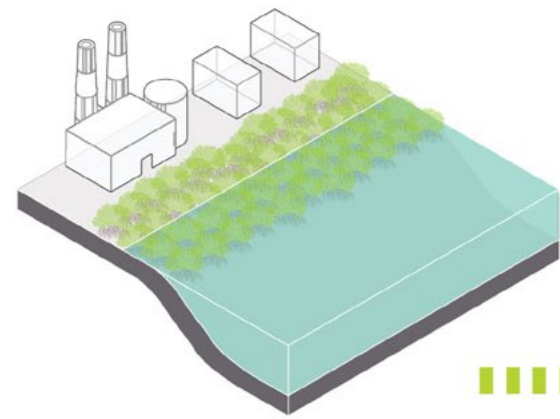


Activate networks of public spaces building on existing cultural infrastructure to reinforce community cohesion and interaction



Facilitate new expressions of collective identity through public functions for the community and its immediate context

Strategic Actions

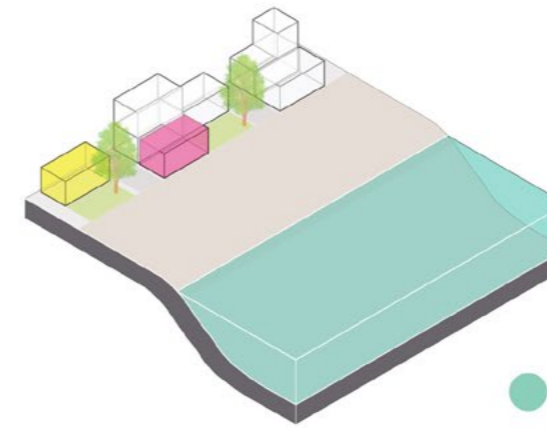


Bioremediation

Phytoremediation using mangroves and other plants that capture heavy metals from the water and soil in edges surrounding the industries and restoring the natural ecology.

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> TNCZMA TNPCB ULBs NGOs 	<ul style="list-style-type: none"> NGOs Residents Govt. Industries Pvt. Industries 	<ul style="list-style-type: none"> NGOs Research Institutions

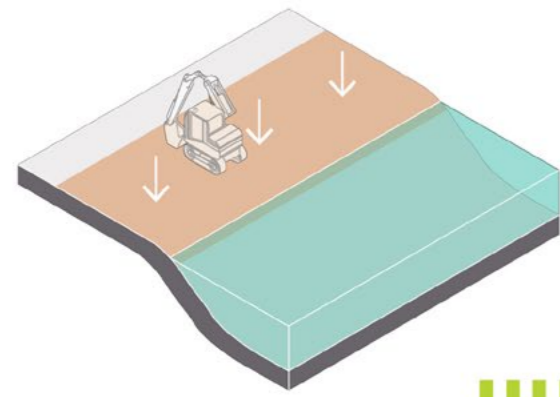


Activate Edges

Activating nodes at ecological edges with economic and socio-cultural functions - built and open, to foster a sense of ownership of the community with the edges.

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> Ward committee TNSCB Residents 	<ul style="list-style-type: none"> NGOs Local residents Architects & urban designers TNSCB 	<ul style="list-style-type: none"> SHGs Community Council

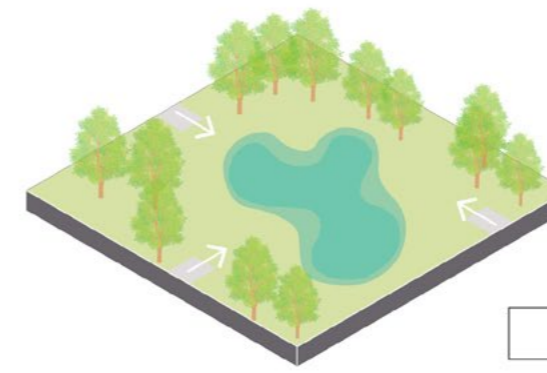


In-situ soil stabilisation

Stabilising the heavy metals present within the soil, preventing them from spreading.

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> TNCZMA TNPCB 	<ul style="list-style-type: none"> Private companies 	<ul style="list-style-type: none"> NGOs Research Institutions Local residents

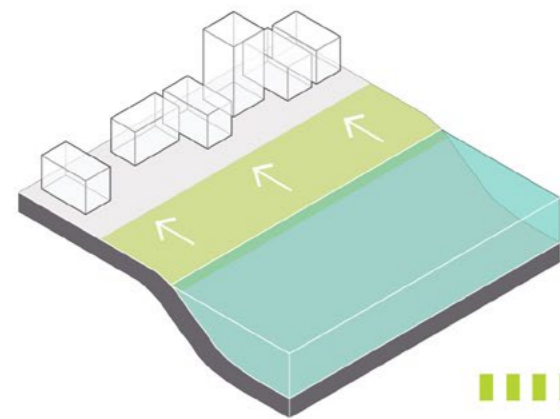


Create retention spaces with buffer areas

Retention areas as large open spaces accessible to the neighbouring settlements, acting as recreational areas that foster healthy relationships with the ecology.

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> CMDA Ward committee NGOs 	<ul style="list-style-type: none"> NGOs Local residents PWD Landscape architects 	<ul style="list-style-type: none"> NGOs Research Institutions Local residents Horticulture department

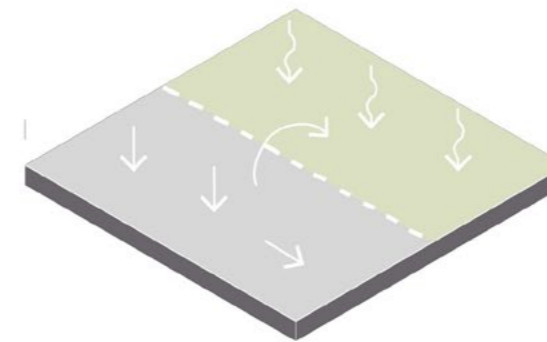


Delineate buffer area

Accommodating water level fluctuations with floodable areas and natural edges, and building on higher ground

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> TNSDMA CMDA 	<ul style="list-style-type: none"> Private companies TNSCB ULBs Local residents 	<ul style="list-style-type: none"> NGOs Research institutions



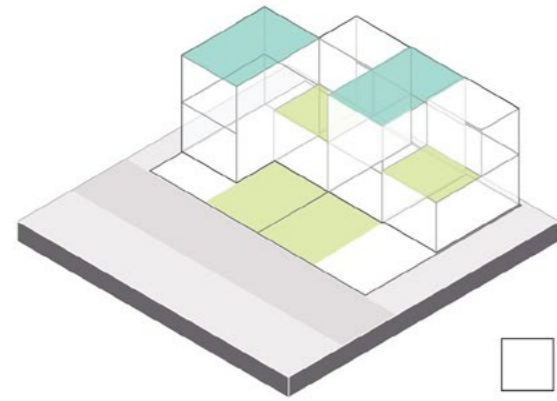
Increase permeable ground cover

Material palette to include porous/permeable material to increase ground water recharge and reduce run-off.

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> CMDA 	<ul style="list-style-type: none"> Architects, urban designers & landscape architects 	<ul style="list-style-type: none"> NGOs Research institutions

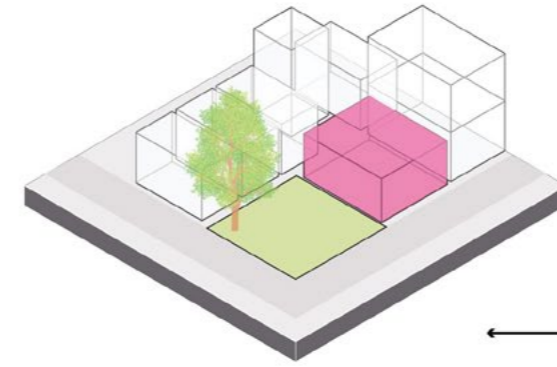
Strategic Actions



Create separate plots with services
Offering individual plots with fixed open space - built ratio, with individual gardens acting as retention spaces, offering the possibility of urban farming.

Stakeholders

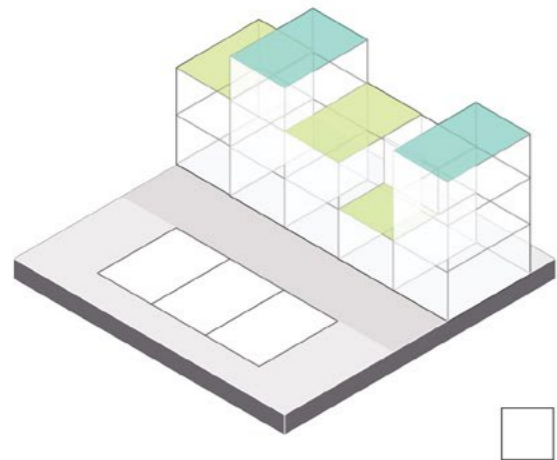
Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> TNSCB CMWSSB Communities 	<ul style="list-style-type: none"> Residents Architects & urban designers TNSCB 	<ul style="list-style-type: none"> Fisheries department Community Council



Create spaces for local economy
Semi-open spaces for local economy to flourish that can be used by the fishermen to carry out net repair and fish drying on open space that could be used for public gathering.

Stakeholders

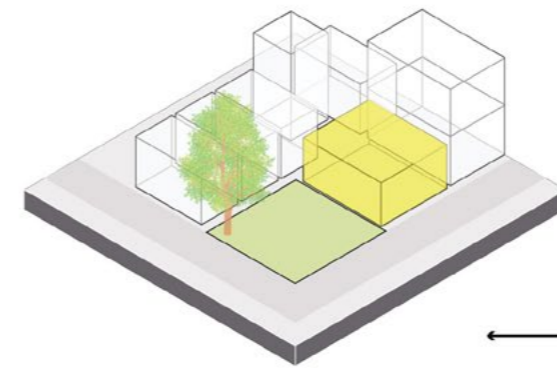
Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> TNSCB CMWSSB Local communities 	<ul style="list-style-type: none"> Architects Residents TNSCB CMWSSB 	<ul style="list-style-type: none"> Fisheries Department Community Council



Build modular units - CBA
Modular housing that can facilitate personalisation and transformation over time or sharing with other families, with rooftop RWH and terrace gardens that encourage active participation in adaptation.

Stakeholders

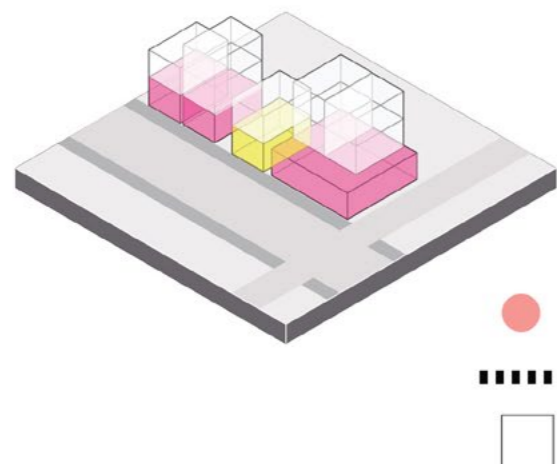
Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> TNSCB CMWSSB Communities 	<ul style="list-style-type: none"> Residents Architects & urban designers TNSCB 	<ul style="list-style-type: none"> Fisheries department Community Council



Create community spaces
Community halls and canteens that can engage the collective and absorption grounds that can be used as parks and playgrounds.

Stakeholders

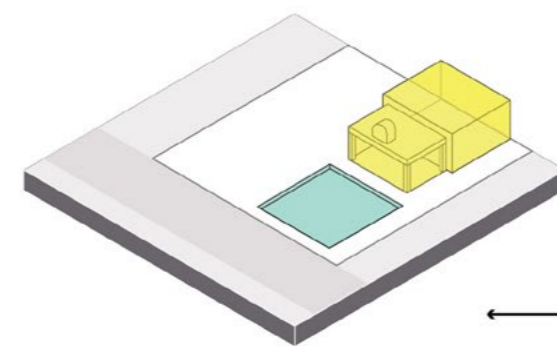
Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> TNSCB CMWSSB Local communities 	<ul style="list-style-type: none"> Architects Residents TNSCB CMWSSB 	<ul style="list-style-type: none"> NGOs Community Council



Facilitate mixed-use buildings
Mixed-use functions along primary linkages, especially around market areas to activate public realm and accommodate apartment housing

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> Ward committees Fisheries Department Communities 	<ul style="list-style-type: none"> Architects Construction companies 	<ul style="list-style-type: none"> Community Council Commercial establishments Private companies

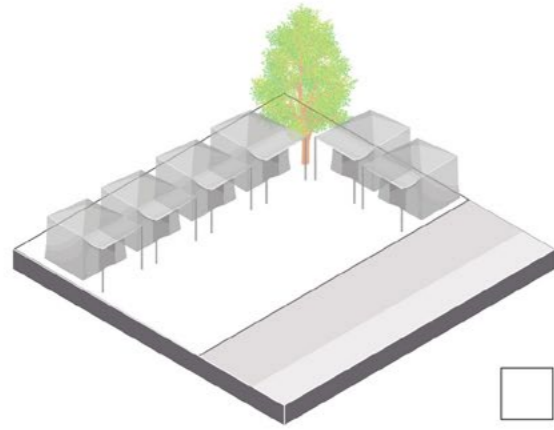


Activate cultural centres
Temples and other cultural centres activated with retention ponds and space for festivals and larger public gatherings.

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> Residents Ward committees 	<ul style="list-style-type: none"> Architects CMWSSB 	<ul style="list-style-type: none"> Community Council

Strategic Actions

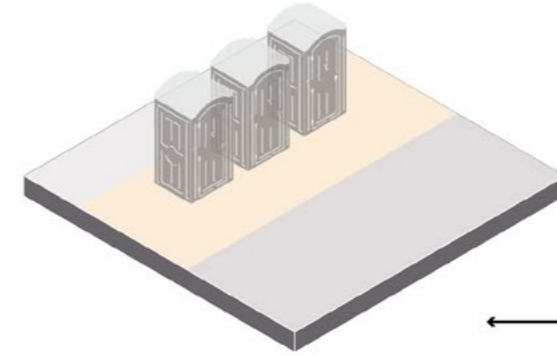


Facilitate temporary markets and fairs

Spaces for markets and fairs for the surrounding communities along commercial spines, also doubling up as temporary night shelters for the homeless to encourage economic integration.

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> Ward committee CMDA 	<ul style="list-style-type: none"> Residents Architects & urban designers Construction companies 	<ul style="list-style-type: none"> Community councils (Ward)

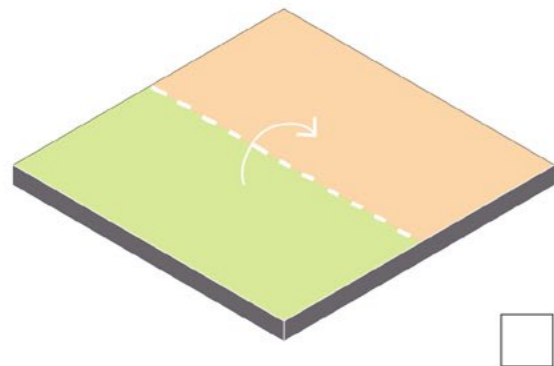


Provide public toilets

Open defecation due to the lack of adequate toilet facilities contributes to deterioration of public health. Public toilets need to be installed along primary links and within communities.

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> GCC CMWSSB 	<ul style="list-style-type: none"> Residents Ward committee Private companies 	<ul style="list-style-type: none"> Research institutions

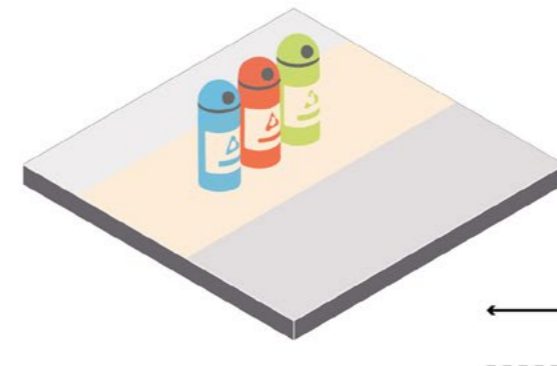


Reclassification of zone functions

Reclassification of CRZ areas, or change in to curb industrial expansion on ecologically sensitive areas

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> TNSCZMA CMDA 	<ul style="list-style-type: none"> Architects Planners Urban designers 	<ul style="list-style-type: none"> Research Institutions

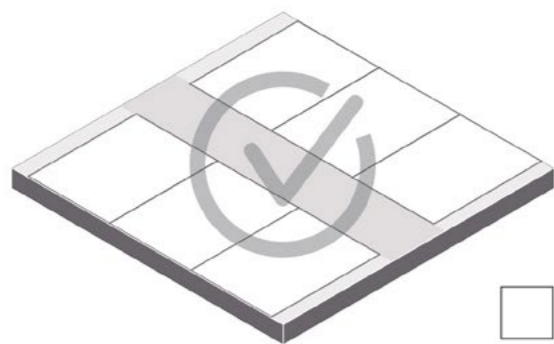


Enable waste segregation

In order to avoid dumping of garbage along water bodies, waste segregation bins need to be installed in multiple points and the residents must be educated on using them.

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> GCC Ward committee 	<ul style="list-style-type: none"> Residents 	<ul style="list-style-type: none"> NGOs

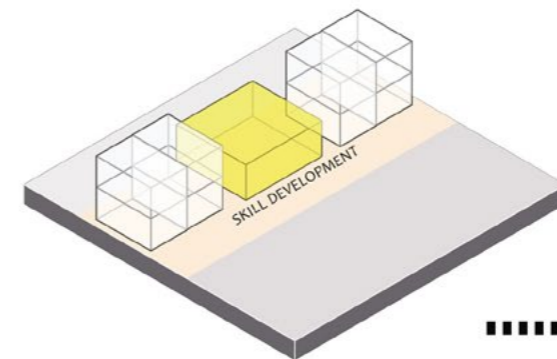


Facilitate tenure security for residents

Tenure security measures and subdivision of plots to facilitate modularity and flexibility in housing should be encouraged.

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> TNSCB Revenue Department 	<ul style="list-style-type: none"> GoTN Finance Department 	<ul style="list-style-type: none"> NGOs Residents



Create skill development centres

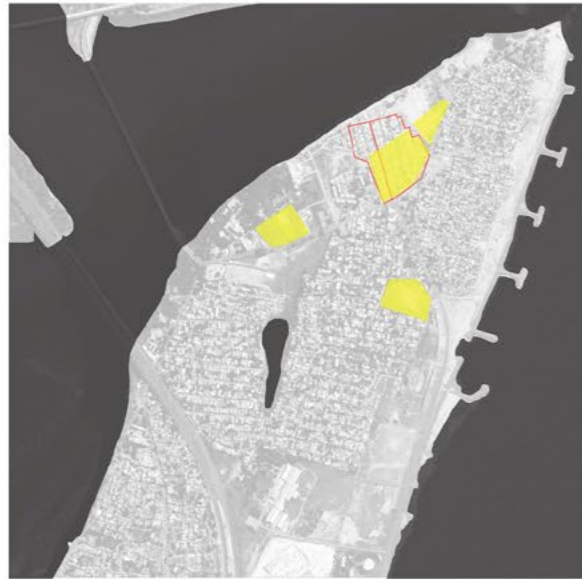
Each ward should have a skill development centre to equip residents, especially women, with skills that will aid economic growth and opportunities.

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> TNSCB Fisheries Department Communities 	<ul style="list-style-type: none"> NGOs Architects TNSCB - Community Development Wing 	<ul style="list-style-type: none"> Community Council, residents

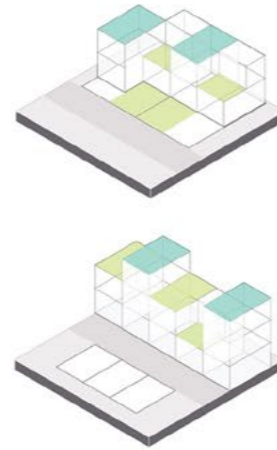
Strategic Actions - Locations

Relation between the spatial framework and actions



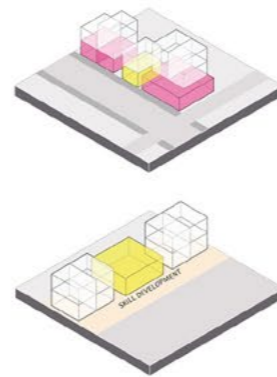
Housing

Areas that could accommodate housing for the settlement to be rehabilitated - preferred spaces along the coast for easy access to creek for fishing.



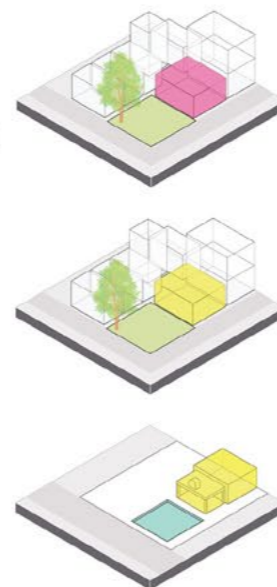
Mixed use

Areas that could accommodate mixed use development with a combination of housing, and social and economic activities - around primary corridor, connecting existing commercial area.



Public function

Areas that could create a network of small social and cultural spaces (built and open) along access routes within the housing areas that connect the central corridor and ecological edges.



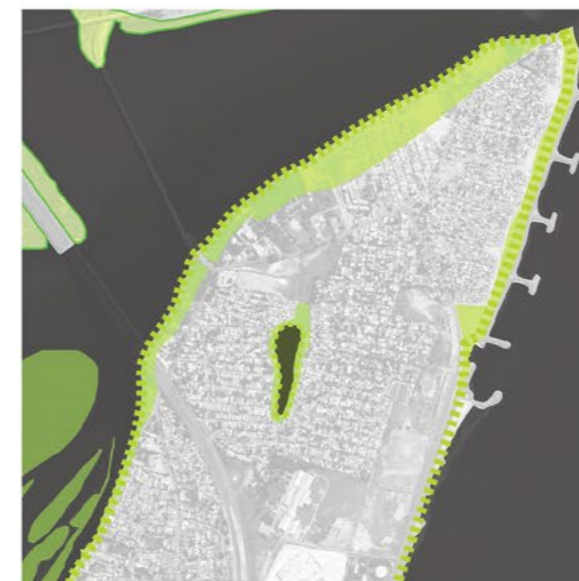
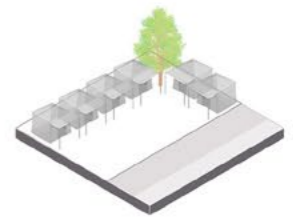
Open green spaces

Areas that could be transformed into larger community greens (retention areas) - along primary (large) and secondary links (small-medium).



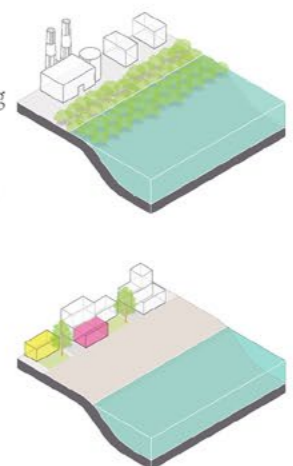
Market areas

Areas that are flexible to host markets, fairs and other temporary functions and events, along the primary link.









Buffer areas

Areas that are located along the edges - nodes that house social and economic functions that interact with the edge. These could be built or open activities that engage the community in a healthy relationship with the ecology.

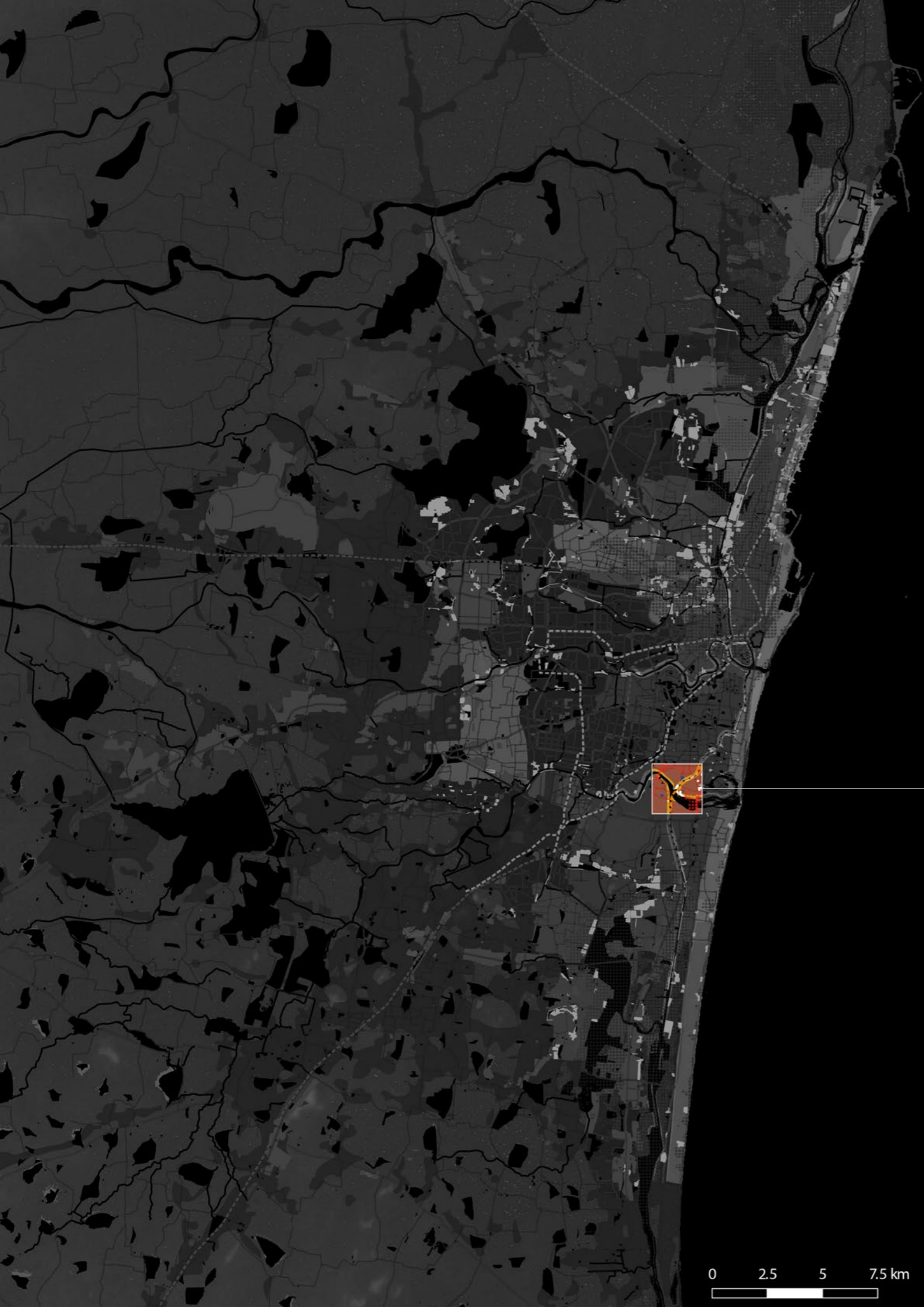




LEGEND

-  Buffer areas along ecological boundaries, respecting natural processes and conditions
-  Nodes of integration with ecology
-  Nodes of integration with the context
-  Primary corridors with existing commercial activity
-  Strengthen existing roads - link interactive spaces connecting nodes within and between settlements
-  Proposed links within and between settlements
-  Areas that can house different functions - not predefined
-  Existing zones of informal settlements
-  Existing zones of commercial areas

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Goals

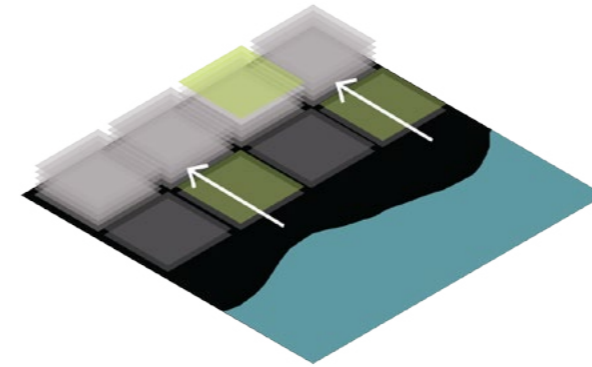
ENVIRONMENTAL REMEDIATION



Restore quality of water in the Buckingham canal



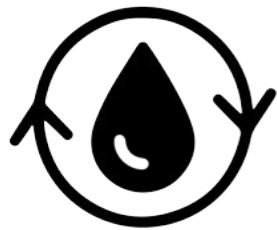
Revive health of ecosystem and biodiversity of Adyar river



LIVING SPACE

Create resilient high density housing spaces, on higher ground while retaining ground relationship.

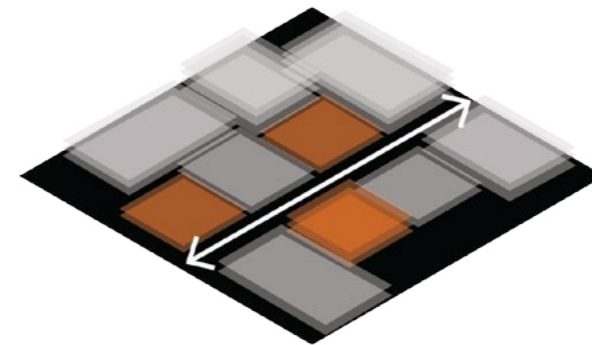
WATER INCLUSIVITY



Increase perviousness of ground in order to recharge ground water and alleviate flooding



Facilitate ecological edges as flood buffer zones and promote development on higher ground



ECONOMIC SPACE

Enhance relationship with the immediate context through providing mixed functions and creating opportunities for interaction.

LIVING SPACE

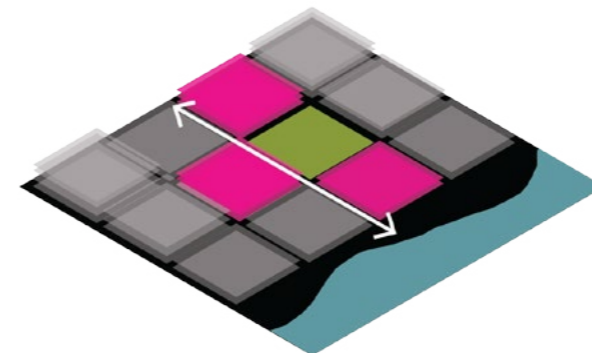


Facilitate higher densities in living spaces while retaining existing street character and flexibility

ECONOMIC SPACE



Facilitate space for local economy to flourish, adapt and transform, and enhance interaction with the formal city (immediate context)



COMMUNITY SPACE

Build relationship with the river and canal edges through accessible routes with public functions creating a network of public spaces

COMMUNITY SPACE

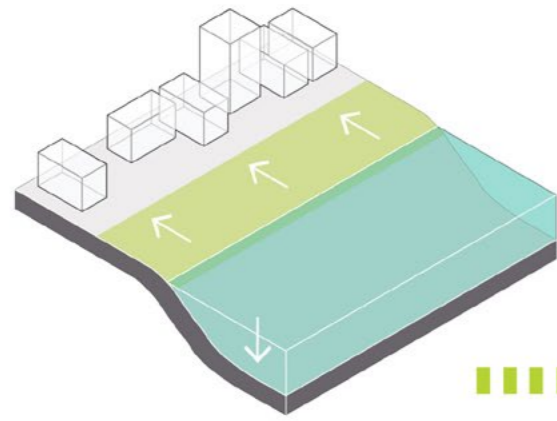


Activate networks of public spaces to reinforce community cohesion and interaction



Enhance the accessibility to the river and canal through public functions, offering the potential for new collective identities

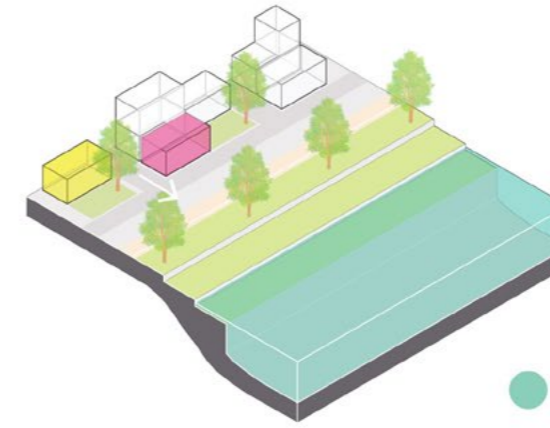
Strategic Actions



River cleaning and widening
Desilting and cleaning the river of debris and demarcation of buffer area with natural edge that accounts for fluctuations, building on higher ground.

Stakeholders

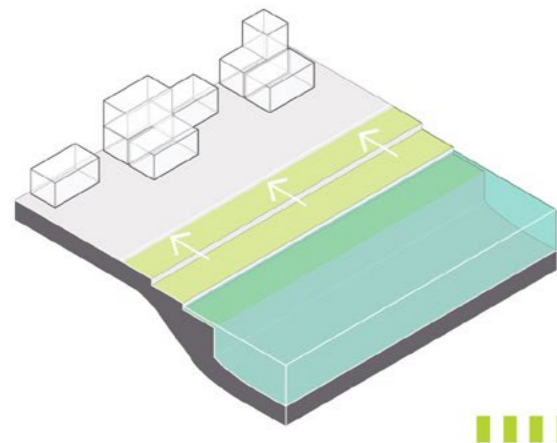
Regulation	Collaboration	Consultation
CRRT	WRD	NGOs
CMDA	CMWSSB	Research Institutions
NGOs	CRRT	Residents
	PWD	
	TNSCB	



Activating canal edges
Increasing accessibility to canal edge and facilitating social and recreational functions - built and open, at multiple points along the canal.

Stakeholders

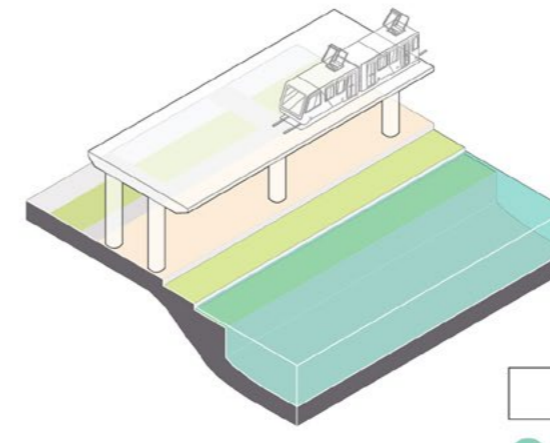
Regulation	Collaboration	Consultation
Ward committee	NGOs	SHGs
CRRT	Local residents	Community Council
Communities	Architects & urban designers	
	TNSCB	



Opening canal edge and buffer area
Removing canal wall obstruction and widening it to accommodate horizontal flow.

Stakeholders

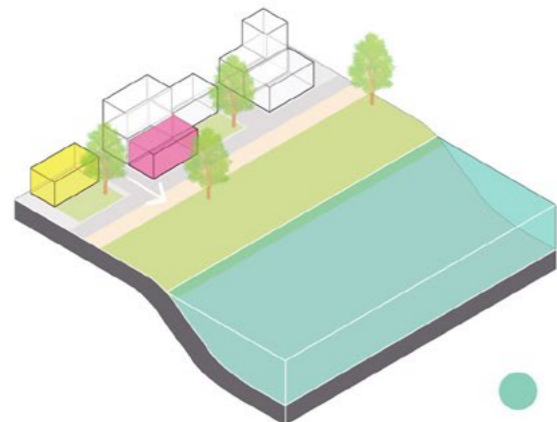
Regulation	Collaboration	Consultation
CRRT	WRD	NGOs
GCC	CMWSSB	Research Institutions
	CRRT	Residents
	PWD	
	TNSCB	



Repurposing spaces below the MRTS line
Facilitating temporary functions such as markets, pop up stalls and games below the Metro bridge to provide opportunities for economic activity.

Stakeholders

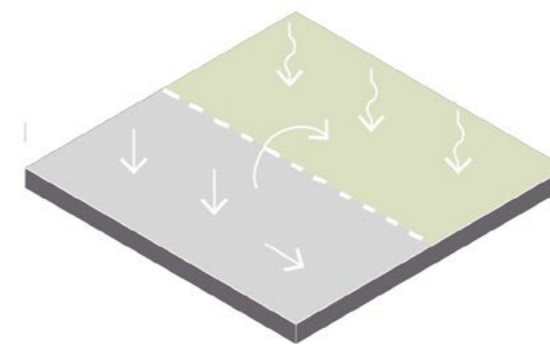
Regulation	Collaboration	Consultation
Ward committee	NGOs	Research Institutions
CRRT	Local residents	Ward residents
Communities	Urban designers	
	CMRL	



Activating river edges
Increasing accessibility to river edge and facilitating economic, social and cultural activities - built or open.

Stakeholders

Regulation	Collaboration	Consultation
Ward committee	NGOs	SHGs
CRRT	Local residents	Community Council
Communities	Architects & urban designers	
	TNSCB	

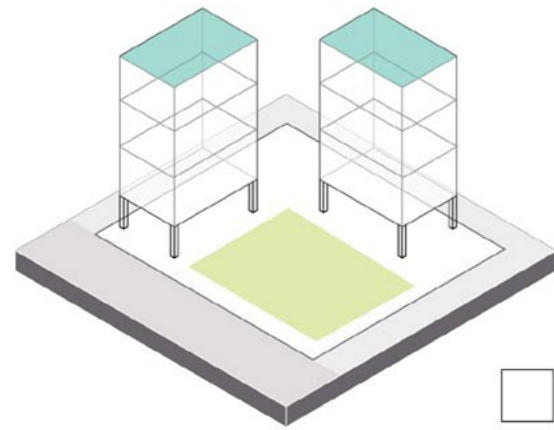


Increasing permeable ground cover
Material palette to include porous/permeable material to increase ground water recharge and reduce run-off

Stakeholders

Regulation	Collaboration	Consultation
CMDA	Architects, urban designers & landscape architects	NGOs
		Research institutions

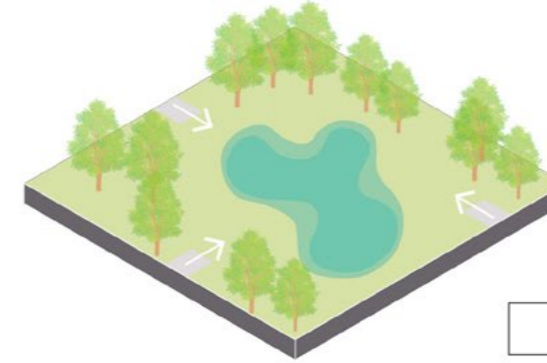
Strategic Actions



Build tenements / apartments
Apartment buildings with rooftop RWH facility and open play areas or community gardens.

Stakeholders

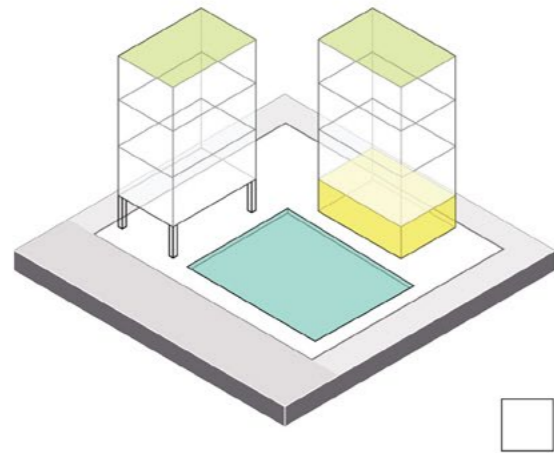
Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> TNSCB CMWSSB Communities 	<ul style="list-style-type: none"> Residents Architects & urban designers TNSCB 	<ul style="list-style-type: none"> Fisheries department Community Council



Create retention spaces with buffer areas
Retention areas as medium open spaces accessible to the neighbouring settlements, acting as recreational areas that foster healthy relationships with the ecology.

Stakeholders

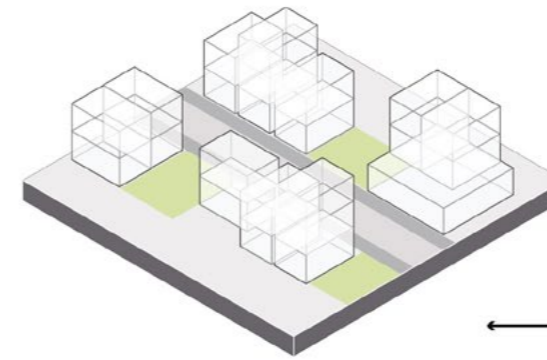
Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> CMDA Ward committee NGOs 	<ul style="list-style-type: none"> NGOs Local residents PWD Landscape architects 	<ul style="list-style-type: none"> NGOs Research Institutions Local residents Horticulture department



Build apartments with social spaces
Apartment buildings with community hall and gathering space and terrace gardens.

Stakeholders

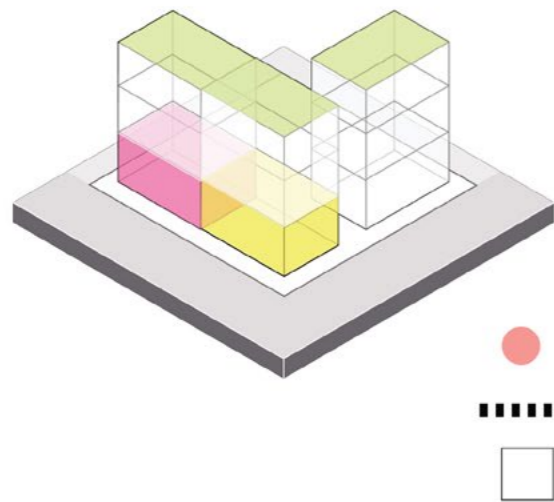
Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> TNSCB CMWSSB Communities 	<ul style="list-style-type: none"> Residents Architects & urban designers TNSCB 	<ul style="list-style-type: none"> Fisheries department Community Council



Create a network of open spaces
Network of open spaces managed locally by resident communities to promote urban horticulture and interaction

Stakeholders

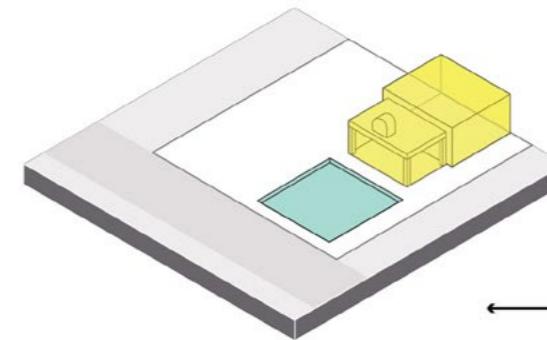
Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> CMDA Ward committee Local resident groups 	<ul style="list-style-type: none"> Local residents PWD Landscape architects 	<ul style="list-style-type: none"> NGOs Research Institutions Local residents Horticulture department



Facilitate mixed-use buildings
Mixed-use functions along primary linkages, especially around market areas to activate public realm

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> Ward committees Communities 	<ul style="list-style-type: none"> Architects Construction companies TNSCB 	<ul style="list-style-type: none"> Community Council Commercial establishments Private companies

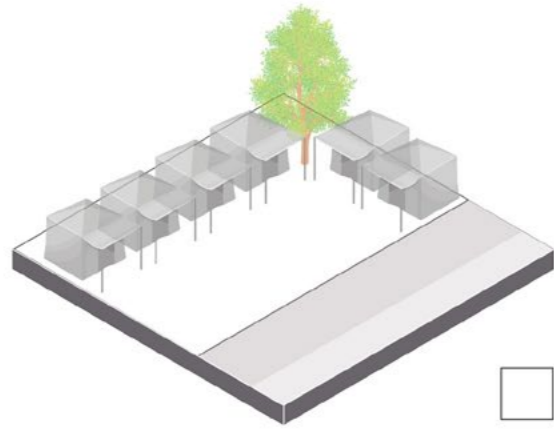


Activate cultural centres
Temples and other cultural centres activated with retention ponds and space for festivals and larger public gathering

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> Residents Ward committees 	<ul style="list-style-type: none"> Architects CMWSSB Temple authorities 	<ul style="list-style-type: none"> Community Council

Strategic Actions

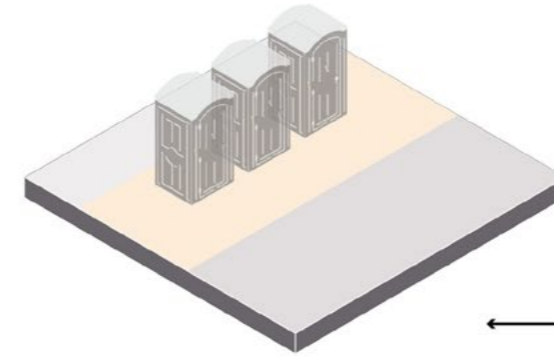


Facilitate temporary markets and fairs

Spaces for markets and fairs for the surrounding communities along commercial spines, also doubling up as temporary night shelters for the homeless to encourage economic integration.

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> Ward committee CMDA 	<ul style="list-style-type: none"> Residents Architects & urban designers Construction companies 	<ul style="list-style-type: none"> Community councils (Ward)

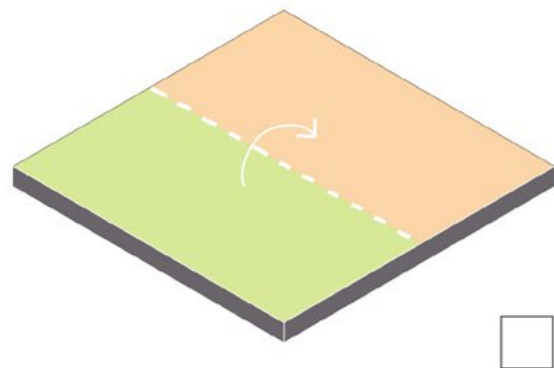


Provide public toilets

Open defecation due to the lack of adequate toilet facilities contributes to deterioration of public health. Public toilets need to be installed along primary links and within communities.

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> GCC CMWSSB 	<ul style="list-style-type: none"> Residents Ward committee Private companies 	<ul style="list-style-type: none"> Research institutions

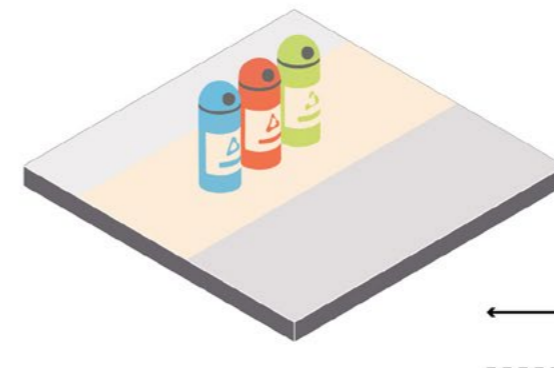


Reclassification of zone functions

Reclassification of OSR areas to allow for residential functions in certain cases, in order to offer safe public edges along waterways.

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> TNSCZMA MoEF 	<ul style="list-style-type: none"> Architects Planners Urban designers 	<ul style="list-style-type: none"> Research Institutions

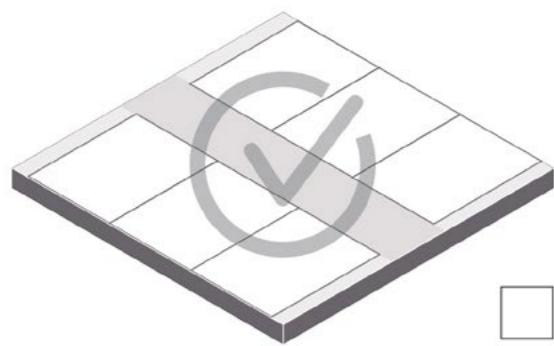


Enable waste segregation

In order to avoid dumping of garbage along water bodies, waste segregation bins need to be installed in multiple points and the residents must be educated on using them.

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> GCC Ward committee 	<ul style="list-style-type: none"> Residents 	<ul style="list-style-type: none"> NGOs

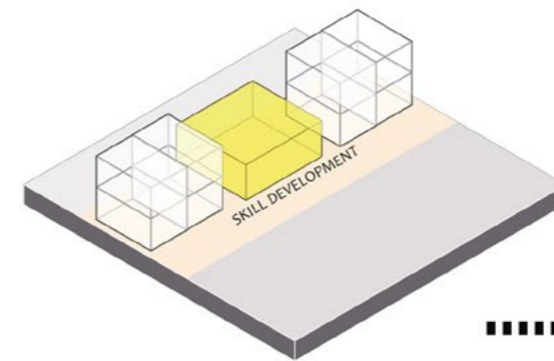


Facilitate tenure security for residents

Tenure security measures and subdivision of plots to facilitate modularity and flexibility in housing should be encouraged.

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> TNSCB Revenue Department 	<ul style="list-style-type: none"> GoTN Finance Department 	<ul style="list-style-type: none"> NGOs Residents



Create skill development centres

Each ward should have a skill development centre to equip residents, especially women, with skills that will aid economic growth and opportunities.

Stakeholders

Regulation	Collaboration	Consultation
<ul style="list-style-type: none"> TNSCB Fisheries Department Communities 	<ul style="list-style-type: none"> NGOs Architects TNSCB - Community Development Wing 	<ul style="list-style-type: none"> Community Council, residents

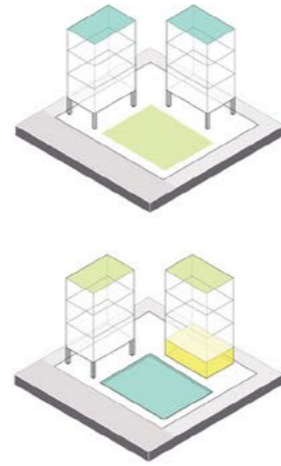
Strategic Actions - Locations

Relation between the spatial framework and actions



Housing

Areas that could accommodate housing for the settlement to be rehabilitated - in parts of the settlement area and around primary link.



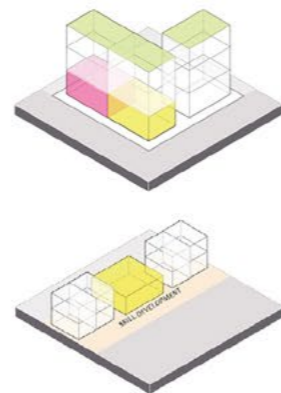
Open green spaces

Areas that could be transformed into community greens (retention areas) - along primary and secondary links.



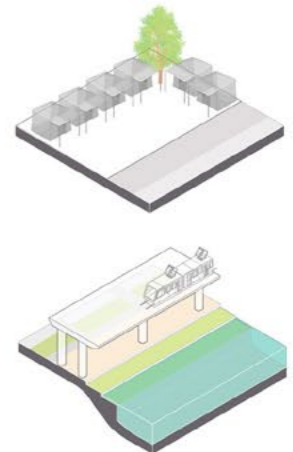
Mixed use

Areas that could accommodate mixed use development with a combination of housing, and social and economic activities - around primary corridor, connecting existing commercial area.



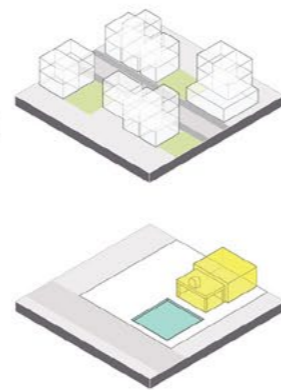
Market areas

Areas that are flexible to host markets, fairs and other temporary functions and recreational events. This can also be accommodated under the MRTS bridge.



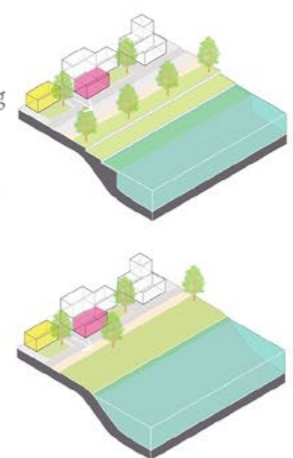
Public function

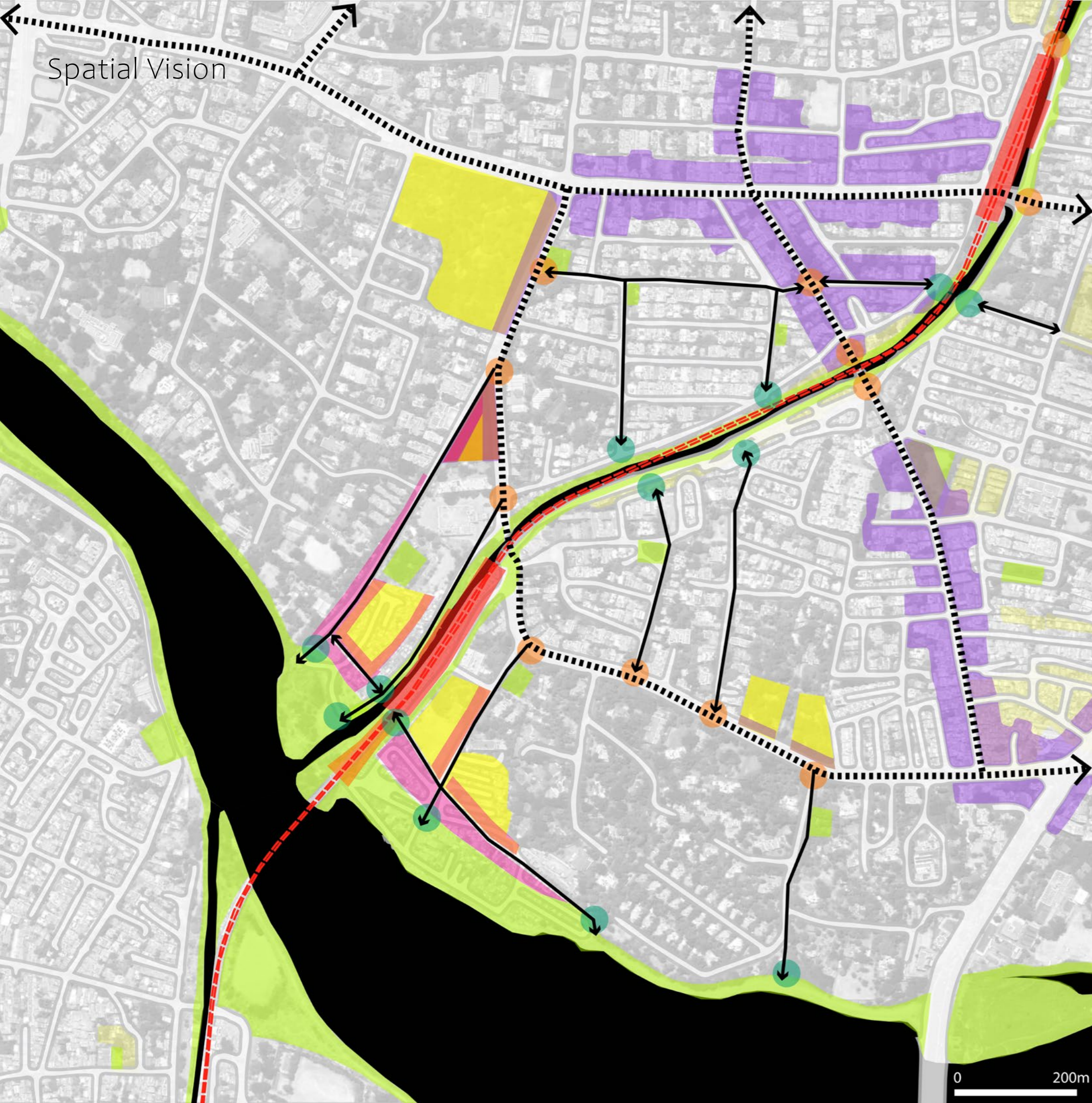
Areas that could create a network of small social and cultural spaces (built and open) along access routes within the housing areas that connect the central corridor and ecological edges.



Buffer areas










Areas that are located along the edges - nodes that house social and economic functions that interact with the edge. These could be built or open activities that engage the community in a healthy relationship with the ecology.





Spatial Vision

LEGEND

-  Buffer areas along ecological boundaries, respecting natural processes and conditions
-  Nodes of integration with ecology
-  Nodes of integration with the context
-  Primary corridors with existing commercial activity
-  Strengthen existing roads - link interactive spaces connecting nodes within and between settlements
-  Proposed links within and between settlements
-  Areas that can house different functions - not predefined
-  Existing zones of informal settlements
-  Existing zones of commercial areas

0 200m

Process

Spatial Conditions that contribute to Climate vulnerability

Elements of Culture - Framing the challenge

Formulating the Adaptive Framework

Testing the Adaptive Framework

Implementing the Adaptive Framework

Key Stakeholders & Capacities

Key Stakeholders	Level	Current Capacities	Desired Capacities
MoEFCC CRZ	India	CRZ zones classification and permissible activities	Revise permissible activities to curb industrial encroachment into ecologically sensitive areas, strict enforcement
GCC CDMP	City	Zone-wise plan for disaster response measures	Involvement of civic society in adaptation
CRRT	City	Eco-restoration plans for waterways within city	Incorporate society in carrying out restoration at different points along the waterway, encourage local management of commons
TNSCB	State	Rehabilitation and resettlement to peripheral areas In-house architects Fixed tenement typologies with a focus on only housing	Resettlement to parcels of land within a 2 km radius of current location Alternate affordable housing delegated to private developers and architects Involving communities in developing typologies based on requirements for housing, social and economic needs
CMDA	City	Land use/ zoning and building regulations	Revision of land use norms for Open Space and Recreational (OSR) areas to include residential functions and incorporate permeability rules in zoning norms Definition of minimum buffer areas along waterways and coasts for tidal protection
Ward committees	Local	No planning power, civic representation	Enable planning power within committee with in-house planners to address issues within ward boundary Civic representation in ward committee
Resilient Chennai Office	City	Resilience Strategy; access to solutions, service providers and partners from across public, private and non-profit sectors; and membership to a global network of member cities to learn from and collaborate.	
World Bank TNSF	International	Tamil Nadu Shelter Fund (TNSF) invests in affordable housing and/or in situ livelihood infrastructure for vulnerable people and economically weaker sections.	
NGOs - IRCUDUC, CRC, EFI, CET, CAG	City	Carrying out restoration activities and social studies, and creating awareness among civil society about social and environmental issues	Reaching out to the vulnerable communities and engaging them in restoration efforts
Resident and Community groups	Local	Insufficiently involved	Key stakeholders in decision-making represented in councils and ward committees
Private developers	City	Insufficiently involved	Funding and execution for projects, and incentivise transfer of ownership of land through TDR
Architects and Engineers	City	Insufficiently involved	Affordable housing design and execution
Urban planners and designers	City	Insufficiently involved	Design of community spaces with the community residents
Research institutions	City/State/Natio	Technical assistance, scientific study and formulation of strategies	
Religious Bodies	Local	Insufficiently involved	Collaborating with communities to preserve cultural values relating to environment

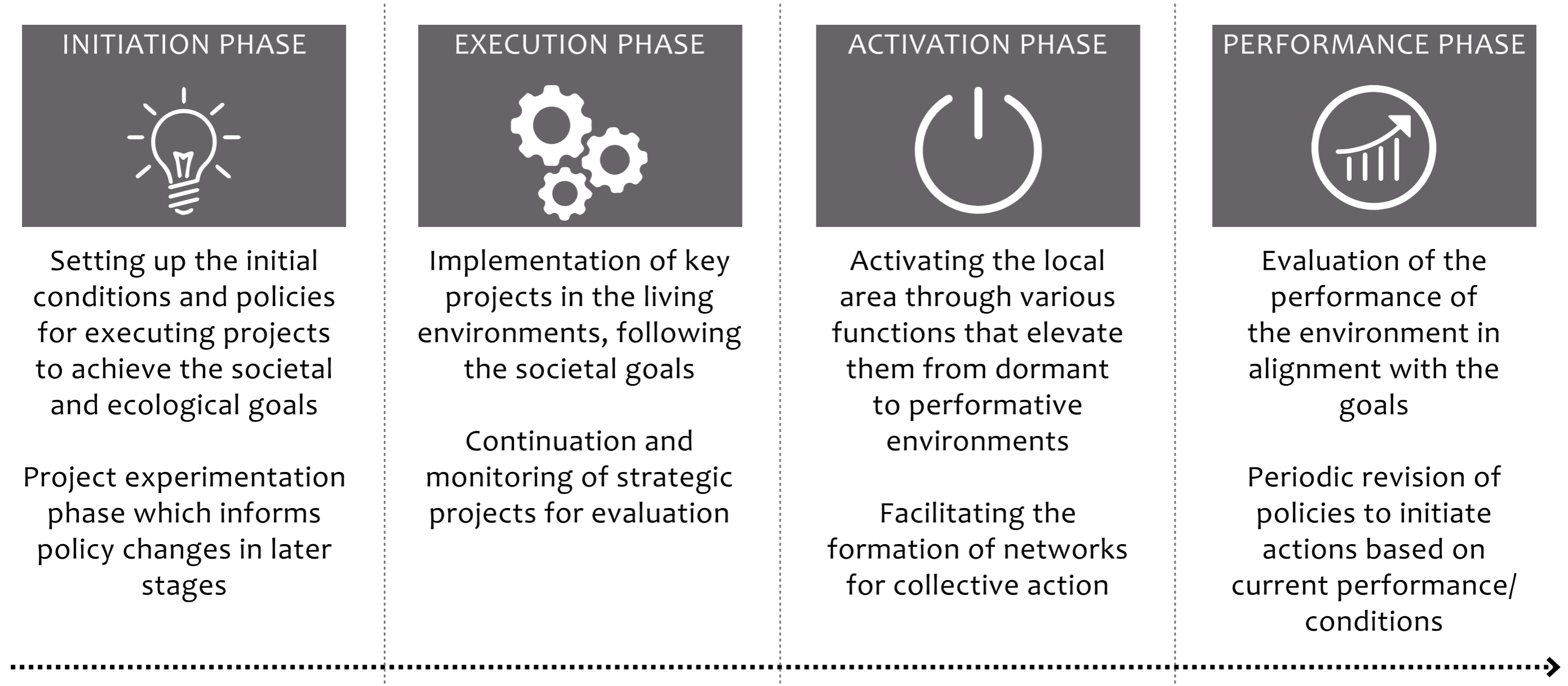
Key Stakeholders & Incentives

KEY AGENTS	DESIRED CAPACITIES	INCENTIVES
<p>● Public Sector (City, State and National level organisations)</p>	<p>Revised norms and regulations to help facilitate actions towards goals</p> <p>Decentralised control of development and planners at local level</p>	<p>Quicker results and assessment of sustainable development measures</p> <p>Easy management and coordination of different projects with vision-oriented development</p>
<p>● Private Sector (private companies, architects, etc.)</p>	<p>Increased involvement in execution and funding</p>	<p>Financial incentives - tax exemption</p> <p>Subsidies on building materials</p> <p>Transferable Development Rights (TDR)</p> <p>Cross-subsidisation</p>
<p>● Research Institutions</p>	<p>Increased role in consultation</p>	<p>Funding/grants for research</p>
<p>● Non-Governmental Organisations</p>	<p>Increased alignment and coordination with government in plans and goals</p>	<p>Funding</p>
<p>● Community Groups (Resident Welfare Associations, fishermen cooperatives, etc.)</p>	<p>Increased agency in decision-making process and management of built environment</p>	<p>Build accountability</p> <p>Quality of life</p> <p>Sense of ownership and empowerment</p>

Evolutionary Goals

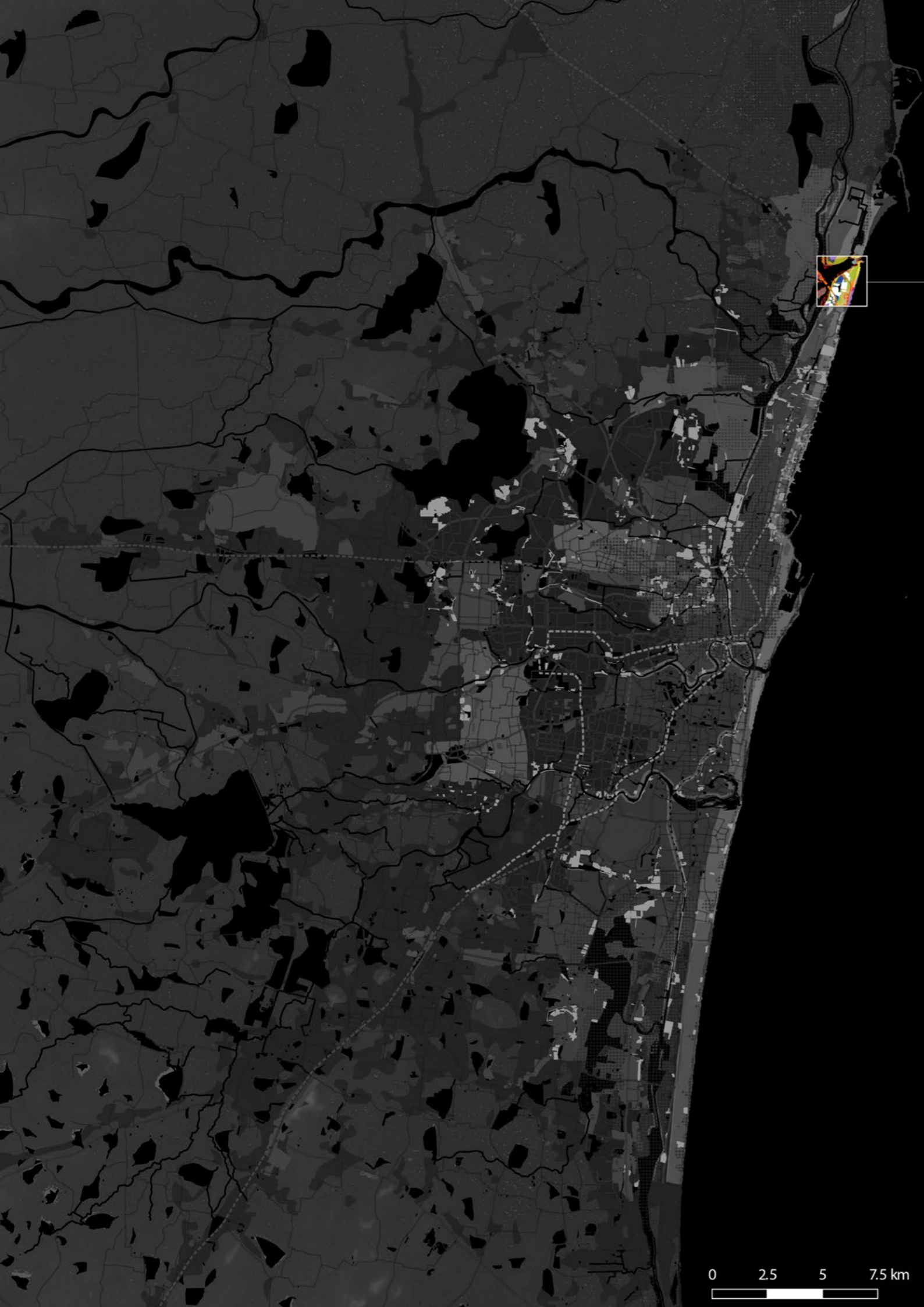
Timeframe	5 years	10 years	15 years	
Ecological Goals	Environmental Restoration	Improved quality of water, reduction in pollution	Restored activities on water bodies, like fishing	Water provides opportunity for new economic and recreational activities
	Water Inclusivity	Reduction in flooding impact, improvement in ground water table	Reduction in flooding impact, adapting to SLR, stabilisation of ground water table	No flooding impact - the urban environment is able to adapt to extreme rainfall and SLR
Societal Goals	Living Space	Rehabilitation of existing settlements	Improved quality of life in rehabilitated settlements	Residents have more power and are able to transform their living environments
	Economic Space	Reduction in poverty levels and increase in number of employed people	Stabilisation of local economy	New economic activities within the settlements responding to external changes
	Community Space	Increased social/public activity within the community	Increased participation in planning and design process	Agency over public realm to cope with unforeseen events and external pressures

Phasing

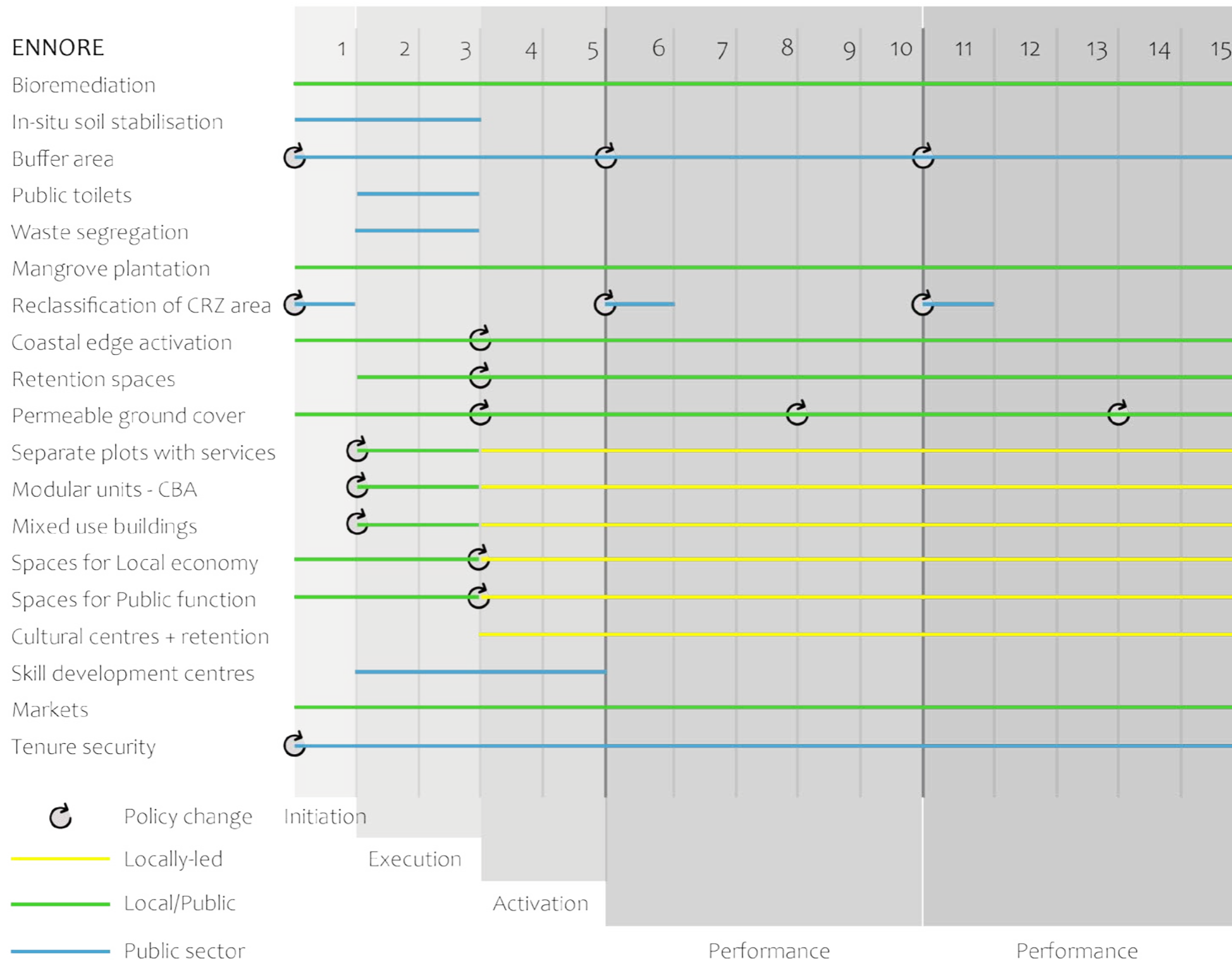


Involvement of key stakeholders in phasing

Stakeholder	Platform	Level	Involvement Phase			
			1	2	3	4
MoEFCC	CRZ	India	■			■
GCC	CDMP	City		■	■	
CRRT		City		■		
TNSCB		State		■		
CMDA		City	■	■		
Ward committees		Local		■		
Resilient Chennai Office		City	■			■
World Bank	TNSF	International	■			
NGOs - IRCDUC, CRC, EFI, CET, CAG		City	■		■	
Resident and Community groups		Local		■	■	■
Private developers		City		■		
Architects and Engineers		City		■		
Urban planners and designers		City		■		
Research institutions		City/State/National	■			
Religious Bodies		Local			■	

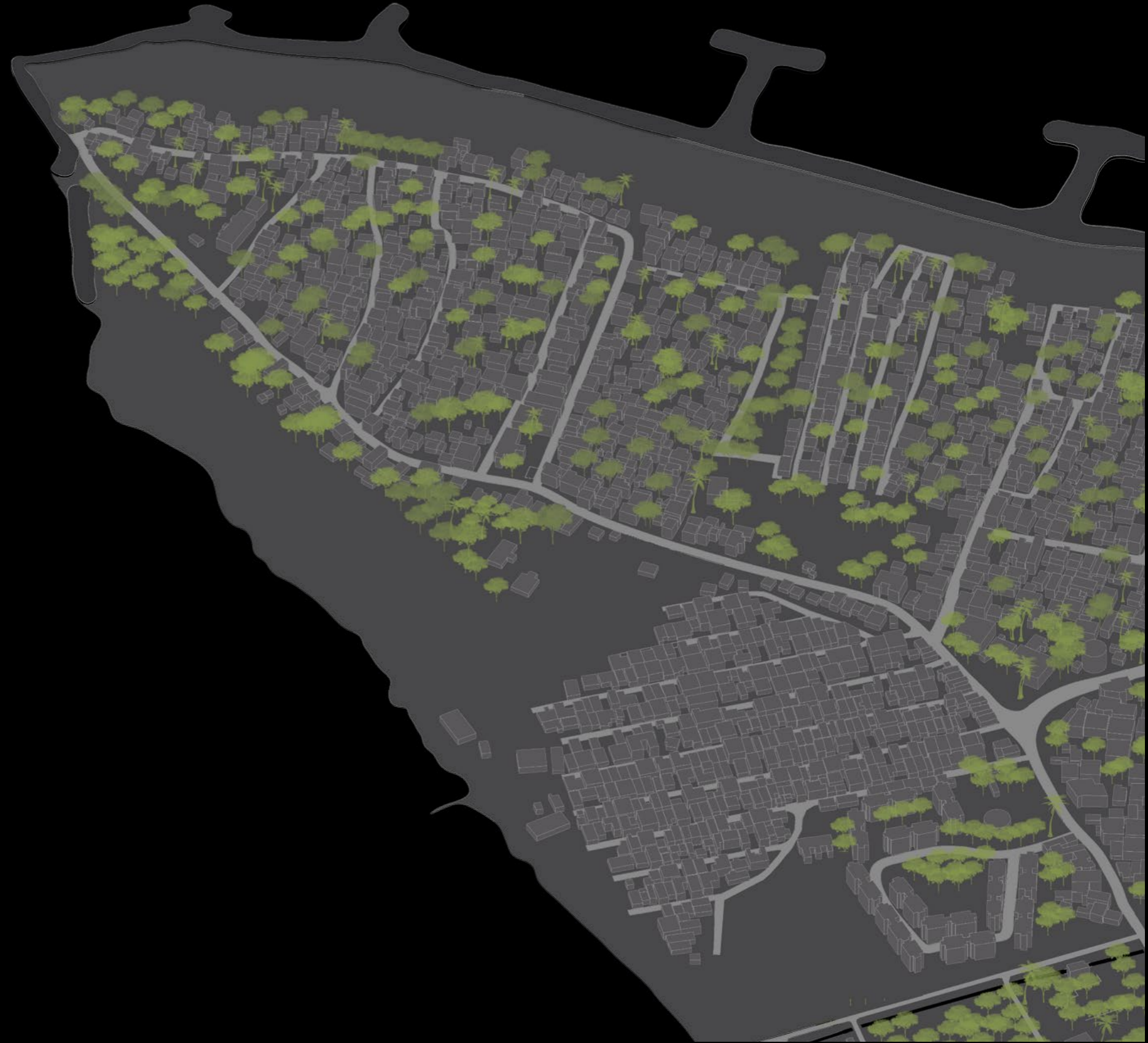


Stakeholder Involvement through the phases







Development Pathways

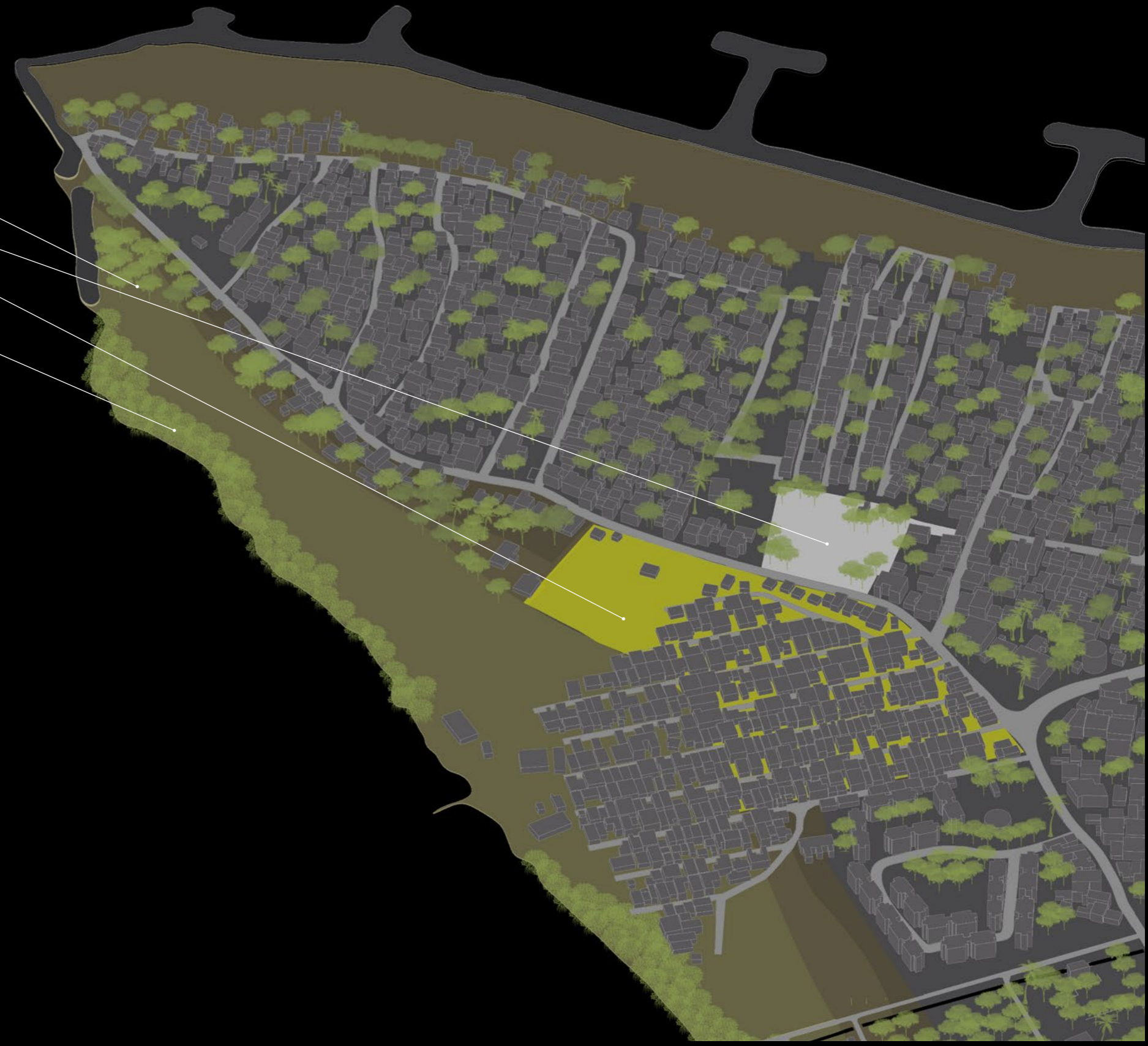
EXISTING CONDITION



Development Pathways

INITIATION PHASE

Actor	Role
 CMDA	Delineation of buffer area
 TNSCB	In-situ rehabilitation proposed, temporary shelter area identified
  NGOs CRRT TNPCB	Remediation work begins



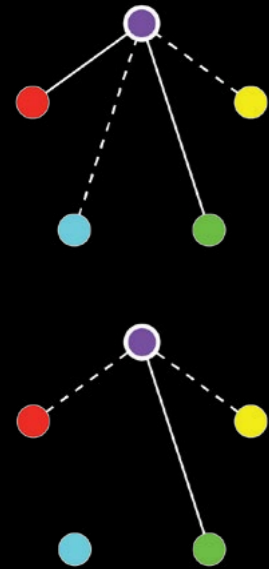
Development Pathways

EXECUTION PHASE

Scenarios

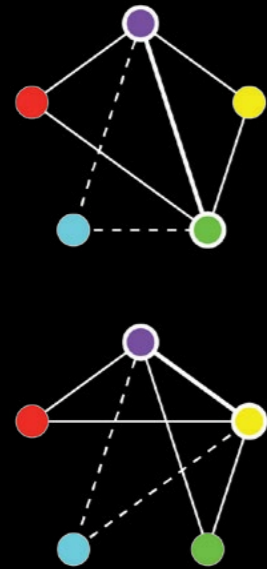
1






LEAST PREFERRED



2








MOST DESIRABLE



Actor	Role
 TNSCB	Rehabilitation through TNSCB tenements without community involvement
 Private sector	Mixed use buildings
  NGOs CRRT TNPCB	Continuation of restoration and naturalisation of edge
 TNSDC	Skill development centres

1



Actor	Role
  Community Private sector	Rehabilitation by private sector in collaboration with community groups
 Private sector	Mixed use buildings
  NGOs CRRT  TNPCB Community	Continuation of restoration and naturalisation of edge with local community groups involved
 TNSDC	Skill development centres

2

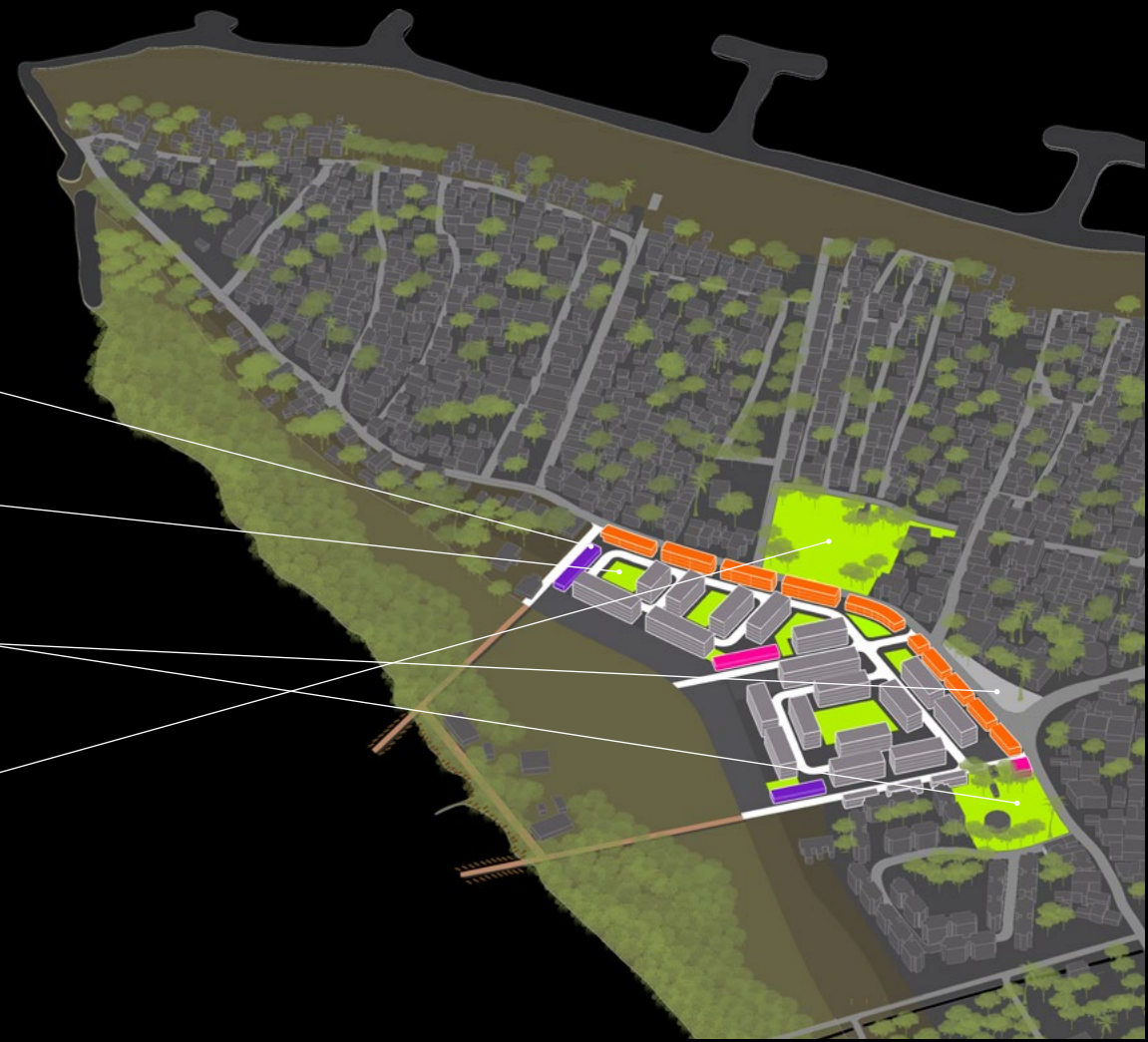


Development Pathways

ACTIVATION PHASE

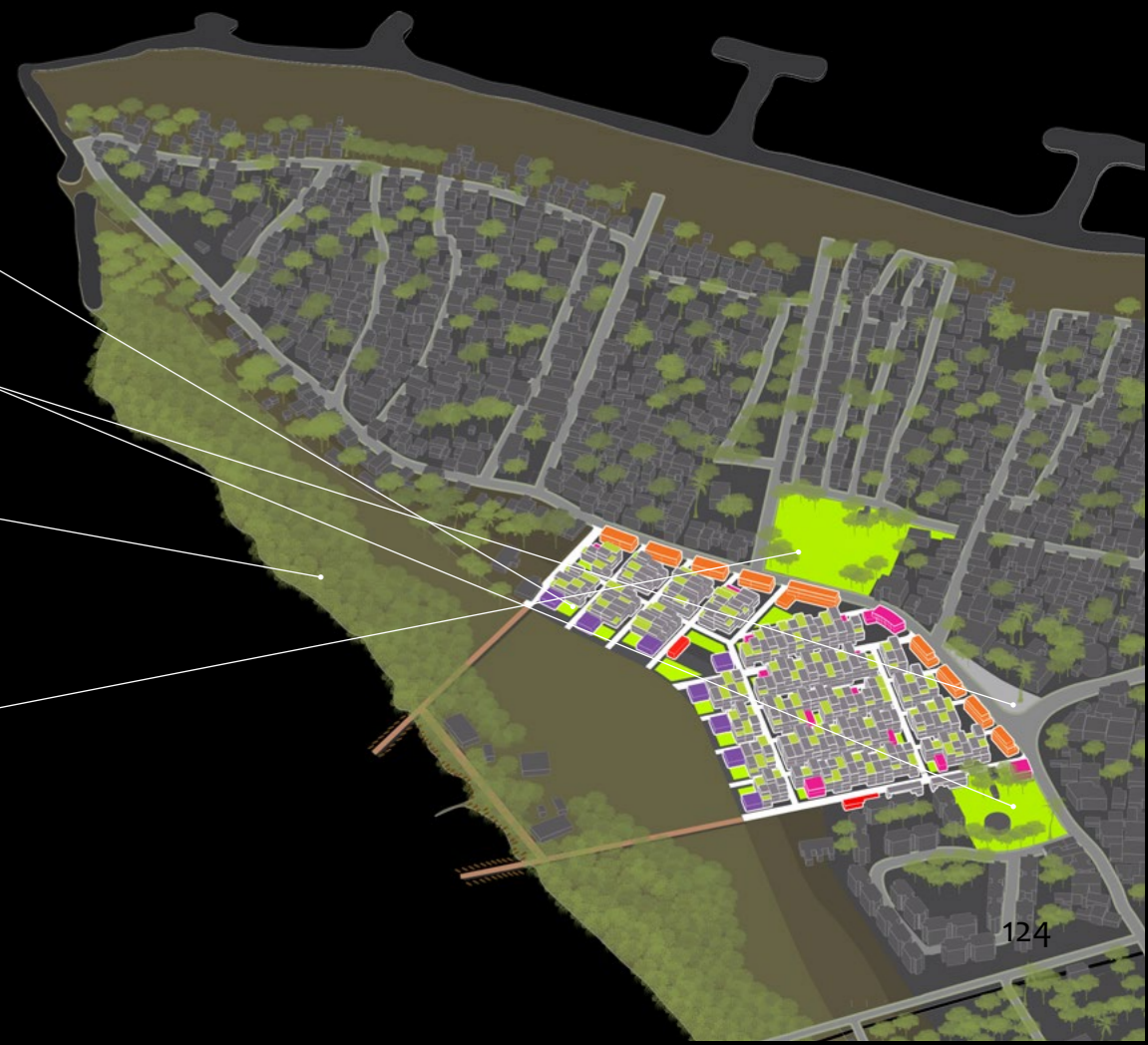
1

Actor	Role
 NGOs	Public awareness creation in communities
 Community	Community gardens and other appropriations
  Community NGOs	Temporary markets, fairs and workshops
 Ward committee	Retention area developed - large public space



2

Actor	Role
 Community	Appropriation of living environments and public spaces by communities
  Community NGOs	Temporary markets, fairs and workshops
  NGOs   CRRT   TNPCB Community	Restoration continues as communities adapt to changing edge conditions
 Ward committee	Retention area developed - large public space

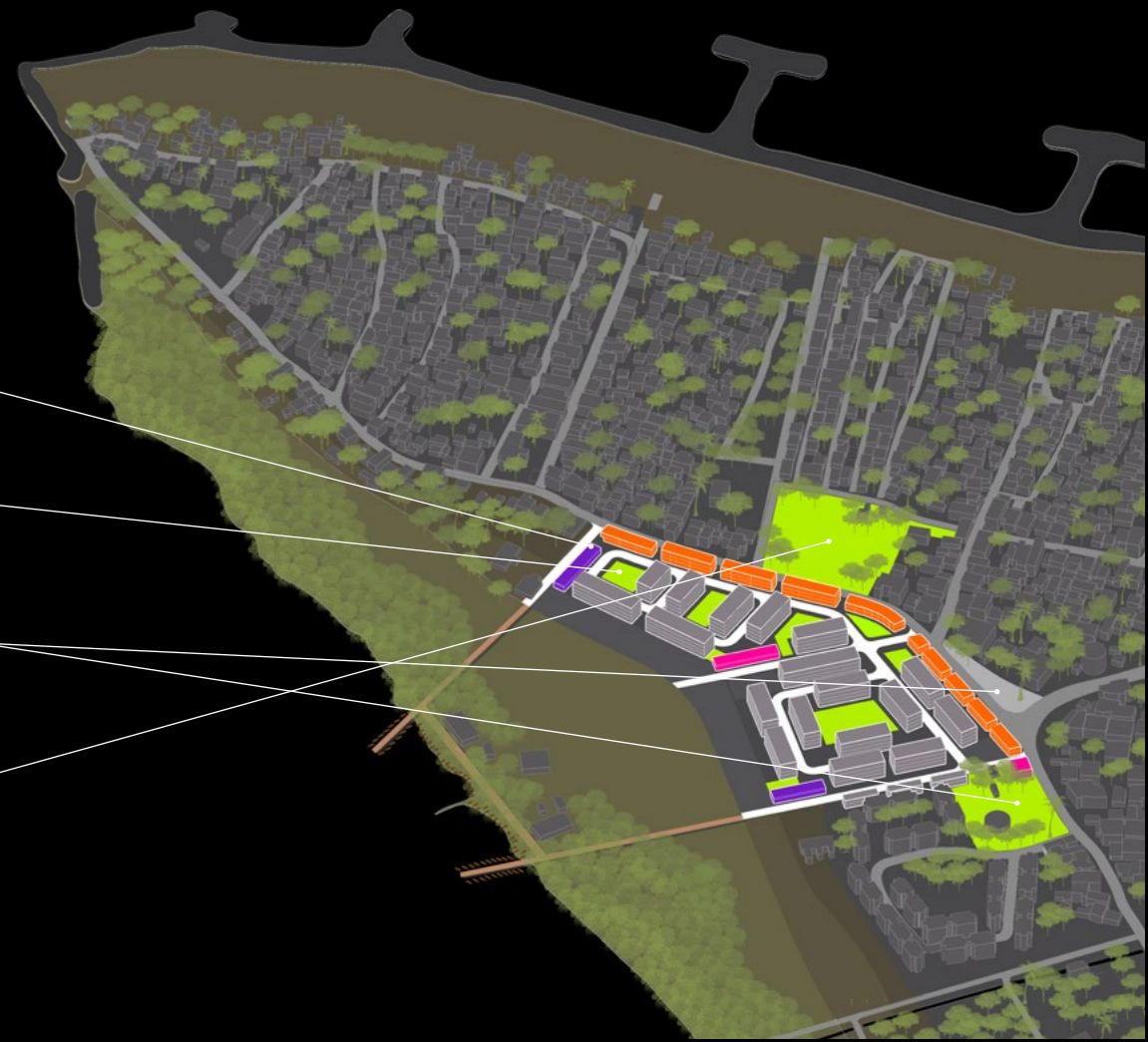


Development Pathways

ACTIVATION PHASE

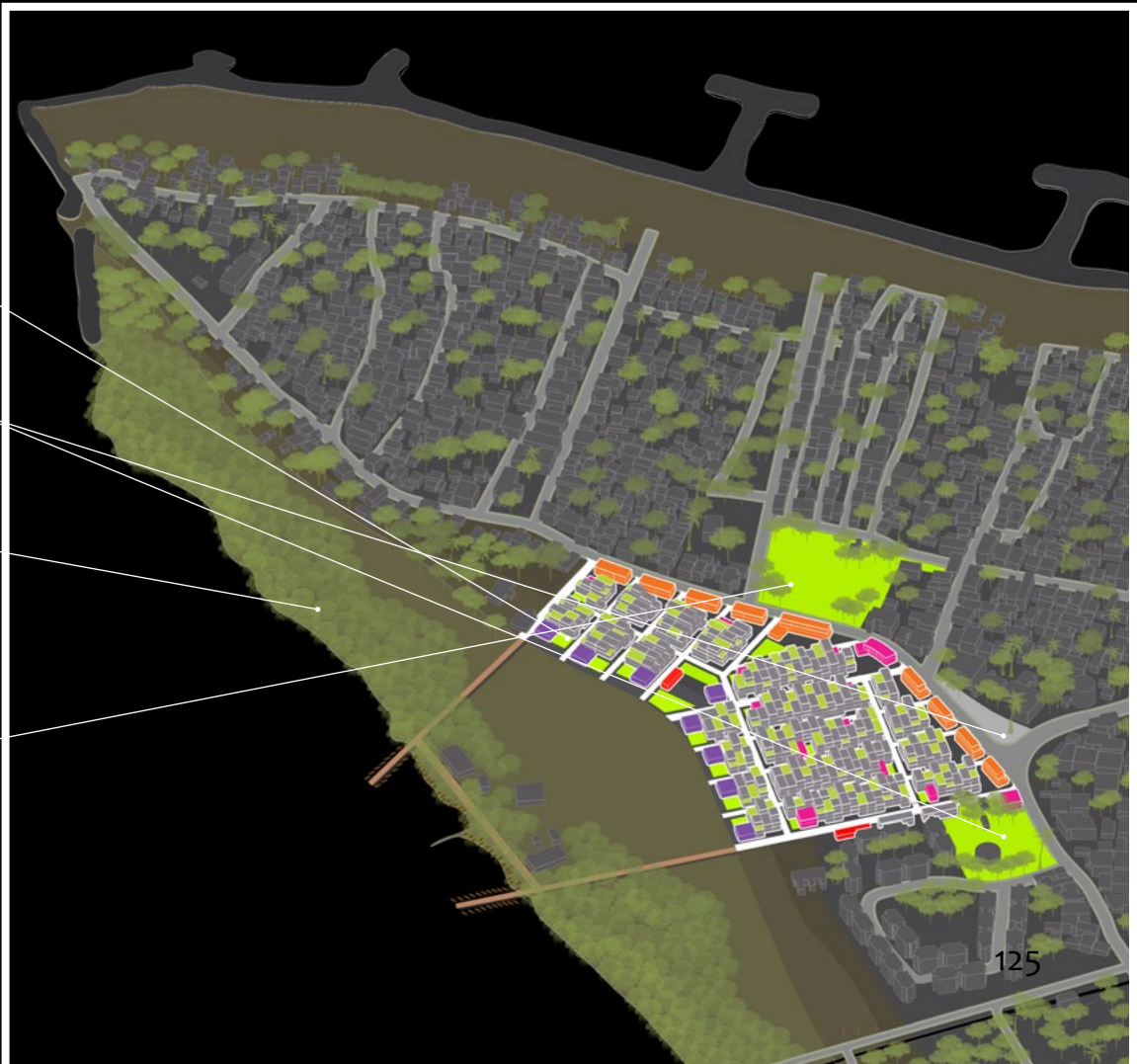
1

Actor	Role
 NGOs	Public awareness creation in communities
 Community	Community gardens and other appropriations
  Community NGOs	Temporary markets, fairs and workshops
 Ward committee	Retention area developed - large public space



2

Actor	Role
 Community	Appropriation of living environments and public spaces by communities
  Community NGOs	Temporary markets, fairs and workshops
  NGOs   CRRT   TNPCB Community	Restoration continues as communities adapt to changing edge conditions
 Ward committee	Retention area developed - large public space



Development Pathways

PERFORMANCE PHASE 

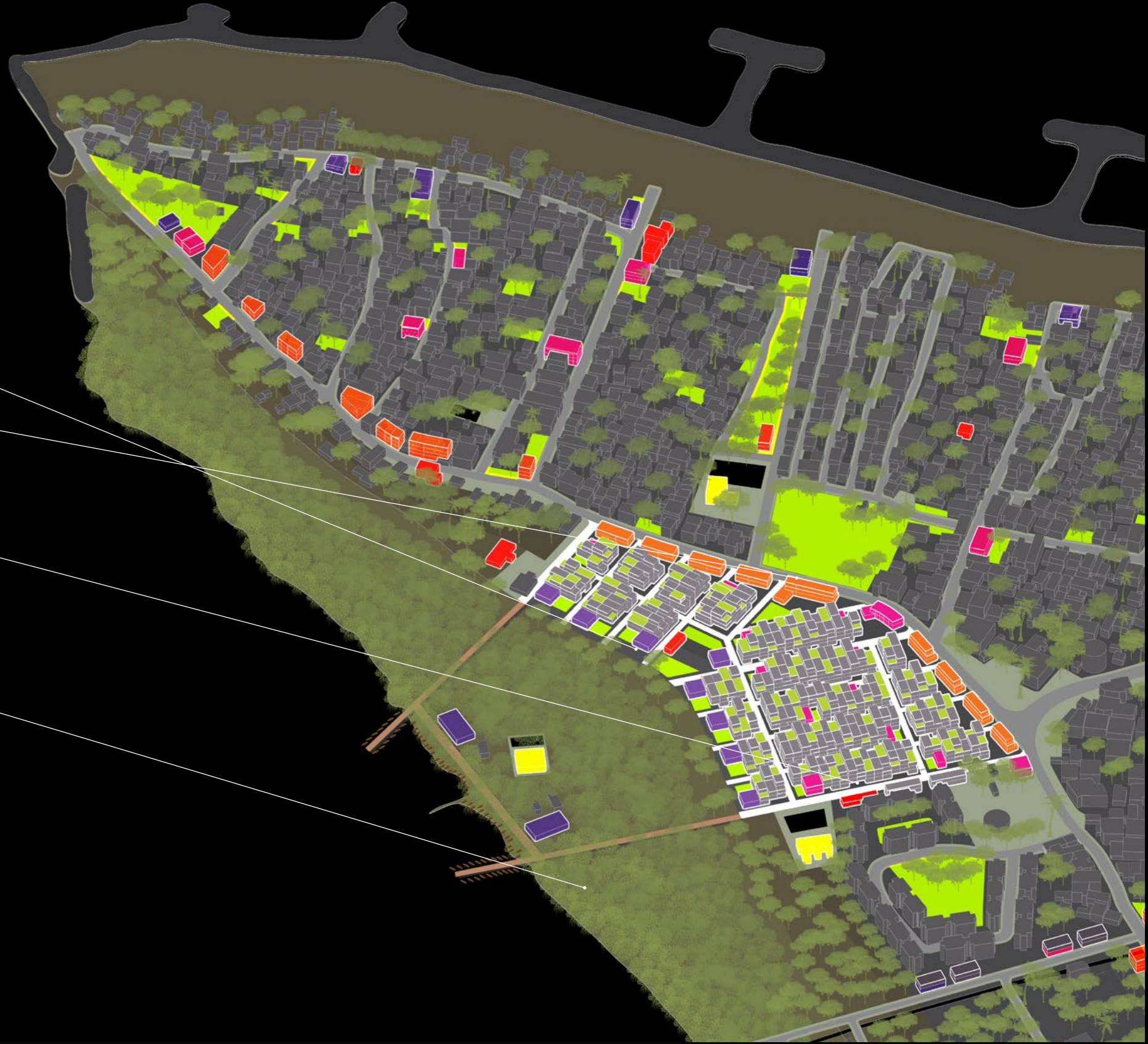
2

New edges of economic activity

Primary link - mixed use buildings + large public spaces + market areas

Secondary links connecting nodes with community spaces and gardens

Renaturalised edges responding to creek health and flooding



economic space

economic space

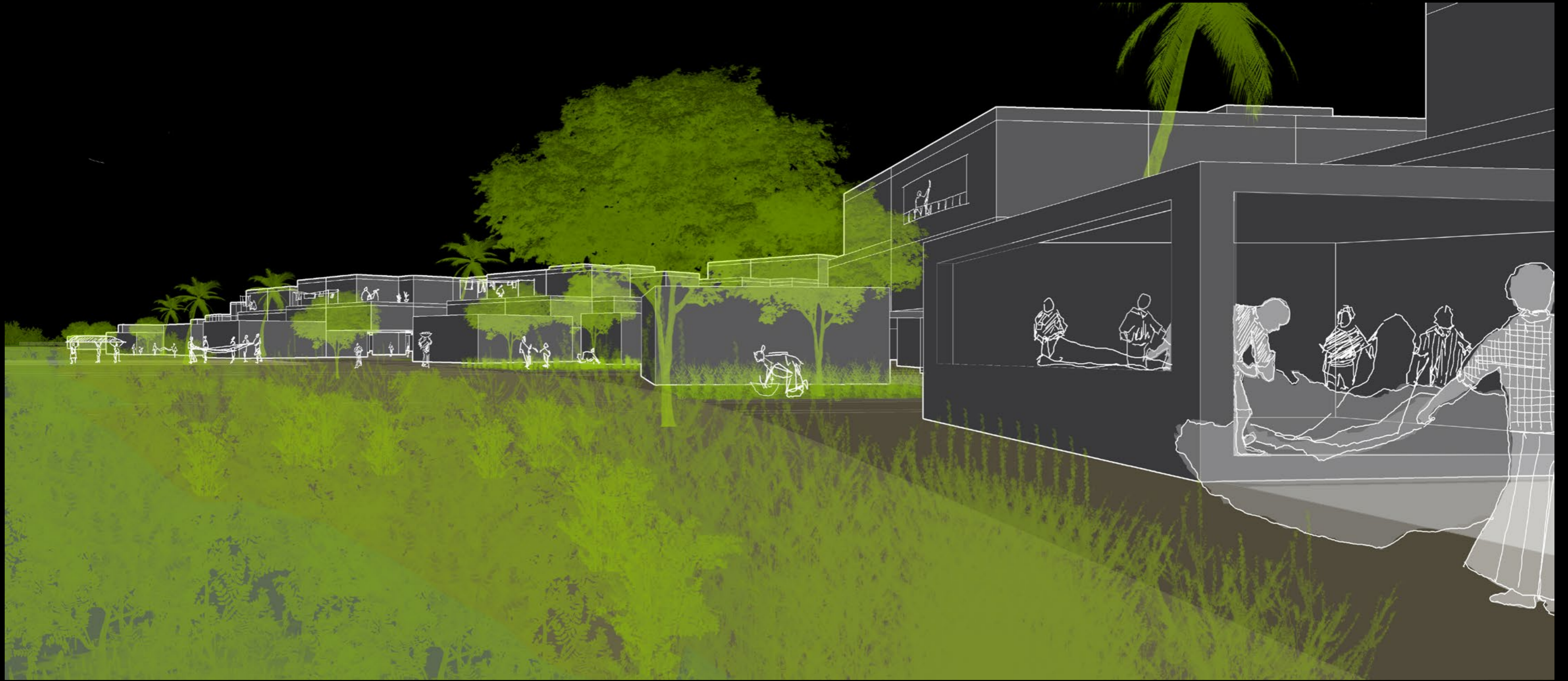
community space

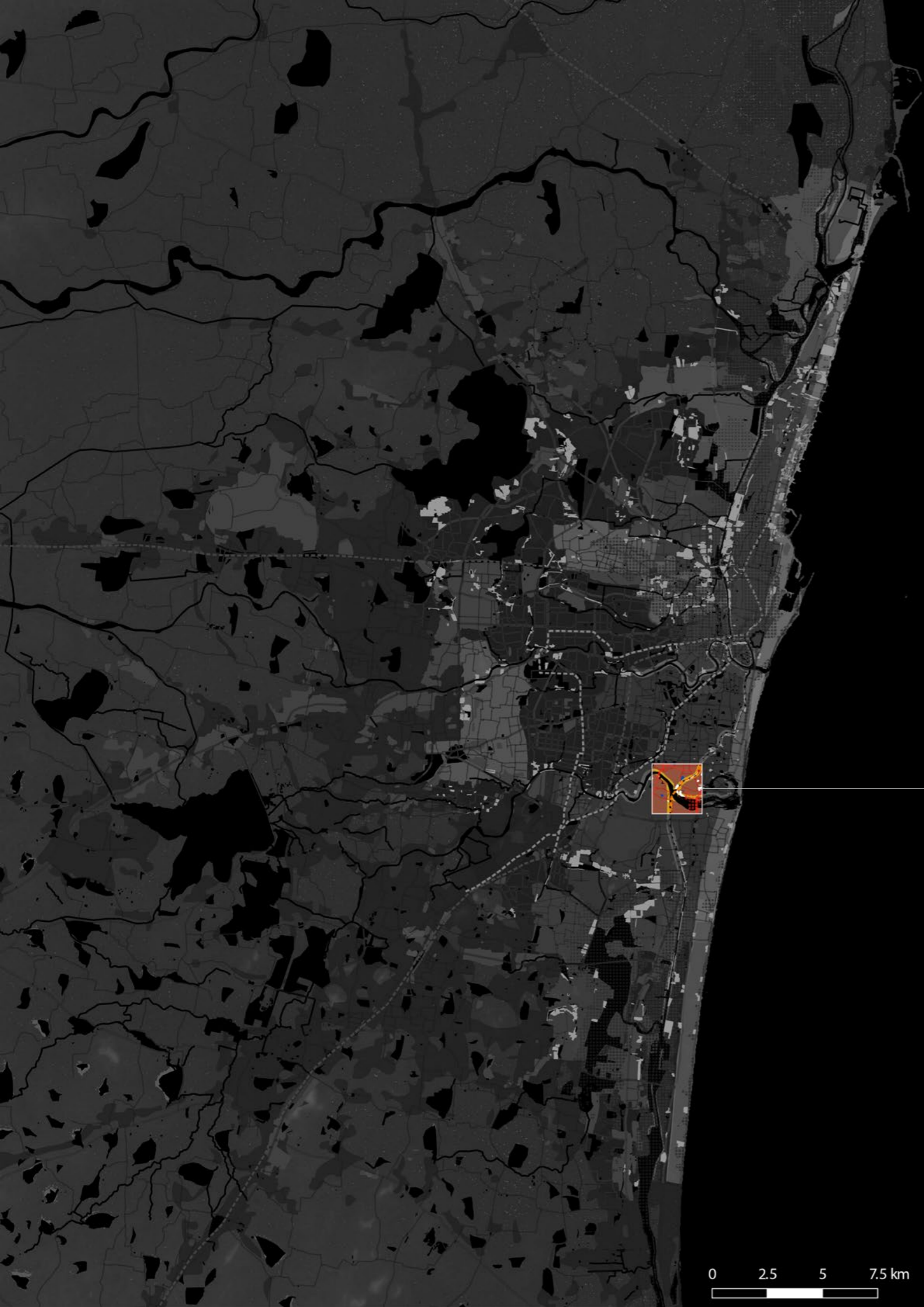
economic + community space

CREEK SECTION

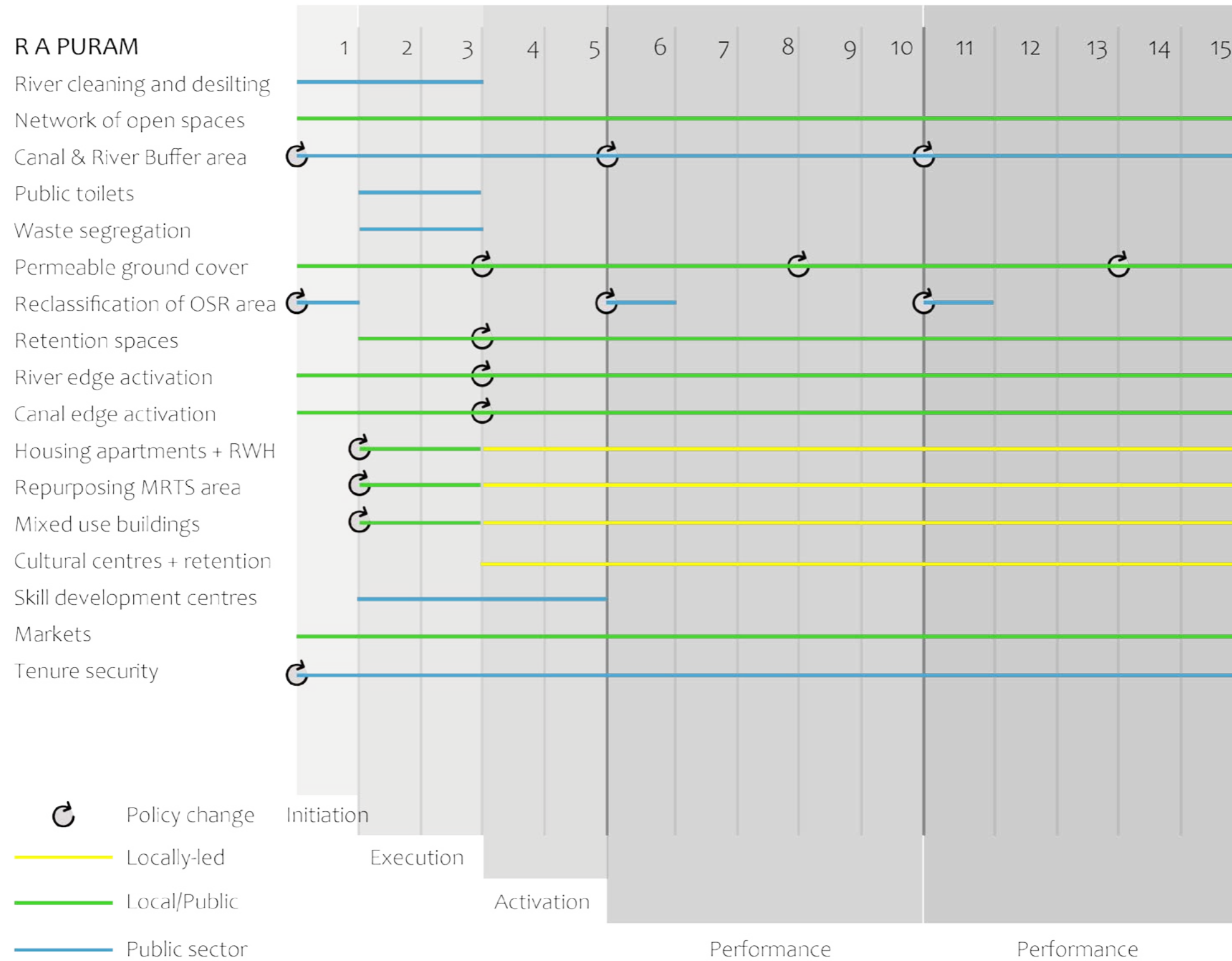


Vision for Ennore



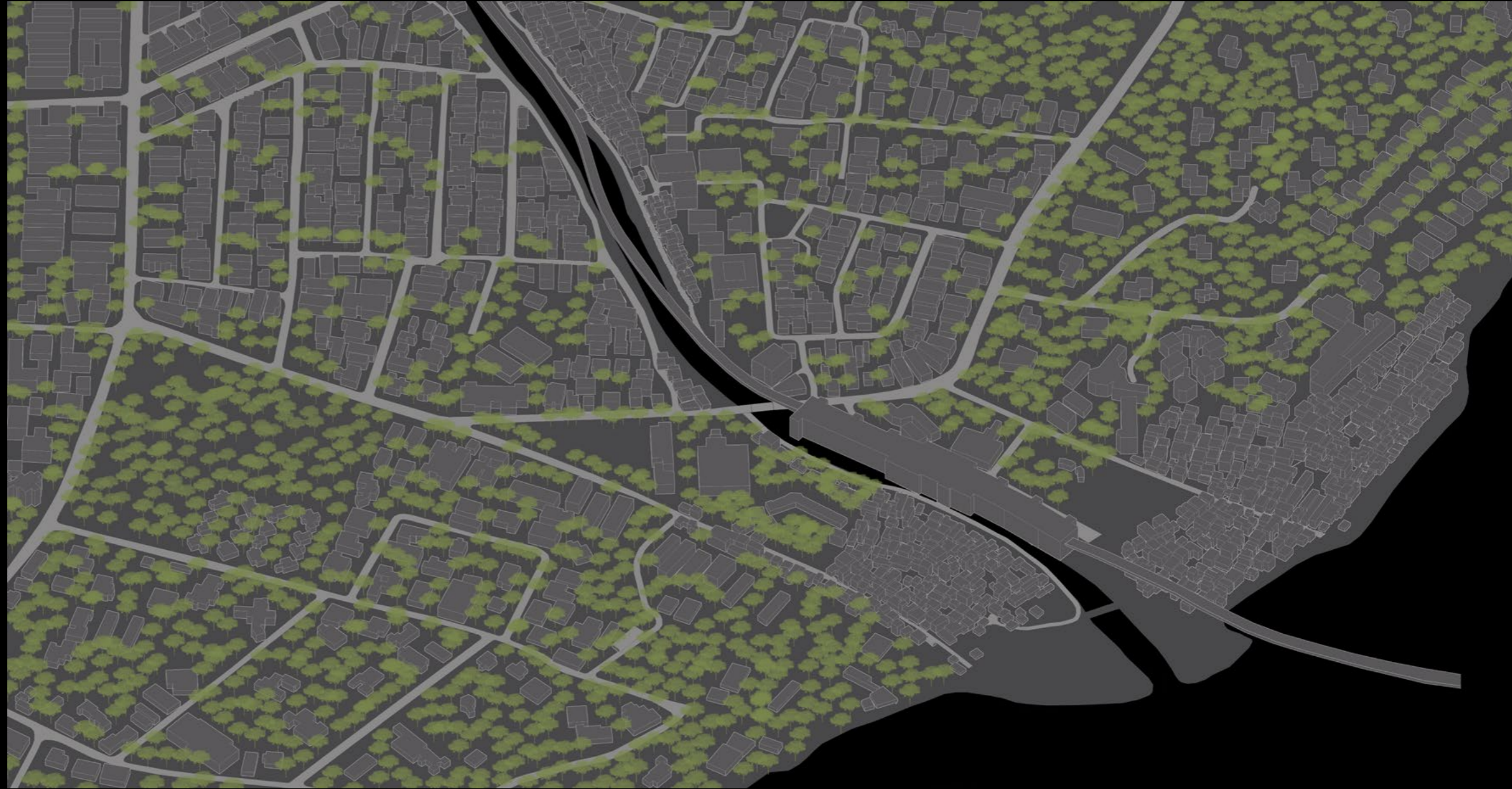


Stakeholder Involvement through the phases



Development Pathways

EXISTING CONDITION



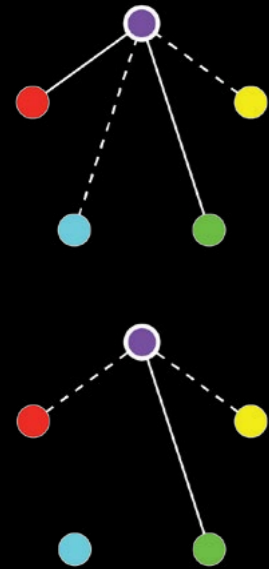
Development Pathways

INITIATION PHASE

Scenarios

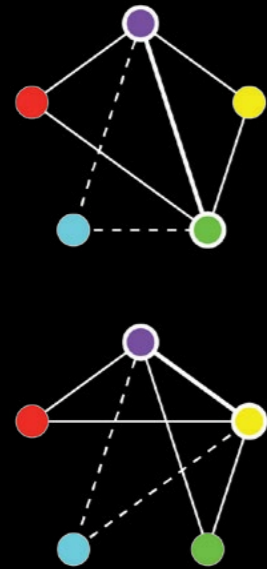
1

LEAST PREFERRED






2

MOST DESIRABLE



Actor

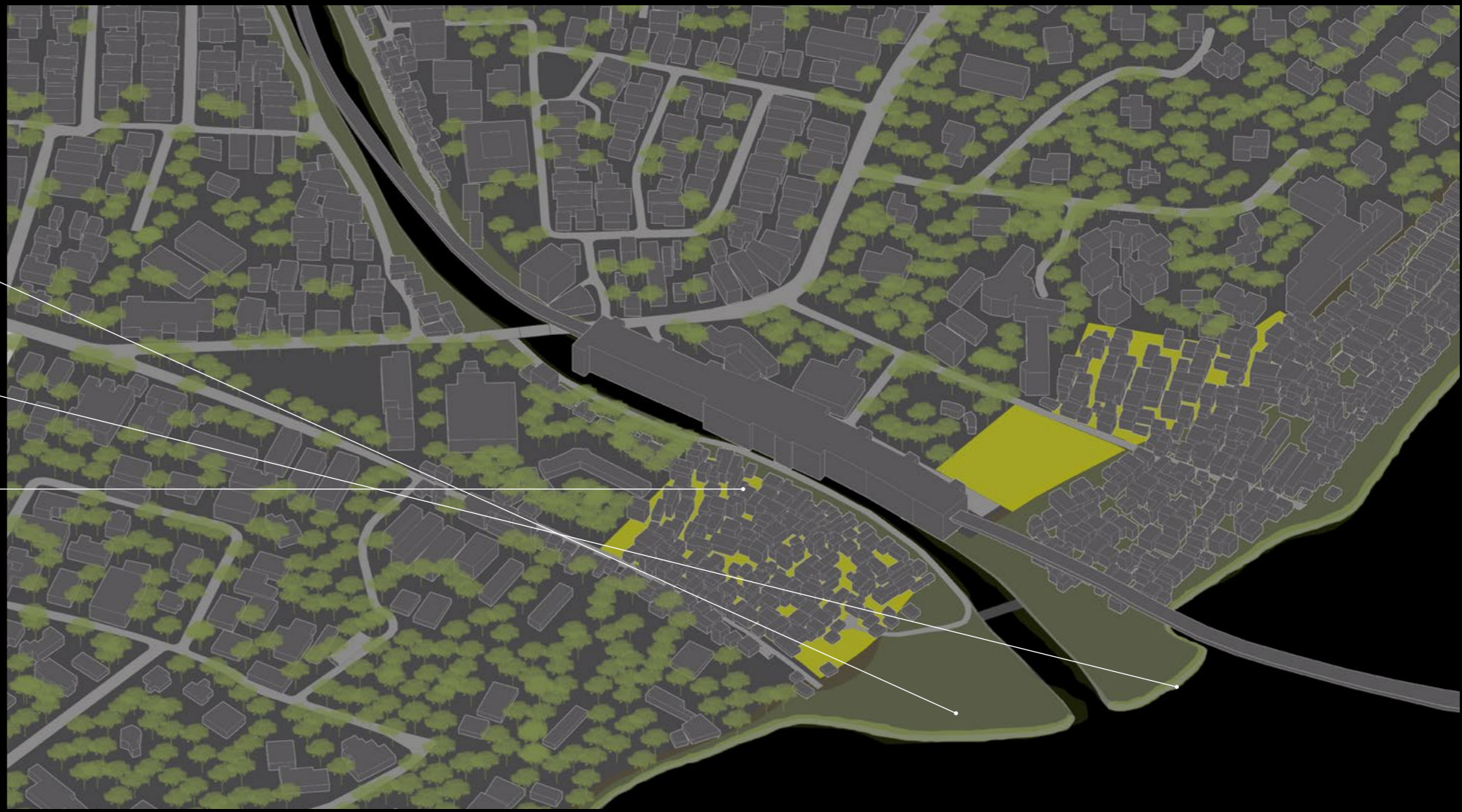
Role

	CMDA	Delineation of buffer area
	TNSCB	Rehabilitation areas selected
	NGOs CRRT TNPCB	Remediation work begins

1









2



Development Pathways








1

EXECUTION PHASE

Actor	Role
 TNSCB	Rehabilitation through TNSCB tenements without community involvement
 Private sector	Mixed use buildings
  NGOs CRRT TNPCB	Continuation of restoration and naturalisation of edge
  TNSDC Private sector	Skill development centres and other public functions creating nodes close to the edge



2

Actor	Role
  Community Private sector	Rehabilitation by private sector in collaboration with community groups
 Private sector	Mixed use buildings
  NGOs CRRT  TNPCB Community	Continuation of restoration and naturalisation of edge with local community groups involved
 TNSDC	Skill development centres and other public functions creating nodes close to the edge



Development Pathways






1

ACTIVATION PHASE

Actor	Role
 NGOs	Public awareness creation in communities
 Community	Community gardens and other appropriations
 Community NGOs	Temporary markets, fairs and workshops
 Private sector	New public spaces along access route to edge



2

Actor	Role
 Community	Appropriation of living environments and public spaces by communities
 Community NGOs	Temporary markets, fairs and workshops under MRTS spaces
 NGOs CRRT	Restoration continues as changing edge conditions offer opportunities for the community
 TNPCB Community	Retention area developed - large public space connecting the surrounding fabric to the edge
 Ward committee	



Development Pathways





1

ACTIVATION PHASE

Actor	Role
 NGOs	Public awareness creation in communities
 Community	Community gardens and other appropriations
 Community NGOs	Temporary markets, fairs and workshops
 Private sector	New public spaces along access route to edge



2

Actor	Role
 Community	Appropriation of living environments and public spaces by communities
 Community NGOs	Temporary markets, fairs and workshops under MRTS spaces
 NGOs CRRT	Restoration continues as changing edge conditions offer opportunities for the community
 TNPCB  Community	Retention area developed - large public space connecting the surrounding fabric to the edge



Development Pathways

PERFORMANCE PHASE

New ecological edge + public activity along the river

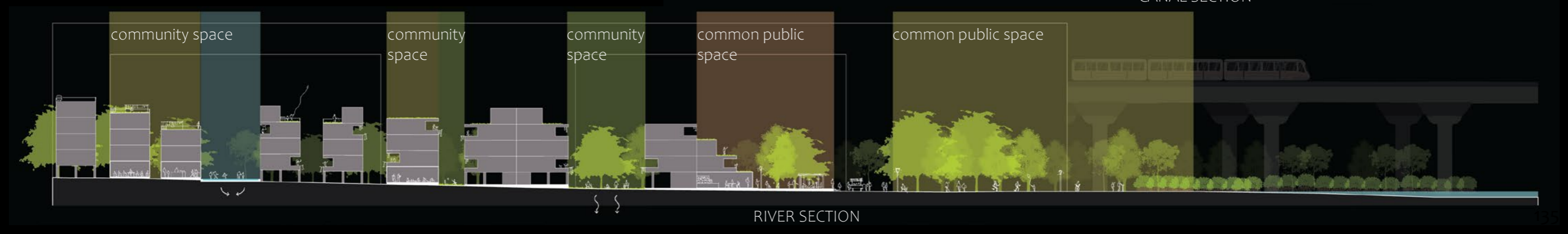
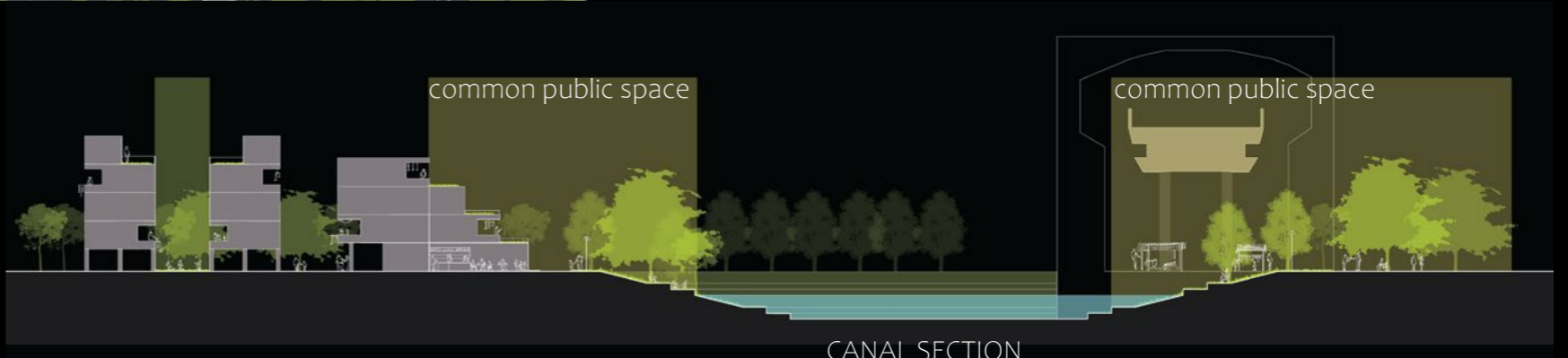
Primary link - mixed use buildings + large public spaces + market areas

Secondary links connecting the primary link and the edge with community spaces

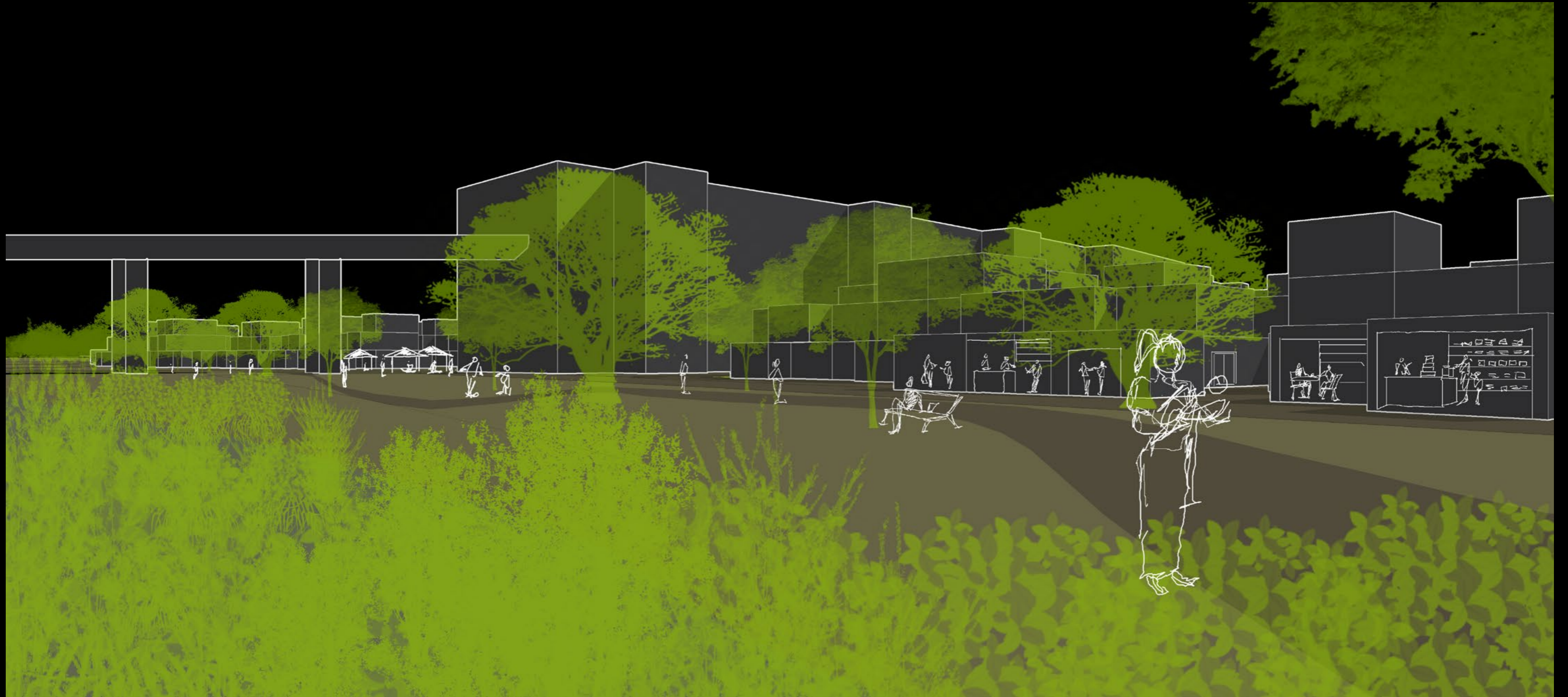
Renaturalised edges of the canal with nodes of public functions linking neighbourhoods



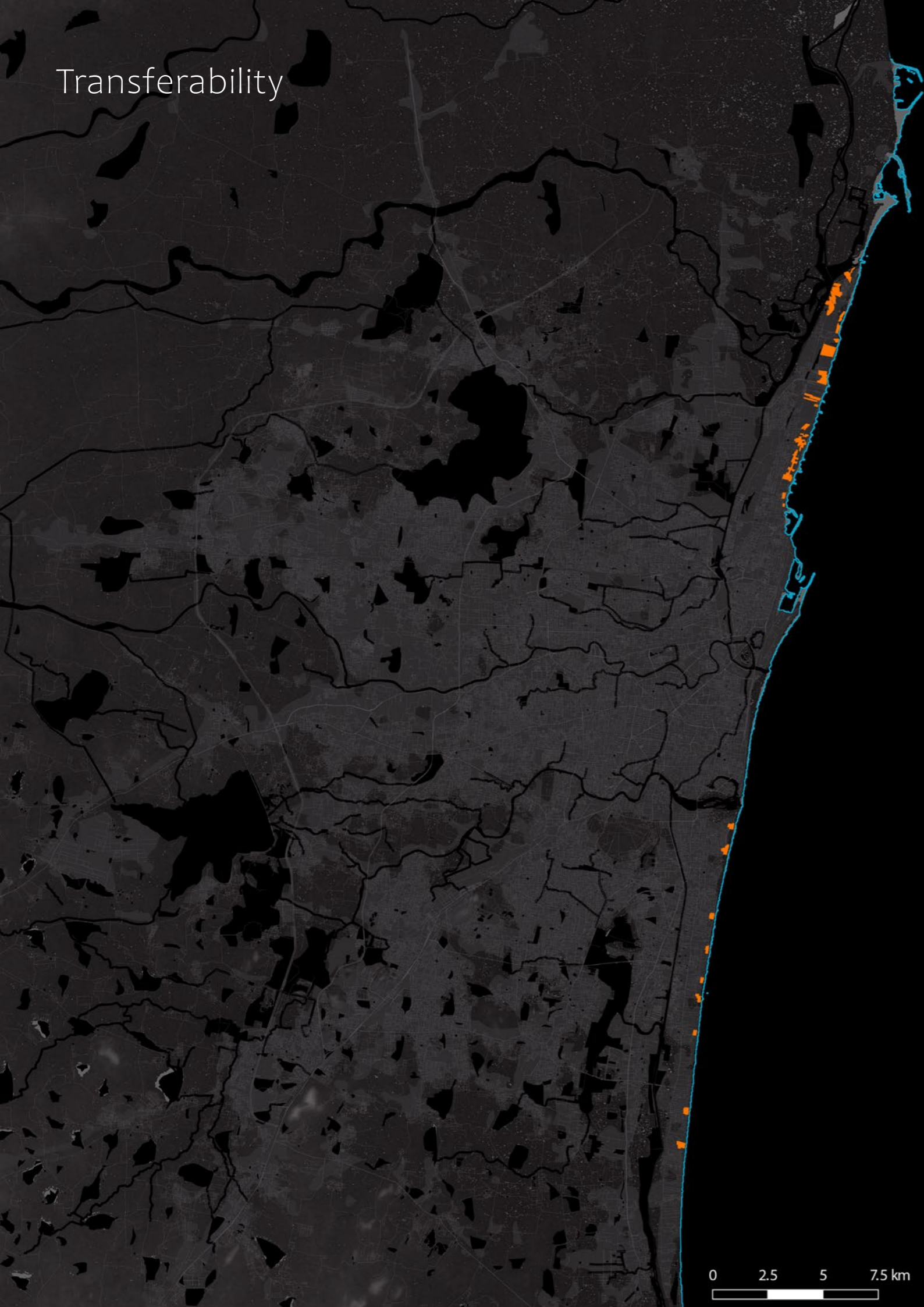
2



Vision for R A Puram



Transferability



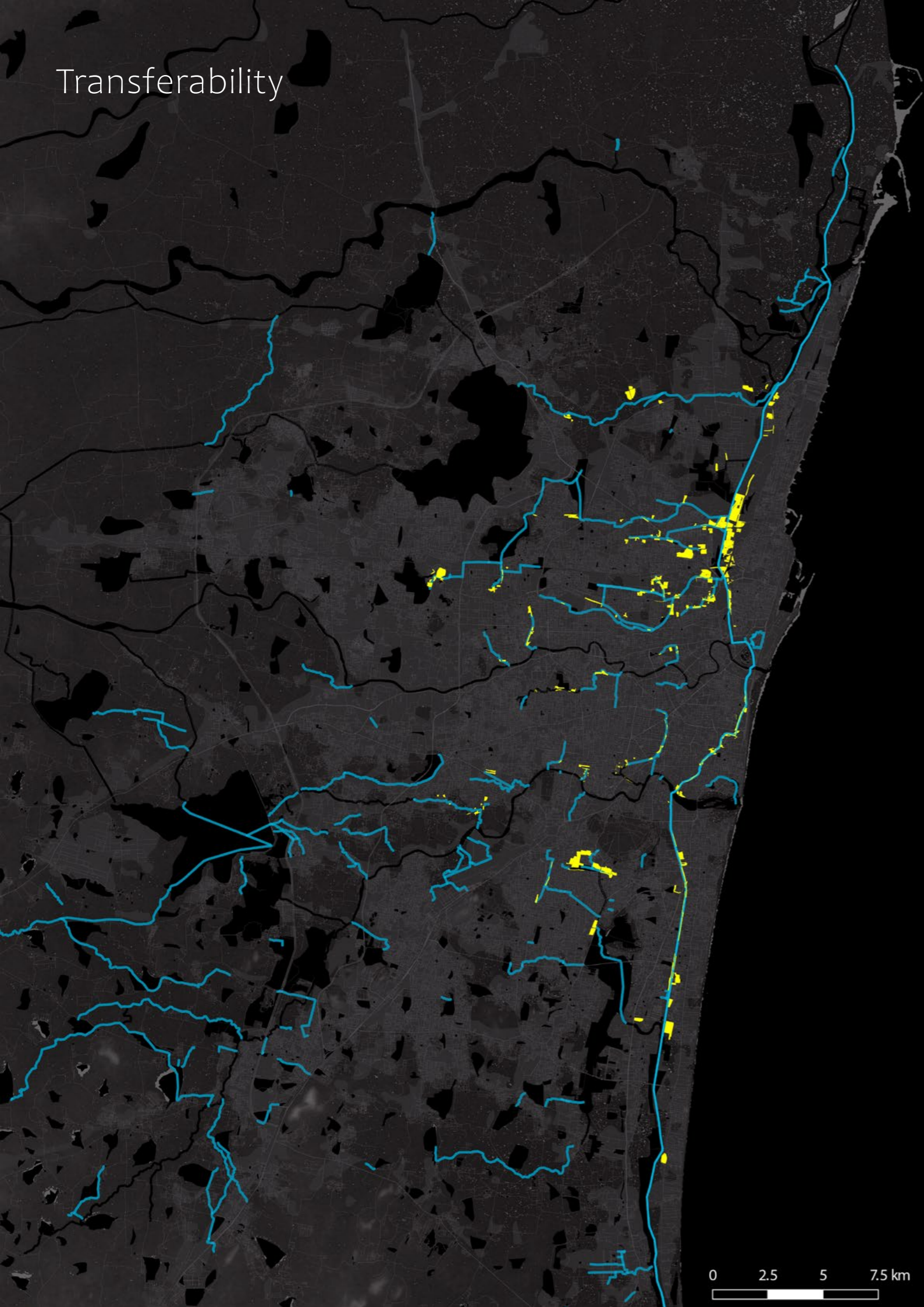
Creek & Coastal edge

Vulnerable to coastal flooding - sea level rise

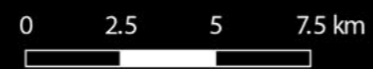
Residents dependent on natural ecology for livelihoods such as fishing activity



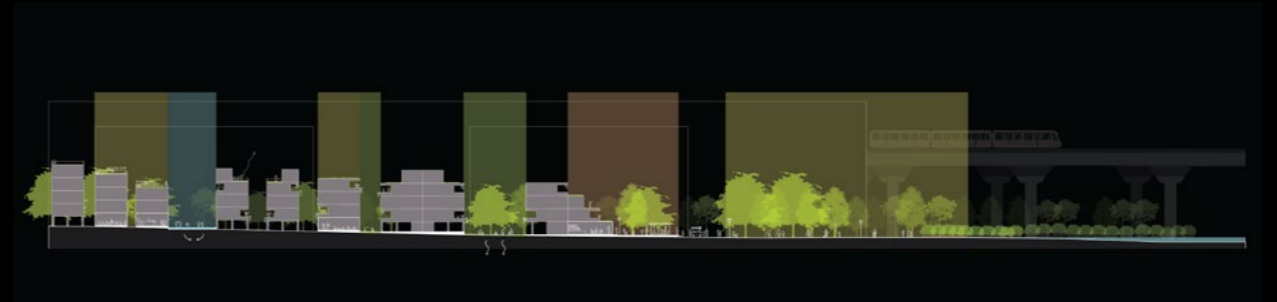
Transferability



Canal edge
Vulnerable to pluvial flooding
Residents are dependent on proximity to opportunities for livelihoods

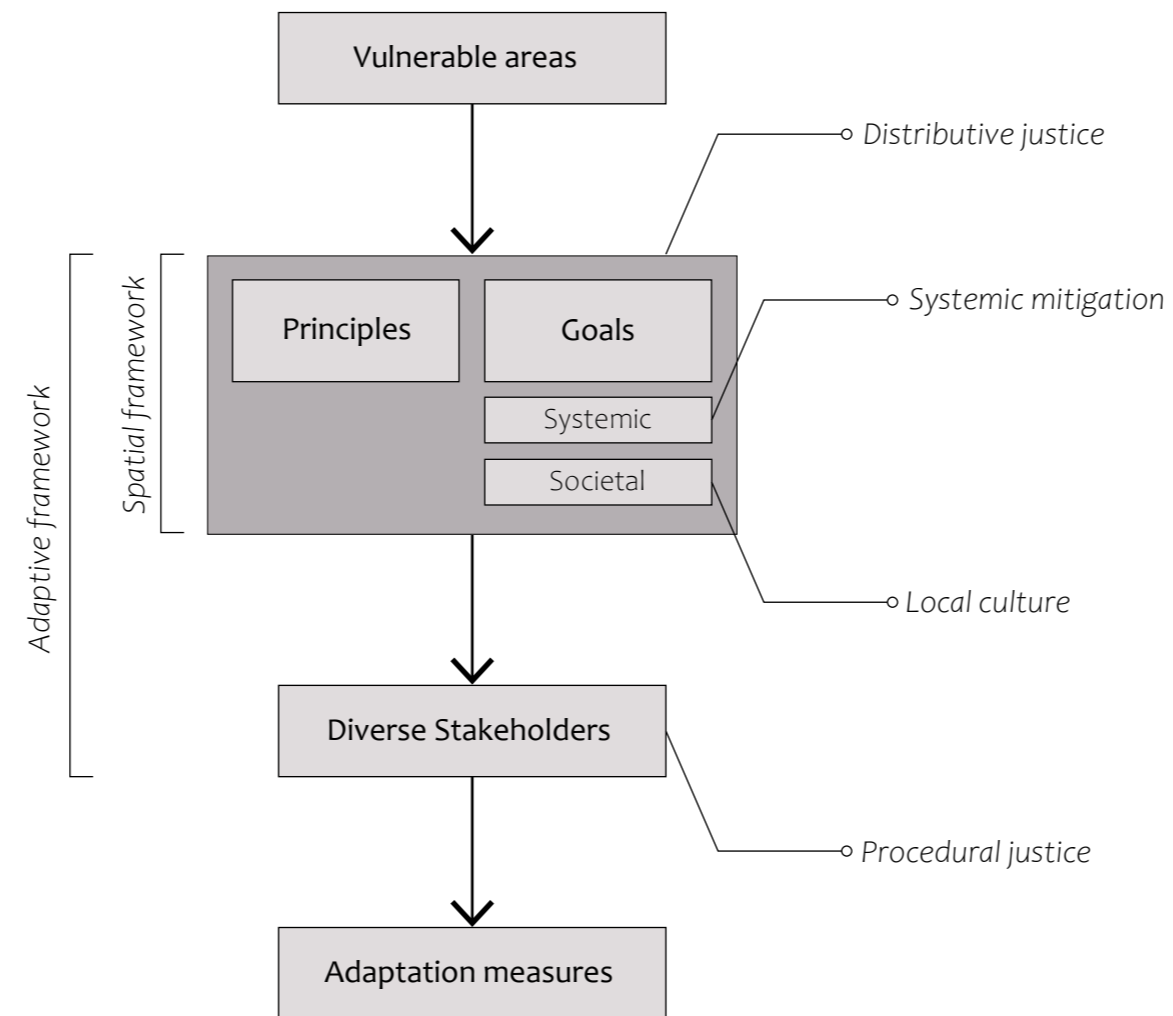


Transferability

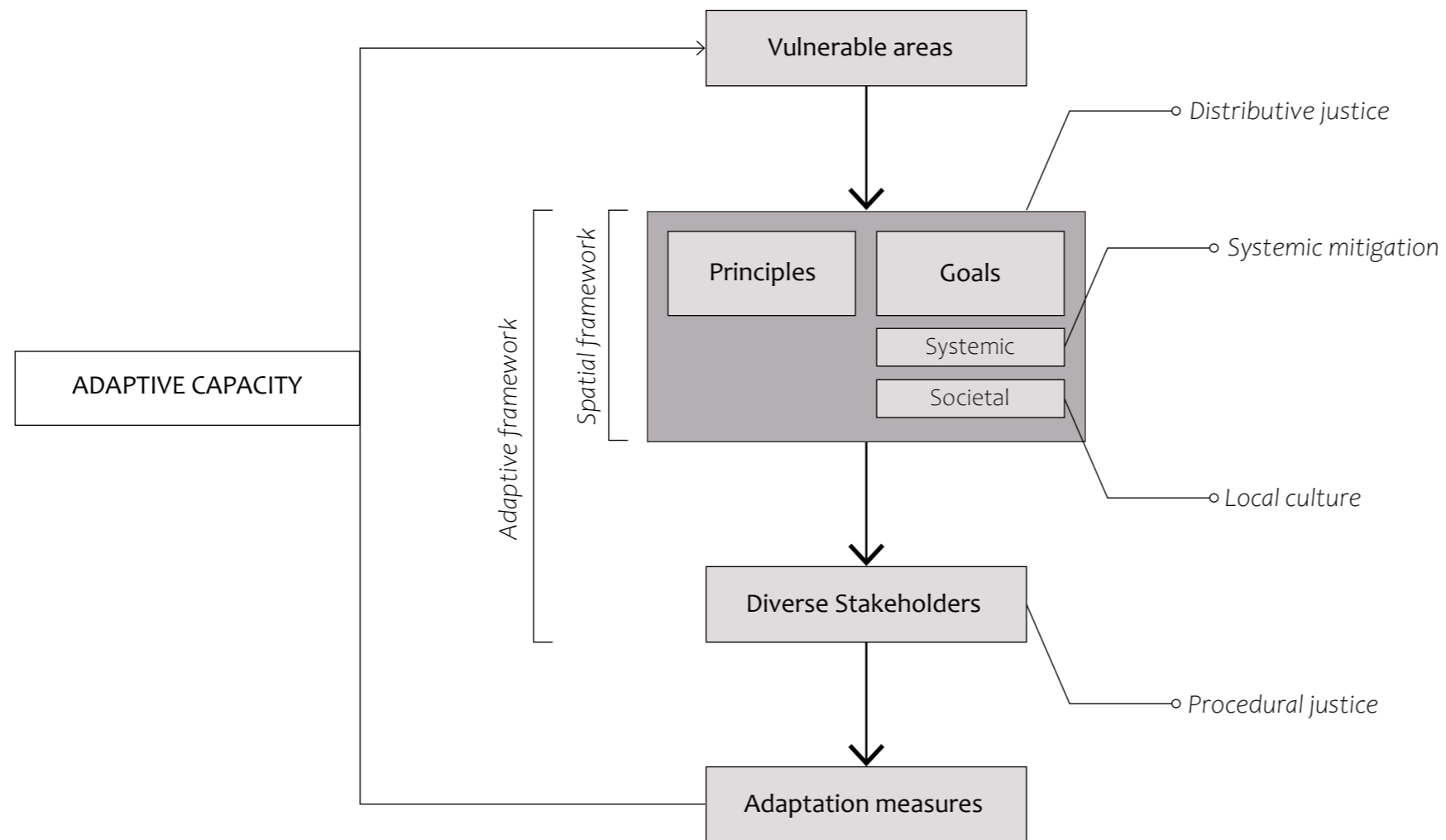


River edge
Vulnerable to pluvial flooding
Residents are dependent on proximity to opportunities for livelihoods

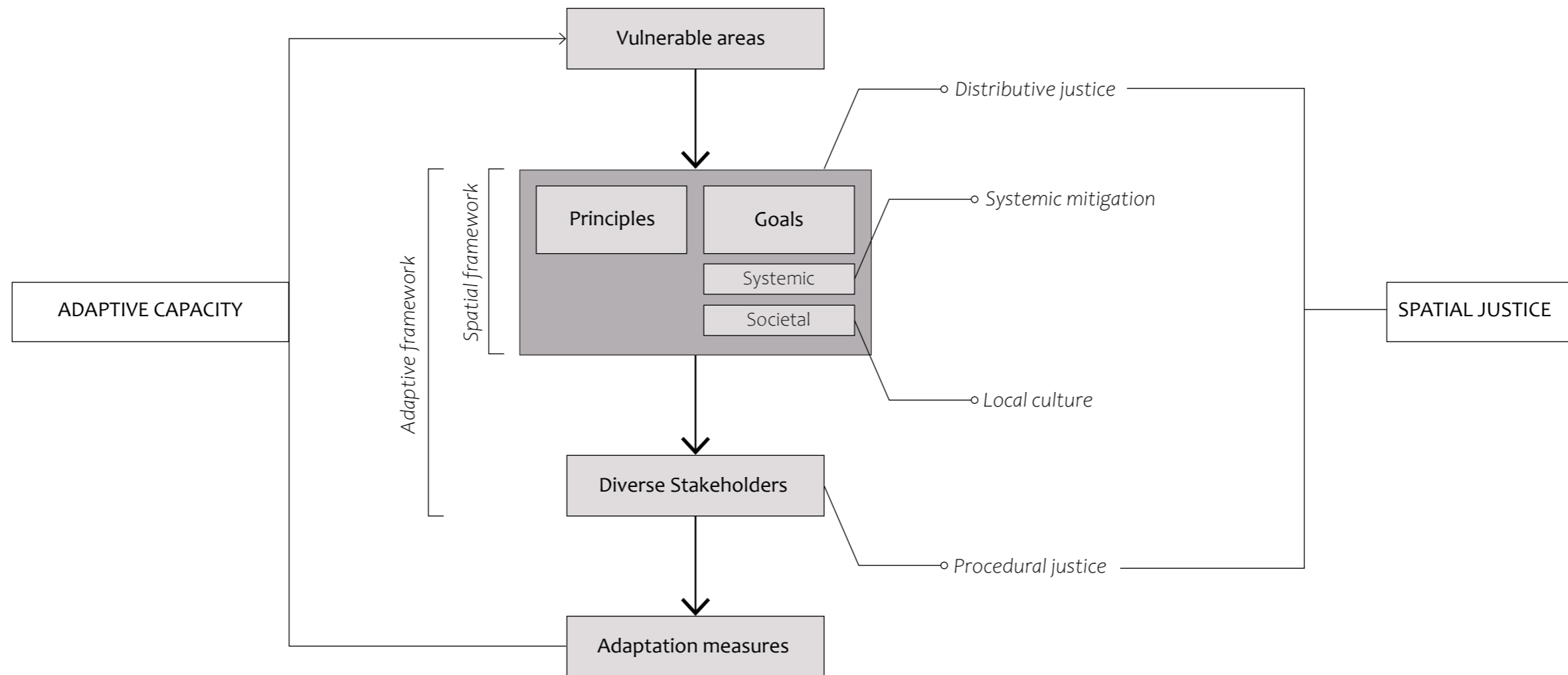
Conclusion



Conclusion



Conclusion



THANK YOU

