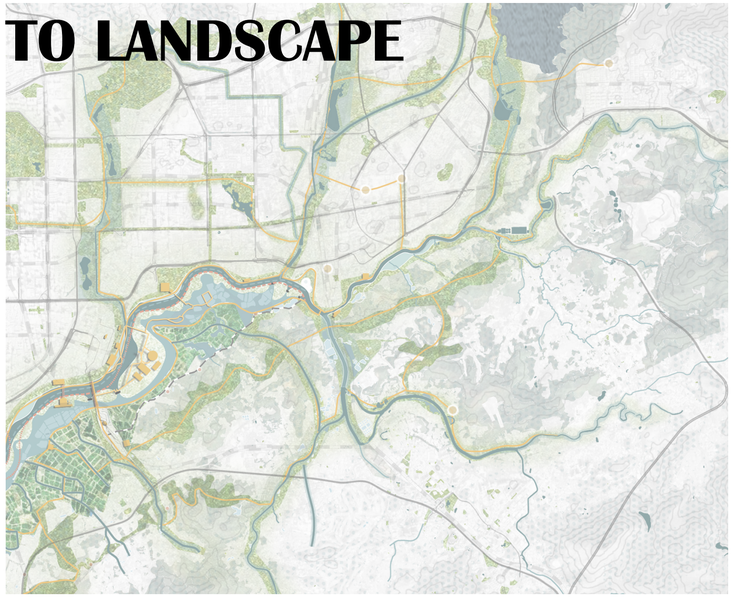
# FROM BORDER TO LANDSCAPE



Designing a resilient landscape corridor in Shenzhen-Hong Kong border area

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Second Mentor: Lei Qu

Resilient Coastal Landscape
M.Sc. Landscape Architecture
P5 Presentation



Retrieved from: https://www.dsd.gov.hk/EN/HTML/392.html

# CHAPTER 1. INTRODUCTION

*-Background*

*-Fascination*

*-Problem statement*

*-Research question*

## | BACKGROUND: RIVER AS BORDER

**Before 1898**

Named "Ming Xi" (Bright Stream)



Natural stream

**1898**

Convention for the Extension of Hong Kong Territory



Political Border

**1951**

FCA created by the British



Restricted barrier

**1997**

Hong Kong return to China



Dissolving border

**2006**

FCA shrinked from 28 to 8 sq k



Human intervene

**2020-2030**

New vision for North New Territory



Land development

**2047**

Border no longer exists

?

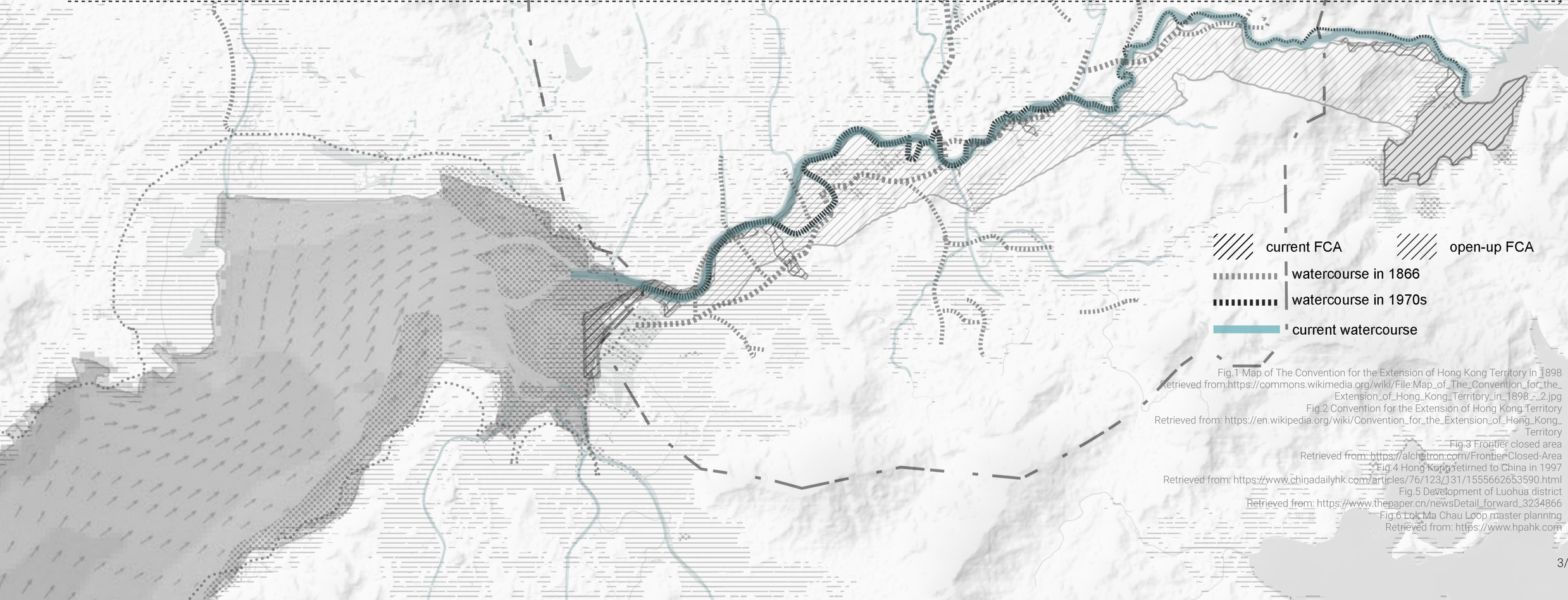
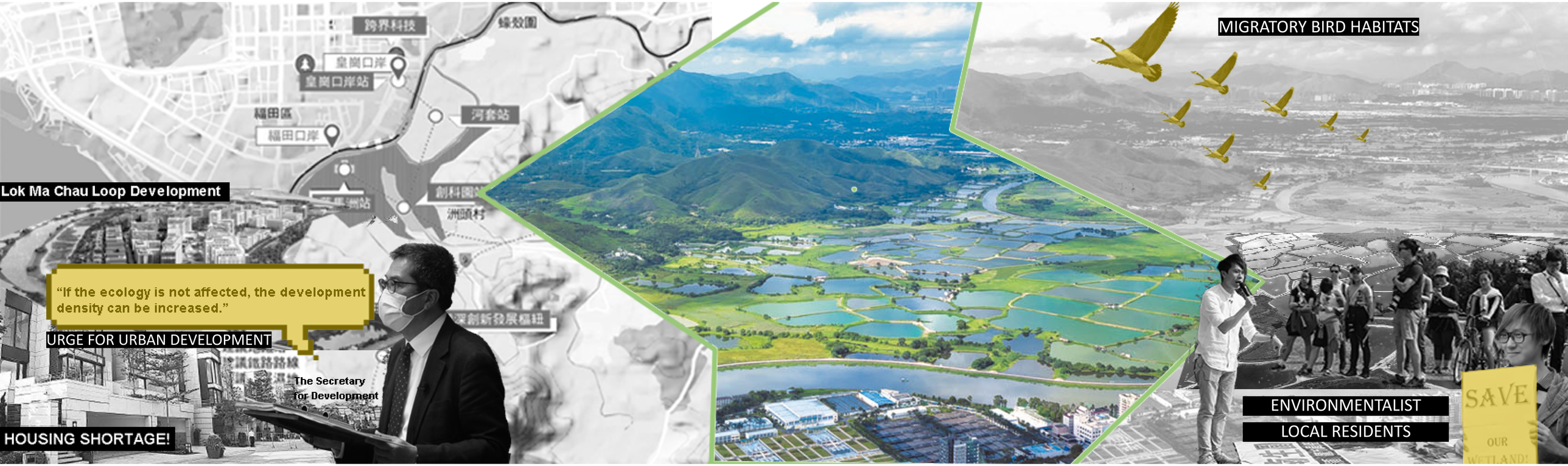



Fig.1 Map of The Convention for the Extension of Hong Kong Territory in 1898
Retrieved from:https://commons.wikimedia.org/wiki/File:Map_of_The_Convention_for_the_Extension_of_Hong_Kong_Territory_in_1898_-_2.jpg
Fig.2 Convention for the Extension of Hong Kong Territory
Retrieved from: https://en.wikipedia.org/wiki/Convention_for_the_Extension_of_Hong_Kong_Territory
Fig.3 Frontier closed area
Retrieved from: https://alchetron.com/Frontier-Closed-Area
Fig.4 Hong Kong retirned to China in 1997
Retrieved from: https://www.chinadailyhk.com/articles/76/123/131/1555662653590.html
Fig.5 Development of Luohua district
Retrieved from: https://www.thepaper.cn/newsDetail_forward_3234866
Fig.6 Lok Ma Chau Loop master planning
Retrieved from: https://www.hpahk.com

# THE CONFLICTS!

*Urban development VS Natural environment.*




PROTECT?
OR
DEVELOP?

## | PROBLEM STATEMENT

**Conflicts** between the **urban development** and **natural system protection** in the context of **urbanization process** and future **climate challenge**.

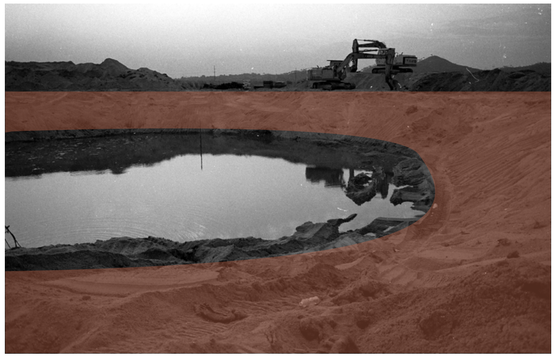
### Towards Rigid Ecosystem



Urbanization around Hong Kong wetland

Retrieved from: https://www.wikiwand.com/zh-sg/%E9%A6%99%E6%B8%AF%E6%BF%95%E5%9C%B0%E5%85%AC%E5%9C%92, modified by author

### Degradation of Cultural Aquaculture



Filled pond

Retrieved from: Google Map street view, modified by author

### Canalized River



Birdview of Shenzhen River bank

Retrieved from: Google map street view, modified by author

### Unknown Fate of Surrounding Settlements




Village in frontier closed area

Retrieved from: https://alchetron.com/Frontier-Closed-Area, modified by author

## | RESEARCH QUESTIONS

*From border to landscape.*

[Main-research Question]:

How to design **a resilient landscape corridor** across the Shen-Kong border from the perspective of **landscape infrastructure** to achieve the **co-development of environment and society**?

[Sub-research Question]:

SQ1: How to **understand the current landscapes** of Shenzhen River and its surroundings from the perspective of landscape infrastructure and what **lessons** can be learnt from them to **engage new challenges** of urban pressure and resilient development? **Understanding**

SQ2: What **principles** can be applied to different layers of landscape infrastructure and how to further **integrate** them to develop **a resilient landscape framework** in Shen-Kong border area? **Principles**

SQ3: How can the principles be **applied** in to create **better living environments** for both human and ecological entities, transforming the current monofunctional land to multifunctional landscape? **Application**

SQ4: How to **evaluate** the current land development plan within Shen-Kong border area using the proposed landscape framework and principles? **Evaluation**

SQ5: What are the **knowledge and experience** can be gained in this project to advance the idea of **resilient landscape infrastructure** in different scales? **Knowledge**

# CHAPTER 2. METHODOLOGY

*-Theoretical background*

*-Methods & Approach*

## RESILIENCE THINKING

solid base for research

A resilience thinking indicates an integrated understanding of the interrelationship of social-ecological system and a sustainable approach of resource management, adapting natural systems and human being through cycles of change (Walker & Salt, 2006).

## LANDSCAPE INFRASTRUCTURE

guiding theory

The proposed concept of landscape as infrastructure treats landscape as an operative field that defines and sustains the urban development, and enable the landscapes have own spatial, ecological and socio-cultural qualities (Nijhuis & Jauslin, 2015).

## NATURE-BASED SOLUTION (NbS)

landscape approach

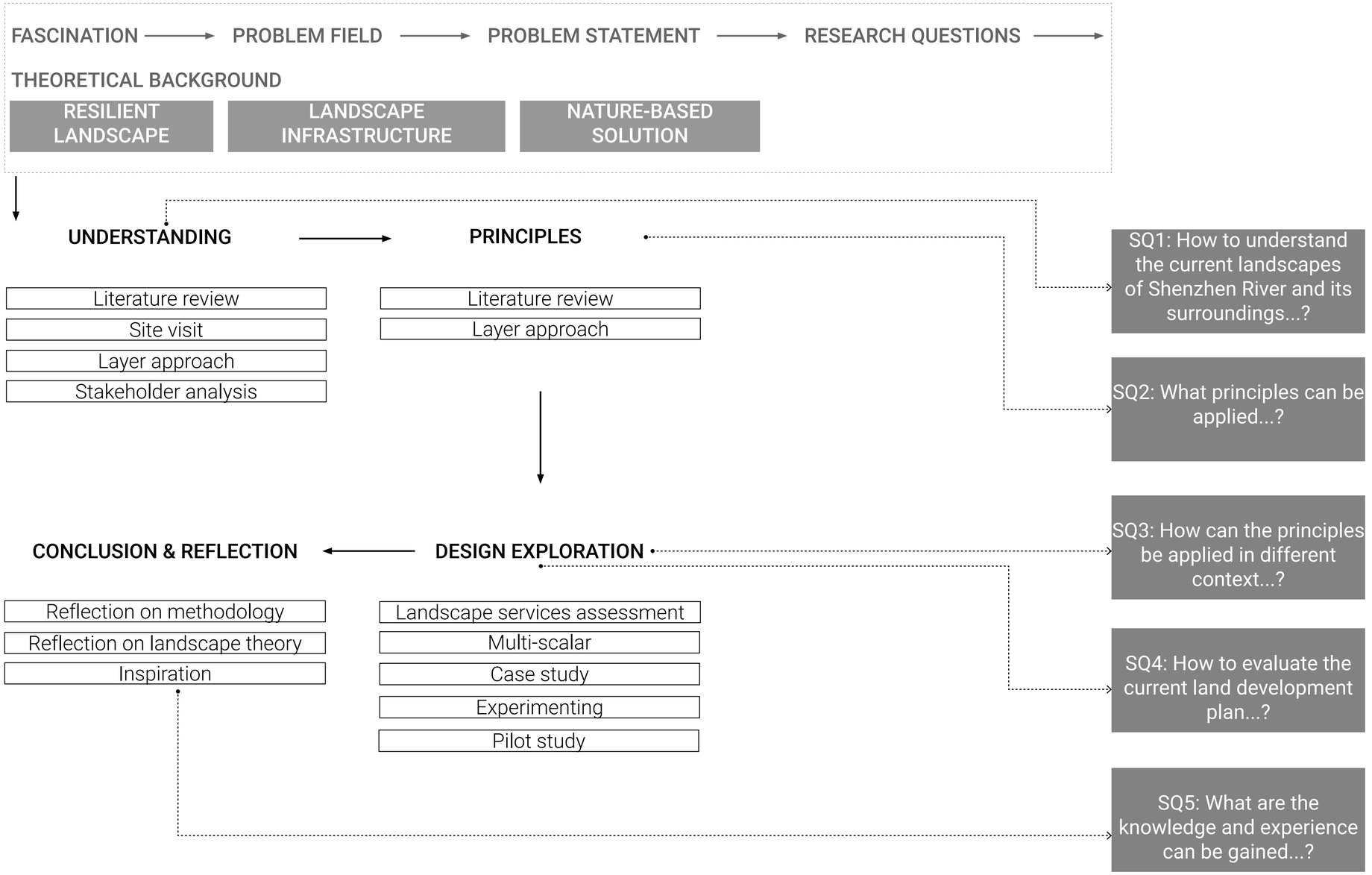
Nature-based Solutions are defined as actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits ("Nature-based solutions", 2022).

## ECOSYSTEM SERVICES

evaluation criteria

Ecosystem services are the many and varied benefits to humans provided by the natural environment and from healthy ecosystems. It can be identified into four major categories of ecosystem services: provisioning, regulating, cultural and supporting services (TEEB, 2010).

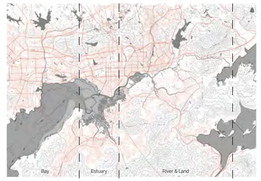
## | METHODS & APPROACH



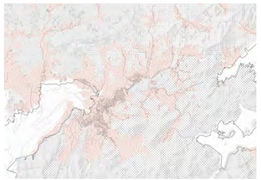
# CHAPTER 3. UNDERSTANDING

## *Basic natural condition*

[Spatial structure]



[Geological condition]



## *Three-layered landscape infrastructure analysis*

[Hydrological landscape infrastructure]



[Ecological landscape infrastructure]



[Socio-cultural landscape infrastructure]





[Main structure]

## *Challenged & Oppurtunities*

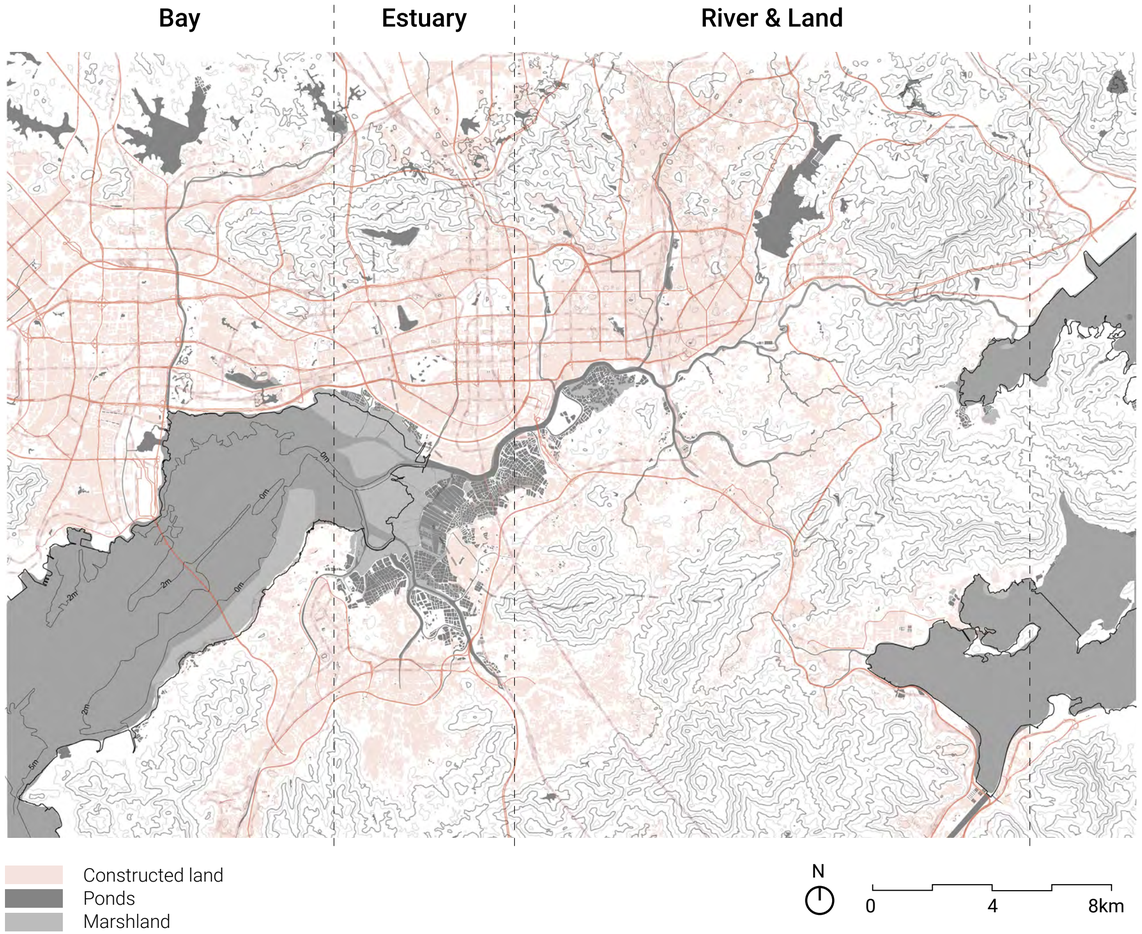


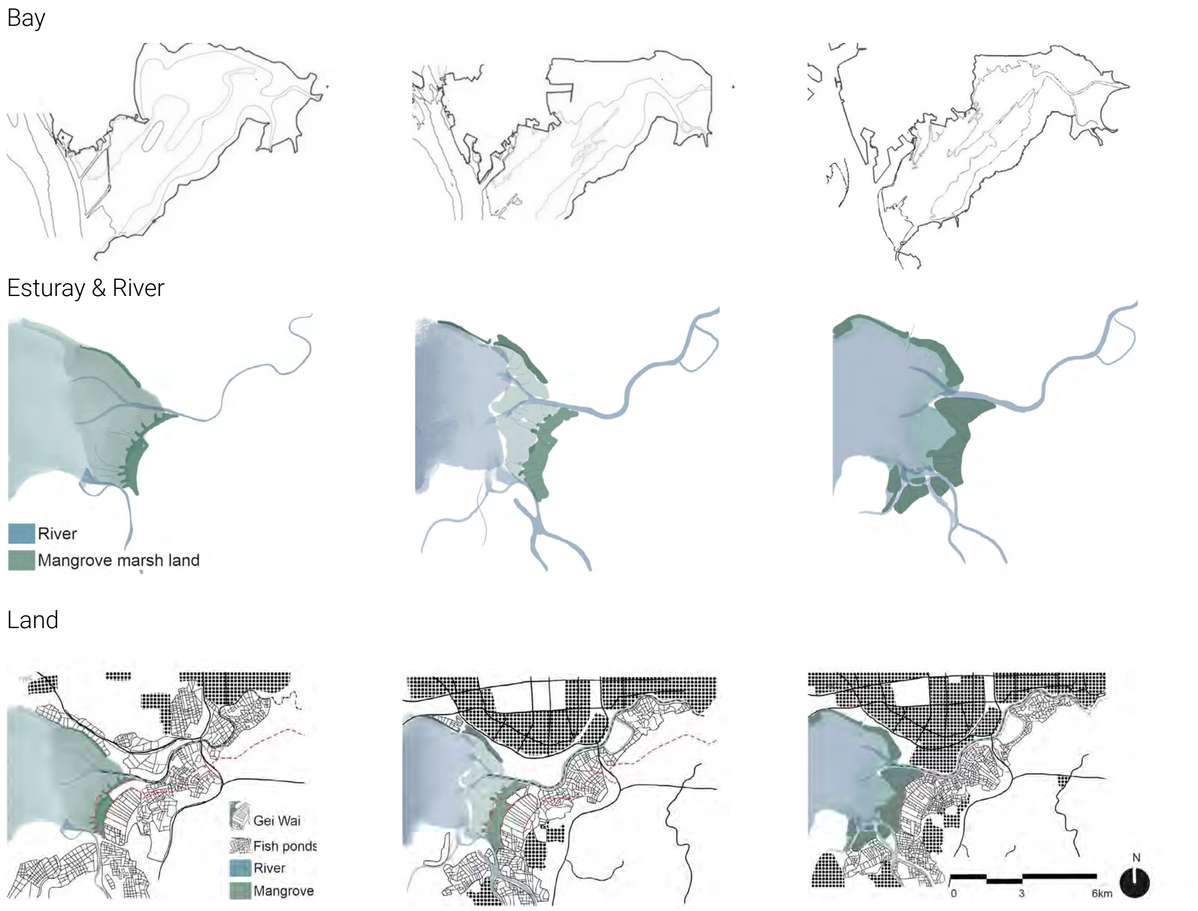


## *Design assignment*

**A resilient blue corridor**
**A diverse & continuous green corridor**
**A connective & cultural living corridor**

## | SPATIAL STRUCTURE: BAY, ESTURARY, RIVER AND LAND

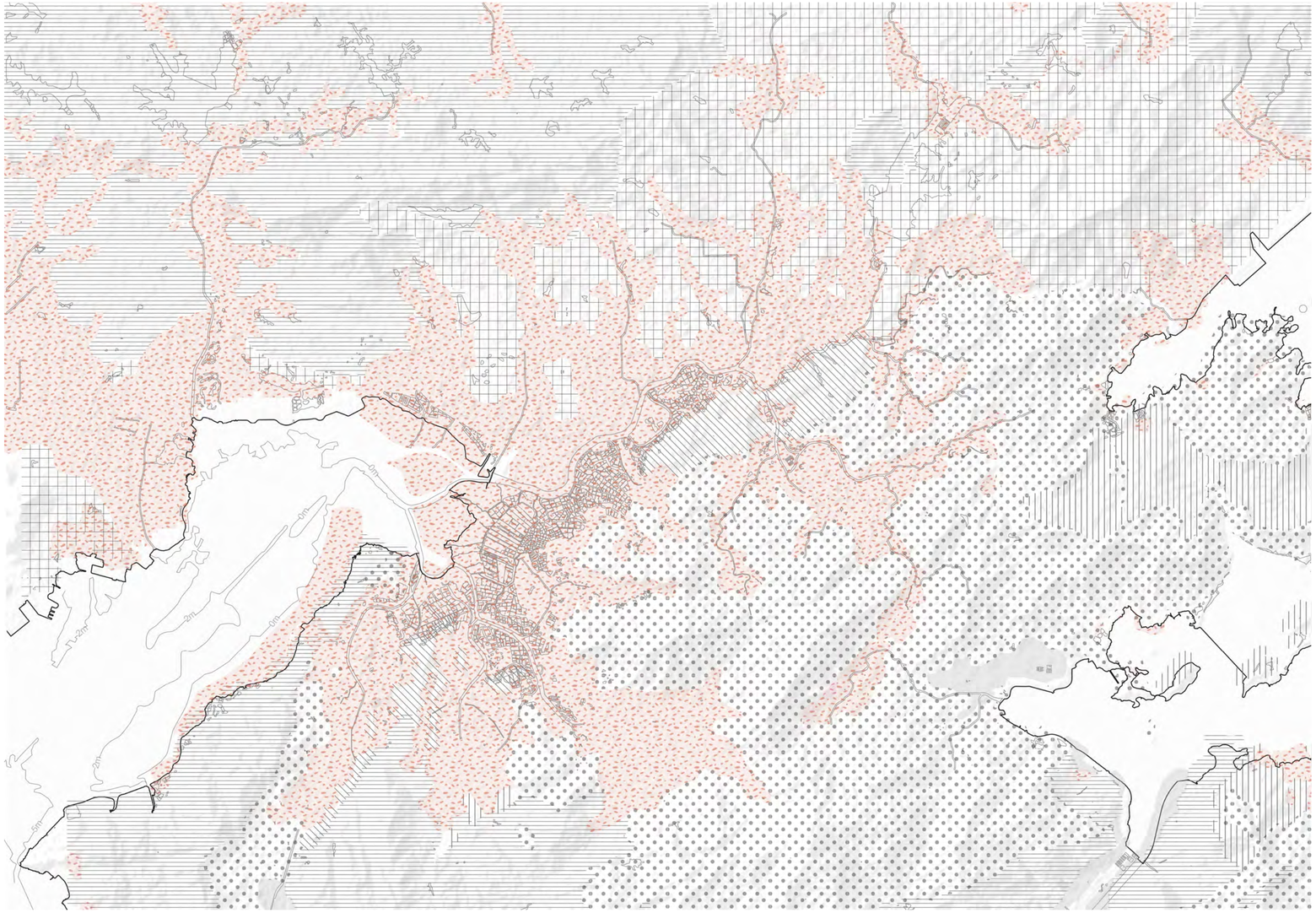



(left) Bay, estuary, river, and land
Made by author, Isobath data retrieved from: https://zhuanlan.zhihu.com/p/123349008
(right) Spatial structure of Shenzhen River Watershed
Made by author, Data retrieved from: GIS OSM data, https://zhuanlan.zhihu.com/p/123349008

## | GEOLOGICAL CONDITION

### Silt-based Bay




The sand and silt gives Deep Bay and the esturay area the character of silt-based bay, providing condition for forming the coastal mudflat (tidal flats) ecosystem.

- Unconsolidated sediments such as gravel, sand, silt and clay
- Graphitic siltstone, sandstone and marble
- Rhyodacitic crystal tuff
- Red conglomerate and coarse sandstone with siltstone
- Granite
- Reclaimation
- Other bedrocks
- Shenzhen River Watershed
- Coastalines
- Isobath

Soil condition of Shenzhen River Watershed
Made by aothor, data retrieved from: He, XC., Xu, YS., Shen, SL. et al., 2020; Sewell, Tang, 2013

# | HYDROLOGICAL LANDSCAPE INFRASTRUCTURE

Current water network

Wutong Mountain

SZ reservoir

N

0 3 6km

## Regional water network

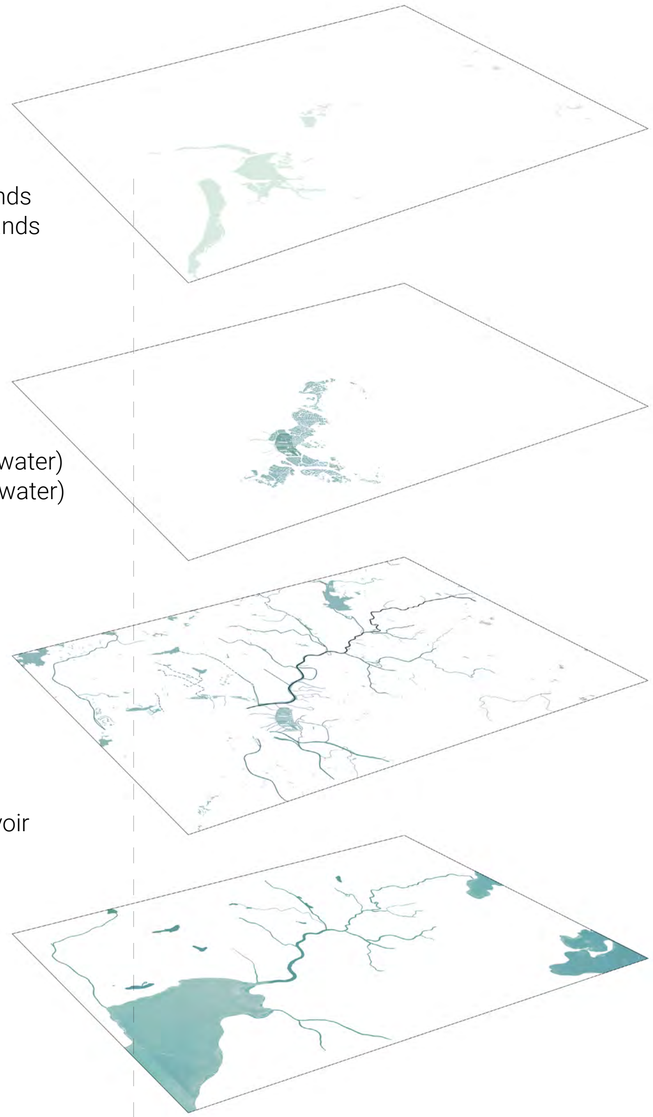
Rely on Dongjiang River for drinking water supply



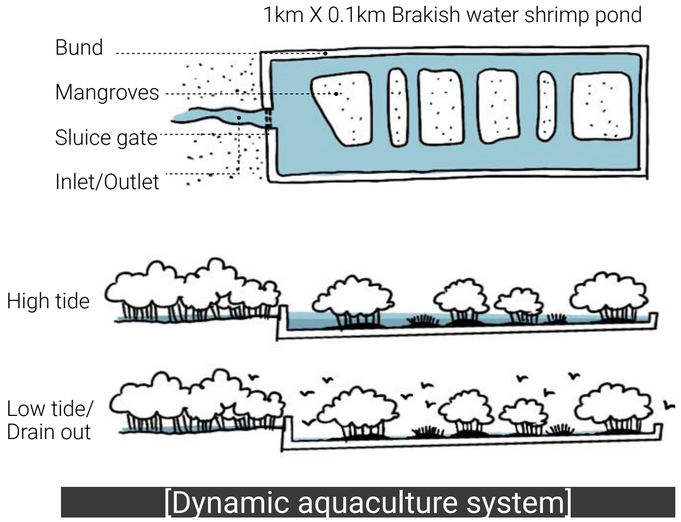

- Sewer network
- Main River
- Tributeries
- Ditches
- Water purification plant
- Rain water outlet
- Sewage water outlet
- Contour lines
- Isobath
- Shenzhen River Watershed

Water features and functionality

The sea, intertidal marshlands, Gei Wai, fishponds, the river, tributeries and the reservoir currently play different functions.



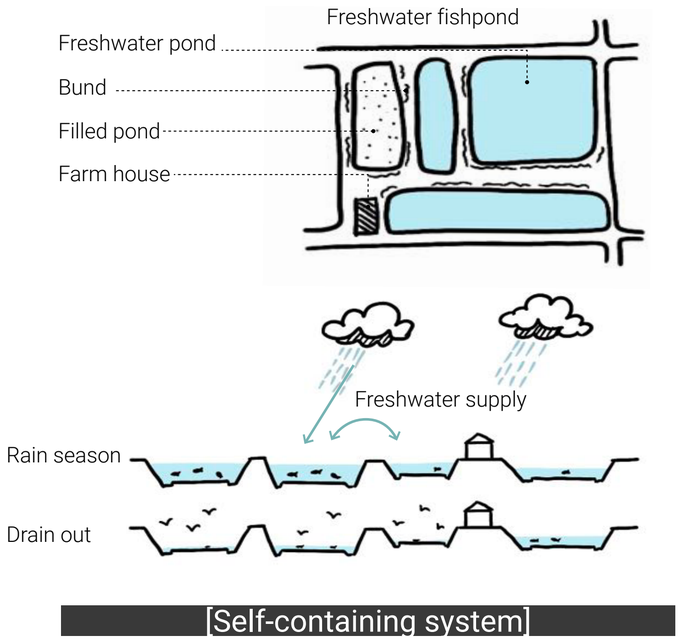
1. Coastal marshlands
2. Freshwater wetlands
3. Gei Wai (brakish water)
4. Fishponds (freshwater)
5. Five Tributaries
6. Ditches
7. Shenzhen River
8. Shenzhen Reservoir
9. Sea




[Dynamic aquaculture system]

**Gei Wai**

A dynamic natural system composed by sea, mangrove marshland, and Gei wai(shrimp ponds). The water flow process is influenced by tidal movement.




[Self-containing system]

**Fishponds**

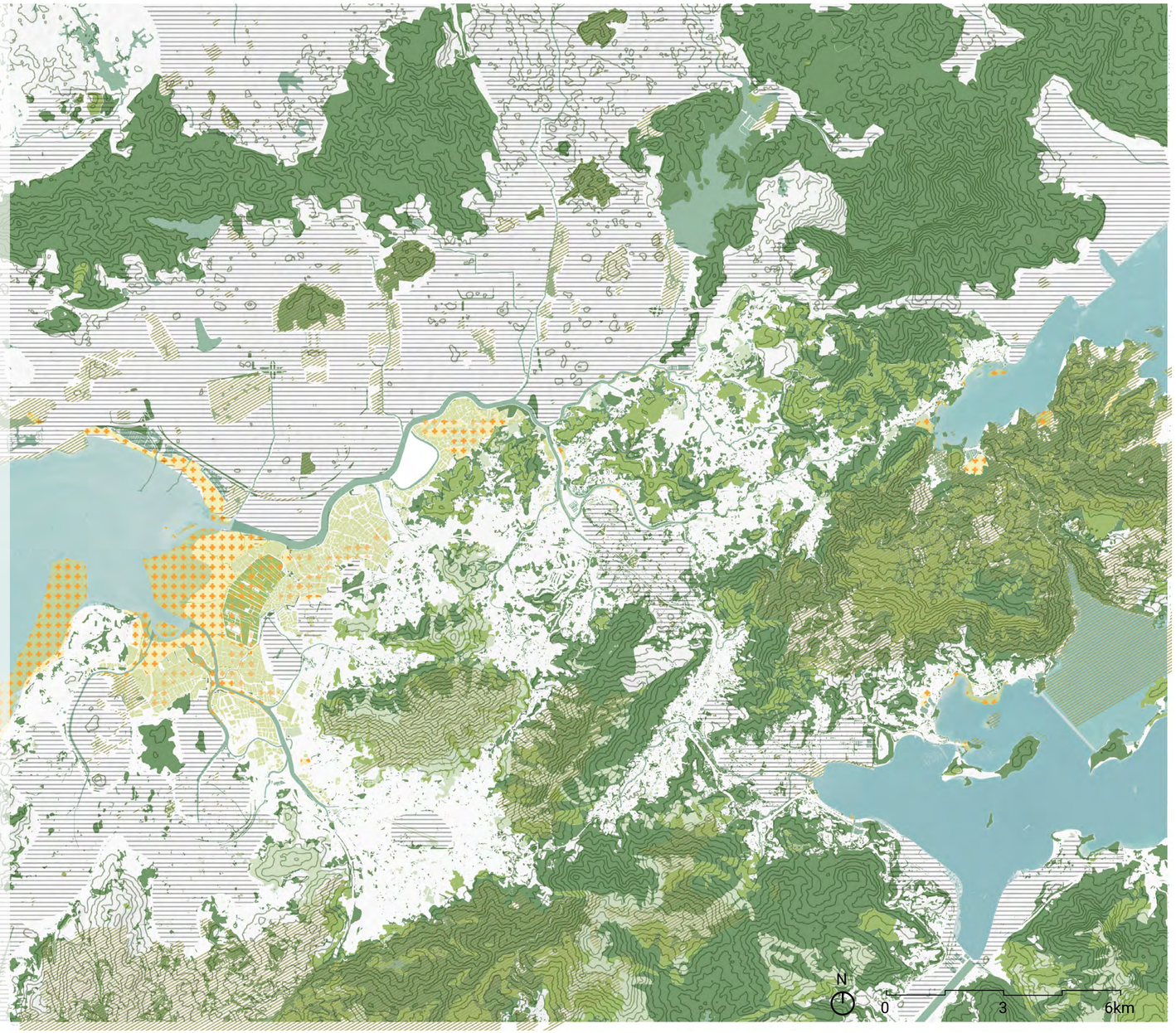
Water circulation of the fishponds, which currently turns to be a self-containing process, and highly relies on rainwater for freshwater supply.

# | ECOLOGICAL LANDSCAPE INFRASTRUCTURE

There are seven types of habitats. The silt-based landscape provides the condition for a rich wetland ecosystem. Due to the precise management of Gei Wei and mangroves by HKWWF and the Hong Kong government, this area became a bird paradise right on the migration route of Est Asian-Australasian Flyway.



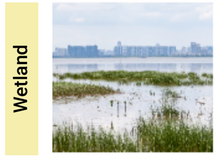
East Asian-Australasian Flyway





Mangrove

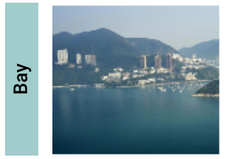

black faced spoonbill


Wetland




Grassland & shrub




Bay




Gei Wai




Fishpond



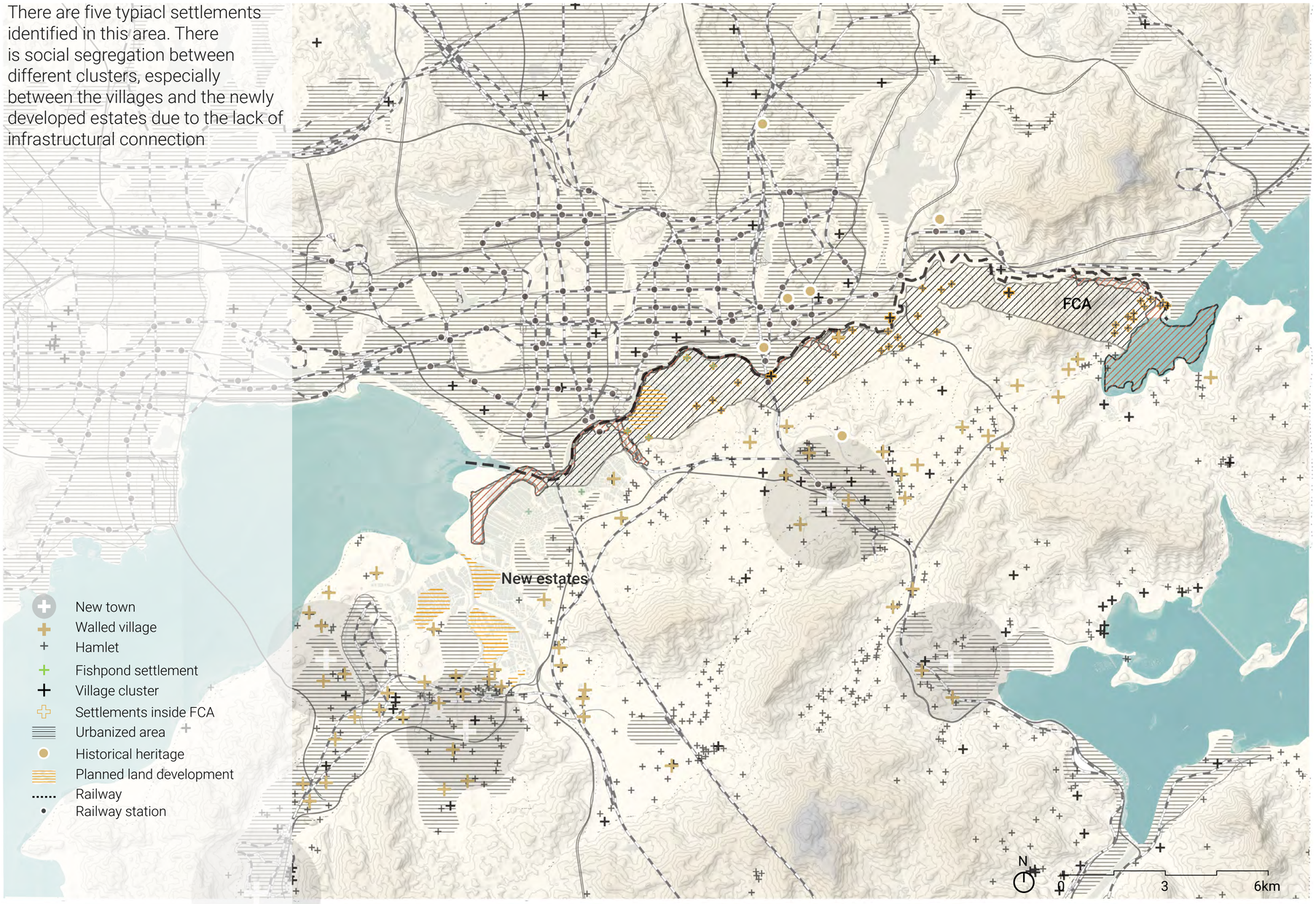



woodland



# | SOCIAL LANDSCAPE INFRASTRUCTURE

There are five typiacl settlements identified in this area. There is social segregation between different clusters, especially between the villages and the newly developed estates due to the lack of infrastructural connection




**Fishpond settlements**



**Walled village**



**Isolated border village**



**Gei Wai education base**
**(only few settlements on the boundary)**

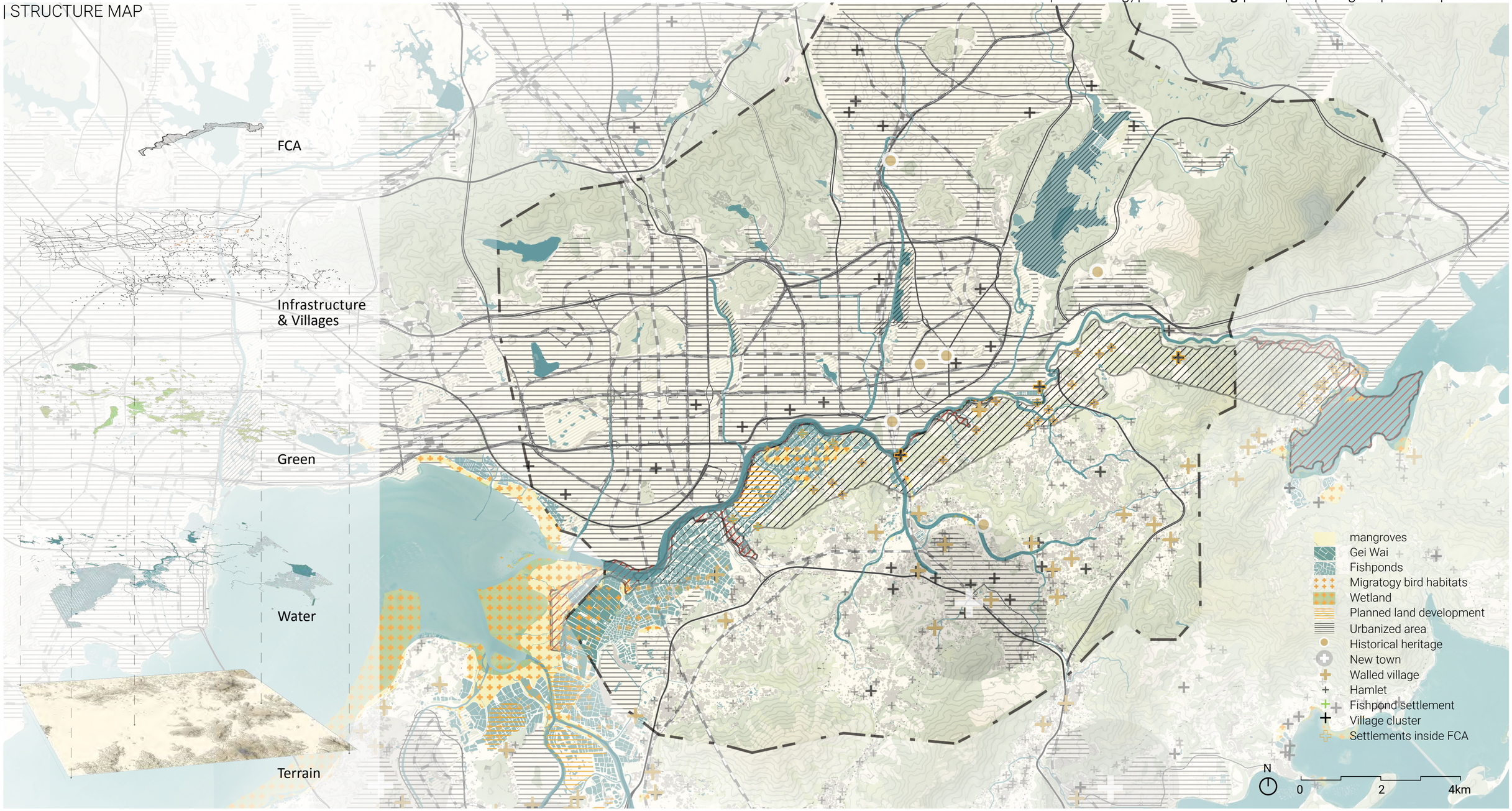


**New estates**



Images retrieved from Google Map street view

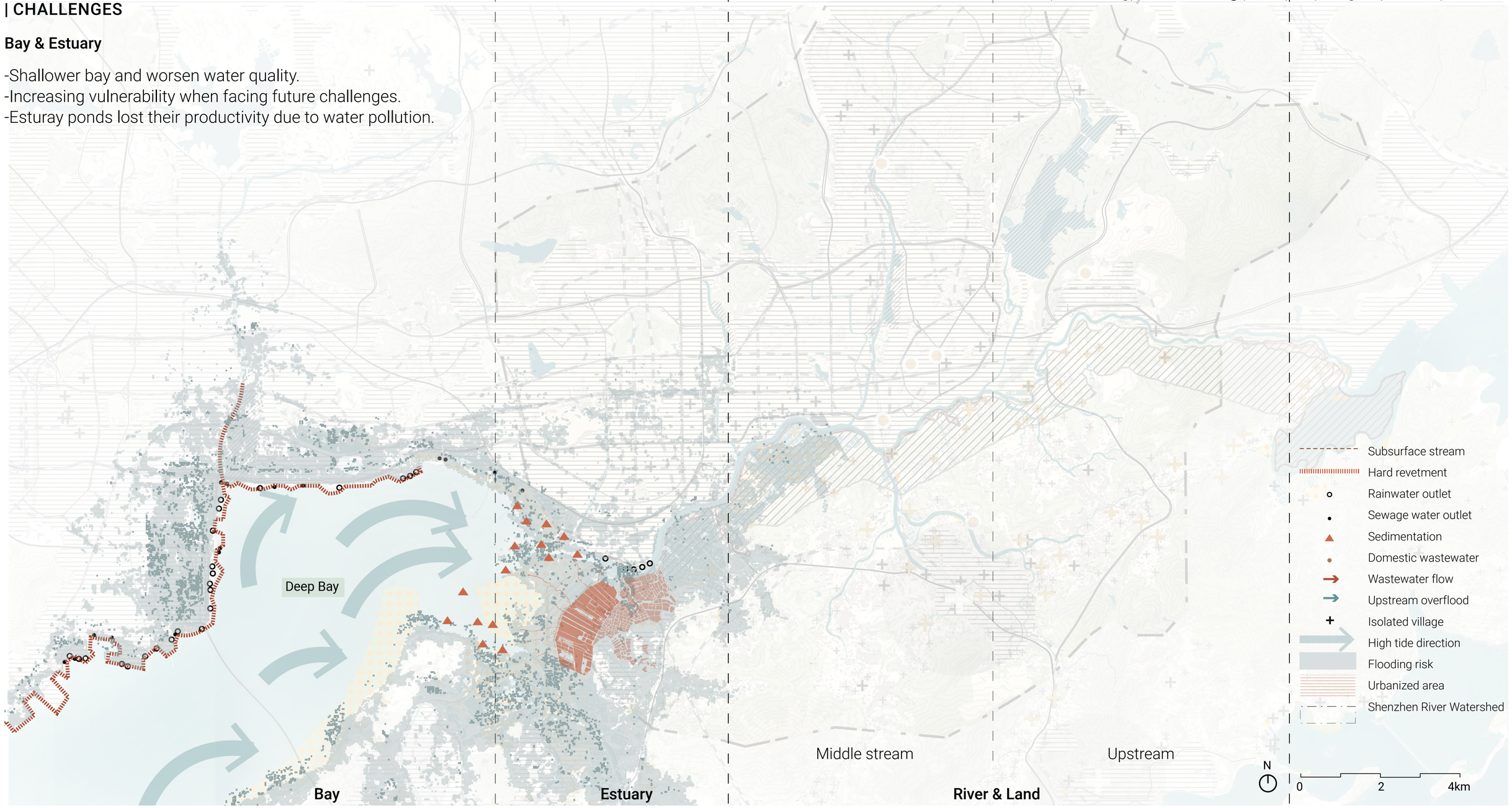
## | STRUCTURE MAP



## | CHALLENGES

### Bay & Estuary

-Shallower bay and worsen water quality.
-Increasing vulnerability when facing future challenges.
-Esturay ponds lost their productivity due to water pollution.

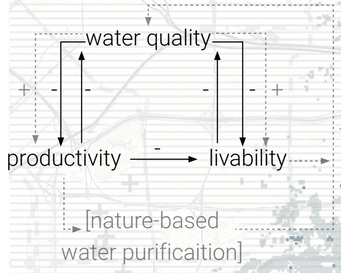


## | CHALLENGES

### River & Land

-Domestic wastes flow from city to river.
-Shenzhen river quality is level V (untouchable).
-Limited space for waterfront green on SZ side.
-Inaccessibility to the river and loss of culture identity.

-Insufficient water retention.
-Reservoir cannot satisfy the demand for freshwater supply.



## | OPPORTUNITIES

### (1). Coastal mangrove & Gei Wai



Mai Po Gei Wai
Retrieved from:https://www.wwf.org.hk/en/wetlands/mai-po/

### (2). Shenzhen River



Shenzhen Rriver
Retrieved from: https://commons.wikimedia.org/wiki/File:Shenzhen_Rriver_between_Futian%26_Lok_Ma_Chau2021.jpg

### (3). Rennovated tributeries

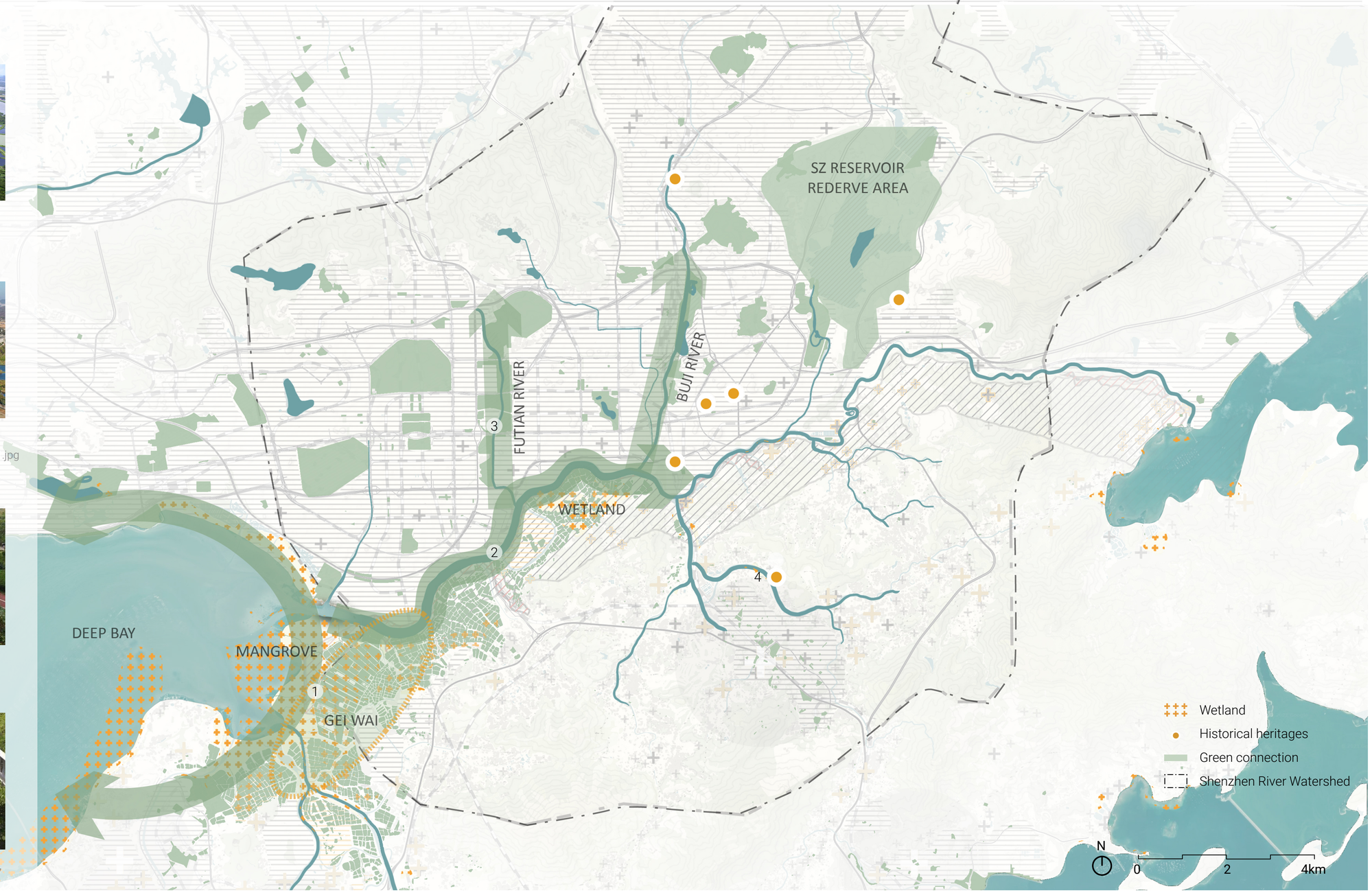


Futian river
Retrieved from: http://www.fooooooot.com/trip/65579/

### (4). Historical heritages



Luo Hu Bridge
Retrieved from: https://www.sohu.com/a/317595978_355807



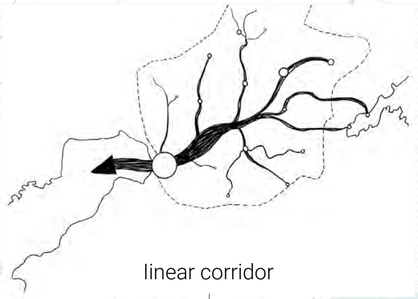
## | DESIGN ASSIGNMENT

A RESILIENT LANDSCAPE CORRIDOR:

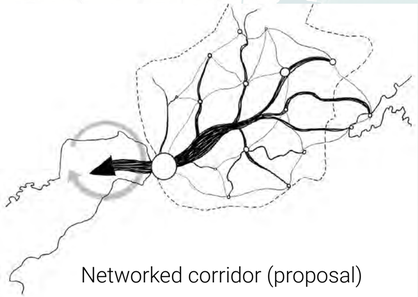
**A Resilient Blue Corridor**

**A Diverse & Continuous Green Corridor**

**A Connective & Productive Living Corridor**



linear corridor



Networked corridor (proposal)

N

0 2 4km

# CHAPTER 4. REGIONAL PRINCIPLES & STRATEGIES

*-Seven regional network principles*

*-Three layers of landscape infrastructure networks*

## | REGIONAL NETWORK PRINCIPLES

Blue corridor | Green corridor | Living corridor
Resilient | Continuous & Diverse | Connective & Cultural identity

### [Hydrological landscape infrastructure]



**01** Sponge capacity network



**02** Water circulation and purification network

### [Ecological landscape infrastructure]



**03** Nature-based habitats network

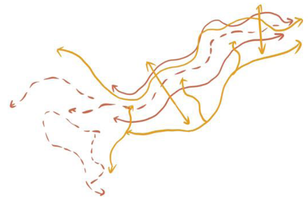


**04** Continuous public green network

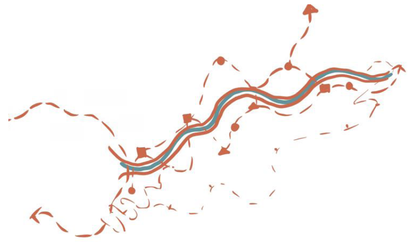
### [Socio-cultural landscape infrastructure]



**05** Productive ecofriendly aquaculture network



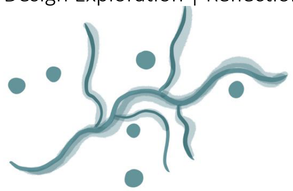
**06** Slow traffic network



**07** Leisure & Innovation network

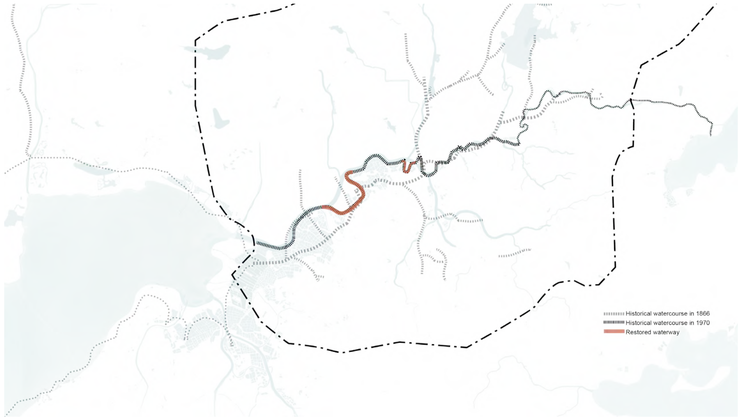
## | SOCIO-CULTURAL LANDSCAPE INFRASTRUCTURE NETWORK

### 01 Sponge capacity network





Current water system



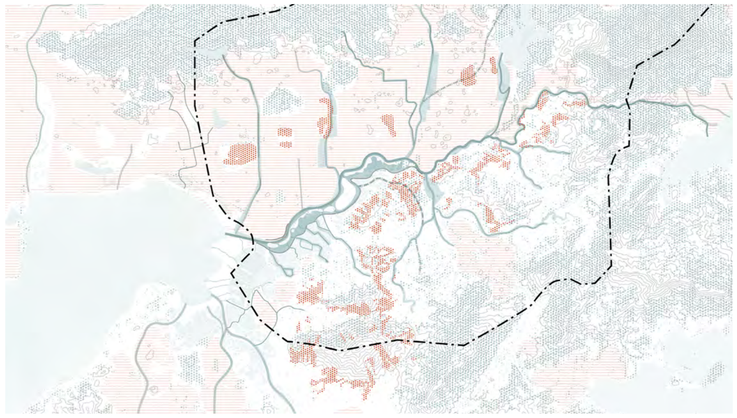

Strategy 1: Restore historical waterways.




Strategy 2: Remove dikes and make room for a new second river bypass and floodplains.




Strategy 3:  Add and expand waterways, improve the urban sewer system



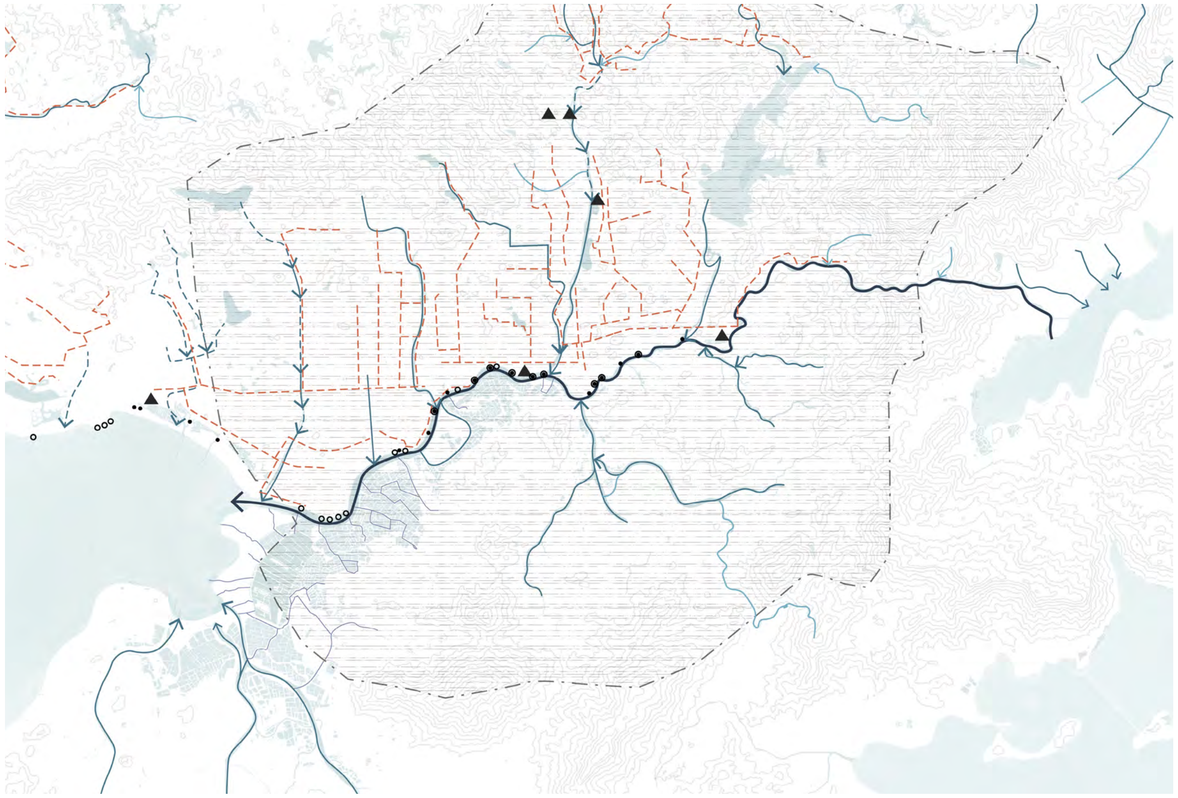
Strategy 4: Increase water retention capacity.

# 02 Water circulation and purification network

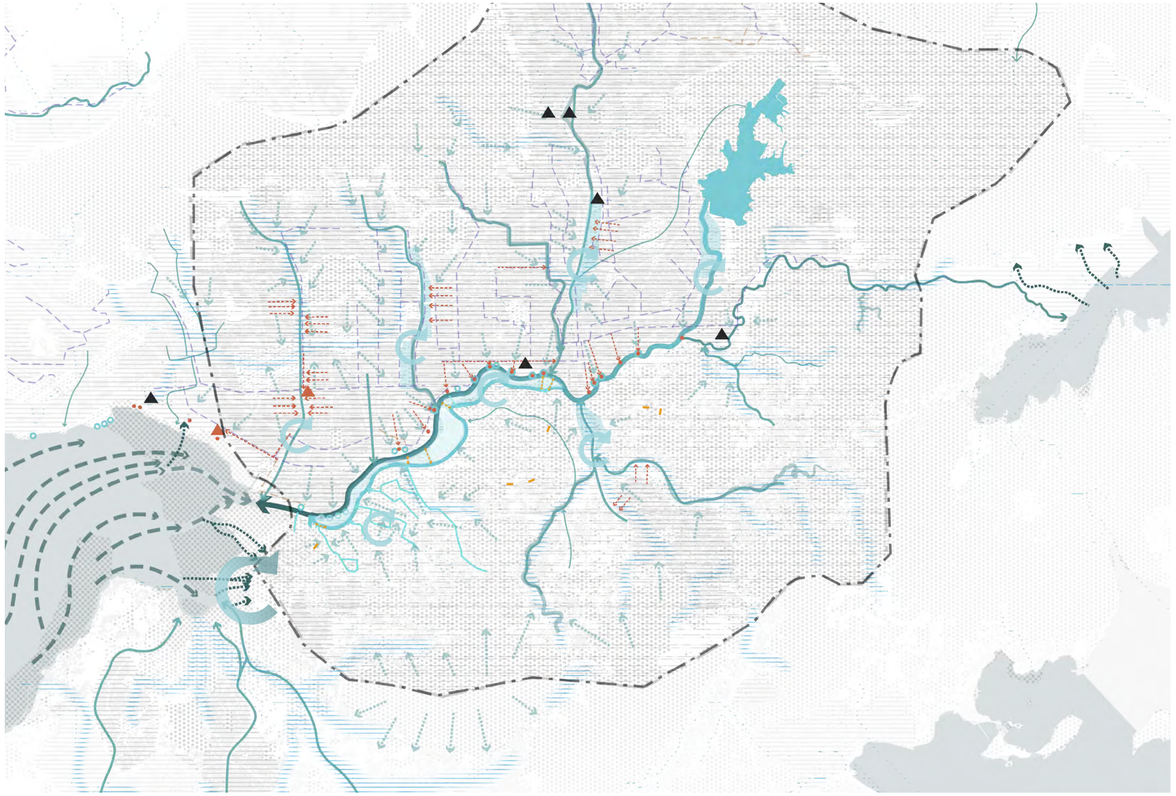
Strategy 1: Create a second river bypass by the new islands and sluice gates.
Strategy 2: Seperate sea water, rain water, wastewater, and river flow.
Strategy 3: Create external and internal water circulation



Current




Proposed



**Rainwater**
- Second waterway
- Surface water flow
- Rainwater outlet
- Water catchment area
- Sluice gate

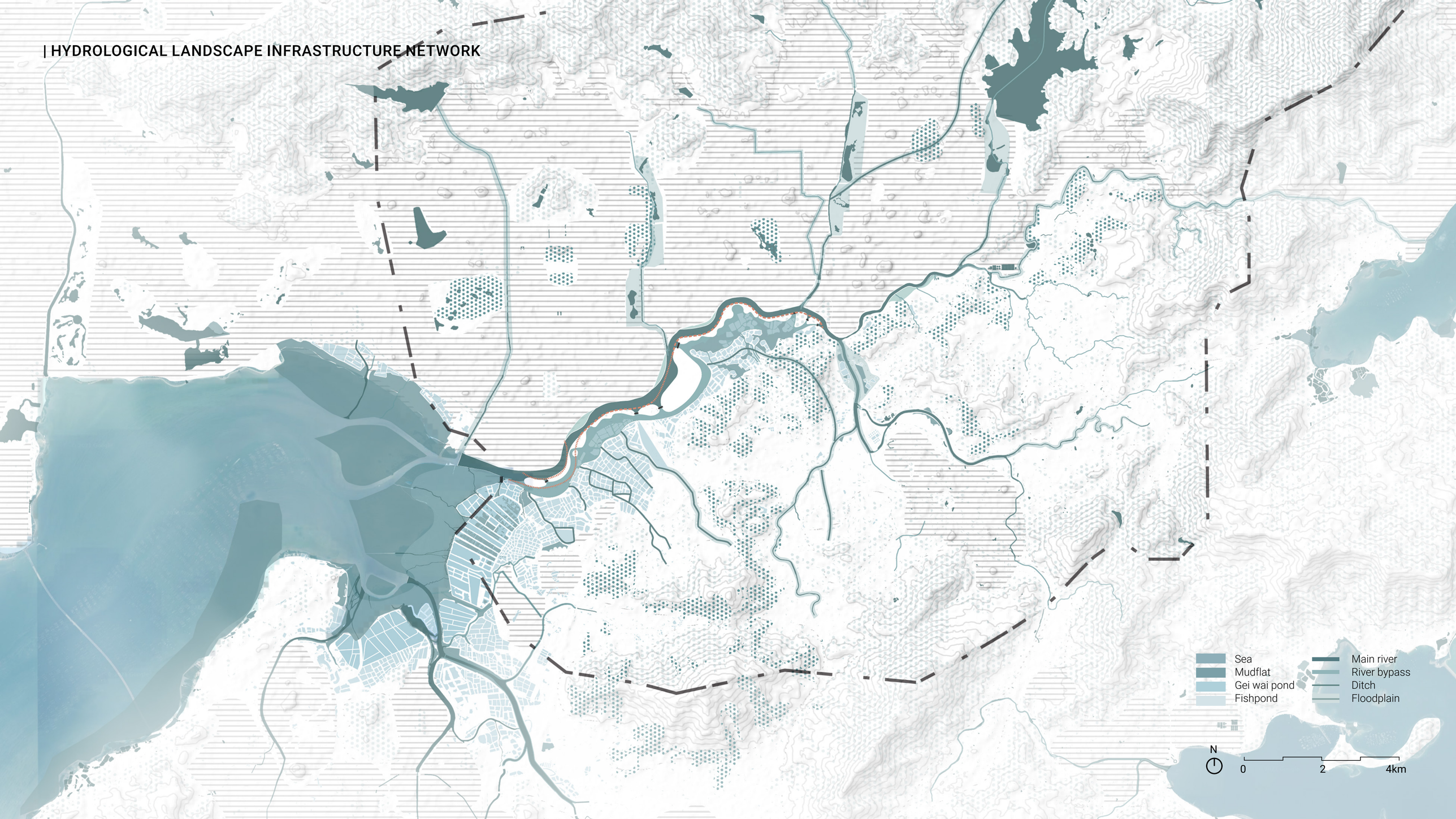
**River water**
- Main river
- Channel

**Sea water**
- Tide

**Wastewater**
- Current plant
- New plant
- Sewage outlet
- Current wastewater flow
- New wastewater flow

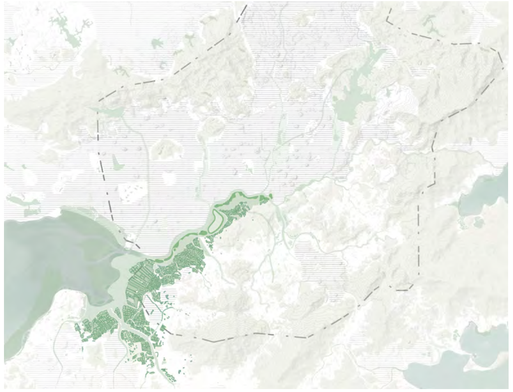
**Circulation**
- Internal water circulation
- External water circulation

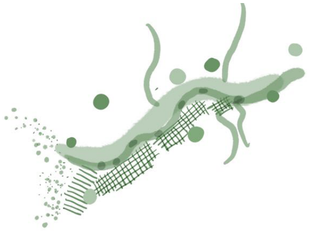
# | HYDROLOGICAL LANDSCAPE INFRASTRUCTURE NETWORK



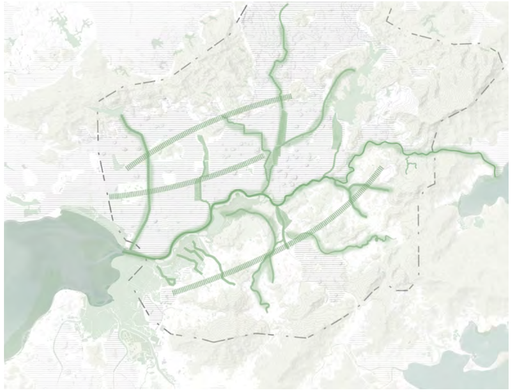
## | ECOLOGICAL LANDSCAPE INFRASTRUCTURE NETWORK

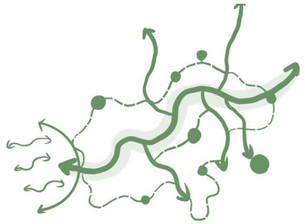
### 03 Nature-based habitats network

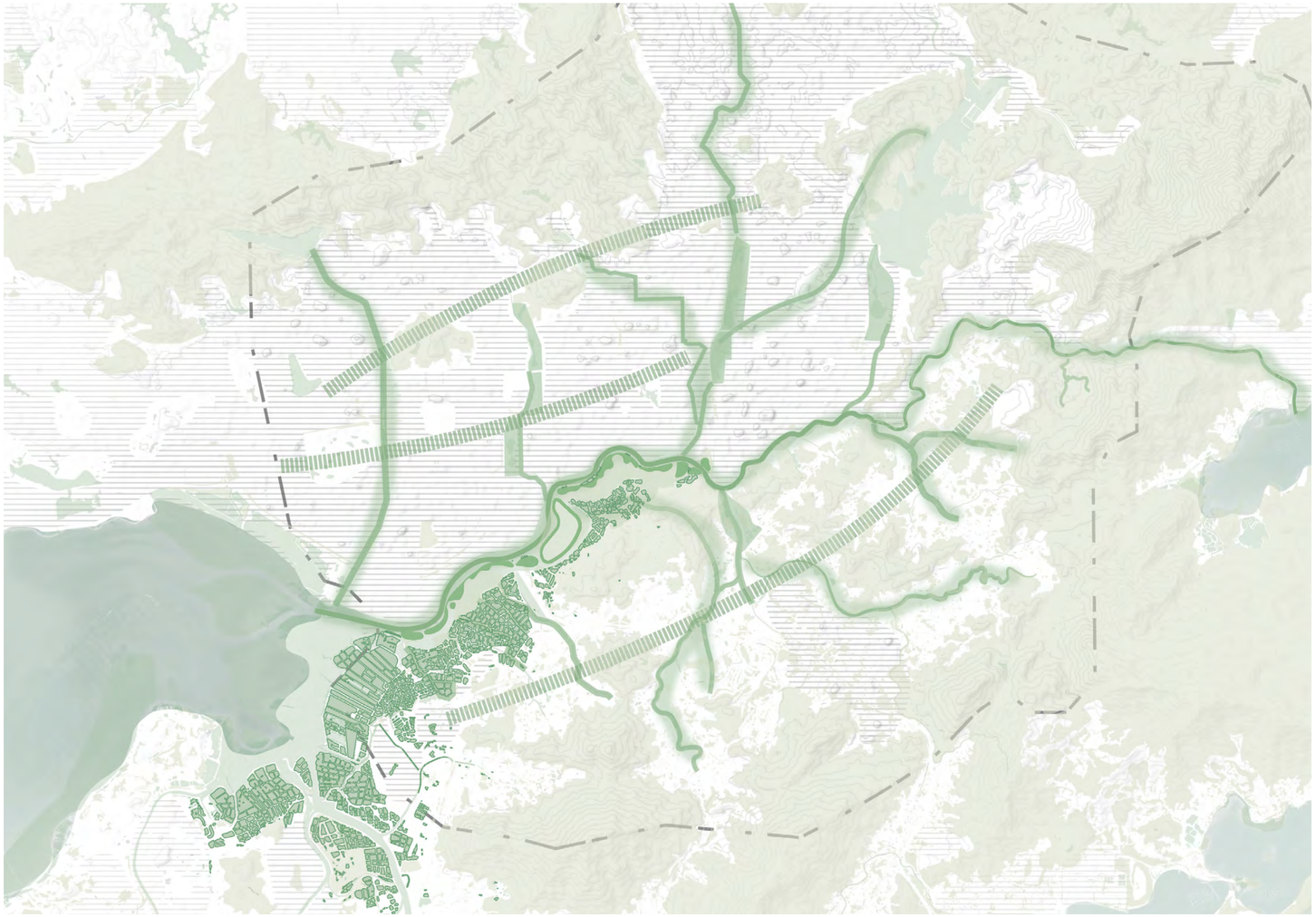




### 04 Continuous public green network







Public green connection

N

0 3 6km

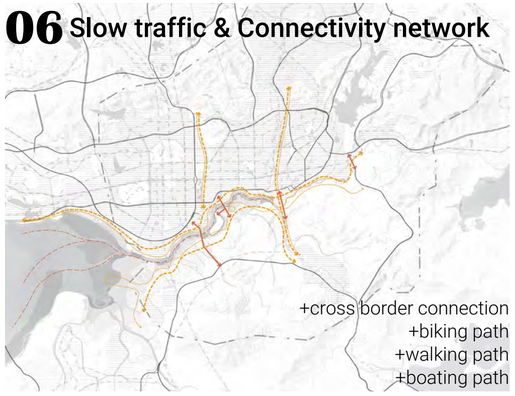
## | SOCIO-CULTURAL LANDSCAPE INFRASTRUCTURE NETWORK

### 05 Productive ecofreindly aquaculture network

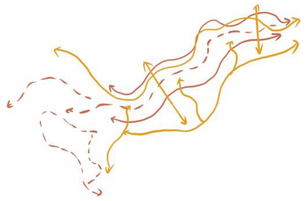




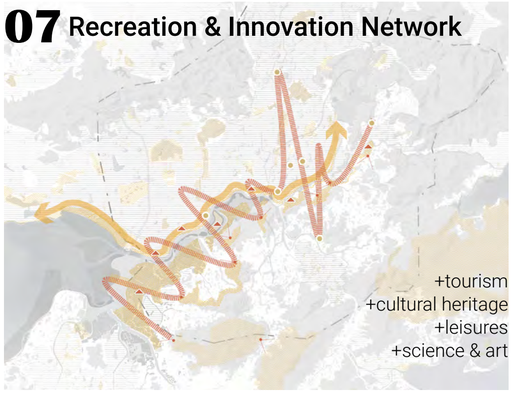
### 06 Slow traffic & Connectivity network



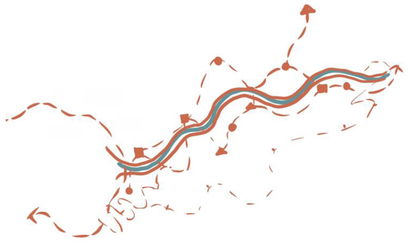
+cross border connection
+biking path
+walking path
+boating path

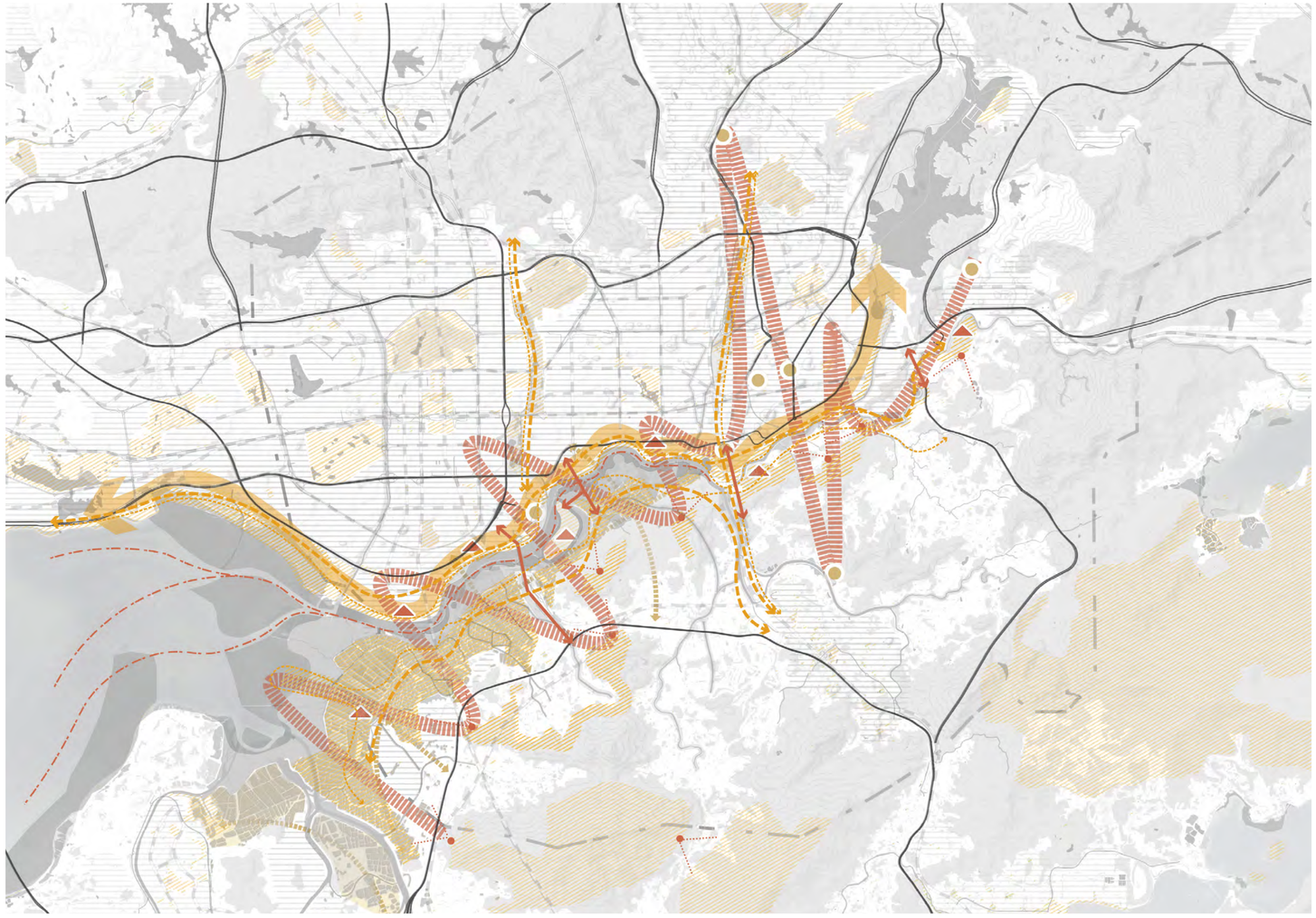


### 07 Recreation & Innovation Network



+tourism
+cultural heritage
+leisures
+science & art





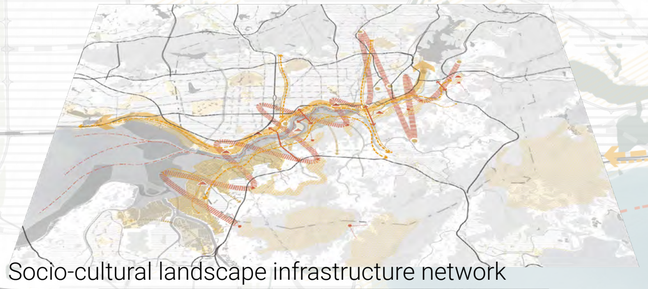
Place of interests
Innovative hub
Cross-border connection
Biking route
Walking route
Boating route
Recreation route
Tourism route

N
0 3 6km

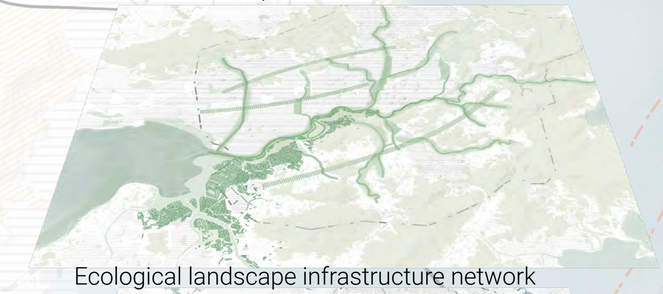
## | INTEGRATION OF THREE NETWORK LAYERS

The landscape networks  suggest holistic connectivity within three layers, but show limited cross-layer relations. Commons and conflicts are noticed when the three networks intertwine.

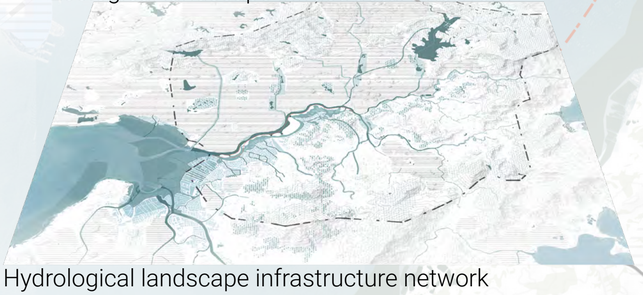
*How to deal with the inter-relationship and complexity?*



Socio-cultural landscape infrastructure network



Ecological landscape infrastructure network



Hydrological landscape infrastructure network

Public green connection
Place of interests
Innovative hub
Cross-border connection
Biking route
Walking route
Boating route
Recreation route
Tourism route

N

0 2 4km

# CHAPTER 5. DESIGN EXPLORATION

*-From strategy to project*

*-From project to landscape framework*

*[Local scale]*
*-Zoom-in I: Sustainable Bay & Estuary*
*Pilot 01: Ecofriendly aquaculture and wetland park*
*Pilot 02: Bay archipelago*

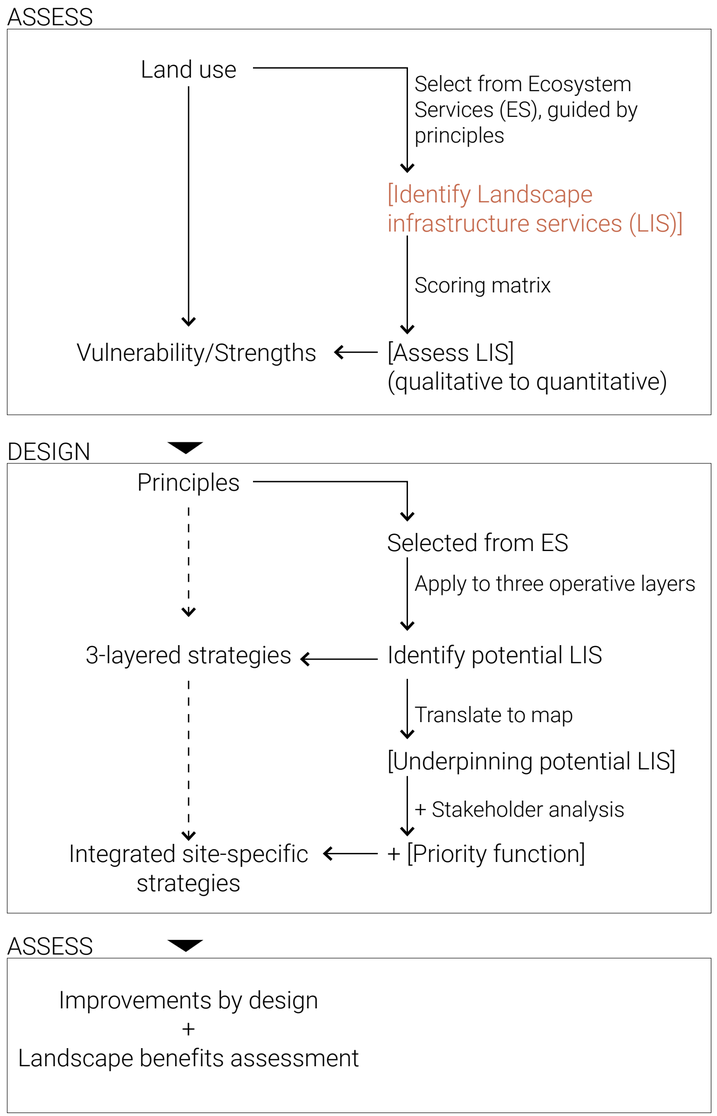
*-Zoom-in II: Livable River & Land*
*Pilot 03: Shenzhen River waterfront*
*Pilot 04: Innovative campus and land development*

*-Local scale design exploration conclusion*

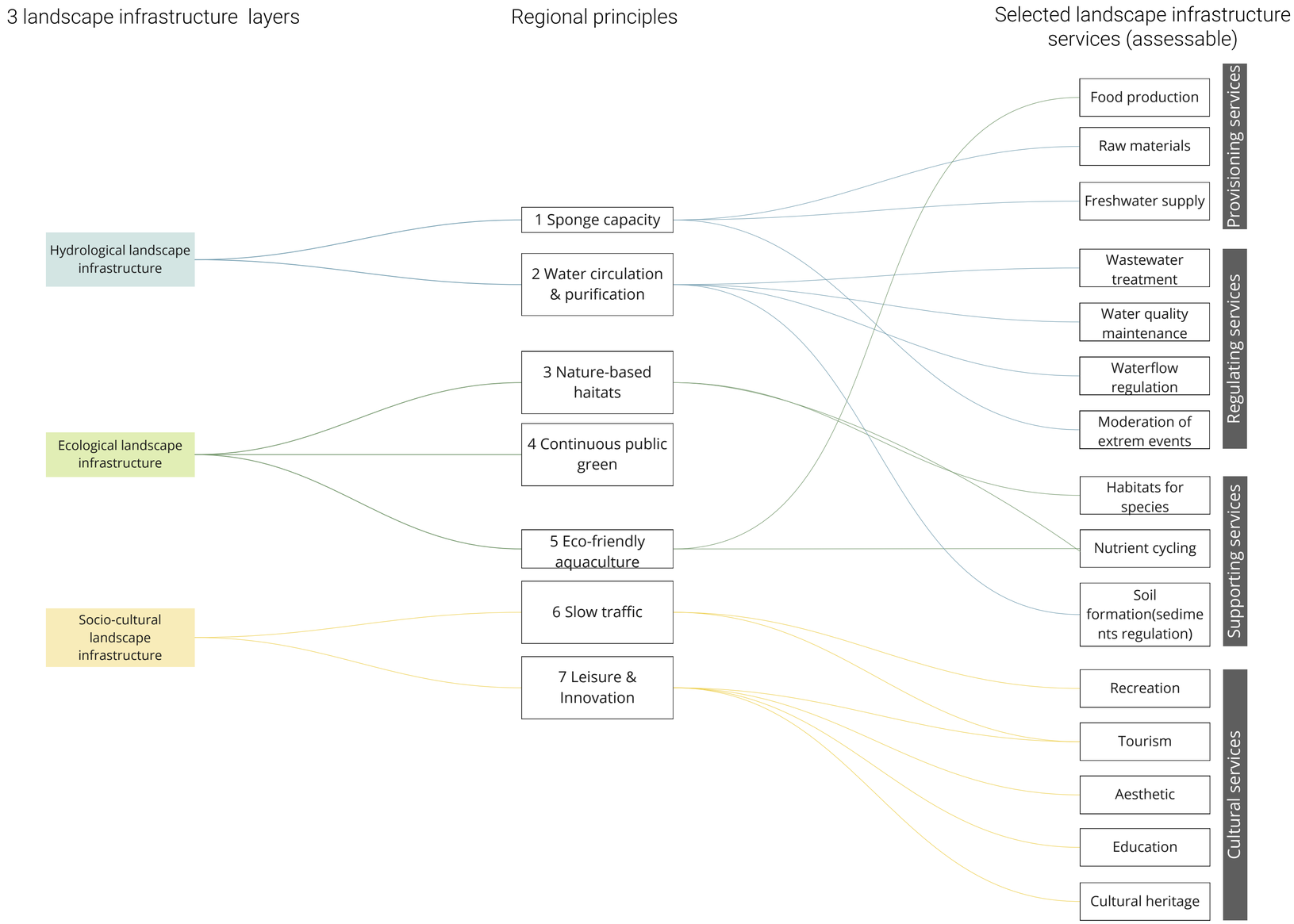
*[Regional scale]*
*-Regional landscape framework*

## | FROM STRATEGY TO PROJECT

A procedural approach is needed to help identify the site's potential landscape values, evaluate them, and further use them to guide the proposal of site-specific strategies.




[ Identify landscape infrastructure services ]



## | FROM STRATEGY TO PROJECT

*"The knowledge needed for decision-making on landscape development, needs to be relevant to the small scale at which local actors perceive their environment and decide about change. " (Termorshuizen & Opdam, 2009)*

ASSESS

Land use → Select from Ecosystem Services (ES), guided by principles → [Identify Landscape infrastructure services (LIS)] → Scoring matrix → [Assess LIS] (qualitative to quantitative) → Vulnerability/Strengths

DESIGN

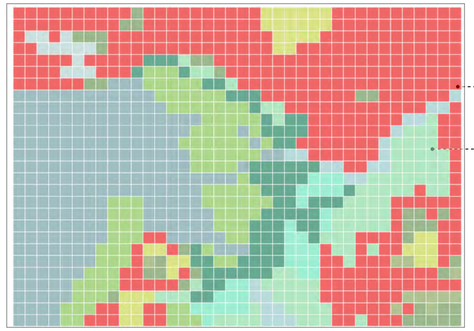
Principles → Selected from ES → Apply to three operative layers → Identify potential LIS → Translate to map → [Underpinning potential LIS] → + Stakeholder analysis → + [Priority function] → Integrated site-specific strategies & projects

ASSESS

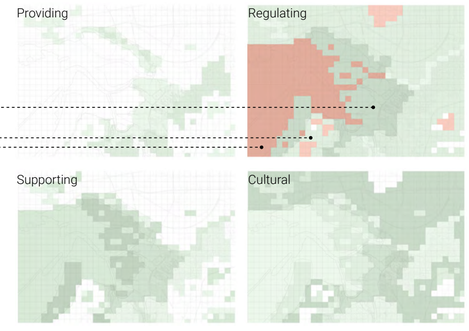
Improvements by design
+
Landscape benefits assessment

## [ Landscape infrastructure services (LIS) assessment ]

**Land Use Map** → **Matrix Model For LIS Supply Capacities** → **LIS Supply Capacity Maps**



| | Providing | | | Regulating | | | Supporting | | | Cultural | | | ES (all) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ES1 | ES2 | ES3 | ES4 | ES5 | ES6 | ES7 | ES8 | ES9 | ES10 | ES11 | ES12 | |
| LU1 | 0 | -1 | 1 | 2 | | | | | | | | | |
| LU2 | | | | | | | | | | | | | |
| LU3 | | | | | | | | | | | | | |
| LU4 | | | | | | | | | | | | | |
| LU5 | | | | | | | | | | | | | |
| LU6 | | | | | | | | | | | | | |




score **by** empirical model result/biophysical inicators/expert estimations

GIS

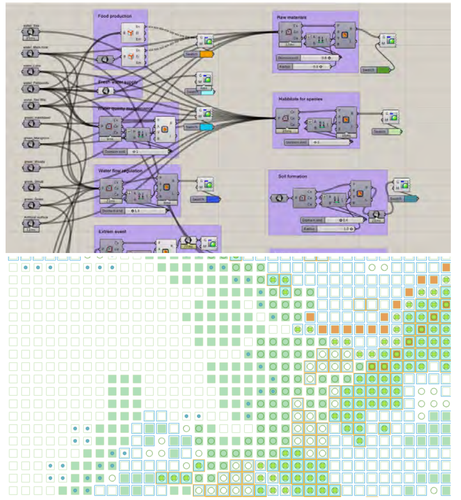
Fig. (Up) LIS Assessment Method
Modified by author, 2022
Reference: Openess method fact sheet-simplematrix approach
https://www.guidetoes.eu/networks/factsheets/Method_Factsheet_SimpleMatrixApproach.pdf

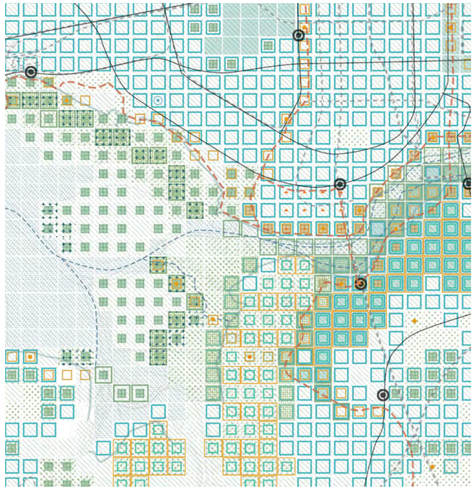
## [ Underpinning potential landscape infrastructure services ]

**Potentials LIS** → **Gh Programming** → **Networked LIS Map**

| | Providing | | | Regulating | | | Supporting | | | Cultural | | | ES (all) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ES1 | ES2 | ES3 | ES4 | ES5 | ES6 | ES7 | ES8 | ES9 | ES10 | ES11 | ES12 | |
| LU1 | 0 | -1 | 1 | 2 | | | | | | | | | |
| LU2 | | | | | | | | | | | | | |
| LU3 | | | | | | | | | | | | | |
| LU4 | | | | | | | | | | | | | |
| LU5 | | | | | | | | | | | | | |
| LU6 | | | | | | | | | | | | | |

hydrological landscape infrastructure layer
ecological landscape infrastructure layer
socio-cultural landscape infrastructure layer





## | FROM PRJECT TO LANDSCAPE FRAMEWORK

Knowledge gained from local scale projects help to build up the landscape framework.



# ZOOM-IN I: SUSTAINABLE BAY & ESTURAY

*ECOLOGY VS SOCIAL ACTIVITY*

*Preserve the culture value and deal with the conflicts between ecological, productive, and recreational functions while adpating to coastal natural processes.*

## | INTRODUCTION & UNDERSTANDING




N

0 2 4km

Bay & Estuary satlellite image
Retrieved from Google Earth



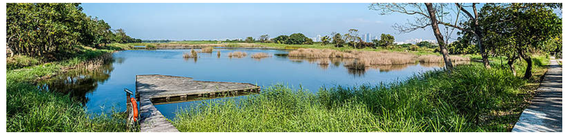
Shenzhen River estuary mudflat

Retrieved from: http://shenzhen.news.163.com/20/1030/10/fq69fm3104178d6r.html



Mangroves

Retrieved from: http://tour.sun0769.com/world/gd/info/t20110103_966276_3.shtml



Mai Po Gei Wai

Retrieved from: https://www.wwf.org.hk/en/reslib/education/wetlands/



New territory fishpond

Retrieved from: https://sc.afcd.gov.hk/TuniS/www.afcd.gov.hk/misc/download/annualreport2017/tc/fisheries.html



Fishpond village near Mai Po

Retrieved from: Google map street view



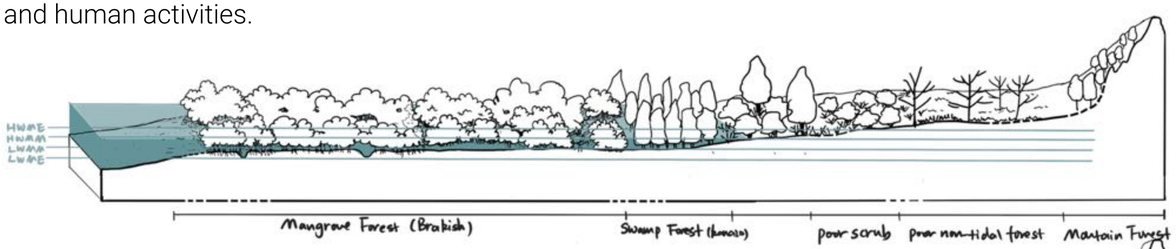
Mountain view in HK new territory

Retrieved from: google map street view

## | INTRODUCTION & UNDERSTANDING

Process of landscape with changing cultural identity and human activities.

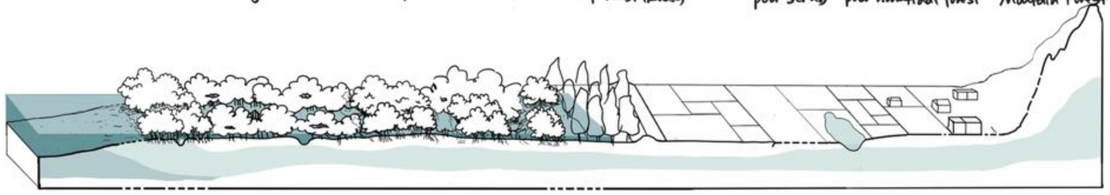
Before 1800




**[Coastal mangal natural succession]**

Original natural landscape

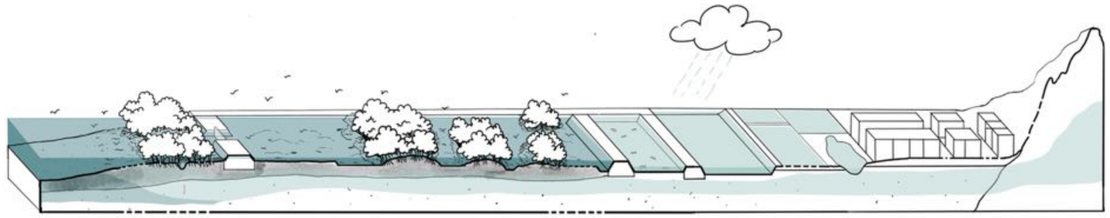
1800s



**[Historical coastal life]**

Demand for agriculture production

1940-1983

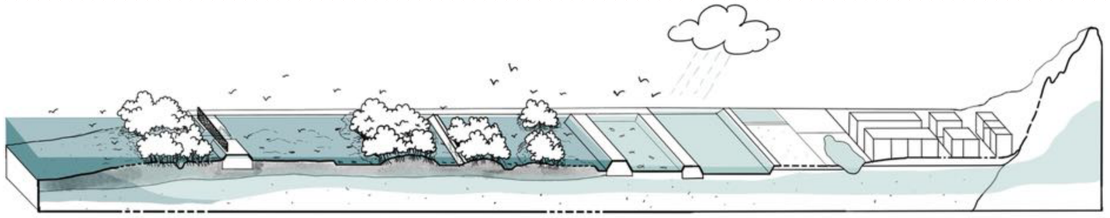


**[Traditional shrimp and fish aquaculture]**

Demand for adaptive agriculture production with less cost but more benefits

Current

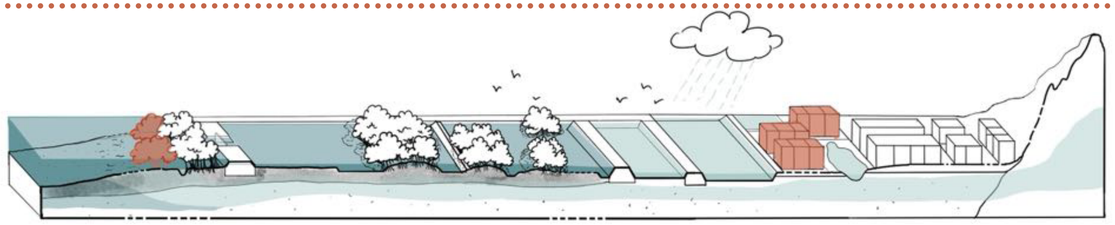
1983- 2022



**[Artificial water management and enhanced ecological value]**

Fading of the aquculture industry due to water pollution

2100



**[Two future challenges]**

Climate change and urbanzation

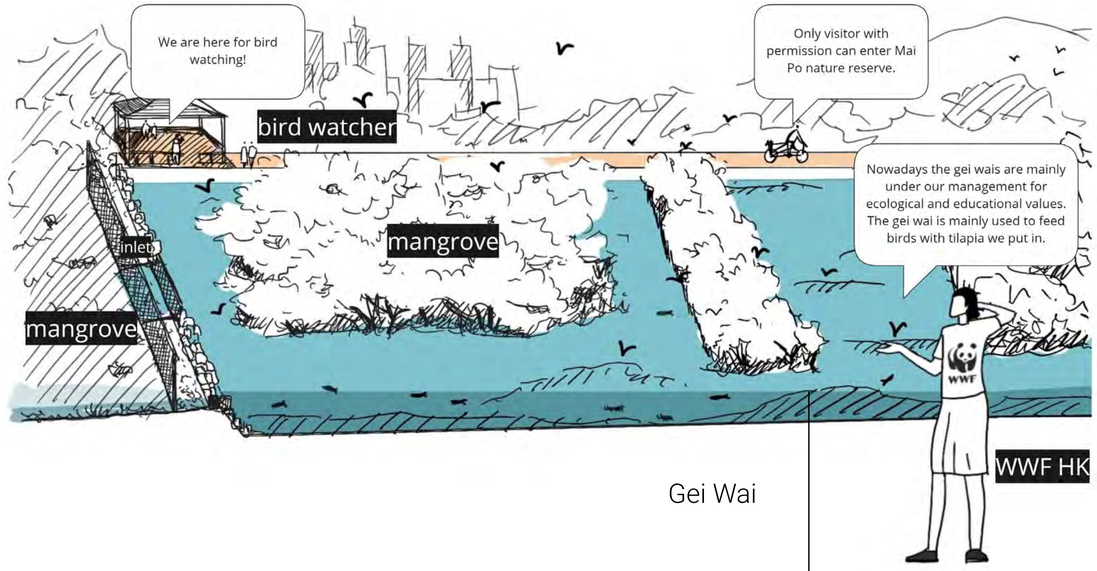
Sea level rise threatens the coastal mangroves

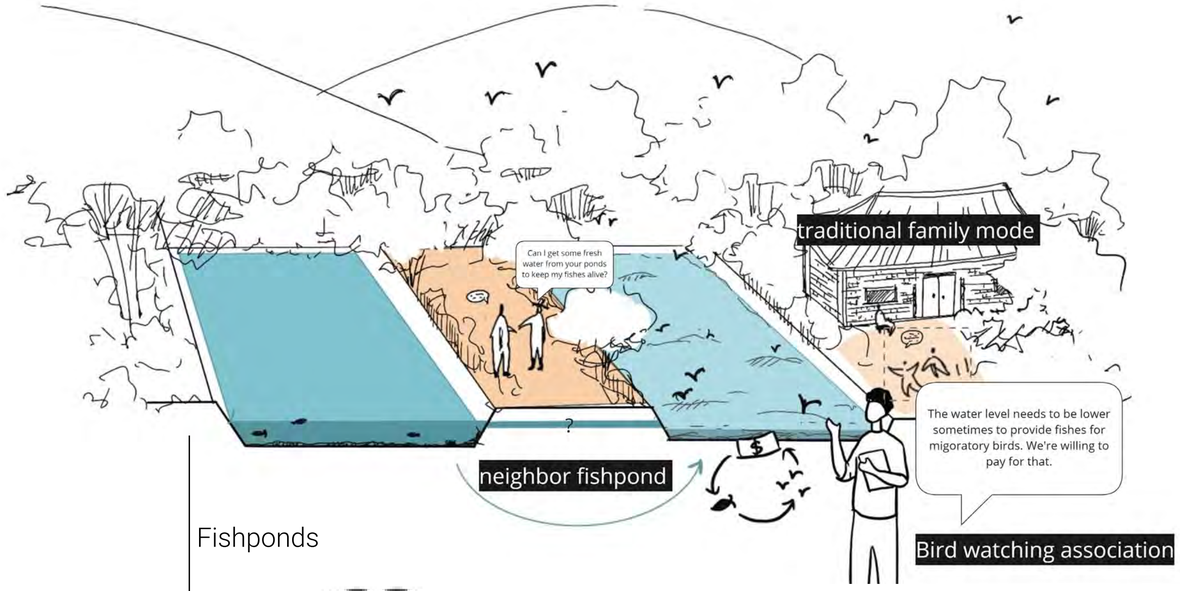
Urban pressure threatens the fishponds and green

Current

*Fading of the aquculture industry due to water pollution.*

The WWF HK took over the management of the coastal mangrove forest and Gei Wei system. The function changed from productivity to nature reserve entirely,  traditional shrimp and fish production is abandoned nowadays.



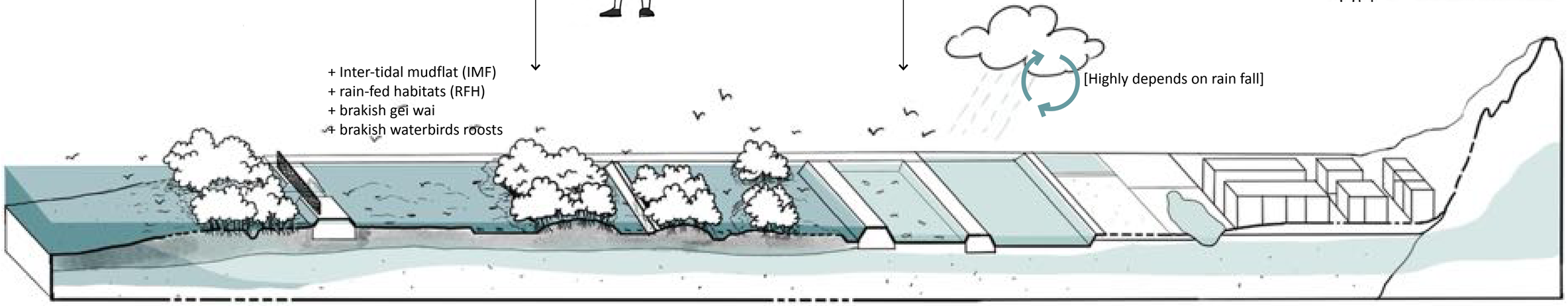




Gei Wai

Fishponds

+ Inter-tidal mudflat (IMF)
+ rain-fed habitats (RFH)
+ brakish gei wai
+ brakish waterbirds roosts

[Highly depends on rain fall]



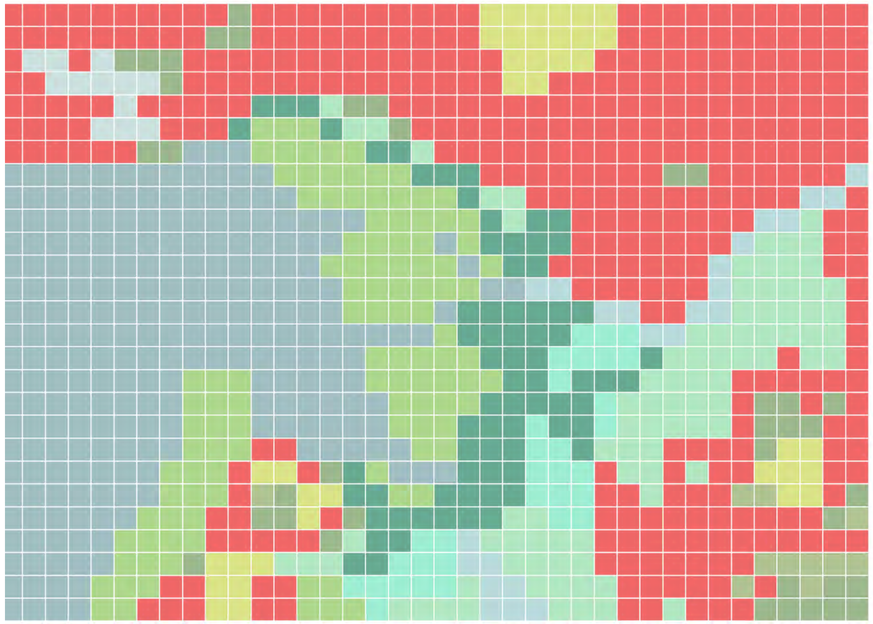
[Human controled system]

[Self-containing system]-Rainwater

# | DESIGN PROJECTION:
# FROM REGIONAL PRINCIPLE TO LOCAL IMPLEMENTATION

## | LANDSCAPE INFRASTRUCTURE SERVICES ASSESSMENT: BAY & ESTURAY

Land use (300X300m)



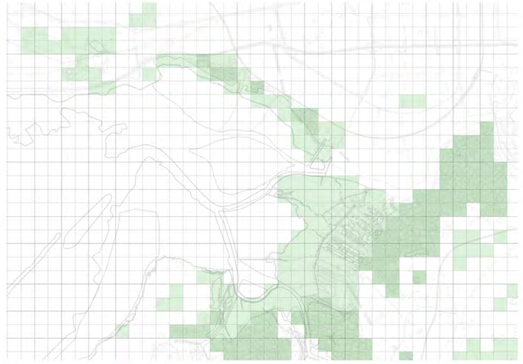
-Use the selected services as the criteria to assess the current landscape and score them from -1 to 2 and show it on the map.

| | PROVISIONING DERVICES | | | REGULATING SERVICES | | | SUPPORTING SERVICES | | | | CULTURAL SERVICES | | | | | SUM | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Food production | Fresh water supply | Raw materials | Waste water treatment | Water quality maintenance | Water flow regulation | Extrem events moderation | Habitats for species | Nutrient cycle | Soil formation | Recreation | Tourism | Aesthetic | Education & Innovation | Cultural heritge | P | R | S | C | ES (all) |
| Sea | 0 | 0 | 0 | -1 | 0 | 0 | -1 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | -2 | 3 | 1 | 2 |
| Main river | 0 | 0 | 0 | -1 | 0 | 1 | 1 | -1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 2 | 3 |
| Lake | 0 | 2 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 2 | 2 | 1 | 2 | 7 |
| Fishponds | 1 | 1 | 0 | -1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 1 | 1 | 1 | 5 |
| Gei Wai ponds | 0 | 0 | 1 | 0 | 1 | 2 | 1 | 2 | 2 | 0 | 0 | 0 | 2 | 1 | 2 | 1 | 4 | 4 | 5 | 14 |
| Marshland | 0 | 0 | 0 | 1 | 1 | 0 | 2 | 2 | 2 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 4 | 6 | 2 | 12 |
| Magrove | 0 | 0 | 1 | 2 | 2 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 1 | 1 | 2 | 1 | 6 | 4 | 4 | 15 |
| Mangrove (park) | 0 | 0 | 1 | 1 | 2 | 0 | 2 | 2 | 2 | 0 | 1 | 1 | 1 | 0 | 2 | 1 | 5 | 4 | 5 | 15 |
| Woods | 0 | 0 | 2 | 0 | 0 | 2 | 1 | 2 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 2 | 3 | 3 | 2 | 10 |
| Woods (park) | 0 | 0 | 1 | 0 | 0 | 2 | 1 | 2 | 1 | 0 | 2 | 0 | 1 | 0 | 0 | 1 | 3 | 3 | 3 | 10 |
| Shrub | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| Grassland | 0 | 0 | 0 | 0 | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | 0 | 0 | -1 |
| Artificial surface | 0 | 0 | 0 | -1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 3 | 3 |

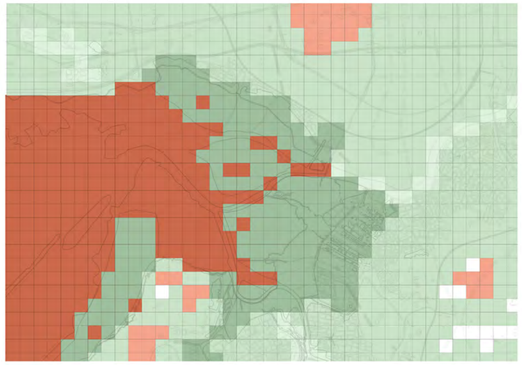
Scale for assessing capacities: -1 for negatively relevant capacity; K60 for not relevant capacity; 1 for low relevant capacity; 2 for high relevant capacity.

Strengths and Vulnerbilities: evaluation of 4 categories of LISs

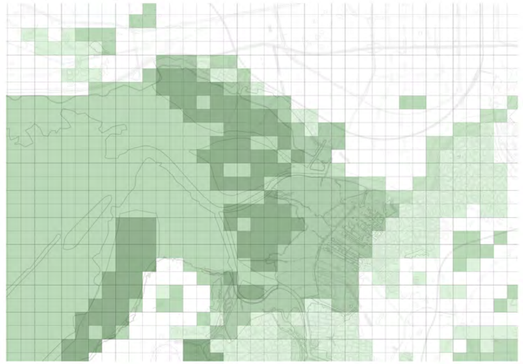
Provisioning services



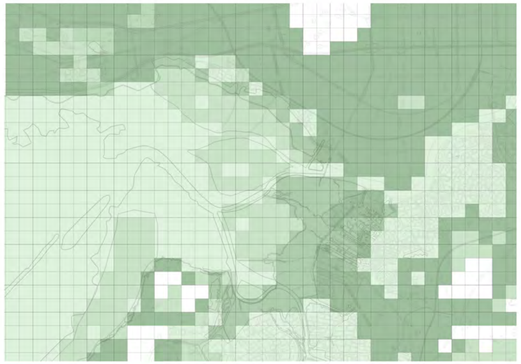
Regulating services



Supporting services



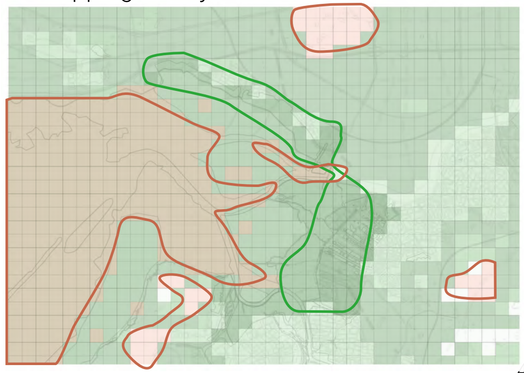
Cultural services



Overall vulnerbilities: General **provisioning services** is weak (limited contribution to food production, freshwater supply and raw materials). Sea, Shenzhen river, shrub and grassland,artificial land ranked the lowest, especially in provisioning and regulating services.

Overall strengths: Gei Wai, marshland, mangroves. These areas are especially advanced in the listed supporting services.

Overlapping: ecosystem services



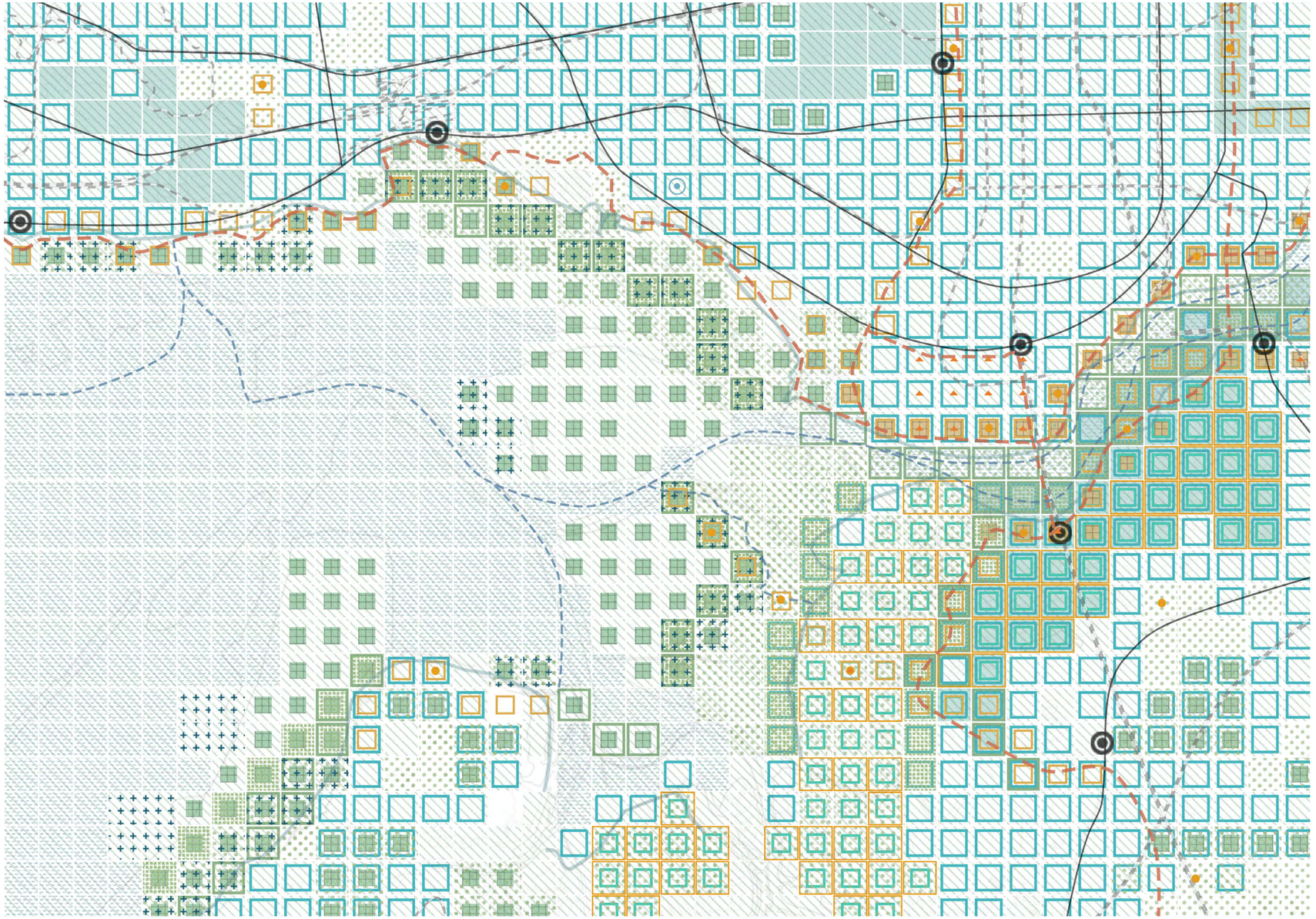
## | IDENTIFY & RECATEGORIZE POTENTIAL LANDSCAPE INFRASTRUCTURE SERVICES|

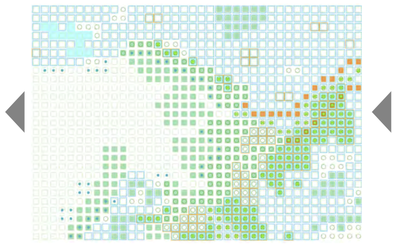
| | HYDROLOGICAL LIS | | | | ECOLOGICAL LIS | | | | | SOCIO-CULTURAL LIS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Water quality maintenance | Water flow regulation | Fresh water supply | Soil formation | Waste water treatment | Raw materials | Habitats for species | Nutrient cycle | Extrem events moderation | Food production | Recreation | Tourism | Aesthetic | Education & Innovation | Cultural heritge |
| Sea | 0 | 0 | 0 | 1 | -1 | 0 | 1 | 1 | -1 | 0 | 0 | 0 | 1 | 0 | 0 |
| Main river | 0 | 1 | 0 | 1 | -1 | 0 | -1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| Lake | 1 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 |
| Fishponds | 0 | 1 | 1 | 0 | -1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 |
| Gei Wai ponds | 1 | 2 | 0 | 0 | 0 | 1 | 2 | 2 | 1 | 0 | 0 | 0 | 2 | 1 | 2 |
| Marshland | 1 | 0 | 0 | 2 | 1 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 2 | 0 | 0 |
| Magrove | 2 | 0 | 0 | 0 | 2 | 1 | 2 | 2 | 2 | 0 | 0 | 0 | 1 | 1 | 2 |
| Mangrove (park) | 2 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 2 | 0 | 1 | 1 | 1 | 0 | 2 |
| Woods | 0 | 2 | 0 | 0 | 0 | 2 | 2 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 |
| Woods (park) | 0 | 2 | 0 | 0 | 0 | 1 | 2 | 1 | 1 | 0 | 2 | 0 | 1 | 0 | 0 |
| Shrub | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Grassland | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Artificial surface | 0 | 0 | 0 | 0 | -1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 |
| |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Scale for assessing capacities: -1 for negatively relevant capacity; K60 for not relevant capacity; 1 for low relevant capacity; 2 for high relevant capacity. | | | | | | | | | | | | | | | |

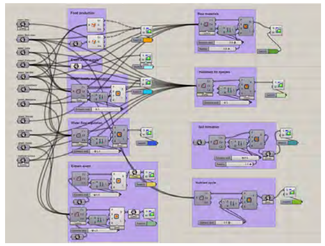
hydrological landscape infrastructure layer
ecological landscape infrastructure layer
socio-cultural landscape infrastructure layer

## | NETWORKED POTENTIAL LANDSCAPE INFRASTRUCTURE SERVICES MAP

The overlapping of potential  services  as factors to be involved in local strategies.







transformed land use
(guided by regional framework)

- Freshwater supply
- Water quality maintenance
- Water flow regulation
- Soil formation
- Wastewater treatment
- Raw materials
- habitats for speies
- Food production
- recreation
- Education
- Tourism
- Cultural heritage
- Extrem events moderation (bio/artificial)
- New station
- New boating route
- New cycle route
- Existing main road
- Existing railway

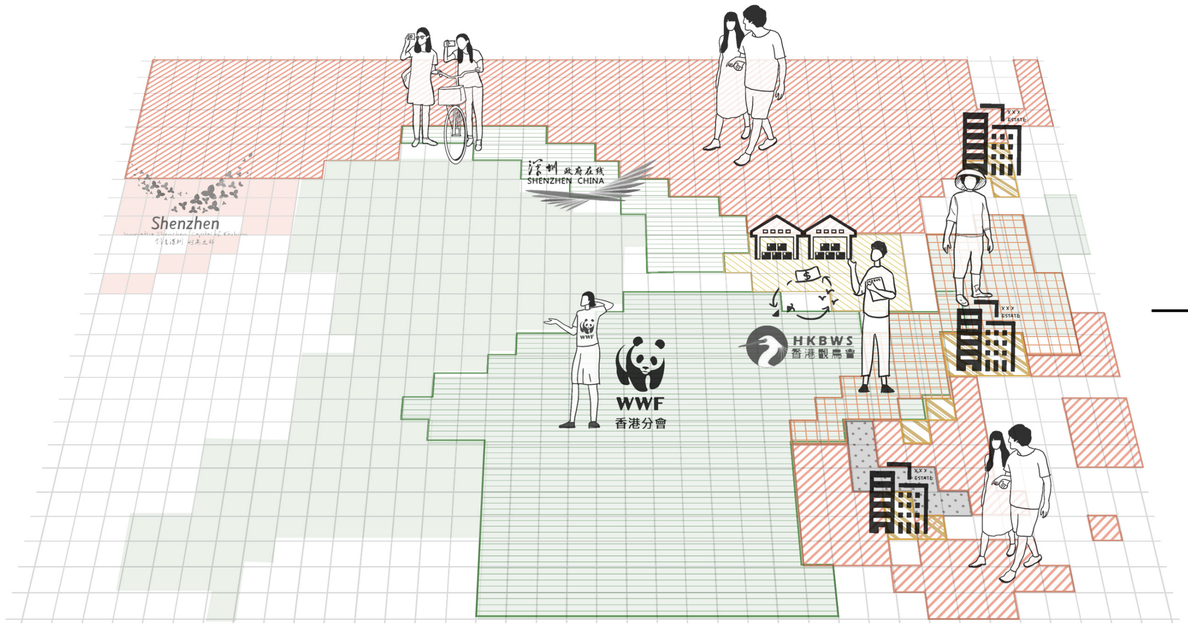
N

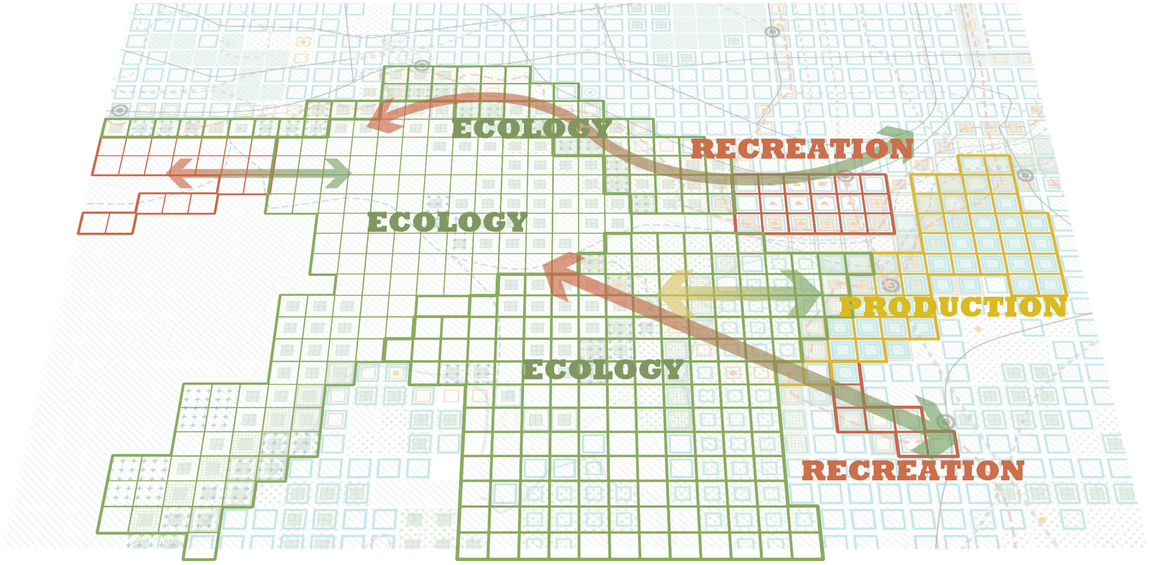
0 1 2km

## | STAKEHOLDER ANALYSIS & PRIORITY FUNCTION

*The potential landscape infrastructure services will guide the transformation of the landscape, so a recognization of the priority service in different areas is needed. Through the stakeholder analysis, we can learn about which values the main stakeholders prioritize and which LIS the environment should provide, and this knowledge helps to generate landscape structures that support those values (Termorshuizen & Opdam, 2009).*

| | | | |
|---|---|---|---|
| **NGO** | HK Bird Watching Society | HK WWF | |
| **Government** | HK Government | SZ Government | |
| | Land developer | Local company | |
| **Individual** | Fisherman | Local residents | Visitors |
| | Students | Workers | |



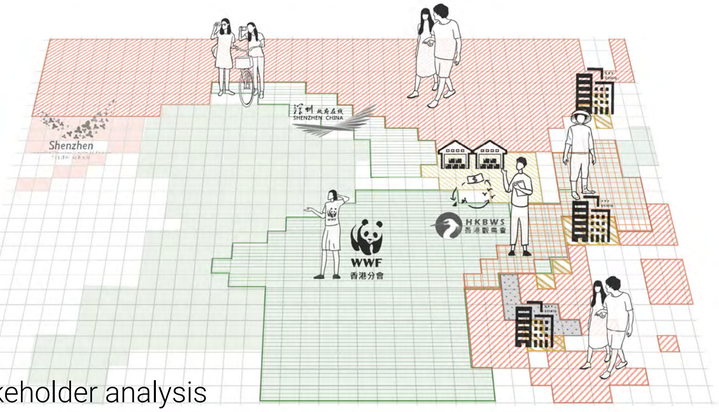



## | SPATIAL STRATEGIES

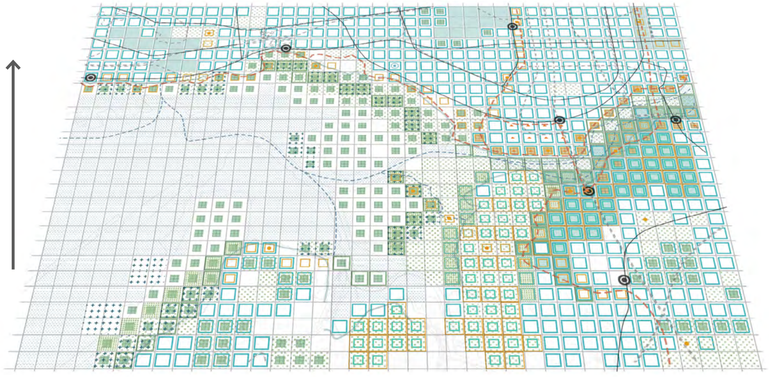



Priority functions+potential services

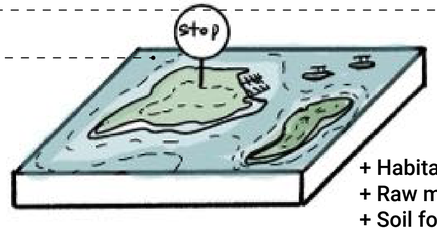
determin




Stakeholder analysis

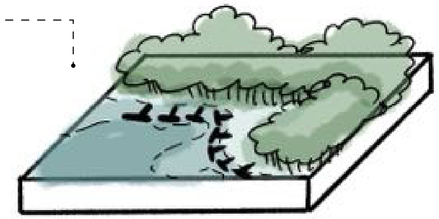


Potential services



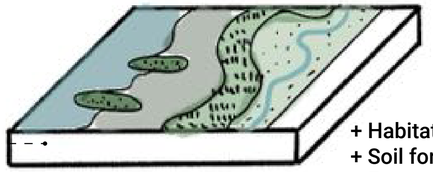

Multifunctional Islands

**+ Habitats for species**
**+ Raw materials**
**+ Soil formation**
+ Tourism



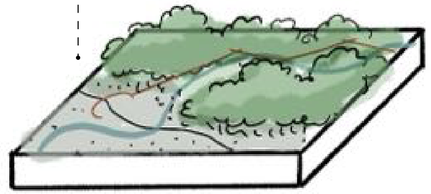
Mangrove forest growing/maintaining

**+ Habitats for species**
**+ Raw materials**
**+ Soil formation**
+ Wastewater treatment
+ Extrem events moderation



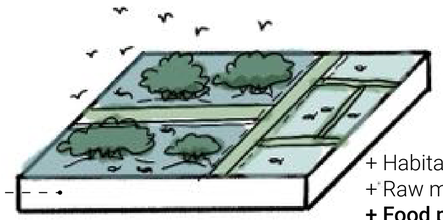
Gradient mudflats

**+ Habitats for species**
**+ Soil formation**
+ Extrem events moderation
+ Recreation



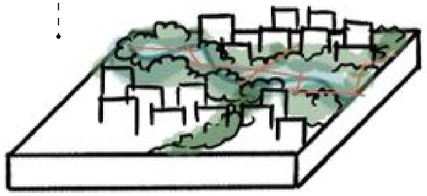
Mangrove forest tourism

**+ Habitats for species**
**+ Raw materials**
**+ Soil formation**
+ Wastewater treatment
+ Extrem events moderation
+ Recreation



Productive eco-aquaculture

+ Habitats for species
+ Raw materials
**+ Food production**
+ Recreation
+ Water quality maintenance
+ Freshwater supply

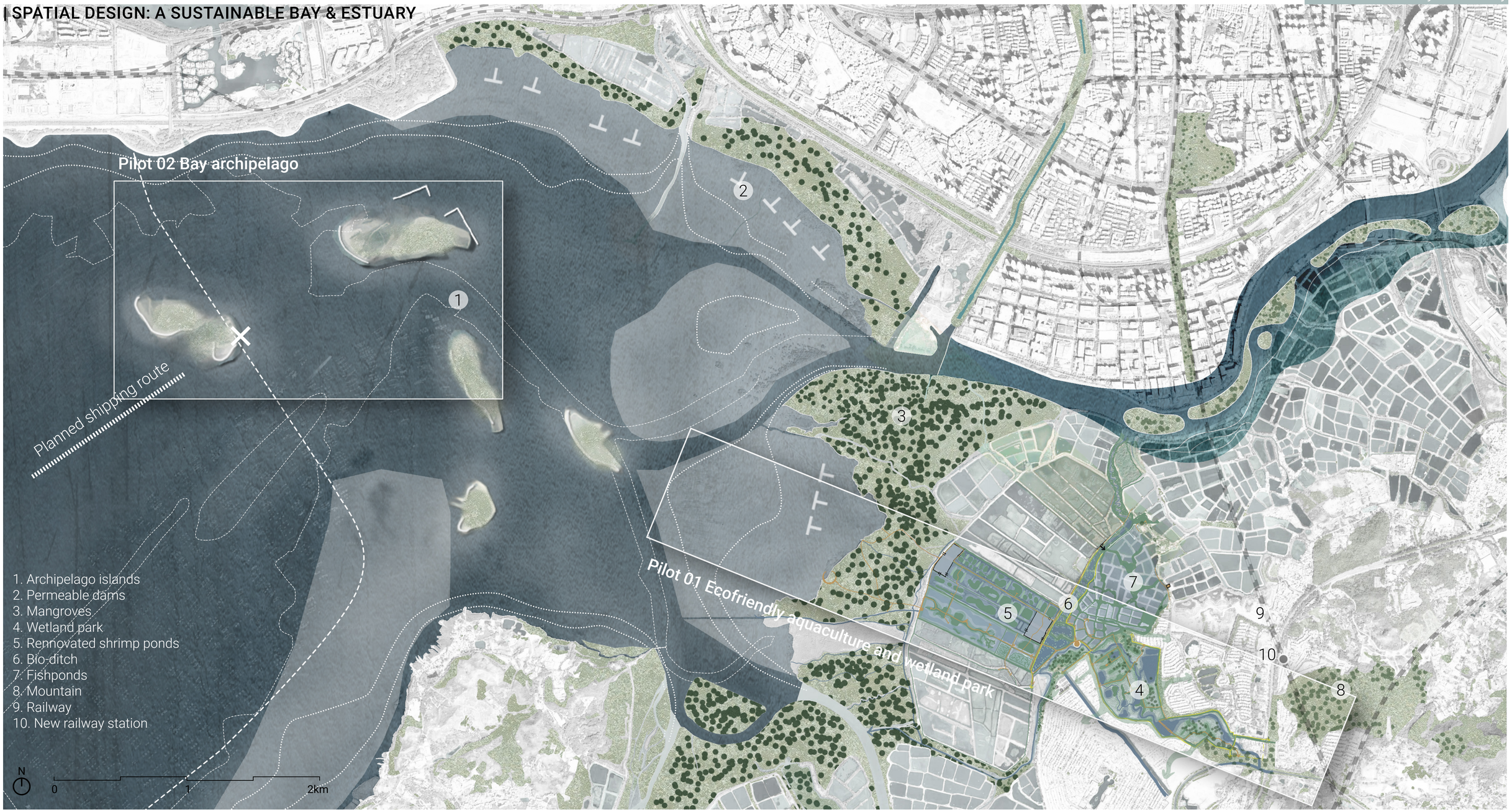


Ecological park

**+ Habitats for species**
+ Raw materials
+ Wastewater treatment
+ Freshwater supply
**+ Recreation**
+ Water quality maintenance

Bay & Esturary spatial strategies (with multiple values)

# SPATIAL DESIGN: A SUSTAINABLE BAY & ESTUARY



# [PILOT 1: ECO-FRIENDLY AQUACULTURE AND WETLAND PARK]

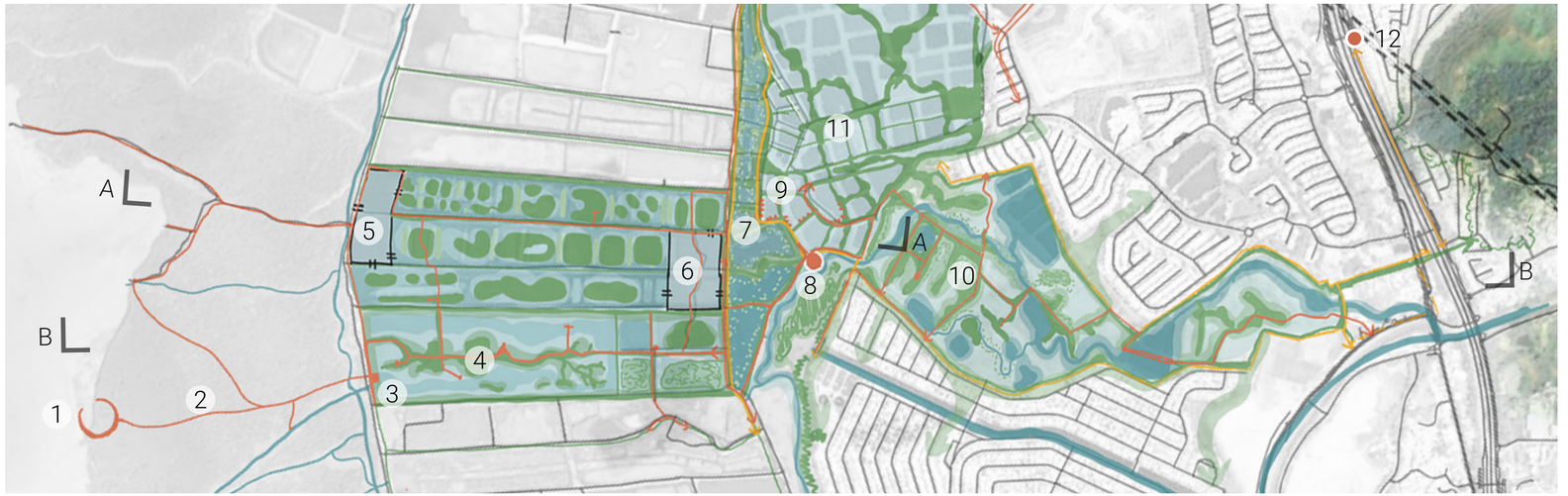
*Ecology & Productivity & Recreation*
*Enhance the value of traditional aquaculture and culture identity*



Current



Proposed



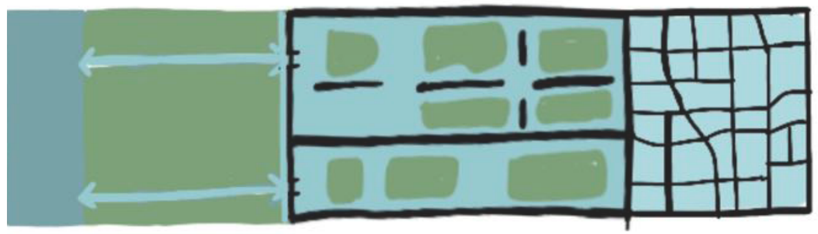

1. Mudflat viewing point
2. Mangrove forest path
3. Watch tower
4. Gei Wai path
5. Reservoir filter pond
6. Sediment pond
7. Bio-ditch
8. Visitor center
9. Fishpond settlements
10. Wetland park
11. Freshwater wetland
12. New railway station

N

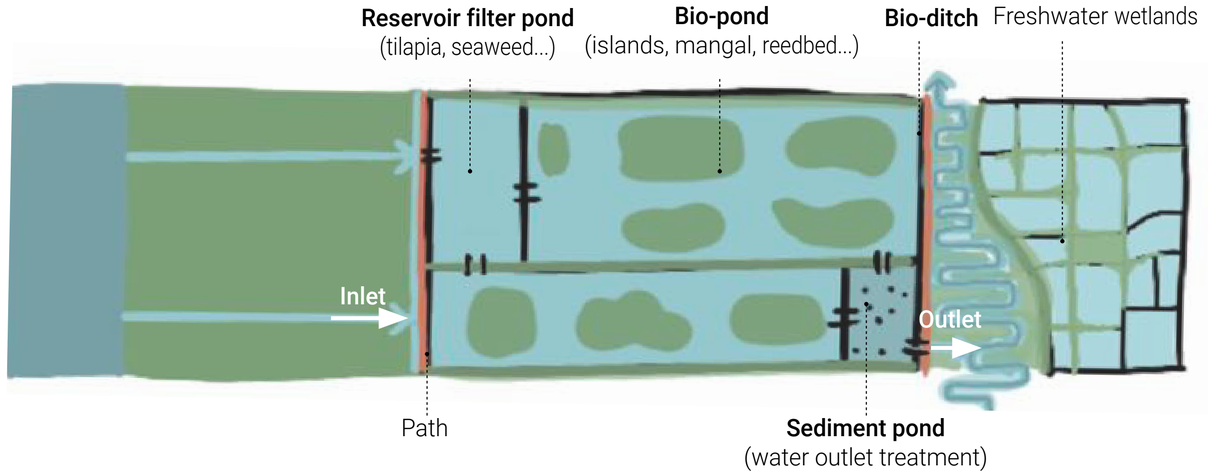
0 0.5 1 km

## | PROPOSED ECO-FRIENDLY AQUACULTURE SYSTEM

**Current system:** Mangrove-Gei Wai- Fishpponds



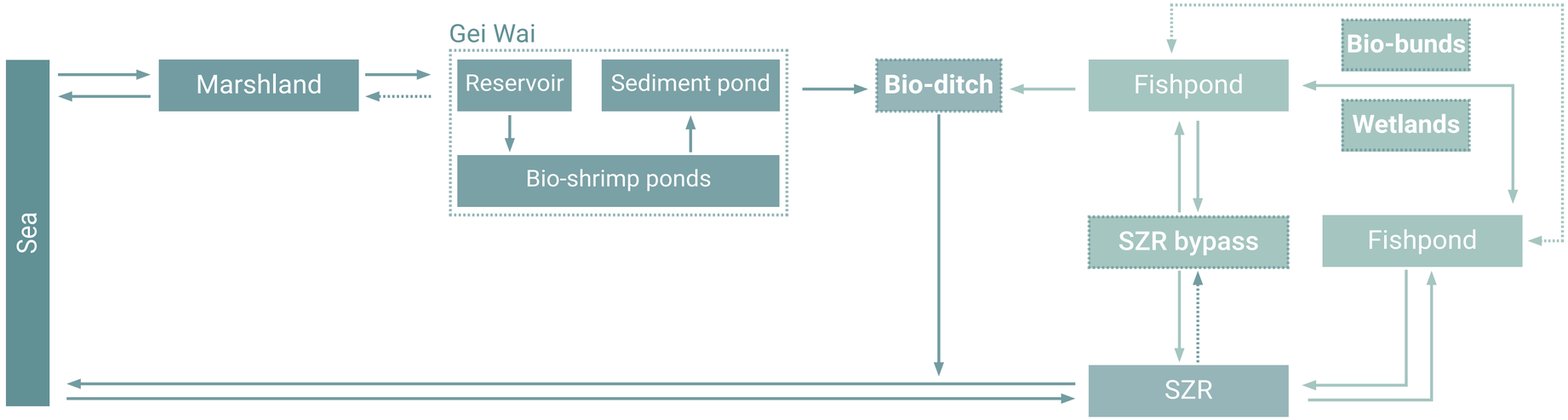
**Proposed system**: Magrove-Gei Wai (reservoir + bio-ponds + sediment ponds)-Bio-ditch- Fishponds - Wetlands




**Strategies**

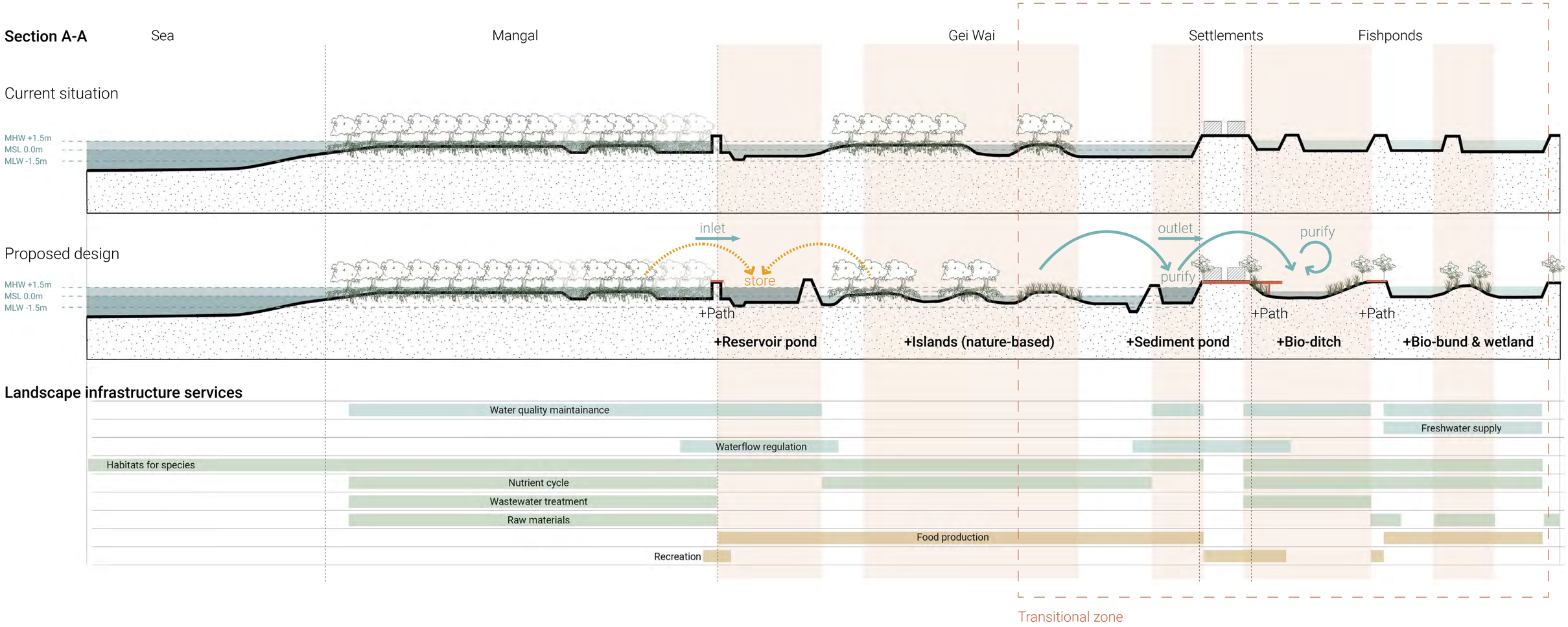
1. Separate inlet and outlet.
2. Add two extra ponds in Gei Wai.
3. Transform in-between fishponds to bio-ditch for purification.
4. Create different morphology of habitats to develop bio-ponds.

**Proposed water flow regulation diagram**



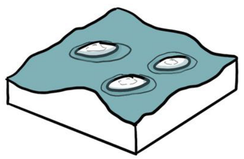
## | LOCAL IMPLEMENTATIONS: SECTION A-A. PONDS RENOVATION

Transformation of the ponds to enhance the productivity and recreation while maintaining the ecolgical value.

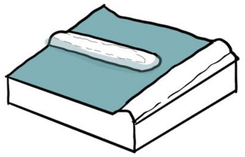


## | TRANSITIONAL ZONE DESIGN: NEW GEI WAI & FISHPONS SYSTEM

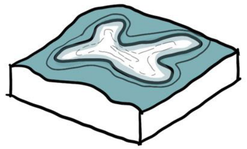
[Tool kit for nature-based habitats morphology]



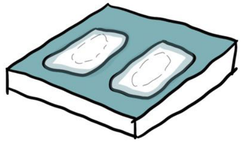
Small islands:
deep emergent wetland
wet meadow



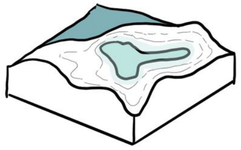
Bund island:
wet meadow
tree



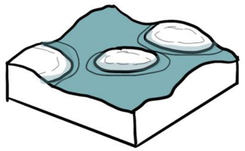
Irregular island :
emergent wetland
forested wetland



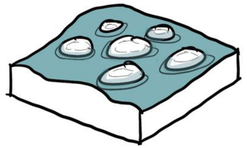
Regular patch:
mangal



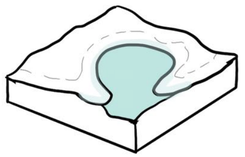
Small islands:
rain-fed wetland
trees



Middle island:
wet meadow
emergent wetland



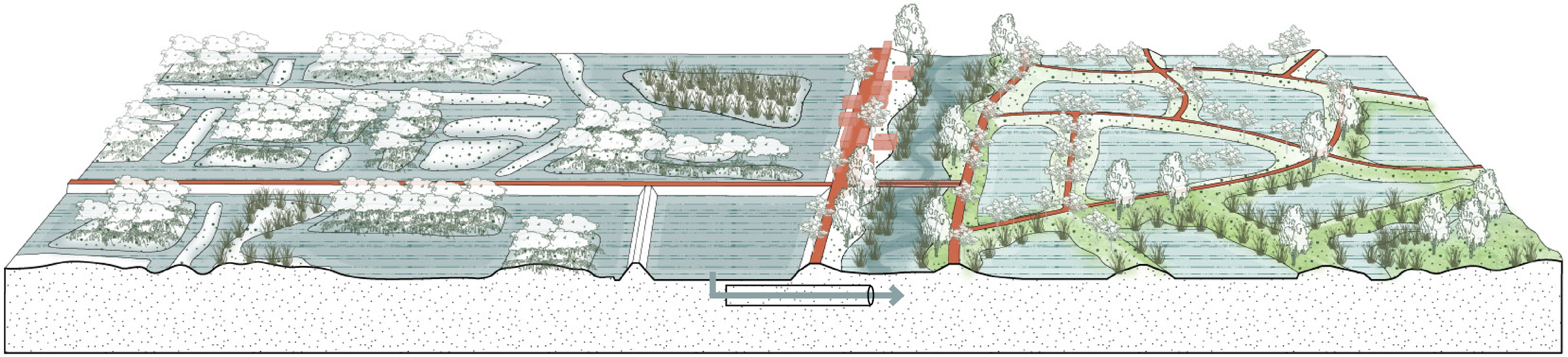
Compact islands:
deep emerged wetland
seasonal shallow wetland



Inner pond:
rain-fed wetland
trees

*Most migratory birds forage in shallow water, water depth > 0.5 m, cormorants and ducks are active; 0.2-0.4 m, egrets and blackskins are active, water depth < 0.1 m, shorebirds are active

**Gei Wai** **Bio-ditch** **Fishponds**

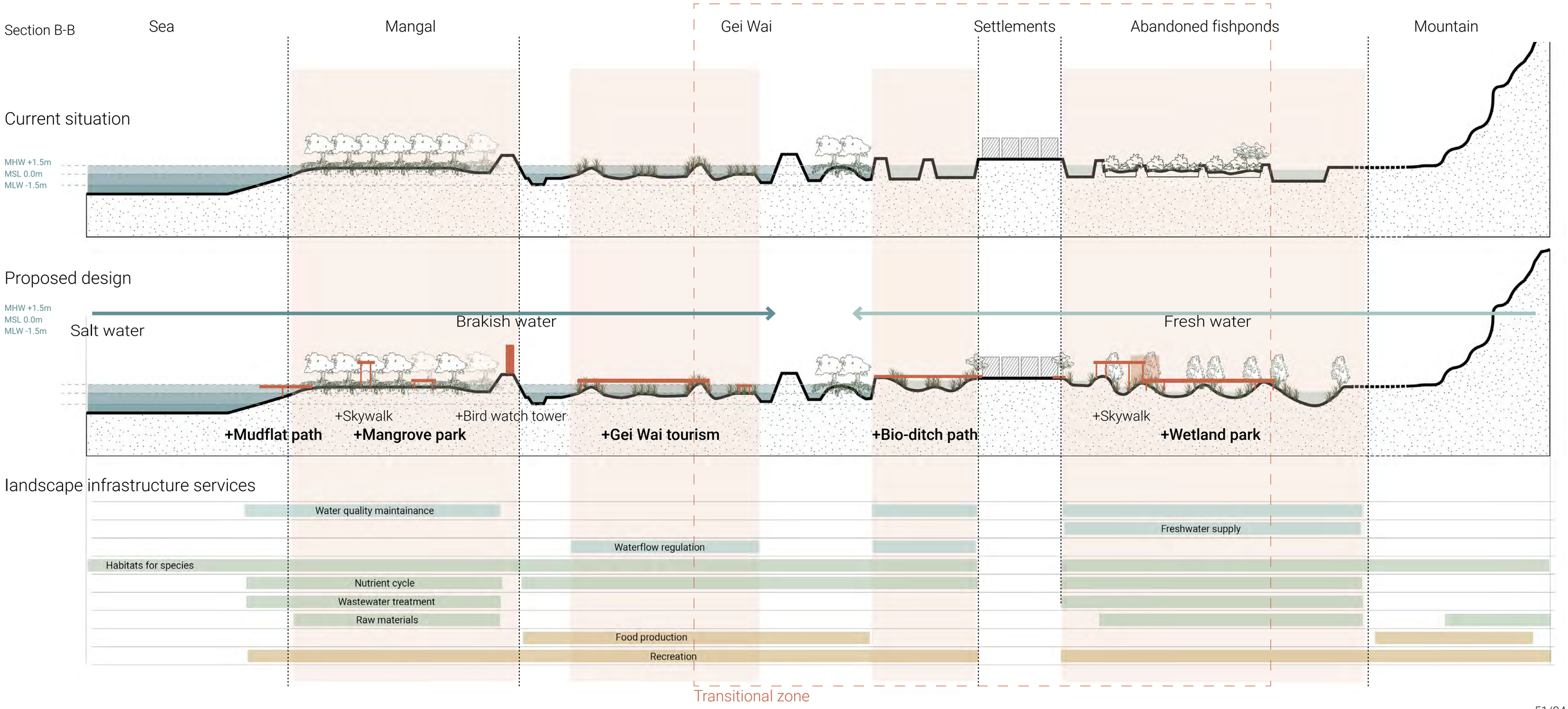


**Islands** **Reedbed** **Mangal**

**Sediment pond** **Reedbed** **Freshwater wetlands**

## | LOCAL IMPLEMENTATIONS: SECTION B-B. WETLAND PARK

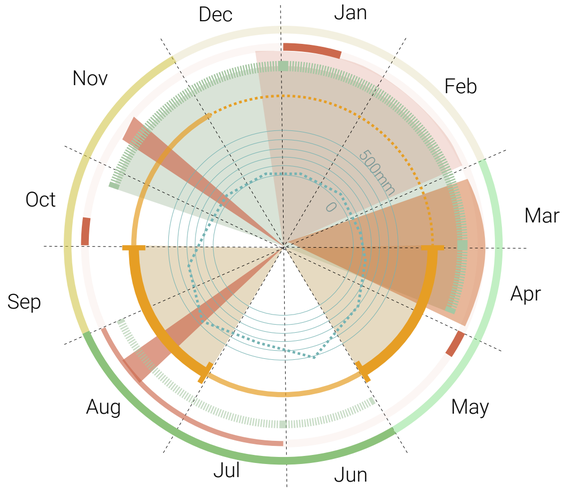
Four major cultural services implementations link the wetlands, fishponds, Gei Wai, mangroves and mudflats to create one continuous landscape experience.



## | TRANSITIONAL ZONE DESIGN: GEI WAI & FISHPONDS & WETLAND PARK

Multifunctional use of the landscape.

[Aquaculture, bird migration, recreation events calender]

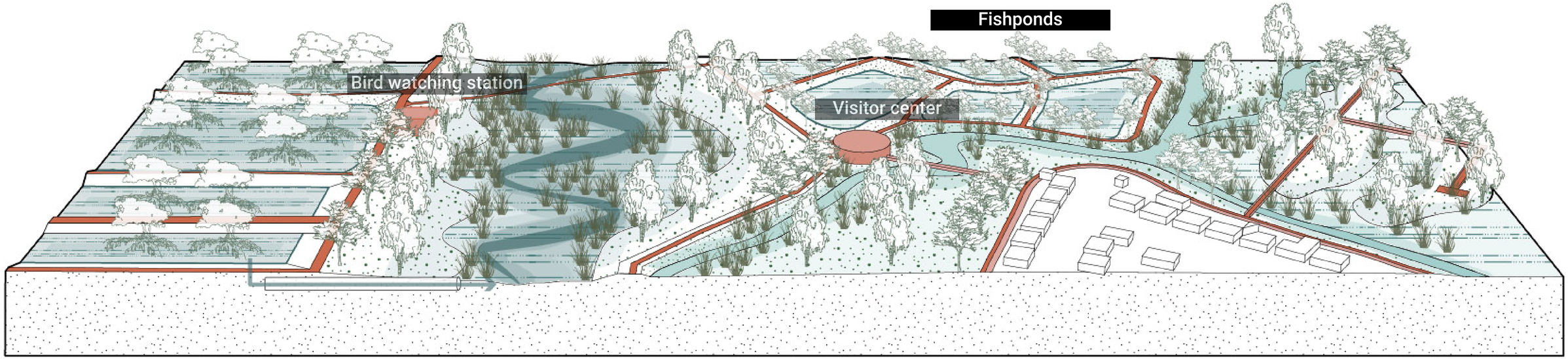



Shrimp farming
- Peak harvesting period
- Harvest period
- Stocking & growing

Black-faced spoonbill (indicator)
- Stay for overwintering
- Possible stay if there is enough food provided by ponds

- Monthly percipitation
- Holidays

**[Proposed activities]:**
- Education
- Bird watching
- Park vsiting
- Agriculture activity
- Bird migration




Cattail


Sedge


Reed


Willow


Catalpas


Fruit plants

A multifunctional aquaculture heritage park with production, recreation, and ecology values.

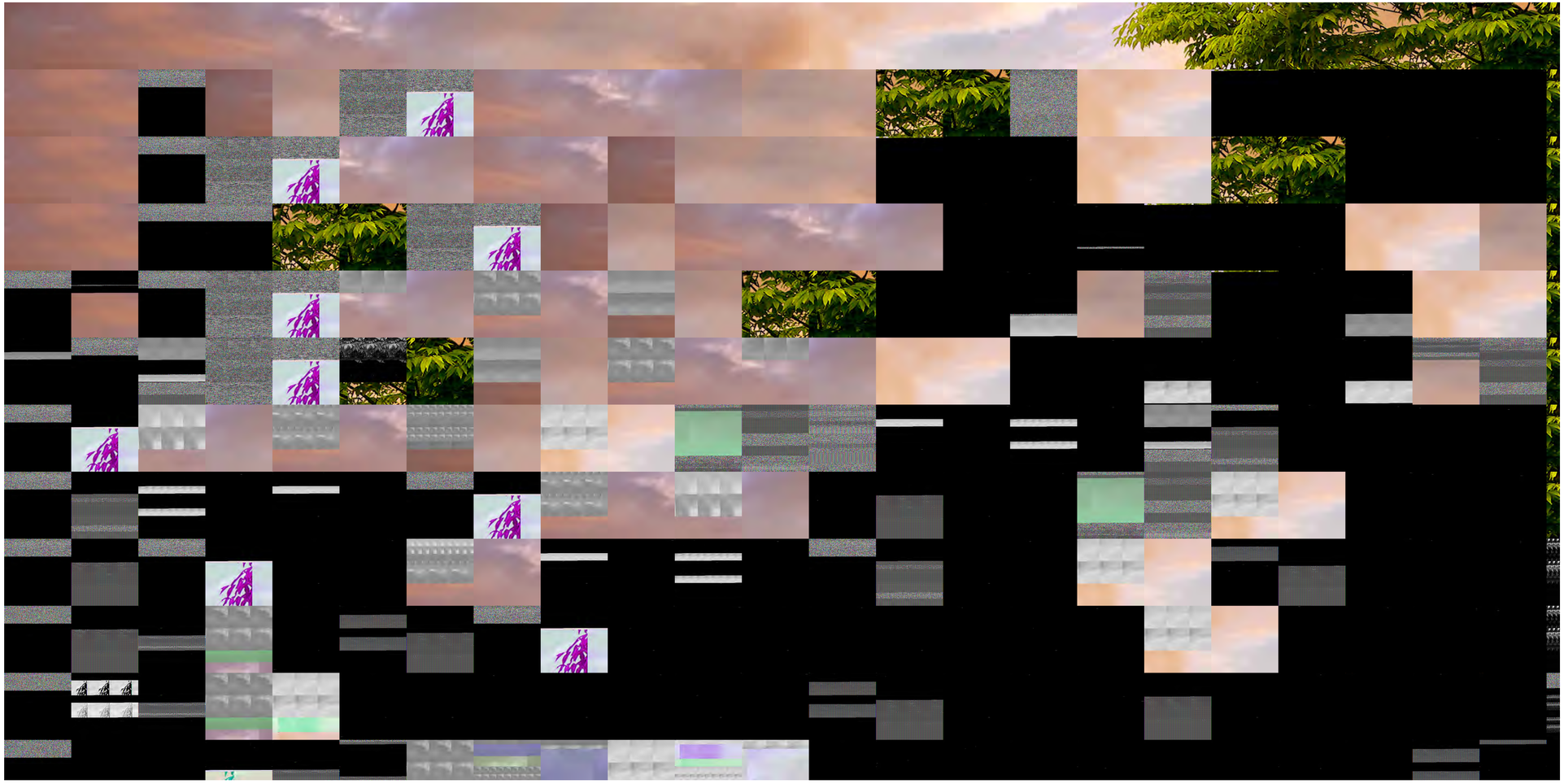


Fig. (top) Plants: cattail, sedge, reeds, willow, catalpas, fruit plants
Retrieved from Wikipedia

Fig.(left bottom) Perspective of current situation
Retrieved from Google Earth, 2022

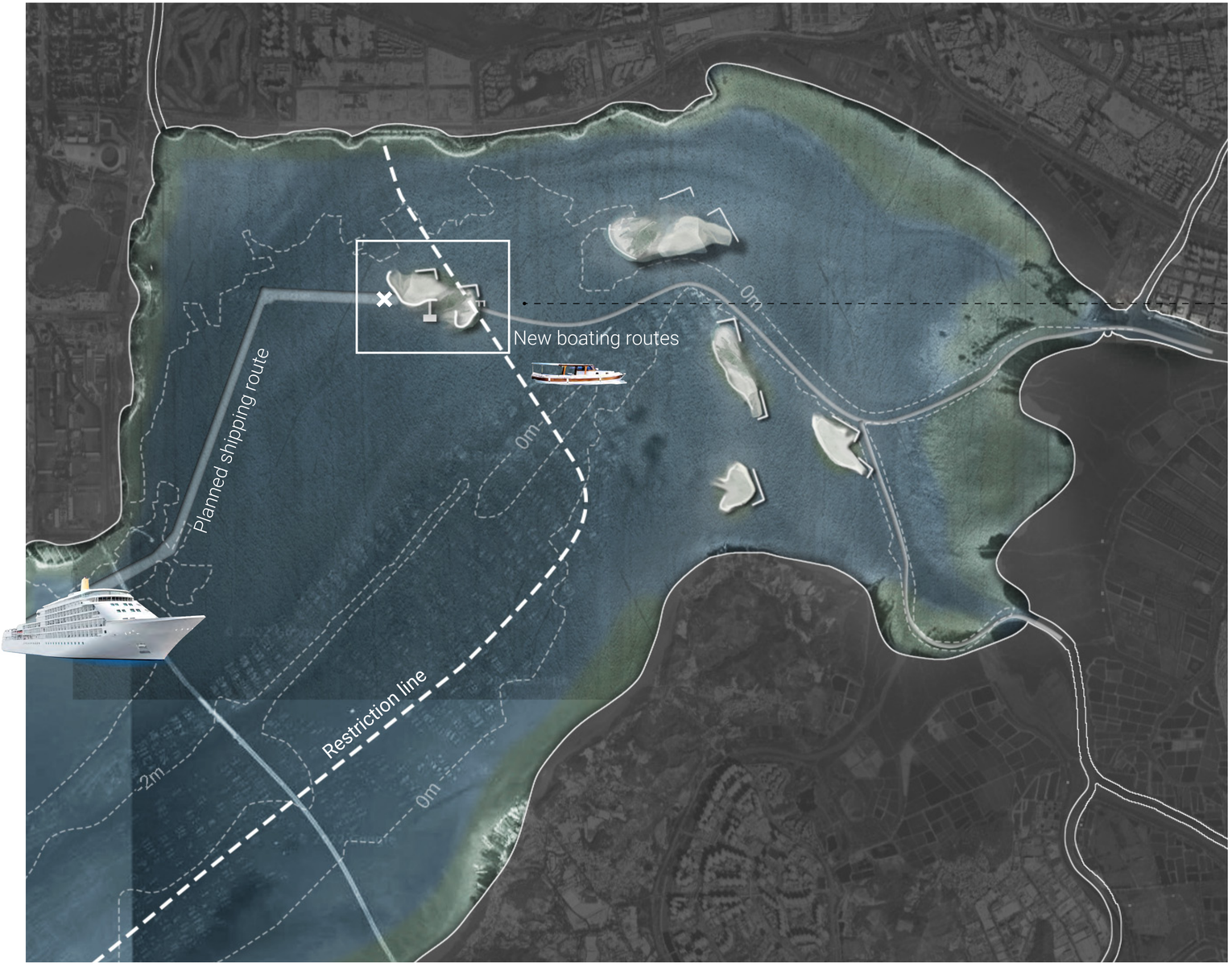


# [PILOT 2: BAY ARCHIPELAGO]

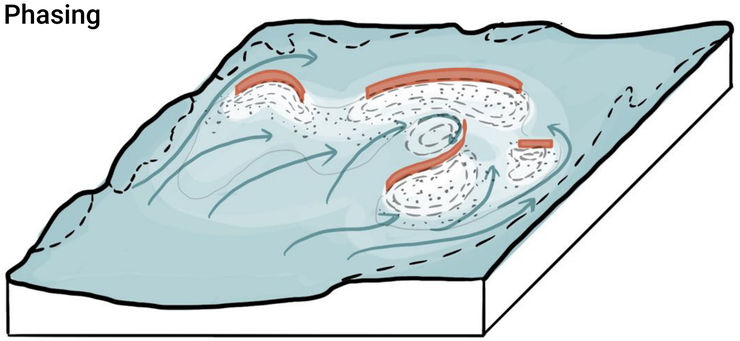
*Ecology & Recreation*
*Vision from the sea & strategic plan for tourism development*



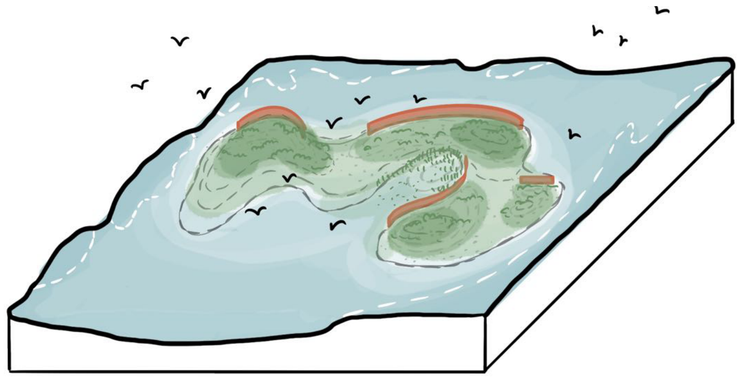
## SPATIAL DESIGN



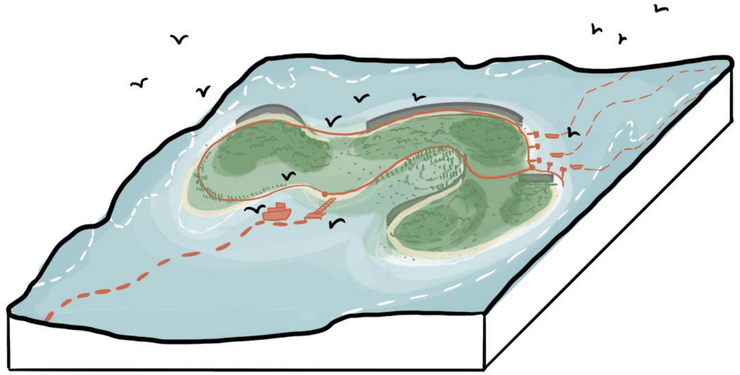

### Phasing



01 Artificial implementation



02 Growing nature

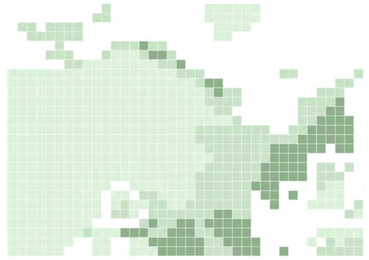


03 New tourism routine

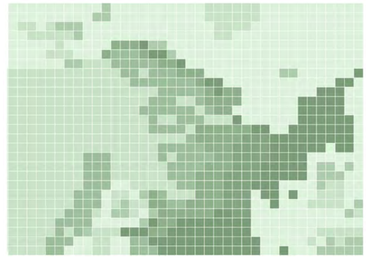
## | SUSTAINABLE BAY & ESTUARY: VISION AND ASSESSMENT

LIS assessment

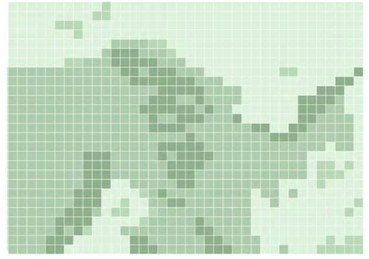
Provisioning services



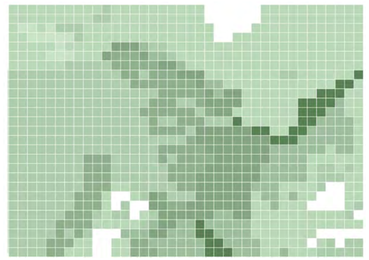
Regulating services



Supporting services



Cultural services



Bay & Esturay vision: Continuous landscape experience

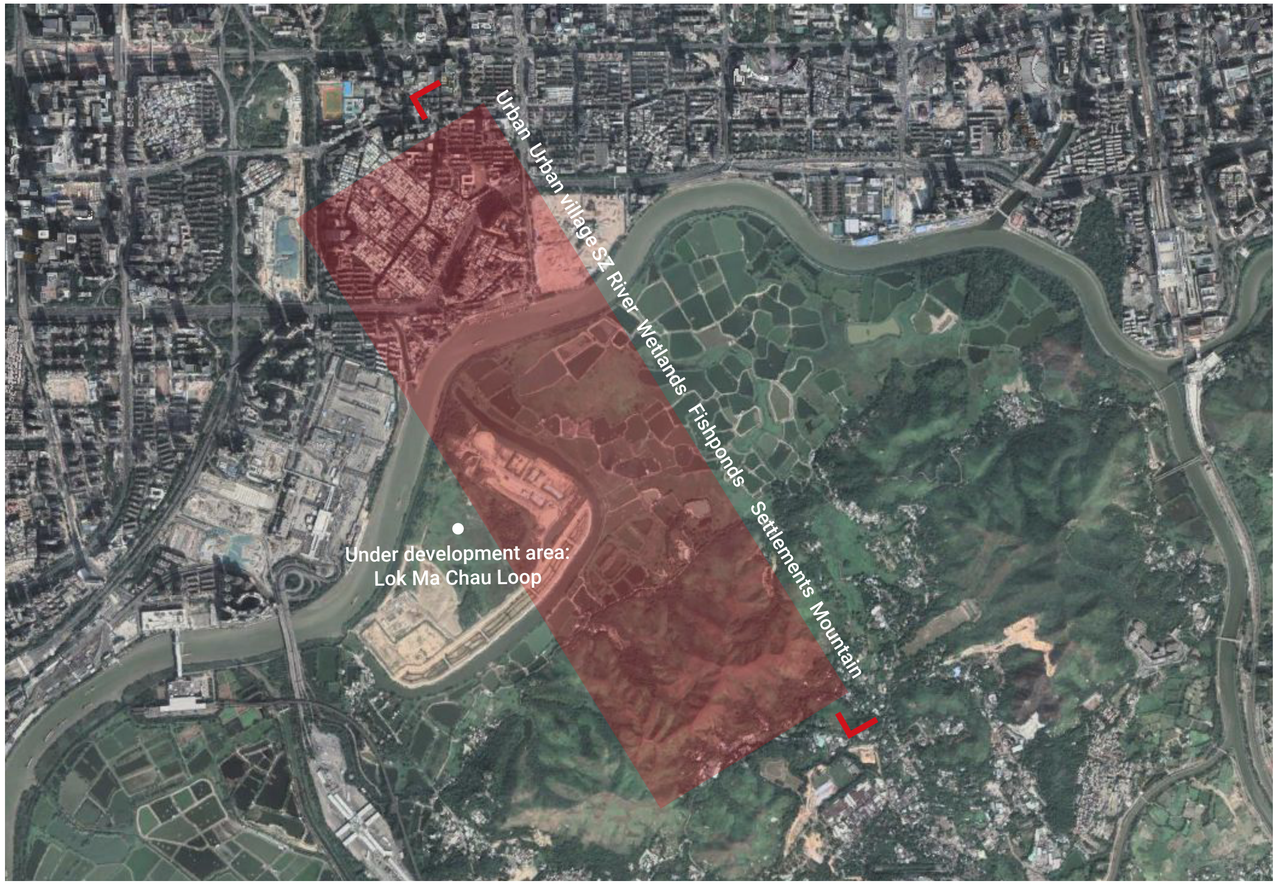


# ZOOM-IN II: LIVEABLE SHENZHEN RIVER WATERFRONT

*LAND DEVELOPMENT VS ECOLOGY*

*Extend the cultural and ecological value from estuary to middle stream land.*
*Improve sponge capacity and accessebility of Shenzhen River.*

## | SITE




N

0 1 2km

River & Land satlellite image
Retrieved from Google Earth



Shenzhen Huanggang Port

Retrieved from: Baidu map street view



Shenzhen Rriver

Retrieved from: https://commons.wikimedia.org/wiki/File:Shenzhen_Rriver_between_Futian%26_Lok_Ma_Chau2021.jpg



Fishpond wetland

Retrieved from: Google map street view



Shun Yee San Tsuen fishponds

Retrieved from: Google map street view



Ma Cho Lung Lutheran New Village

Retrieved from:Google map street view



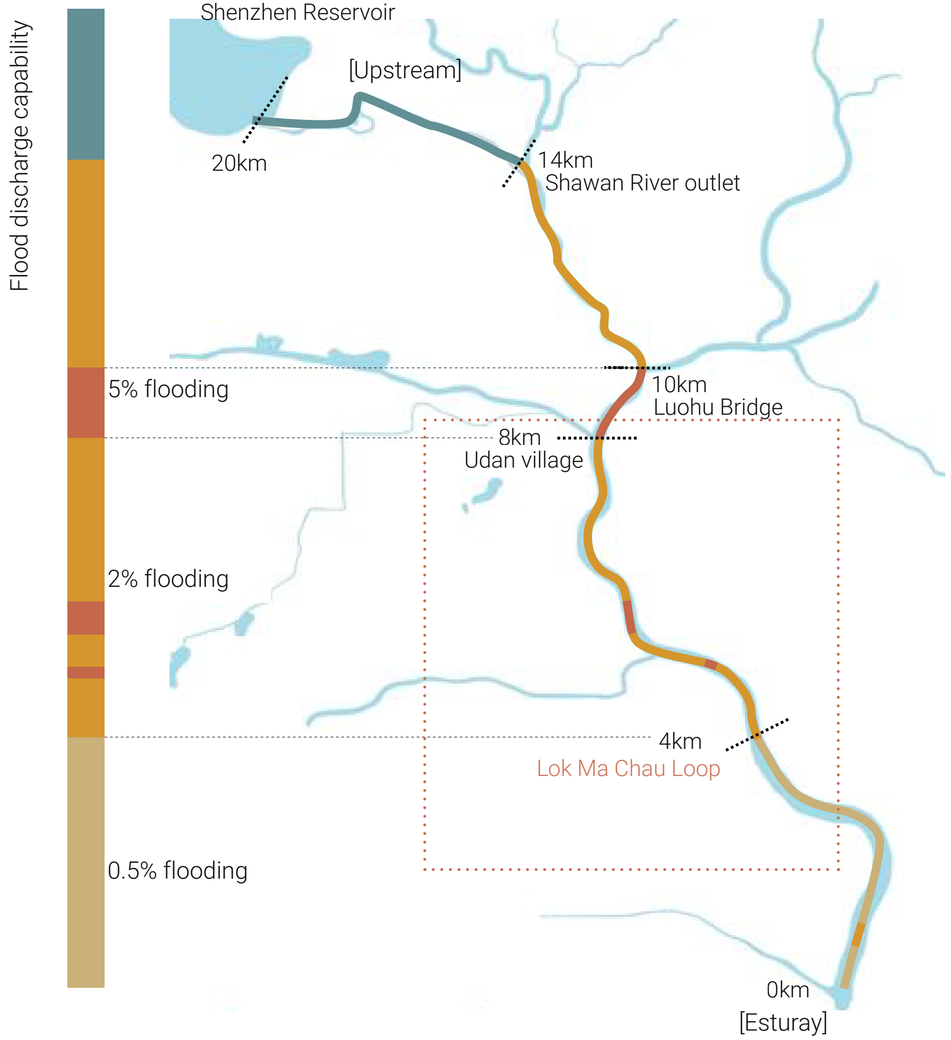
Ma Tso Lung mountain

Retrieved from: Google map street view

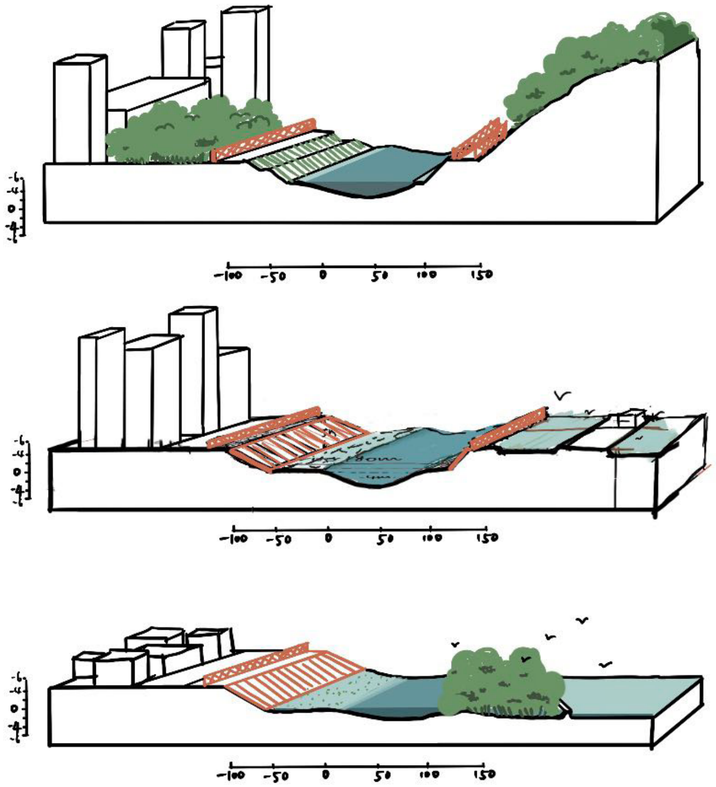
## | CURRENT SITUATION

*Shenzhen River regulation project (1995-2017)*

### Revetments & Flooding control




### Current waterfront bank typology





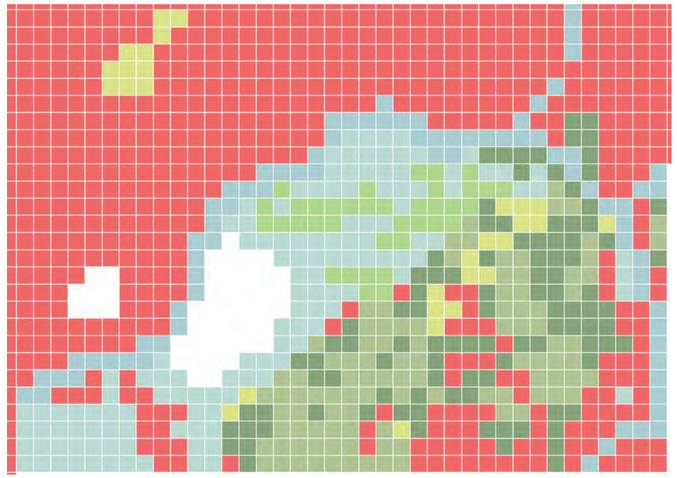


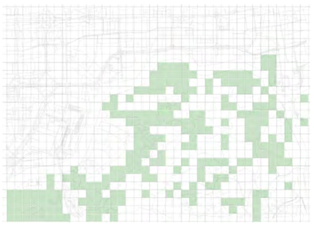


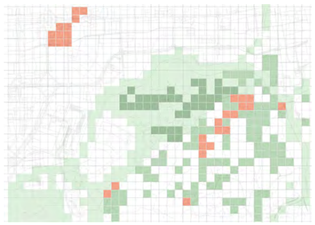
Shenzhen River waterfront view
retrieved from google earth

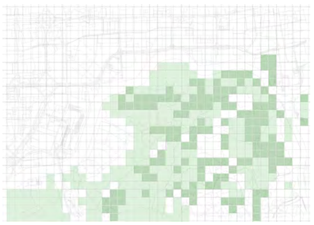
# | DESIGN EXPLORATION PROCESS

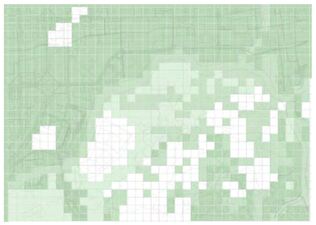
## LIS ASSESSMENT

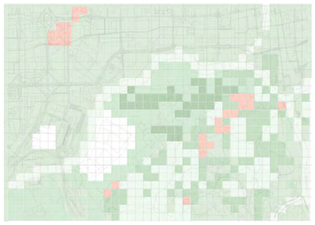








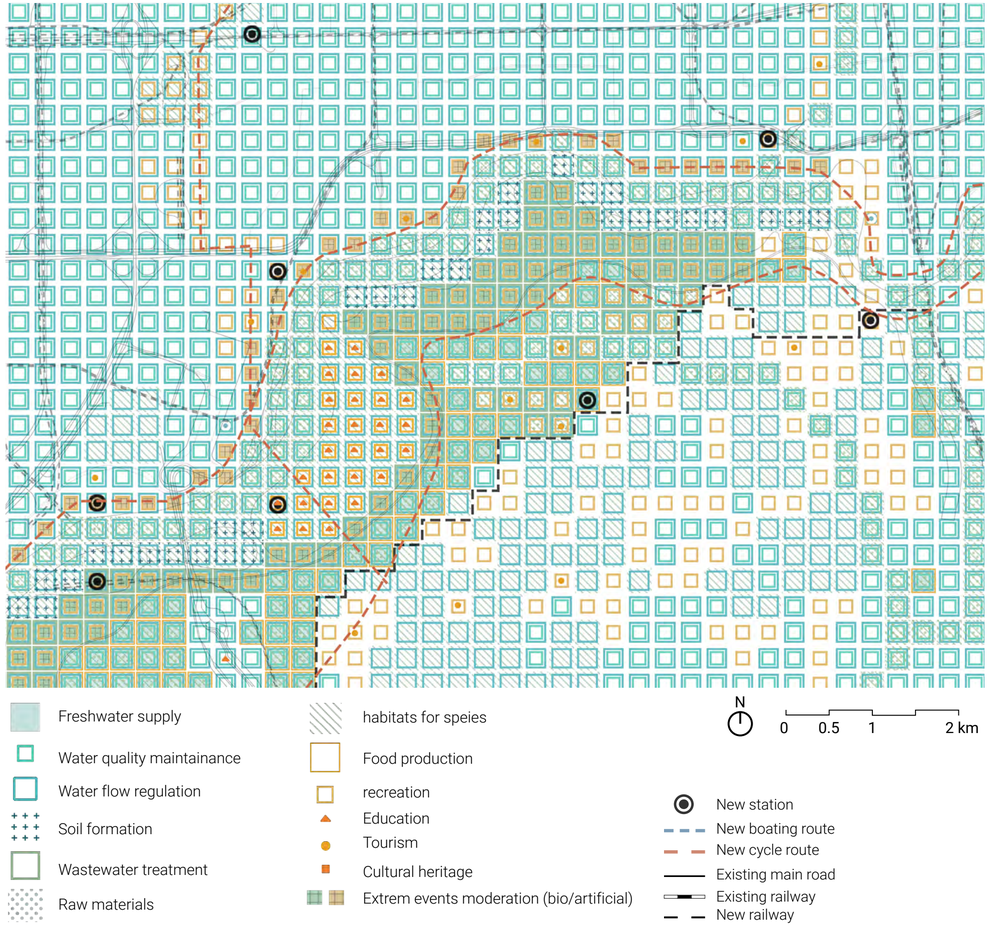




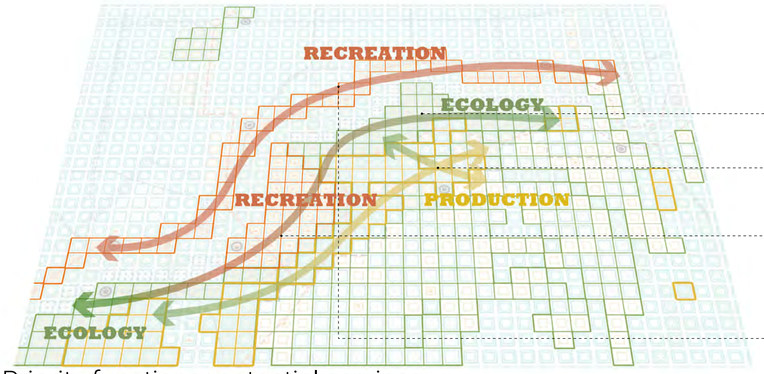
| | | HYDROLOGICAL LIS | | | | ECOLOGICAL LIS | | | | | SOCIO-CULTURAL LIS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Water quality maintenance | Water flow regulation | Fresh water supply | Soil formation | Waste water treatment | Raw materials | Habitats for species | Nutrient cycle | Extrem events moderation | Food production | Recreation | Tourism | Aesthetic | Education & innovation | Cultural heritge |
| 3 | Main river | 0 | 1 | 0 | 1 | -1 | 0 | -1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| 4 | Fishponds | 0 | 1 | 1 | 0 | -1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 |
| 5 | Wetlands | 2 | 1 | 0 | 0 | 1 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |
| 6 | Woods | 0 | 2 | 0 | 0 | 0 | 2 | 2 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 |
| 7 | Shrub | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | Grassland | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | Artificial surface | 0 | 0 | 0 | 0 | -1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| 10 | | | | | | | | | | | | | | | | |
| 11 | Scale for assessing capacities: -1 for negatively relevant capacity; K60 for not relevant capacity; 1 for low relevant capacity; 2 for high relevant capacity. | | | | | | | | | | | | | | | |

Vulnerability: SZ River
Strength: Freshwater wetlands

## NETWORKED POTENTIAL LIS MAP

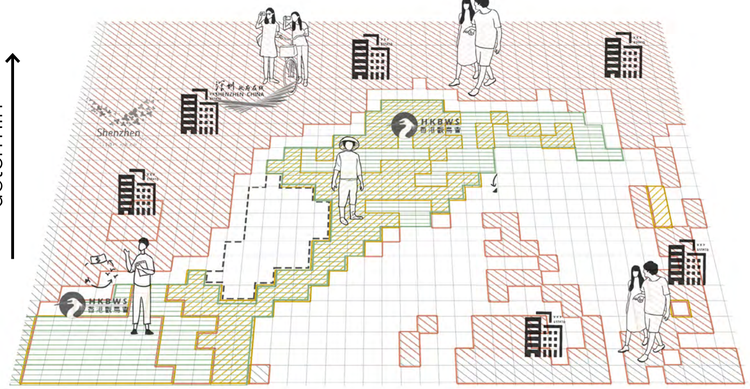


# | PRIORITY SERVICES AND SPATIAL STRATEGIES

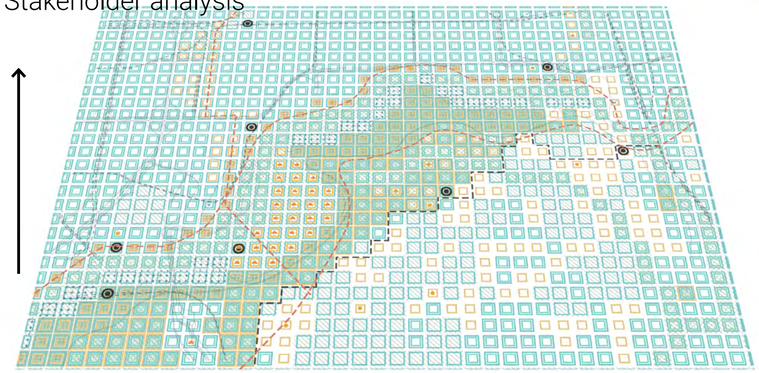


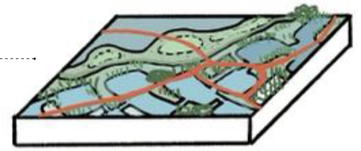

Priority functions+potential services

determin



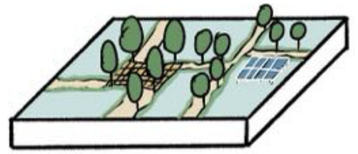
Stakeholder analysis





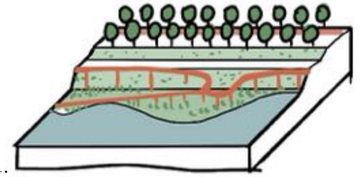
Bypass wetland park

+ Freshwater supply
+ Water qualty maintenance
+ Water flow regulation
**+ Wastewater treatment**
**+ Habitats for species**
**+ Raw materials**
**+ Extrem events moderation**
+ Recreation



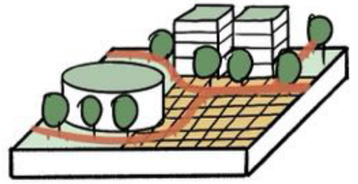
Innovative fishponds

+ Freshwater supply
+ Water qualty maintenance
+ Water flow regulation
**+ Food production**
+ Raw materials
+ Habitats for species
+ Recreation



Waterfront recreation

+ Water qualty maintenance
+ Water flow regulation
**+ Recreation**
**+ Extrem events moderation**
+ Habitats for species



Innovative campus

**+ Education & Rennovation**
**+ Recreation**
+ Water flow regulation
+ Habitats for species

**River & Land spatial strategies**

## | SPATIAL DESIGN

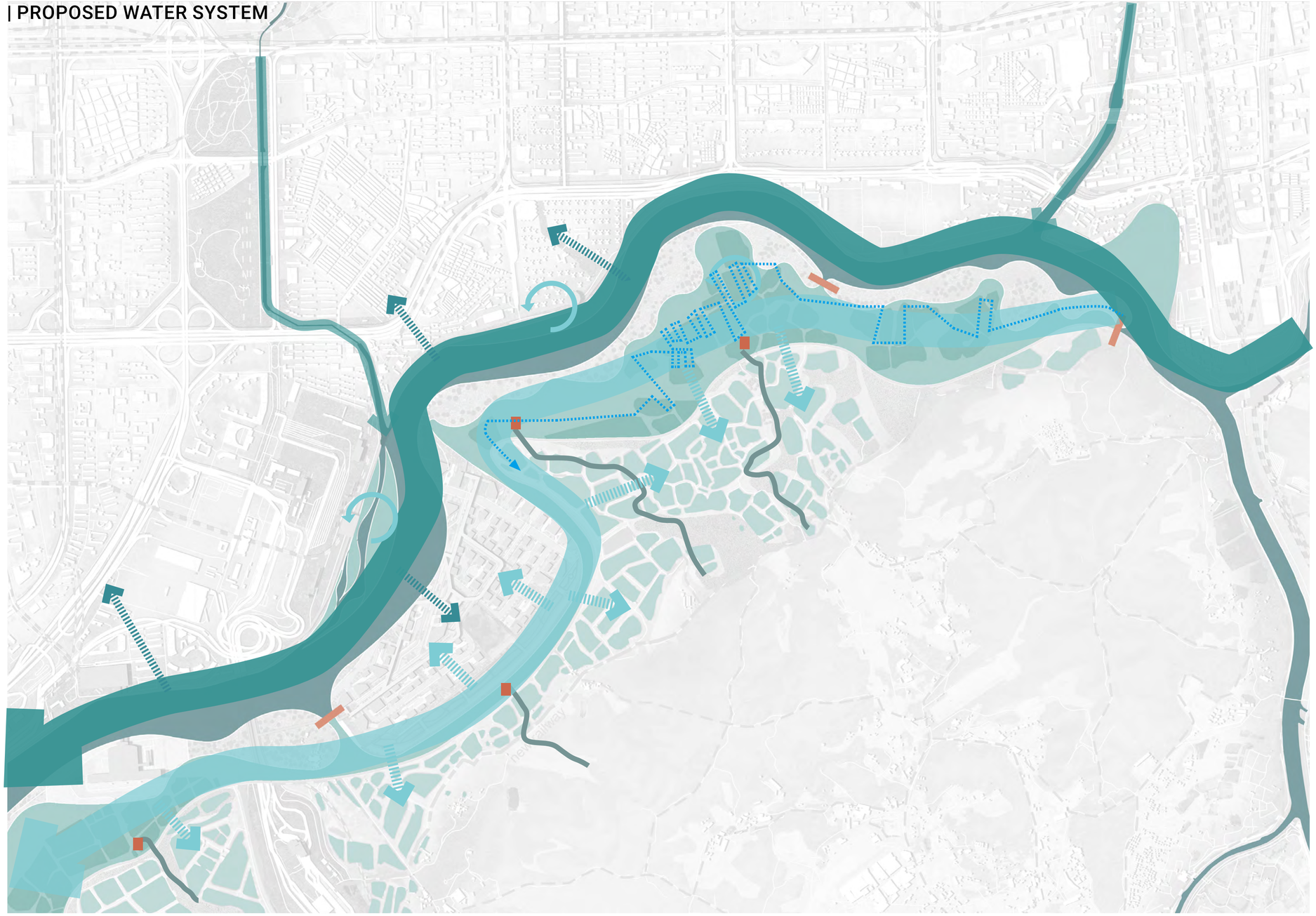



1. Eco-islands
2. Innovative Campus (planed by hpa)
3. Floodplain park
4. Freshwater wetland
5. Sluice gate
6. River bypass park
7. Main River
8. Bridge
9. TOD hub
10. Waterfront boulevard

N

0 0.5 1 km

# | PROPOSED WATER SYSTEM



Main river
Bypass channel
Floodplain
Prurification ponds
Ditch
Productive fishponds
Freshwater supply
Flush system supply
Inner ponds purification
Sluice gate
Pumping station
Helophyte system purification

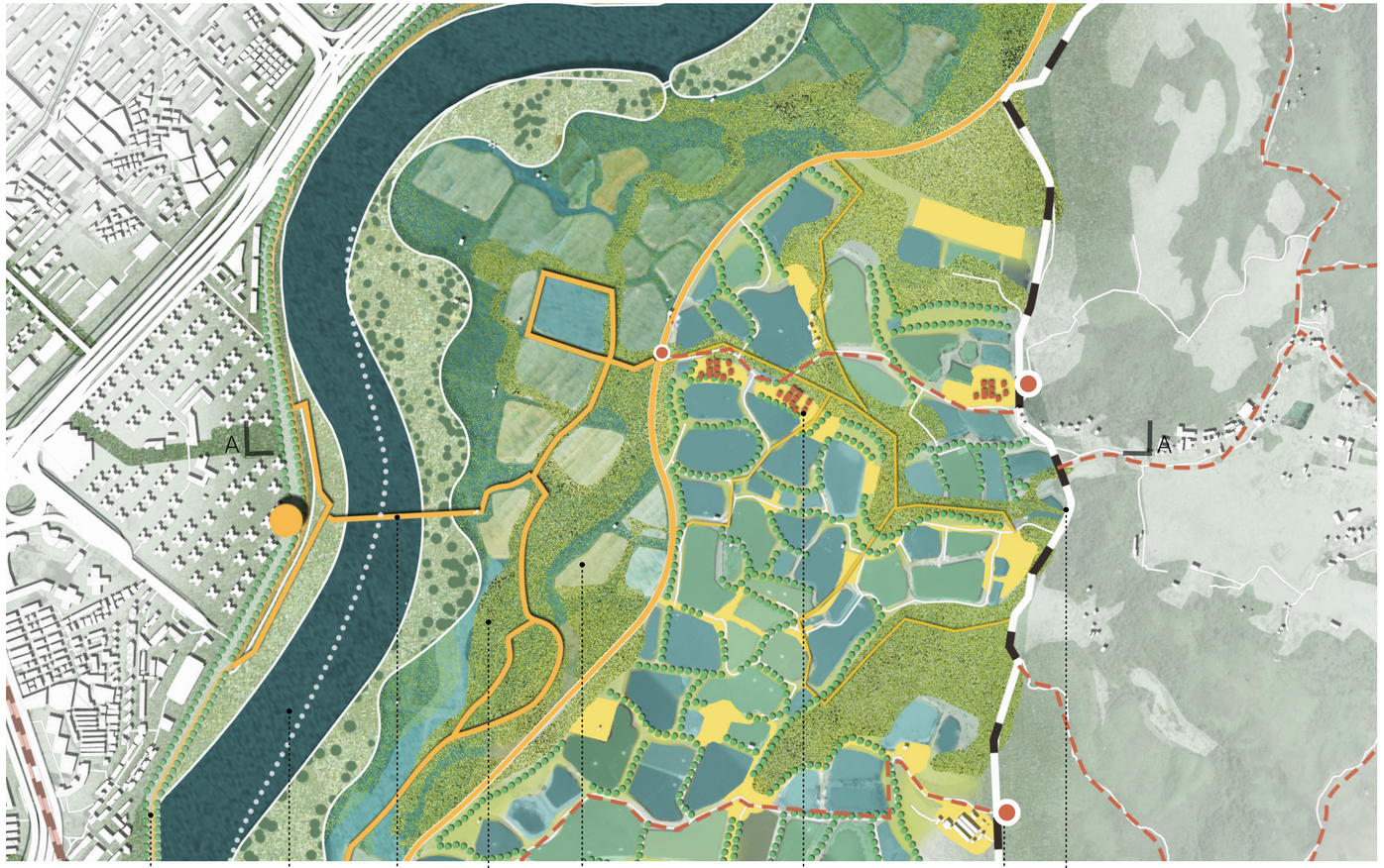
N

0 0.5 1 km

# [PILOT 3: SHENZHEN RIVER WATERFRONT]

*Recreation & Ecology & Production*
*Rennovation of SZR waterfront*

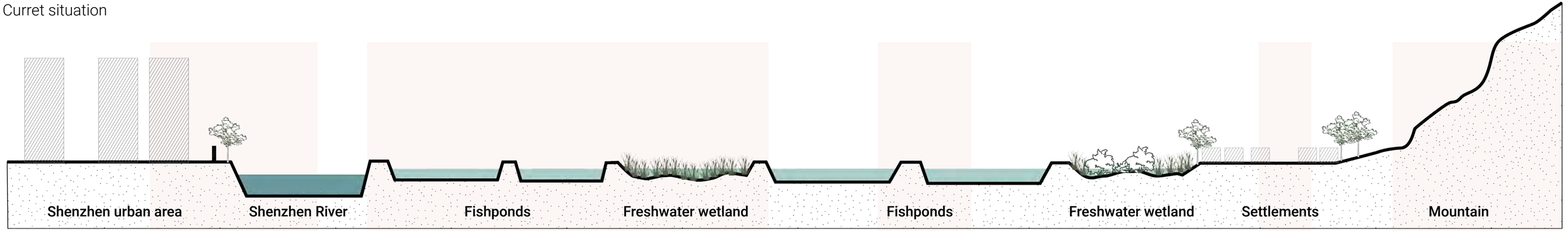



A
A
Boulevard
Musem
Skywalk
Freshwater wetland
Purification ponds
Settlements
Bus line
New station
New railway
Urban
Floodplain
SZ River
River bypass
Fishpond community
Mountain
Traditional fishpond
Educational fishpond
Energy fishpond
Public space
N
0
250
500m

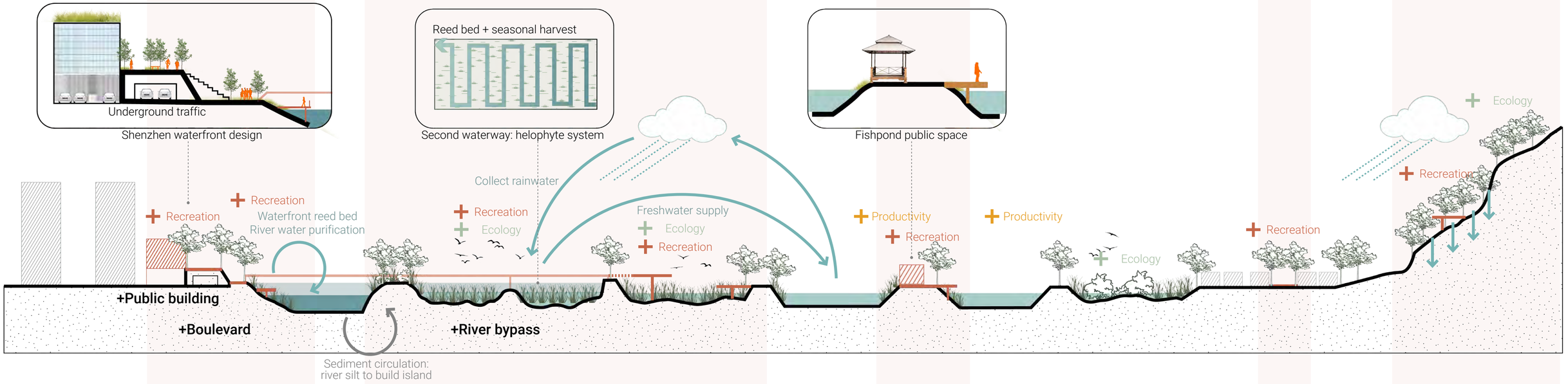
## | LOCAL IMPLEMENTATIONS

Section A-A

Curret situation




Proposed design & local implementation




SZ WATERFRONT BANK

BYPASS WETLAND PARK

INNOVATIVE FISHPONDS

MOUNTAIN TOURISM

## | EXPERIENCE A : RIVER BYPASS AND WETLANDS

**Hong Kong side view**


Cattail


Sedge


Reed


Bulrush


Willow

Extend the cultural and ecological value from the estuary nature reserve to the middle stream of SZ River to create a continuous corridor.

Ecology: diverse habitats.

Productivity: freshwater supply.

Recreation: biking and walking path, aesthetic value.




Fig. (top) Wetland plants: cattail, sedge, reeds, willow
Retrieved from Wikipedia

Fig. (left bottom) Perspective of current situation
Retrieved from Google Map street view



## Facing extrem events


Cattail


Sedge


Reed


Bulrush


Willow

Extrem events moderation:
buffer zone during floods
water retention ponds during droughts

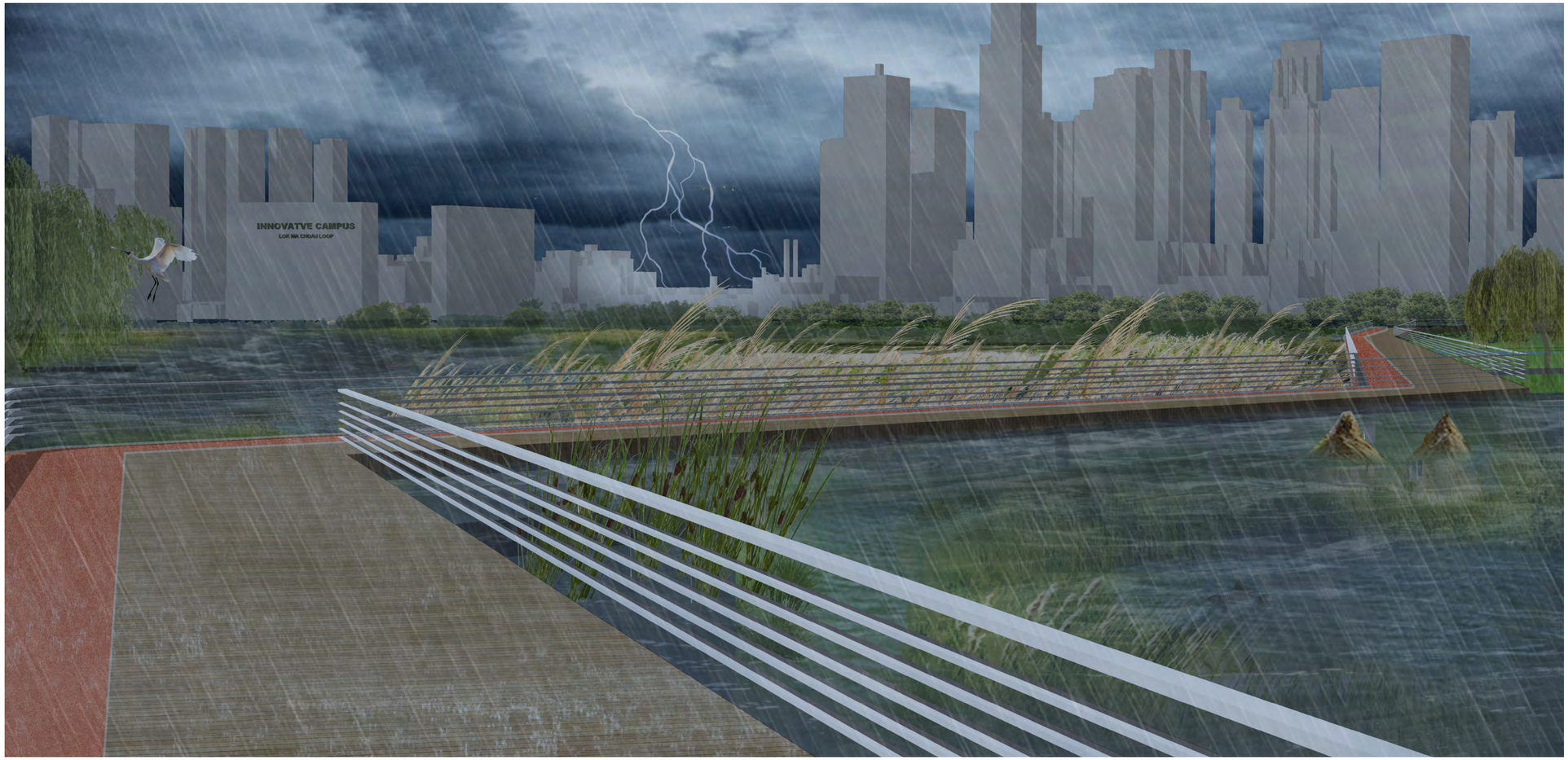



Fig. (top) Wetland plants: cattail, sedge, reeds, willow
Retrieved from Wikipedia

Fig. (left bottom) Perspective of current situation
Retrieved from Google Map street view



## | EXPERIENCE B : SHENZHEN RIVER WATERFRONT

### Shenzhen side view


Cattail


Chinese silver grass


Iris


Jacaranda mimosifolia


Willow

Accessibility: boulevard, biking path, underground traffic, cross-river bridge

Recreation: waterfront terrace, open water for holding festivals.



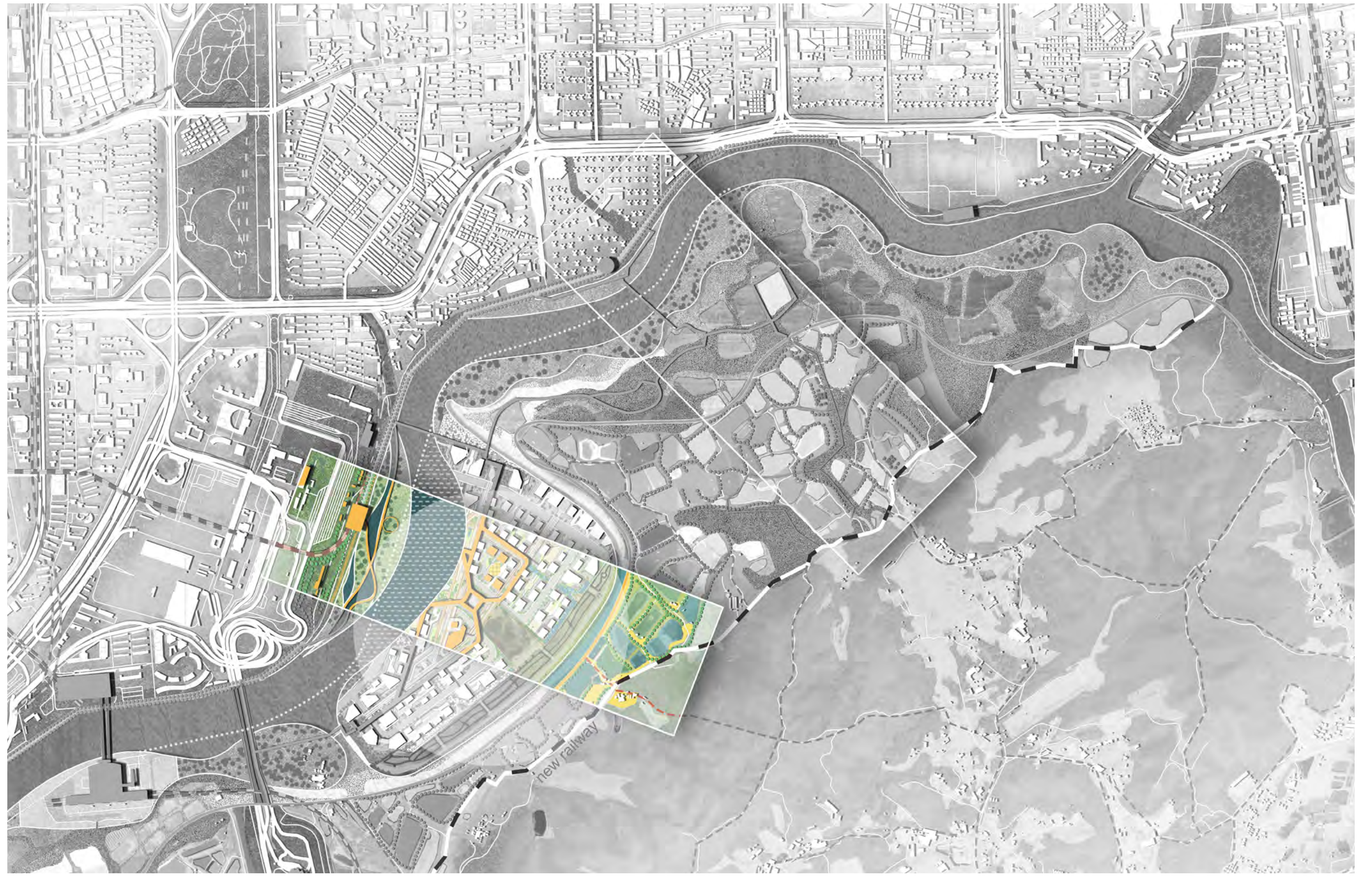
Fig. (top) Plants: cattail, chinese silver grass, iris, jacaranda mimosifolia, willow
Retrieved from Wikipedia

Fig. (left) Bird view image of current situation
Retrieved from Google Map street view



# [PILOT 4: INNOVATIVE CAMPUS AND LAND DEVELOPMENT]

*Planned development & Landscpe framework*
*Land development principles*



## | LAND DEVELOPMENT PRINCIPLE WITHINS THE FRAMEWORK

### Current Lok Ma Chua Master Planning



Fig. Lok Ma Chau master planning
Retrieved from: https://www.hpahk.com/Projects/hk-projects-28/loop

### Land development suggestions




[Blue]
1. Separate the sewer system and purify the water within the neighbourhood.
2. Use the main river for flush system and the bypass channel for irregation system.
3. Apply green roof and permeable materials.

← **WATER CIRCULATION**

← **SPONGE CAPACITY**

[Green]
4. Preserve the current wetlands and add public green to connect.

← **CONTINUOUS PUBLIC GREEN**

[Culture]
5. Involve the value of innovative aquaculture by introducing research center and food market.

← **PRODUCTIVE AQUACULTURE**

6. Connect to the public transportation and slow traffic system.

← **SLOW TRAFFIC & CONNECTIVITY**




Fig. Innovative campus waterfront development
The Lok Ma Chua plan is made by hps, retrieved from: https://www.hpahk.com/Projects/hk-projects-28/loop
Modified by author, 2022


| VISION OF LIVABLE RIVER & LAND
Blue corridor | Green corridor | Living corridor
Resilient | Continuous & Diverse | Connective & Productive
Co-development of environment and society
Museum
Innovative campus
Pumping station
Commercial complex
Aquaculture research center
Purified water pond
Sports gym
New railway
Education center
Ecological pond
Fishpond community
Helophyte pond
Energy fishpond
Sediment pond
Fishpond community

# | LOCAL DESIGN EXPLORATION CONCLUSION

## ZOOM-IN 1: BAY & ESTUARY



PILOT 01: ECO-FRIENDLY AQUACULTURE & WETLAND PARK

**Feed back in local scale**

+ Increase local productivity by water purification
+ Increase logistic connection
+ Develop natural-based habitats by working with water level
+ Create continuous green space from mountain to sea
+ Add recreational value by adding walking/biking path

PILOT 02: BAY ARCHIPELAGO

+ Balance between socio-cultural and ecological value
+ Nature-based island habitats in bay archipelagos

## ZOOM-IN 2: RIVER & LAND



PILOT 03: SHENZHEN RIVER  WATERFRONT

+ Creat connectivity across border
+ Involve management techniques_ "operativeness"
+ Add river bypass water circulation

PILOT 04: INNOVATIVE CAMPUS AND  LAND DEVELOPMENT

+ Land development principles along Shenzhen River
+ Add boulevard and public spaces along Shenzhen River.

**Regional network principles**

1. Sponge capacity network
2. Water circulation & purification networ
3. Nature-based habitats network
4. Continuous public green network
5. Eco-friendly aquaculture network
6. Slow traffic & Connectivity network
7. Leisure & Innovation network



## | REGIONAL LANDSCAPE FRAMEWORK

*-Provide a robust backbone for sustainable land development. Cities face the river to develop.*
*- The border is transformed from a barrier to a resilient and inclusive landscape corridor where nature and culture both prosper.*
*-Preserve the uniqie cultural identity and memorize border history.*
*-Lay condition for cross border cooperations.*

### Blue corridor

- Main river
- River bypass
- Floodplain

### Green corridor

- Mudflats
- Mangroves
- Gei Wai
- Innovative shrimp ponds
- Fishponds
- Mountai park

### Living corridor

- Slow traffic connection
- New Railway
- New railway station
- Places of interasts
- Public building

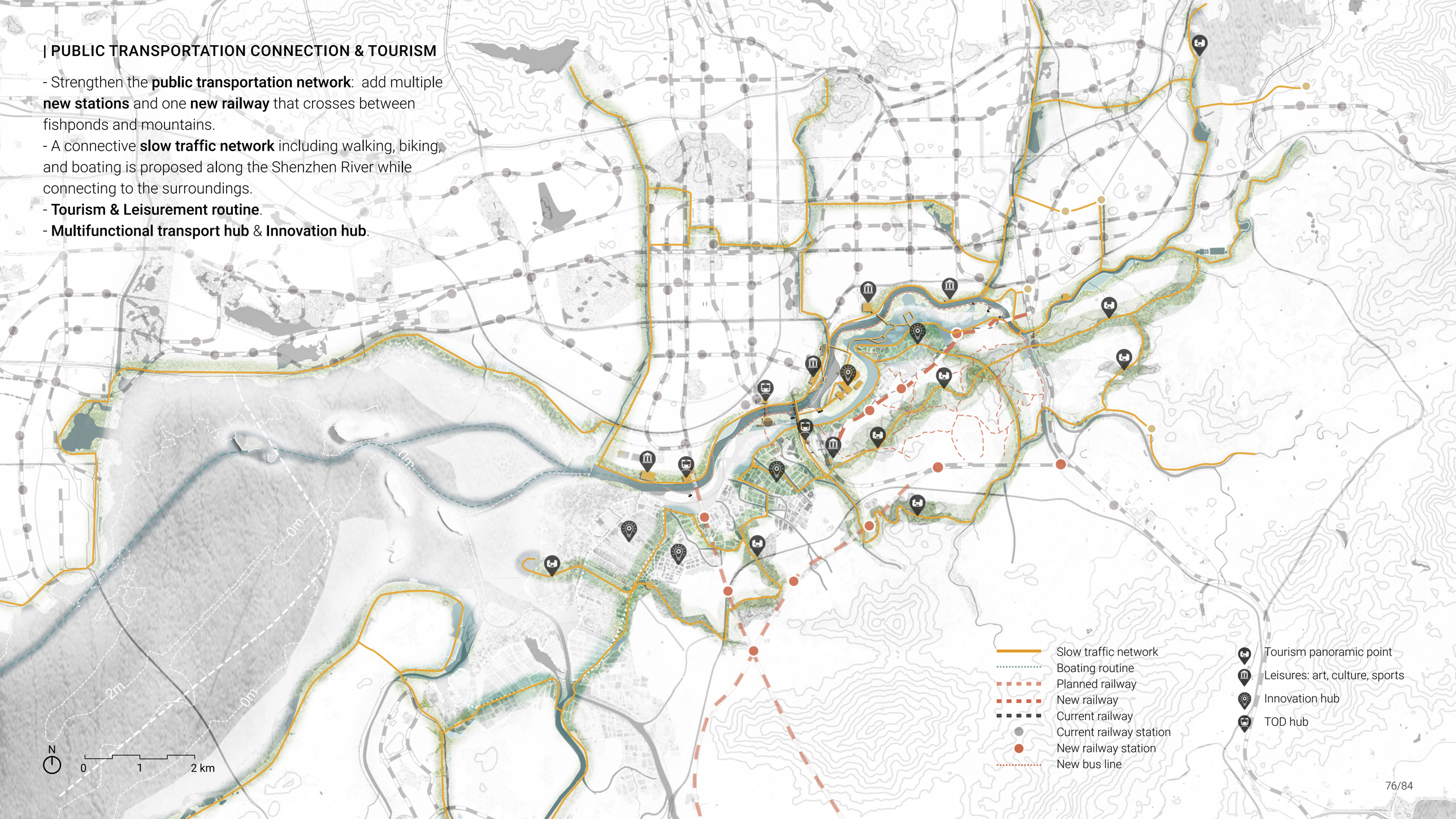
N

0 1 2 km

1. Archipelago
2. Growing mangrove park
3. Rennovative fishponds
4. Gei Wai cultural heritage
5. Wetland park
6. Industry park
7. Fishponds community
8. TOD hub
9. Innovative campus
10. Waterfront Park
11. Waterfront boulevard
12. River bypass wetland park
13. NAture reserve mountain park
14. Floodplain park
15. Shenzhen Reservoir park

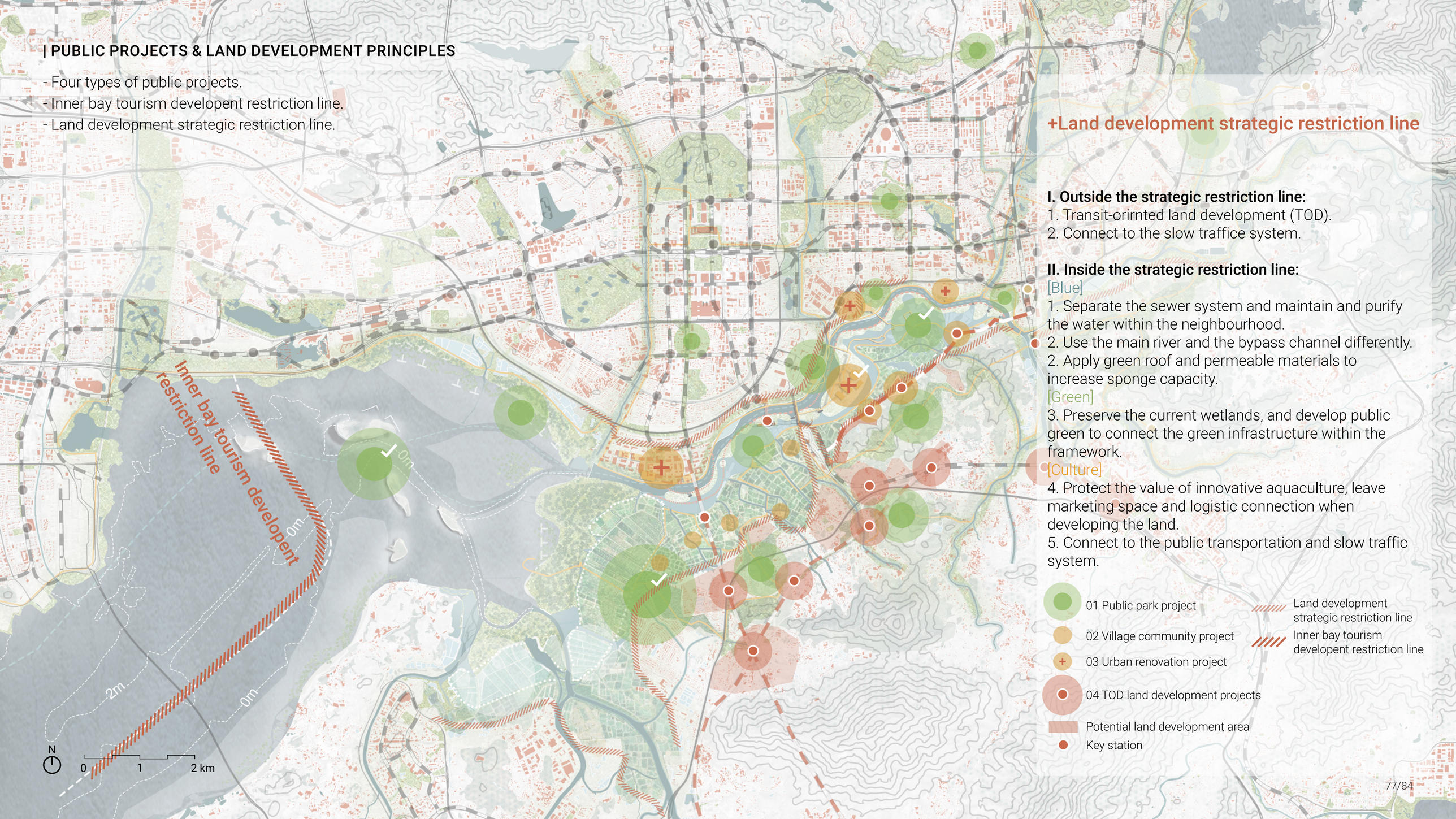
## | PUBLIC TRANSPORTATION CONNECTION & TOURISM

- Strengthen the **public transportation network**:  add multiple **new stations** and one **new railway** that crosses between fishponds and mountains.
- A connective **slow traffic network** including walking, biking, and boating is proposed along the Shenzhen River while connecting to the surroundings.
- **Tourism & Leisurement routine**.
- **Multifunctional transport hub** & **Innovation hub**.



## | PUBLIC PROJECTS & LAND DEVELOPMENT PRINCIPLES

- Four types of public projects.
- Inner bay tourism developent restriction line.
- Land development strategic restriction line.




## +Land development strategic restriction line

**I. Outside the strategic restriction line:**

1. Transit-orirnted land development (TOD).
2. Connect to the slow traffice system.

**II. Inside the strategic restriction line:**

[Blue]

1. Separate the sewer system and maintain and purify the water within the neighbourhood.
2. Use the main river and the bypass channel differently.
2. Apply green roof and permeable materials to increase sponge capacity.

[Green]

3. Preserve the current wetlands, and develop public green to connect the green infrastructure within the framework.

[Culture]

4. Protect the value of innovative aquaculture, leave marketing space and logistic connection when developing the land.
5. Connect to the public transportation and slow traffic system.

- 01 Public park project
- 02 Village community project
- 03 Urban renovation project
- 04 TOD land development projects
- Potential land development area
- Key station
- Land development strategic restriction line
- Inner bay tourism developent restriction line

## | SEASONAL ADAPTATION



**Dry season**

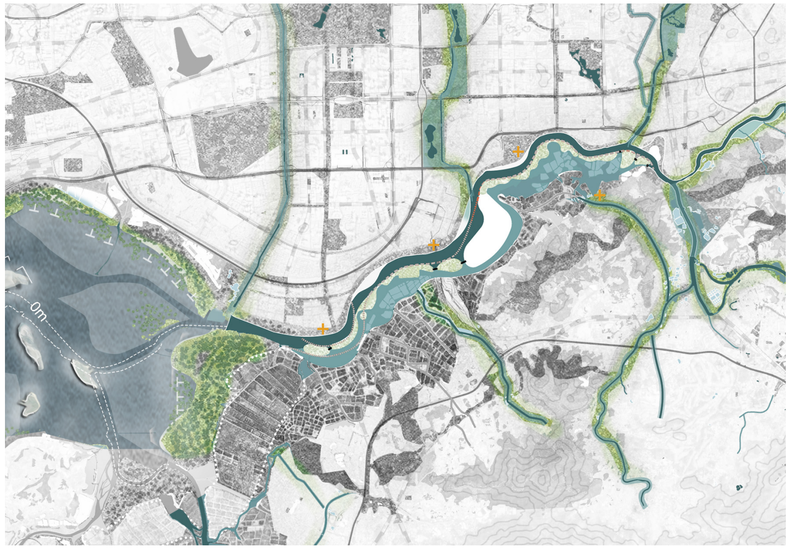


**Rain season**



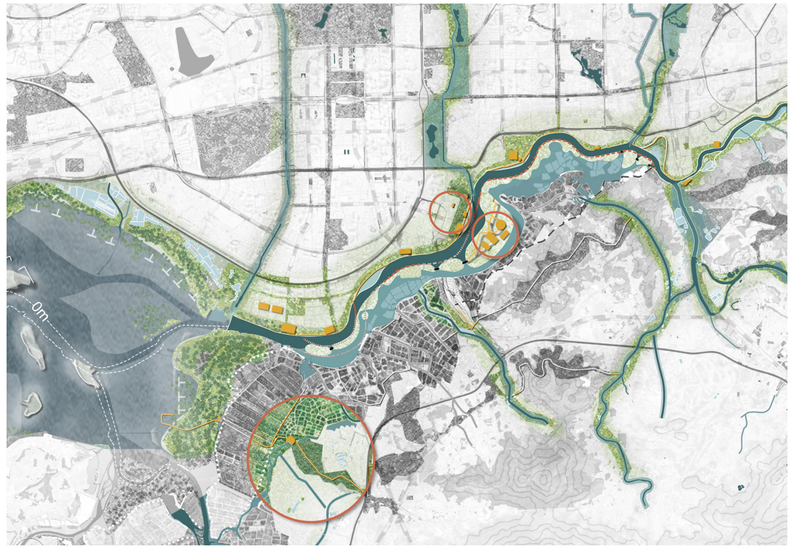
**Heavy rainfall**

## | STRATEGIC PHASING




**2023-2030**

1. Main hydrological structure;
2. Improve urban sewer system and tributers' quality;
3. Bay archipelago project;
4. Coastal permeable dams;
5. Temporary projects like pocket parks.




**2030-2040**

1. Waterfront pedestrian-friendly boulevard;
2. Develop public spaces and building;
3. Cross-border public transportation and slow traffic;
3. Critical nodes (Lok Ma Chau innovative campus, esturay wetland park, Shenzhen waterfront park).




**2040-2050**

1. Open up the sluice gates and integrate the bypass into the main river;
2. Rennovative aquaculture industry.
3. Enhance the public public green connection.
4. Develop a continuous tourism routine.

# CHAPTER 6. REFLECTION

*-Reflection I: Resilient landscape infrastructure thinking*

*-Reflection II: Landscape framework methodology*

*-Reflection III: Benefits of landscape infrastructure services*

-

## | REFLECTION I: RESILIENT LANDSCAPE INFRASTRUCTURE THINKING

*The idea of resilient landscape infrastructure indicates seeing the landscape as a* **multifunctional and operative** *field while equipped with resiliency to* **adapt to** *and* **persist in** *the* **long-term development** *and cope with future* **uncertainties**.

*(1) Capability to cope with extrem events.*
*(2) Balance between social and ecology.*
*(3) Landscape framework as backbone for sustainable development.*

### SETTING

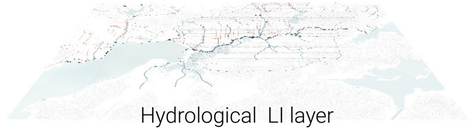
3 landscape infrastructure (LI) layers



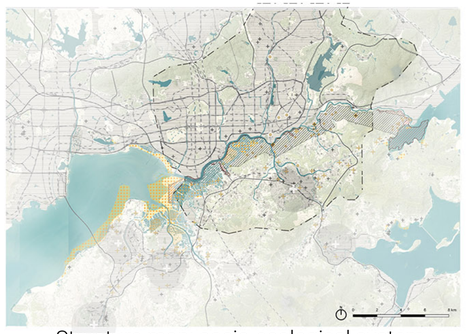
Socio-cultural LI layer



Ecological LI layer



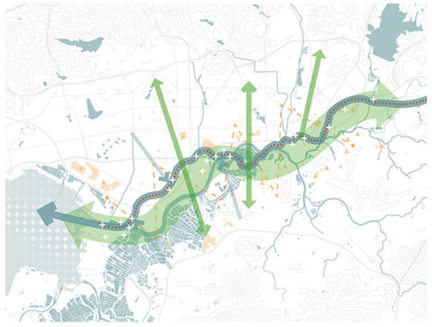
Hydrological LI layer



Structure map: socio-ecological system

### CONNECTIVITY

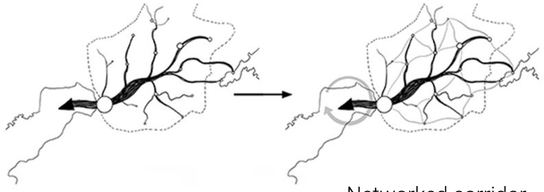
Design assignment: resilient landscape corridor



A resilient blue corridor

A diverse & continuous green corridor

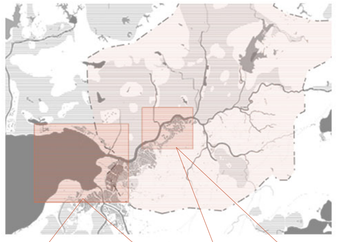
A connective & productive living corridor



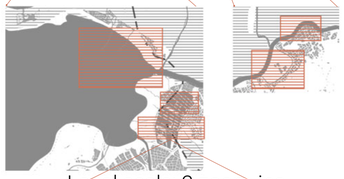
Networked corridor

### SCALE

4 scales



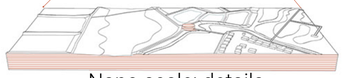
Regional scale: framework project



Local scale: 2 zoom-ins



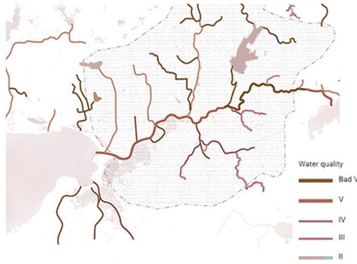
Micro scale: 4 pilot projects



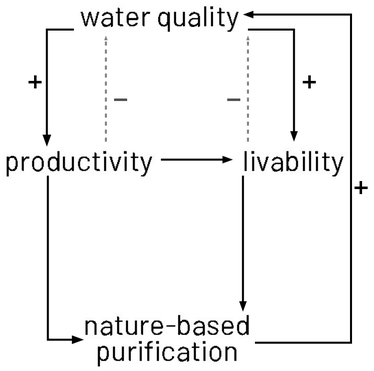
Nano scale: details

### SLOW VARIABLES & FEEDBACK

Key slow variable: water quality

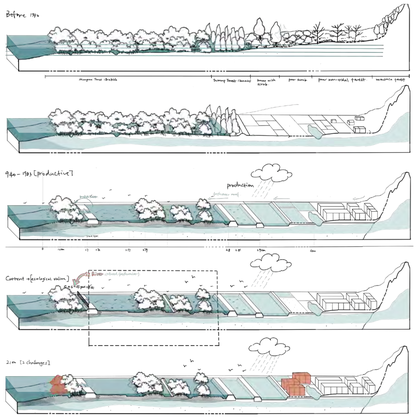



Key feedback




### PROCESS

Understand the processes that create and sustain landscape over time



Design through time

Temporal
Short term
Long term

DIVERSITY & REDUNDANCY

Design for multifunctionality
Cross-layer relation

# | REFLECTION II: LANDSCAPE FRAMEWORK METHODOLOGY

RESEARCH (INPUT)

Theories: resilience, landscape infrastructure, ES, NbS

3 layer understanding

Design assignment:
Resilient Blue Corridor
Continuous & Diverse Green Corridor
Conective & Cultural Living Corridor

Ecosystem services

Land use and potential landscape services



Stakeholder analysis ⟶ priority function






Site relevant study:
-study of traditional coastal aquaculture
-study of mangrove succession
-study of coastal islands formation
-study of water level and habitats
-study of water purification system

METHOD & APPROACH

**Difine the system**:
3 layers of landscape infrastructure:

Hydrological LI
Ecological LI
Socio-cultural LI

**Principles & Strategies**

**Multi-scale design exploration**

**R**egional (Shenzhen River watershed)
**L**ocal scale (Bay&Estuary, River&Land)
**M**icro scale (Pilot projects)

Difine potential landscape infrastructure services

↓

Difine priority services

↓

Spatial strategies (local)

↓

Local inplementations

↓

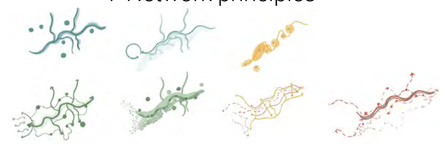
Reflection on regional scale

DESIGN (OUTPUT)

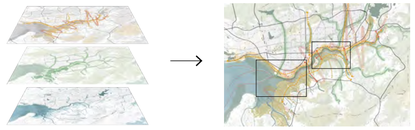
Structure map



7 Network principles



[Regional landscape network]

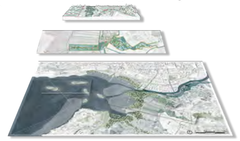


15 Landscape infrastructure services



Local design projects

multi scales



[Regional landscape framework]



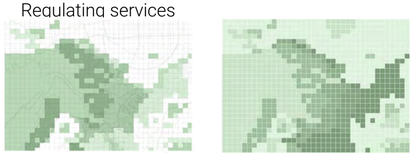
EVALUATION

LIS Assessment: before & after

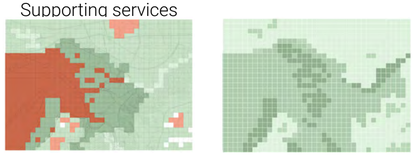
Provisioning services



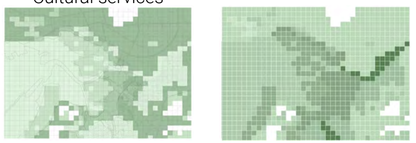
Regulating services



Supporting services



Cultural services



# | REFLECTION III: BENEFITS OF LANDSCAPE INFRASTRUCTURE SERVICES

## ECONOMIC BENEFITS OF LAND DEVELOPMENT

"SEE SHENZHEN AT SEA" CRUISE TOURISM PROJECT: OPERATIVE INCOME CAN BE INCREASED BY

**2,100,000** EUROS IN 2025

**10,240,000** EUROS IN 2035

**23,230,000** EUROS IN 2050

HK NORTH NEW TERRITORY DEVELOPMENT 2030+

**11,880,000** EUROS INVESTMENT

**31,000** HOUSING

## LANDSCAPE VALUE

**"TEEB"** THE ECONOMICS OF ECOSYSTEM AND BIODIVERSITY

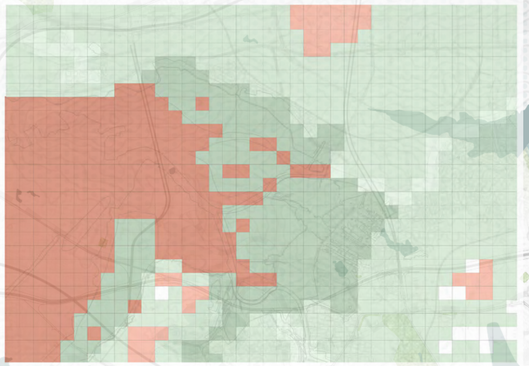
### THE BENEFITS OF LANDSCAPE INFRSTRUCTURE SRVICES?

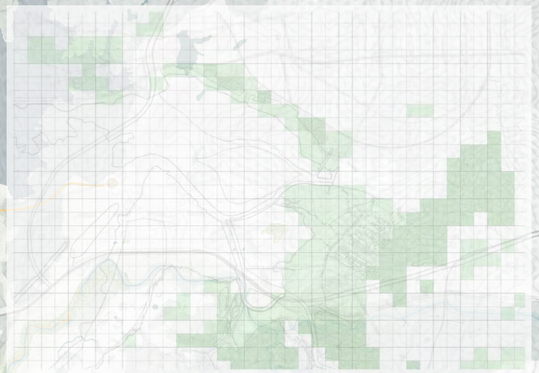
HOW TO MAKE THE LANDSCAPE VALUE MORE VISIBLE?

In this project:

**15** LANDSCAPE INFRASTRUCTURE SERVICES

**ASSESSABLE LIS** —"ValueES"→ Indicators & Methods **?** Potentials





# FROM BORDER TO LANDSCAPE

Designing a resilient landscape corridor in Shenzhen-Hong Kong border area

## P5 presentation


Yuqi Pu

Mentor: Steffen Nijhuis
Second mentor: Lei Qu