TU DELFT
Graduation Lab
Adaptive Landscape Transformation- Pearl River Delta

Retrofitting Panyu District:
adapting green-blue infrastructure to sustain waterlogging and regenerate Panyu district by industrial transformation

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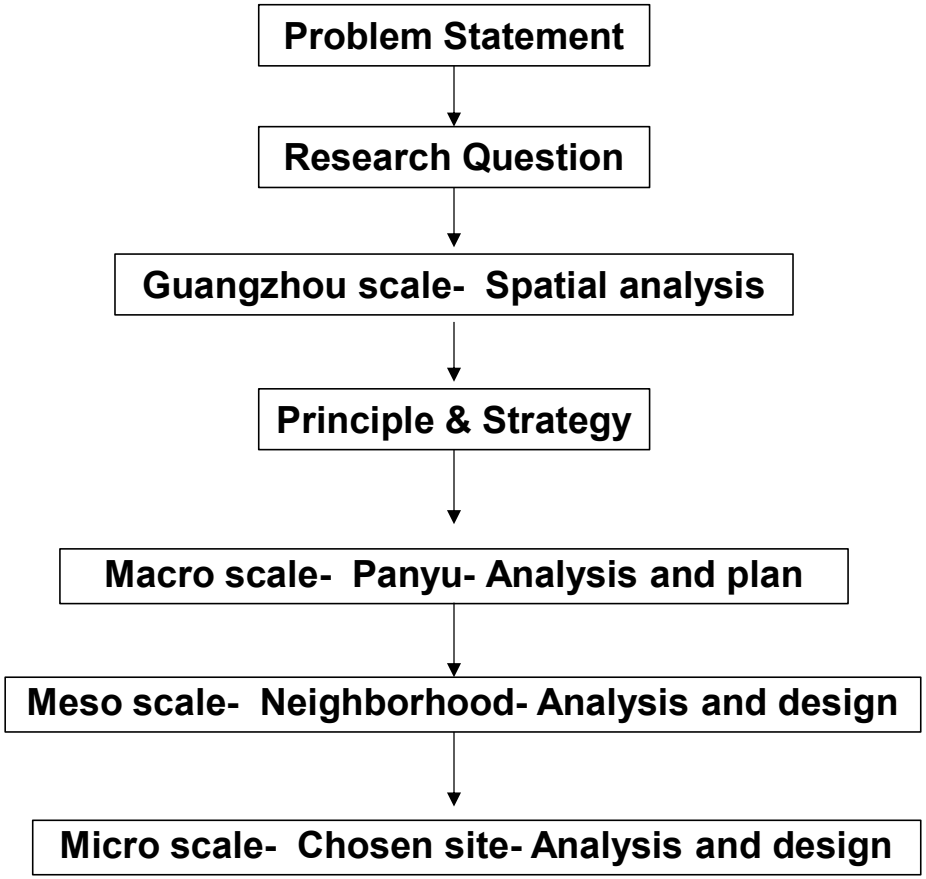

Problem Statement
Research Question
Guangzhou scale- Spatial analysis
Principle & Strategy
Macro scale- Panyu- Analysis and plan
Meso scale- Neighborhood- Analysis and design
Micro scale- Chosen site- Analysis and design

Problem statement

Waterlogging



Urban waterlogging refers to the **phenomenon of waterlogging disasters** in cities due to heavy precipitation or continuous precipitation exceeding urban drainage capacity. (Huang Tielan, Chen Junhao, Huang Fengjie, & Su Zhangcan. 2017)

Source: ChinaDaily, Sohu News

Background

Industrial transformation

Industrial Transformation research based on the assumption that important changes in production and consumption systems will be required in order to meet the needs and aspirations of a growing world population while using environmental resources in a sustainable manner. **Reconstruct or upgrade industries that are no longer able to meet the needs of today's society**. （Vellinga, P., & Herb, N. 1997）

Source: ChinaDaily, Sohu News, Doban

Research Question

Main Question

How to **improve the sponge capacity of the city (objective 1)** in the context of **reassignment of former industrial zones (objective 2)** to find the **adaptive & regenerative urbanism strategy (goal)** ?

Sub Questions

How to improve the sponge capacity of the city?

How can industrial transformation support to resolve the waterlogging problem?

How can a landscape approach be used to improve the sponge capacity of the city?

How can the new green and blue infrastructure improve the living quality of the city districts?

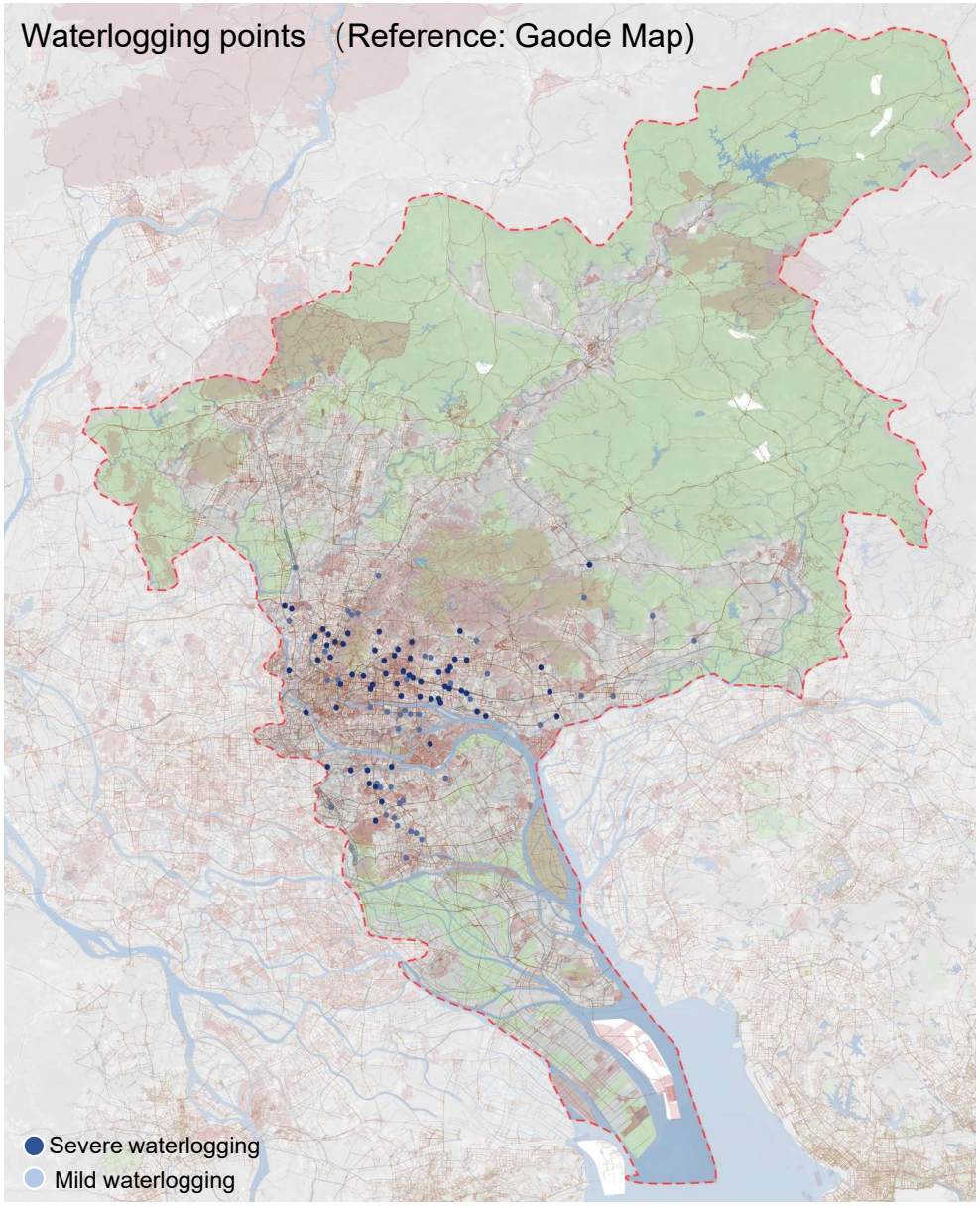
Theoretical framework

Sub Questions	Method	Theoretical Approach
How to improve the sponge capacity of the city?	Analysis Literature review, Case study	Case study - Copenhagen drainage and corrosion prevention Plan
How can industrial transformation support to resolve the waterlogging problem?	Analysis Literature review, Interview	Literature - *"Performance Evaluation-oriented" Thoughts on the Integration and Transformation of Low-Efficiency Village-level Industrial Parks: Taking Guangzhou as an Example*
How can a landscape approach be used to improve the sponge capacity of the city?	Analysis City plan, Case study, Literature review Research by design Scenario analysis, Multi-scale design, Time process	Landscape as infrastructure Green-Blue infrastructure
How can the new green and blue infrastructure improve the living quality of the city districts?	Analysis Literature review, Case study Research by design Multi-scale design, 3D model	Case study

Guangzhou Scale- Spatial analysis

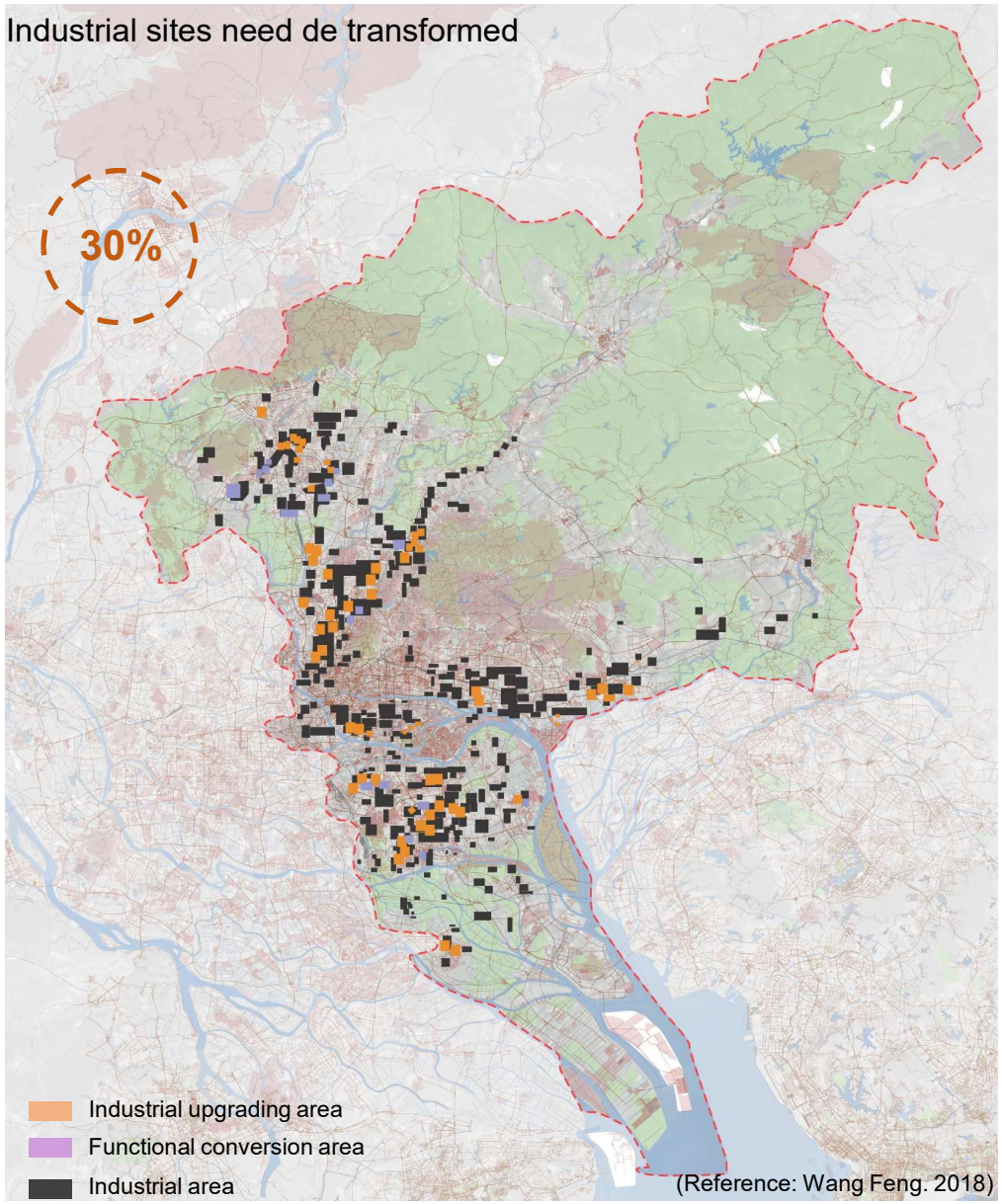
Waterlogging problem

Source:
http://www.baike.sogou.comhistorylemmaId=9828378



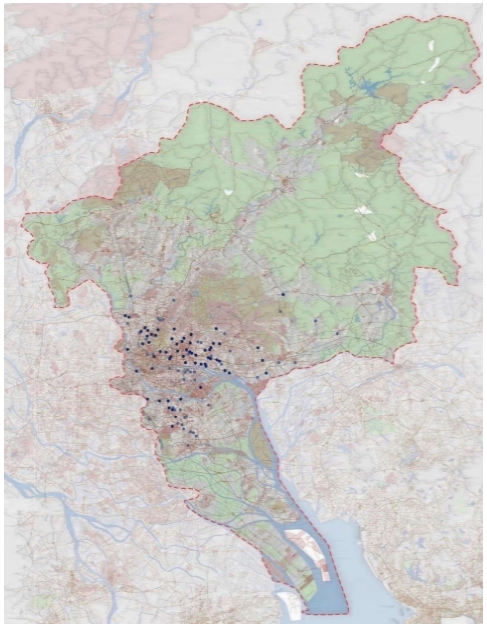
Industrial transformation

Source:
http://www.sohu.coma278914165_763670



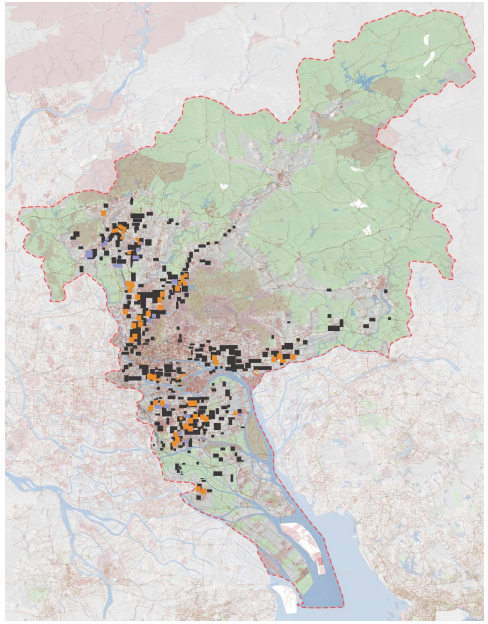
Summary

Challenge 1.
Waterlogging



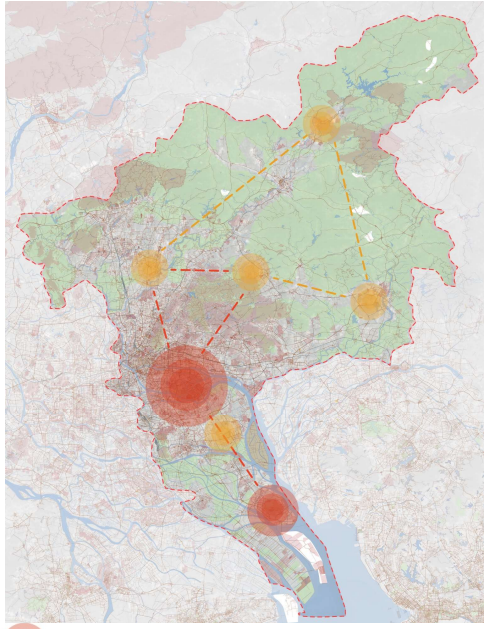
Severe waterlogging
Mild waterlogging

Challenge 2.
Industrial transformation



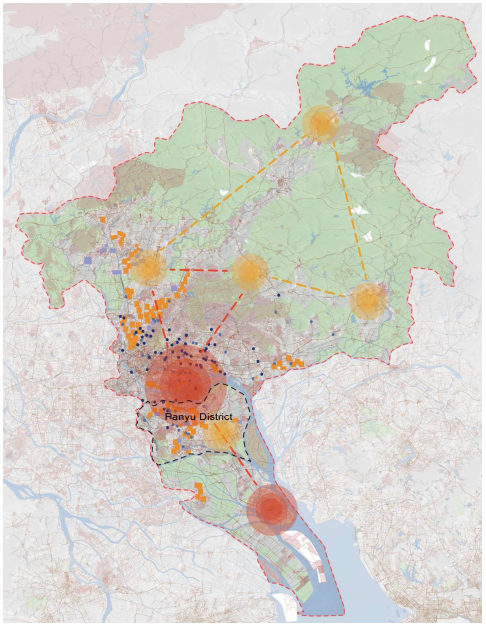
Industrial upgrading area
Functional conversion area
Industrial area

Challenge 3.
City expansion



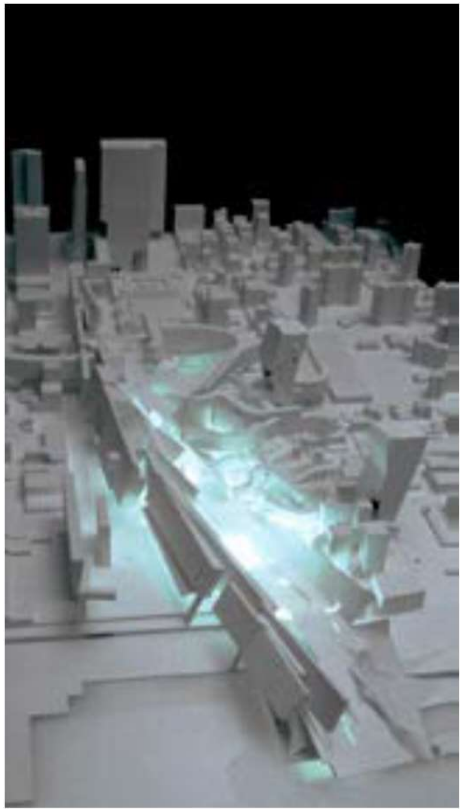
Central area
Sub-central area
Peripheral area

Opportunity.
Sustainable green blue urban development



Theory & Principle & Strategy

Theory: Landscape as infrastructure



Conceiving landscape as infrastructure can be characterised as a goal-oriented approach, where **landscape is treated as an operative field that defines and sustains the urban development** and ecological and economic processes are employed **as formative design tools**.

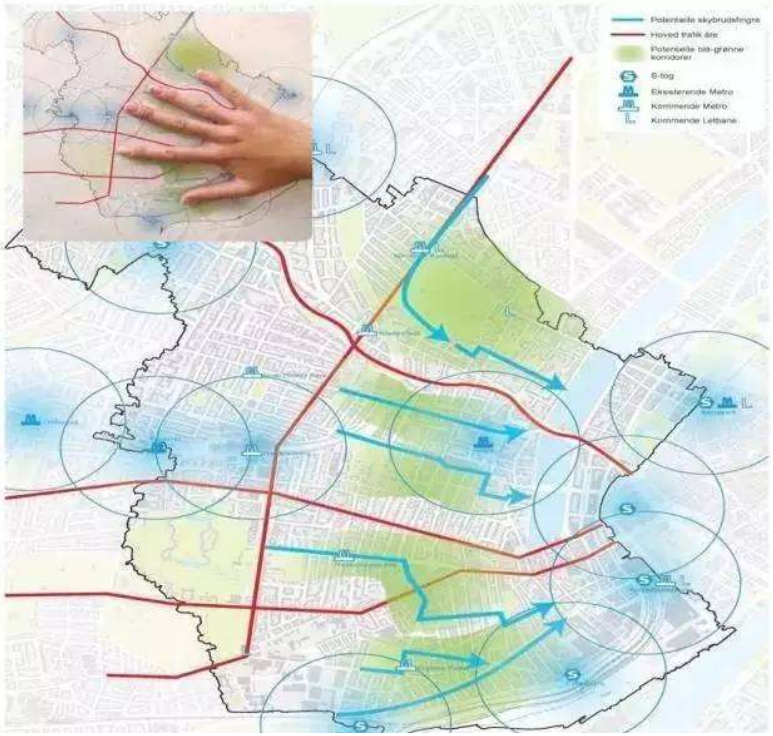
The work of Morphosis Architects in the New City Park competition for Manhattan (New York, USA) in 2009 considers the park as public armature of core programs and infrastructure;landscape as infrastructure (image courtesy: Morphosis Architects)

Reference: Steffen Nihuis, 2015

Principle & Strategy: On waterlogging problem

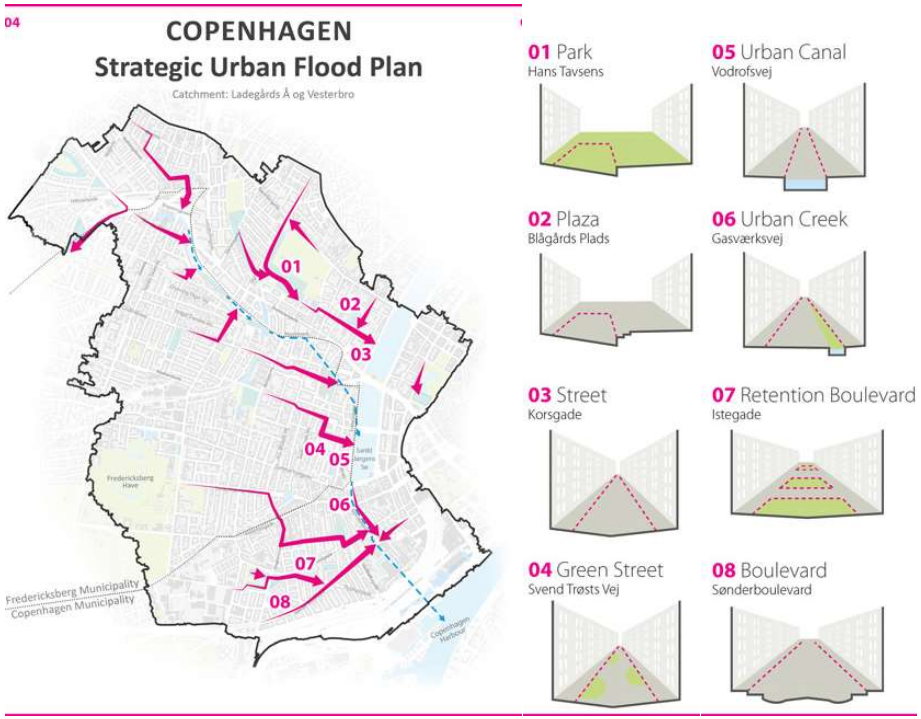
Case study: Copenhagen Urban Flood Plan

Principle 1.
On large scale: Expand connecting green and blue spaces to retain rainfall



Copenhagen green and blue structure plan Source: Atelier Dreiseitl

Principle 2.
On smaller scale: establish flexible stormwater runoff discharge methods.



Copenhagen strategic urban flood plan Source: Atelier Dreiseitl

Case study: Juan Diaz watershed in Panamá City

Principle 1.
Build Green-Blue infrastructure

Green-Blue infrastructure planned **interconnected networks** of natural and seminatural areas, including water bodies and green and open spaces, that provide different ecosystem services. (Voskamp and Van de Ven 2015 and Ghofrani et. Al 2016)

Green-Blue infrastructure has the following benefits:
Economic aspect:
- Low investment and high return
- Construction is less difficult
- Energy saving
- Increasing the value of land in the surrounding area

Environmental aspects
- Improving the quality of the ecological environment
- Rich species diversity
- Improving water quality
- Strengthening water management and sewage management
- Improving air quality
- Regulating the urban microclimate

Social aspects:
- Creating a green entertainment space
- Landscape design improves city appearance
- Improving the quality of public space

Blue-green infrastructure vision for a flood-resilient Juan Diaz watershed in Panamá City
Source: ONE Architecture & Urbanism

Principle & Strategy: On industrial transformation

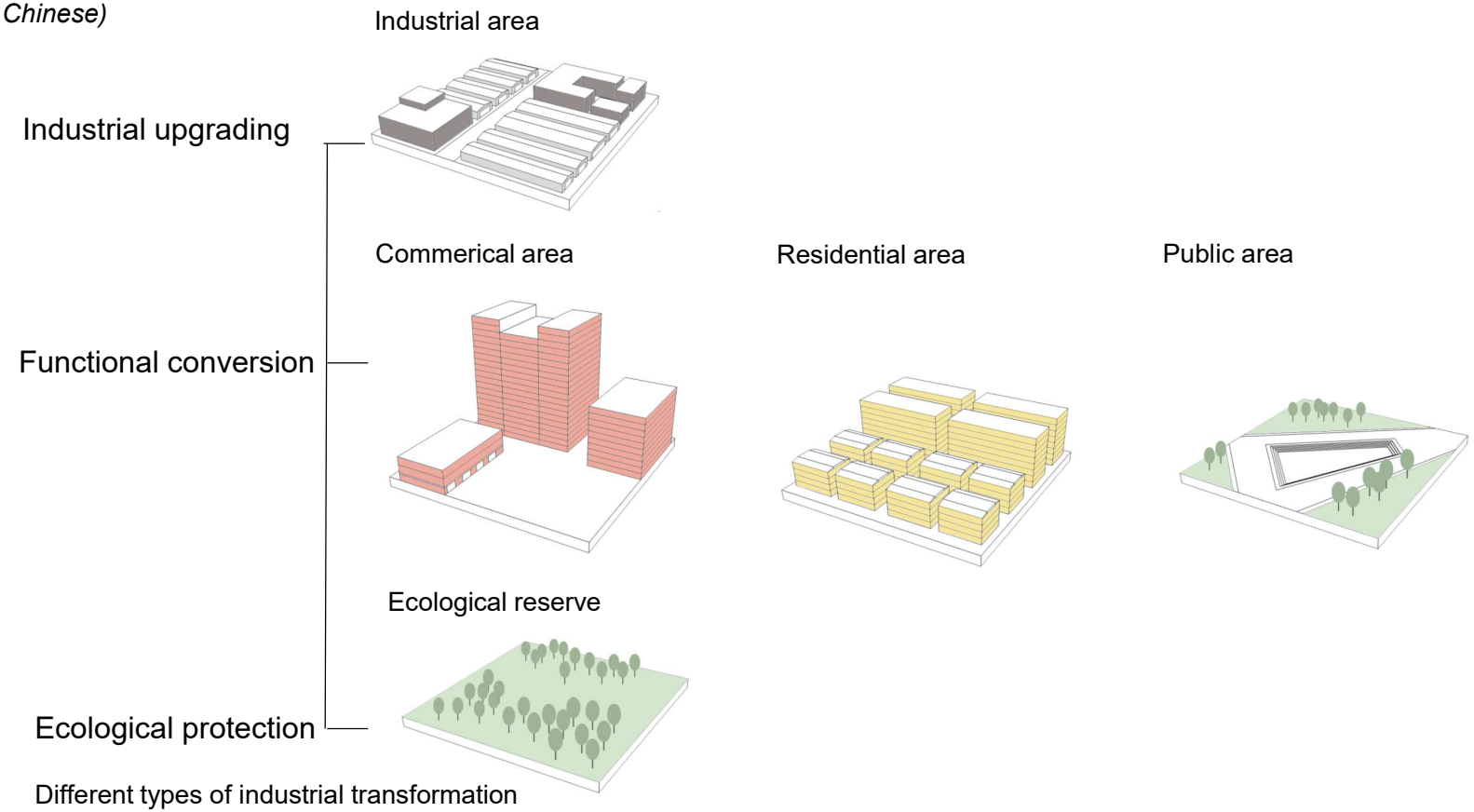
Literature: *Wang Feng. (2018). "Performance Evaluation-oriented" Thoughts on the Integration and Transformation of Low-Efficiency Village-level Industrial Parks: Taking Guangzhou as an Example. Intelligent City, 4 (7), 93-94. (in Chinese)*

Principle 1. **Classified managing** inefficient industrial areas.

Industrial upgrading: Industrial upgrades are possible in these areas.

Functional conversion: They can be considered to convert industrial land into residential land and commercial land.

Ecological protection: They can be considered converting industrial land into green space.



Different types of industrial transformation

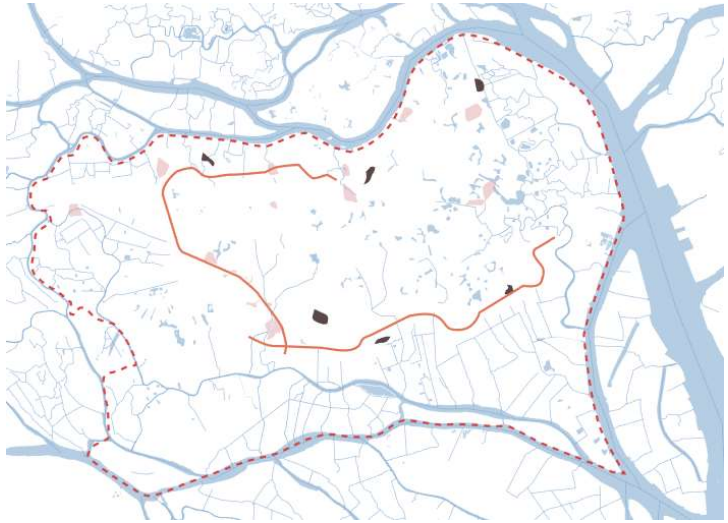
Macro scale- Panyu District - Spatial analysis

Macro scale- Why waterlogging problem exist in Panyu?

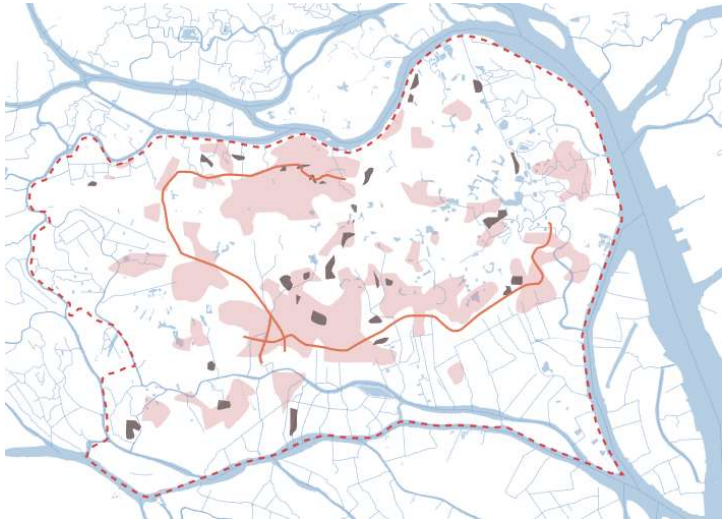
Factor 1. Landscape (green surface and water network)

Urbanization and industrialization in Panyu

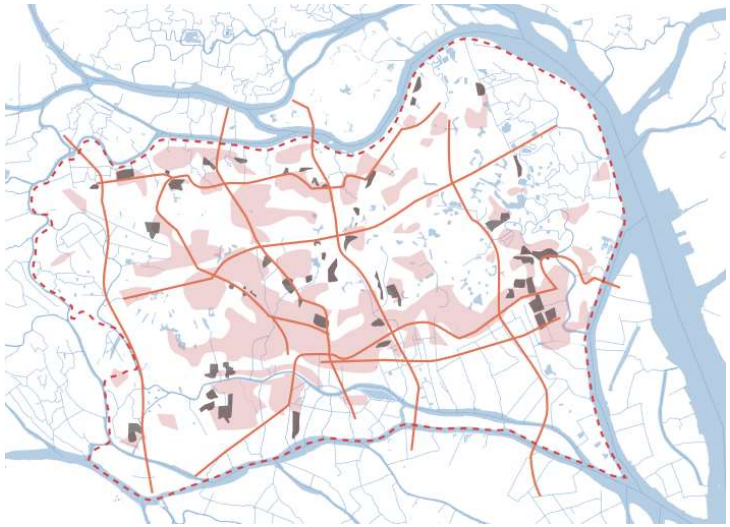
1990



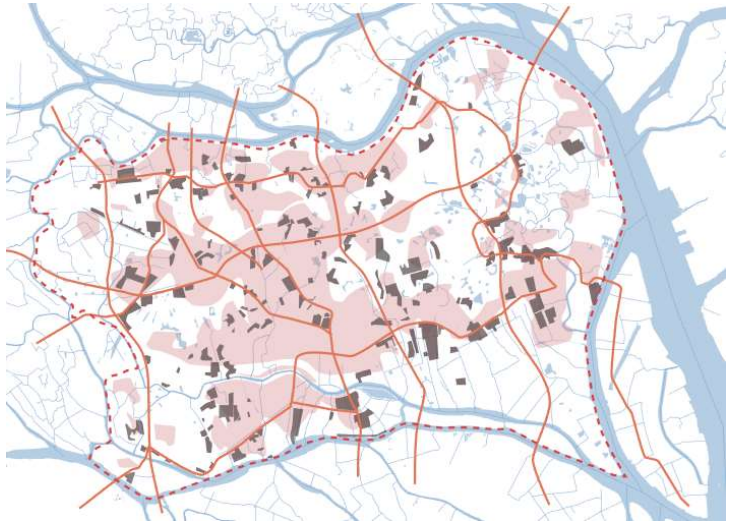
2000



2010



2019



Build up area
Industrial area

Existing landscape

The current green coverage rate in Panyu is **37.8%.**

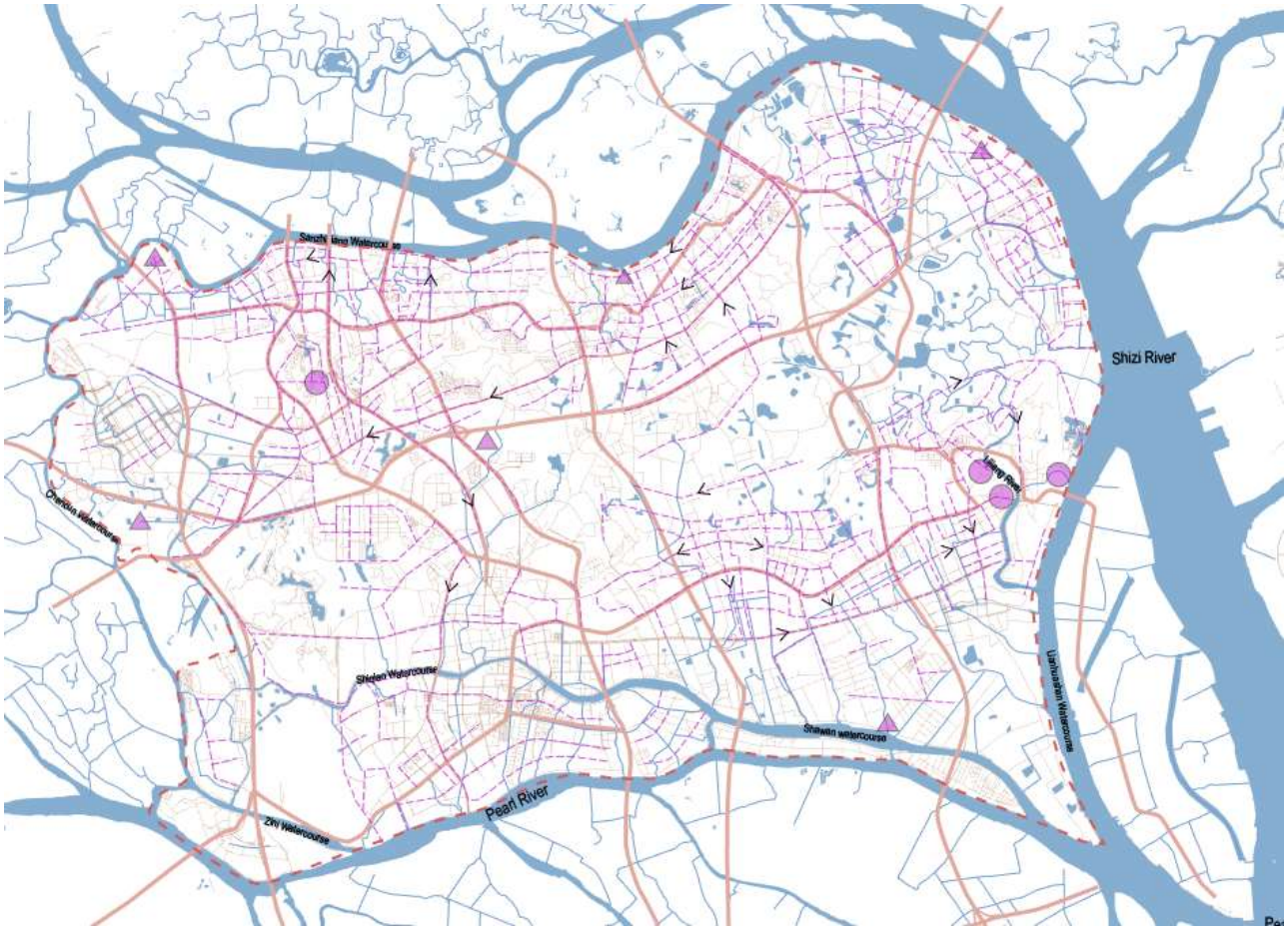
Forests	**18.9%**
Agricultural land and wetlands	**66.1%**
Parks and green buffer areas	**15%**

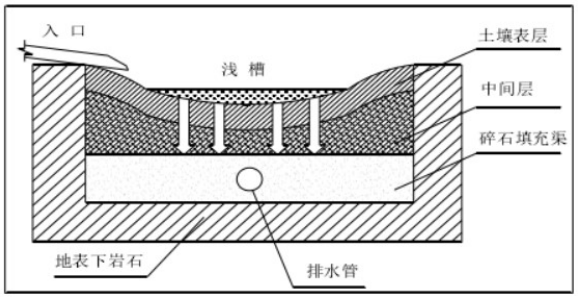
Due to urbanization, natural landscape has been decreasing, and the remaining landscape space is not enough for water capacity.

- Infrastructure
- Build-up area
- Forest
- Agriculture land
- Wetland
- Park
- Green buffer

Macro scale- Why waterlogging problem exist in Panyu?
Factor 2. Drainage Facility

Drainage Facility



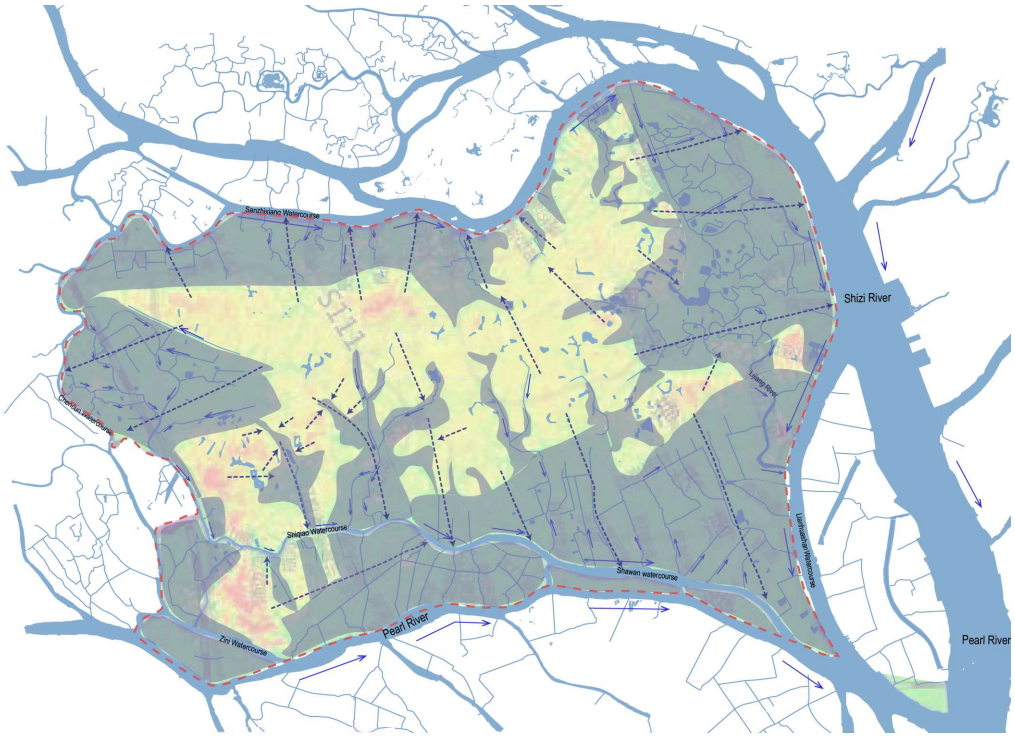


Underground drainage system

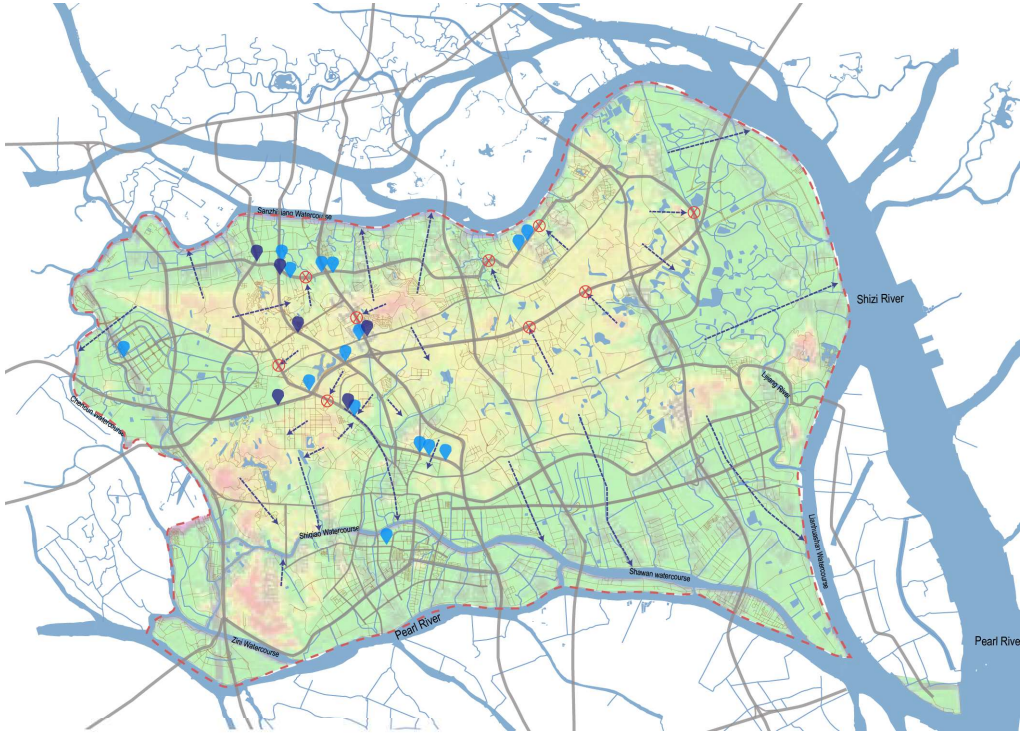
- Drainage pipe
- Pumping station
- Sewage treatment plant

Macro scale- Why waterlogging problem exist in Panyu?
Factor 3. Obstacles on The Ground

Water flow following the topography



Water flow blocked by infrastructure

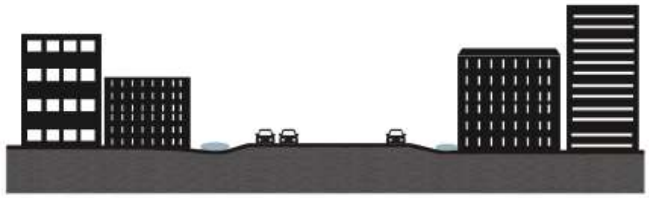


Conclusion- Typical waterlogging situations in Panyu

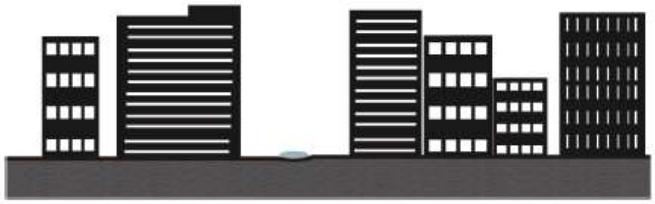
Waterlogging on the lower road

Waterlogging in the tunnel

Waterlogging on sides of the road



Waterlogging in areas with dense construction



Design Strategy

Design Strategy- Expanding and connecting Green-Blue structure

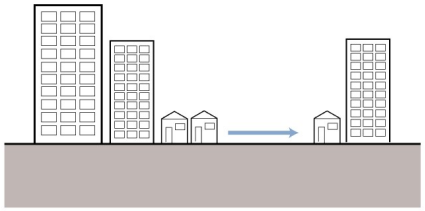
Taichung green corridor Source: mecanoo

'Ecoduct' The Borkeld

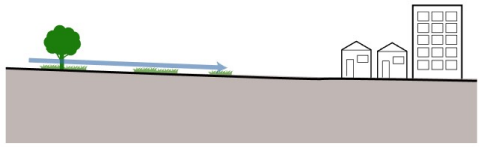
Because most of the waterlogging occurred near the main roads, the new green-blue structure first needs to **have connected structure along the main road**.
Then, adding some **structure to cross the obstacles(roads)** and connect the green spaces on the sides of roads to ensure the smooth flow of water.

Design Strategy- Water Strategy

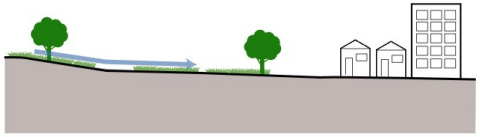
Current situation



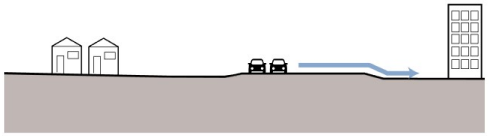
Impervious surface



Fast runoff



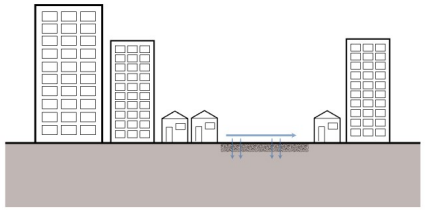
Lack of ground storage space



Lack of purification of road sewage

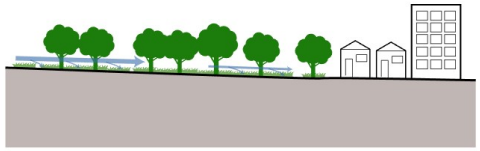
Water strategy

Infiltration



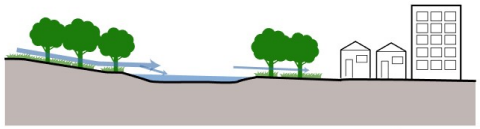
Pervious surface

Detention



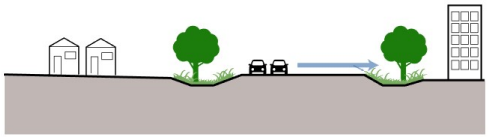
Slow down runoff

Water Harvesting



Increase seasonal ponds

Purification



Roadside green buffer zone purify sewage

Where to expand the Green-Blue structure?

Finding potential spaces

1. Current left-over 'buffer' spaces

By activating current left-over ‘buffer’ spaces in some **low dense area**, like **between neighborhoods and along roads, around road crossing**

-To create **green spaces to slow down runoff in upstream area**

-To create **green buffer along road** for drainage and noise reduction

Finding potential spaces

2. Former industrial sites

By employing former industrial sites located **in neighbourhoods or villages** and **close to roads (in high dense build-up area)**

-To create **(water) parks to increase water capacity and increase public green spaces and parks** for the local

-To create **eco-corridor along roads** for drainage, water purification and noise reduction

Expanding green and blue structure – Step 1: Activate/ preserve existing green and blue spaces

First, **making better use of and protecting** the existing green space and water bodies, which are the basis of the new green-blue structure.

Expanding green and blue structure – Step 2: Reclamation of the left-over buffer spaces

Reclamation of the left-over buffer spaces **between villages**, especially at the higher parts of the district and **along highways** (the central area of the district).

Expanding green and blue structure – Step 3: Reclamation of the old industrial sites

Reclamation of the old industrial sites **near roads and neighborhoods** where waterlogging is occurring and can be used by local residents.

Functional conversion area

Left-over 'buffer' spaces

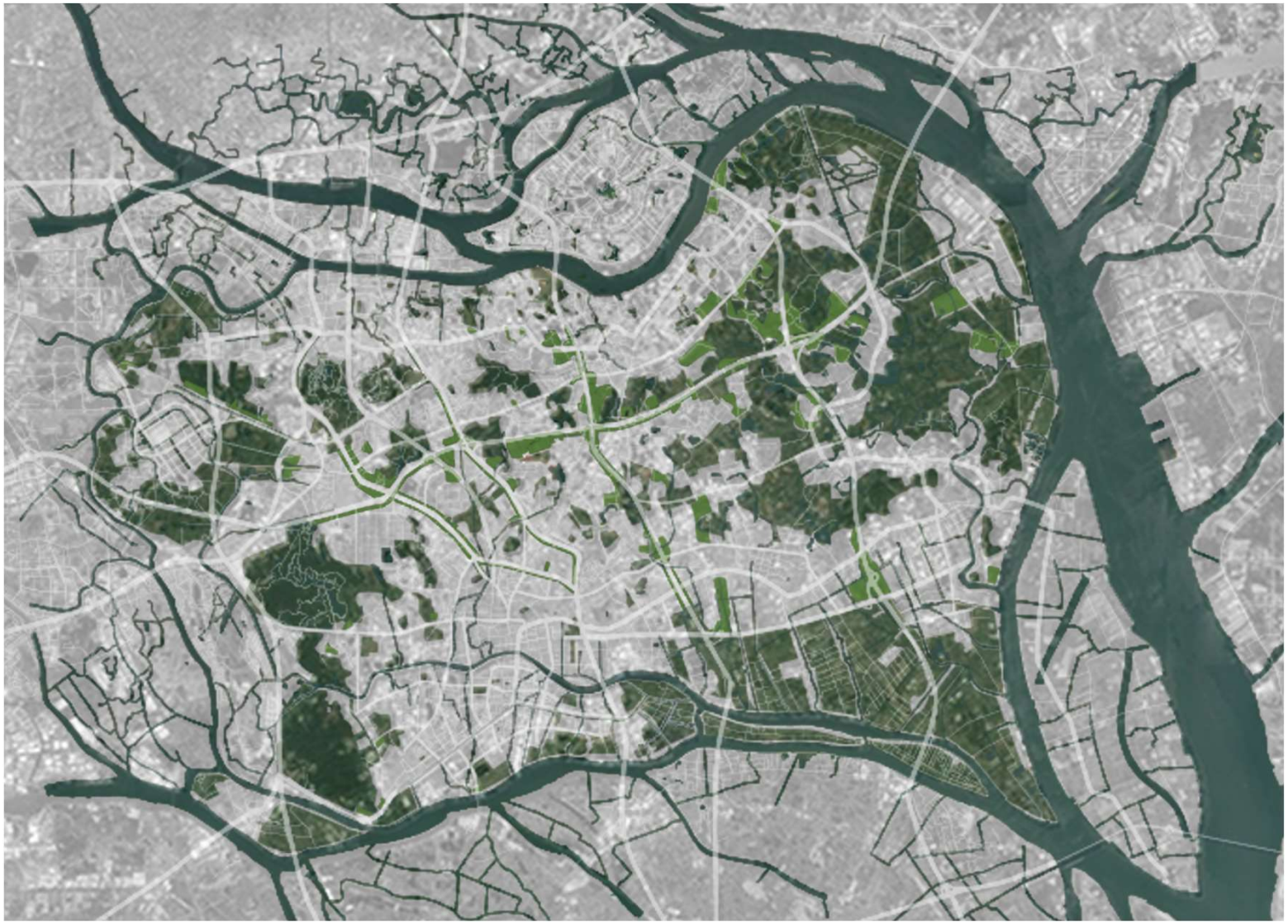
Existing green area

New Green-Blue structure

Increase **49.1 km²** green space
Green space coverage 37.8% → **43.1%**

Increased green area
Existing green area

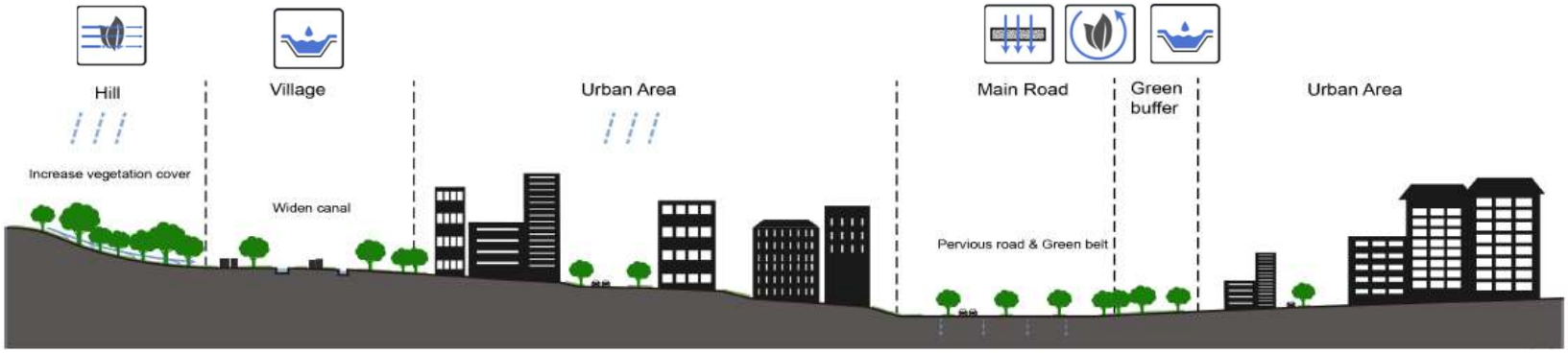
New Green-Blue structure- Overview



New Green-Blue structure with water strategy

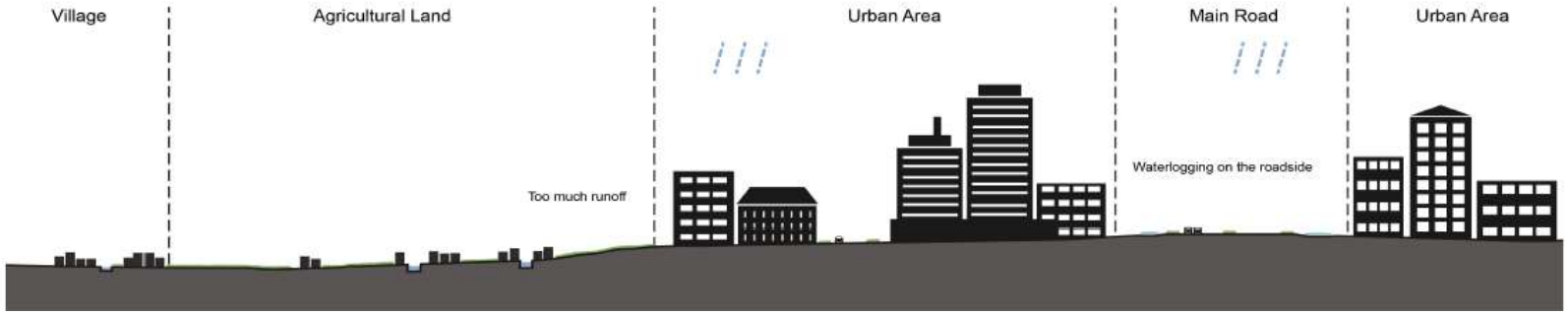
Current situation

Applying green & blue strategy

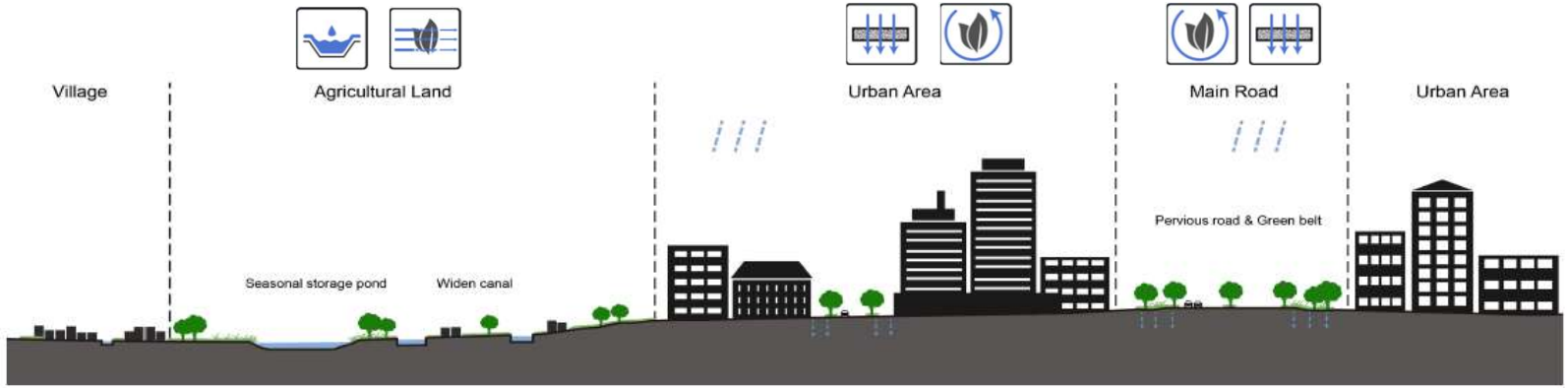


New Green-Blue structure with water strategy

Current situation



Applying green & blue strategy



Summary map

This neighborhood has **waterlogging problem**, and here is one of the **densest build-up area**.

At the same time, here are some **former industrial sites** are used to expand the green-blue structure.

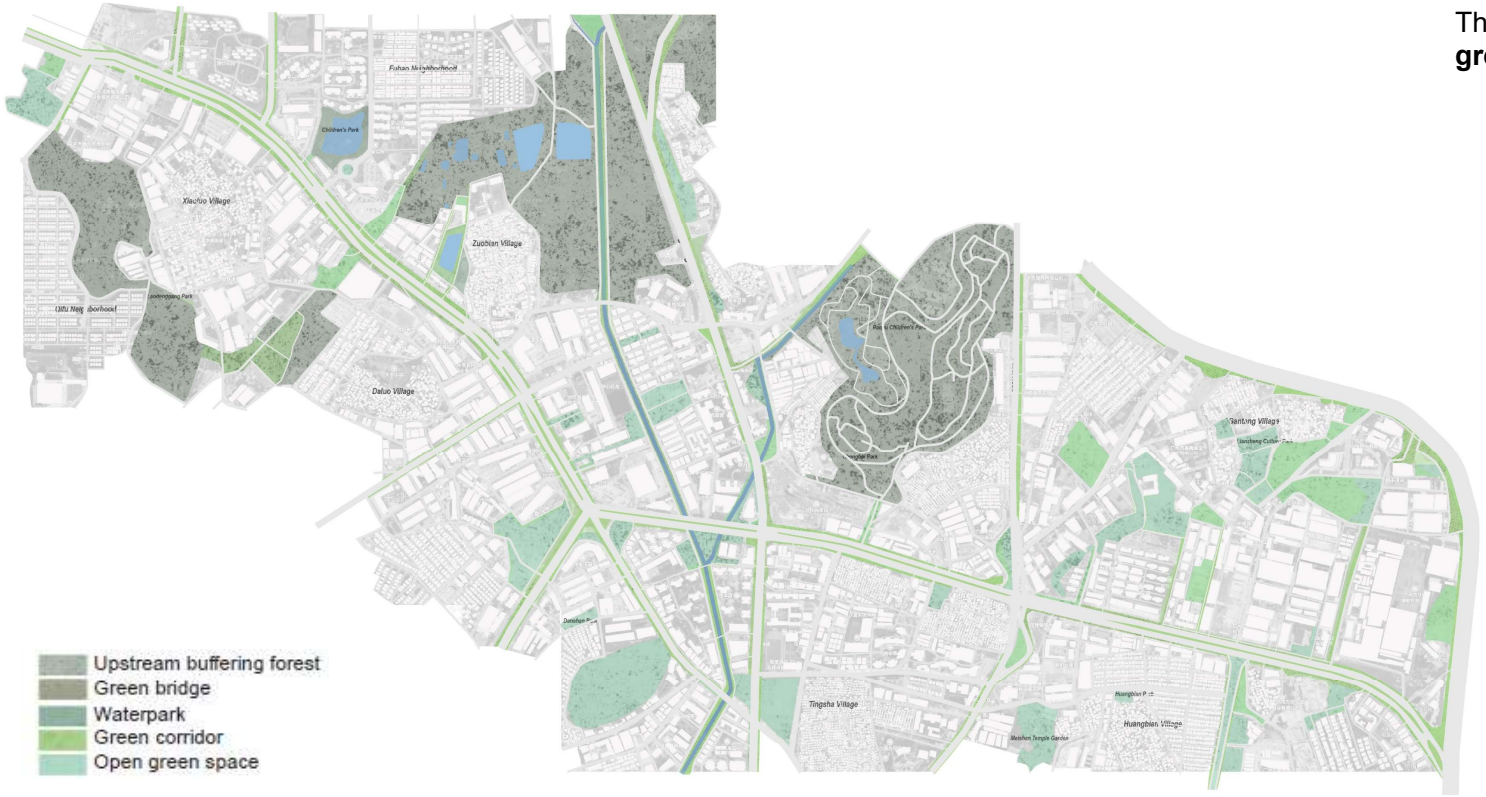
- Severe waterlogging
- Mild waterlogging
- Used industrial transformation area
- Used left-over 'buffer' spaces
- Existing green area

Meso Scale- Neighborhood

Existing Green-Blue structure with water analysis

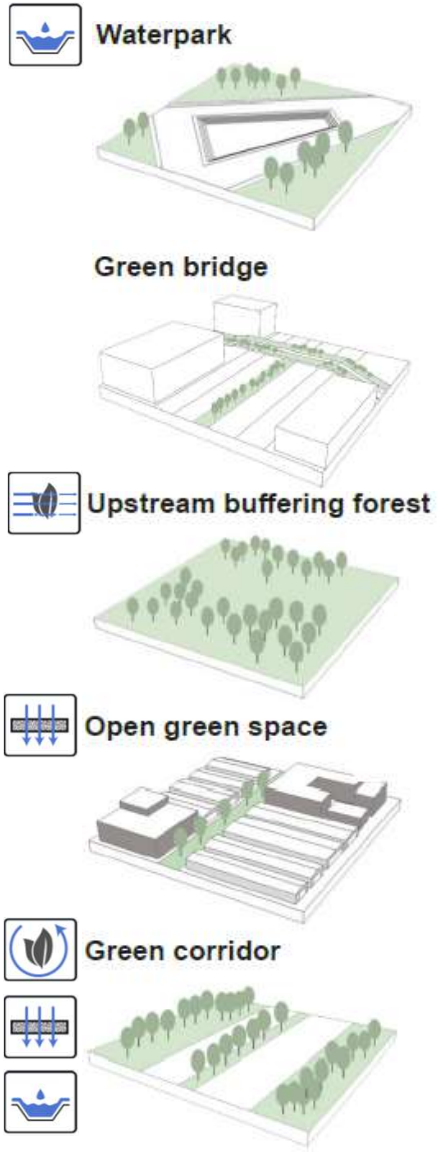
This map shows the **drainage direction** of water, and **the distribution of the waterlogging area**.

Expanded Green-Blue structure



This map is a more **detailed representation** of the new **green-blue structure** at the neighborhood scale.

Expanded Green-Blue structure with green typology (related to water strategy)



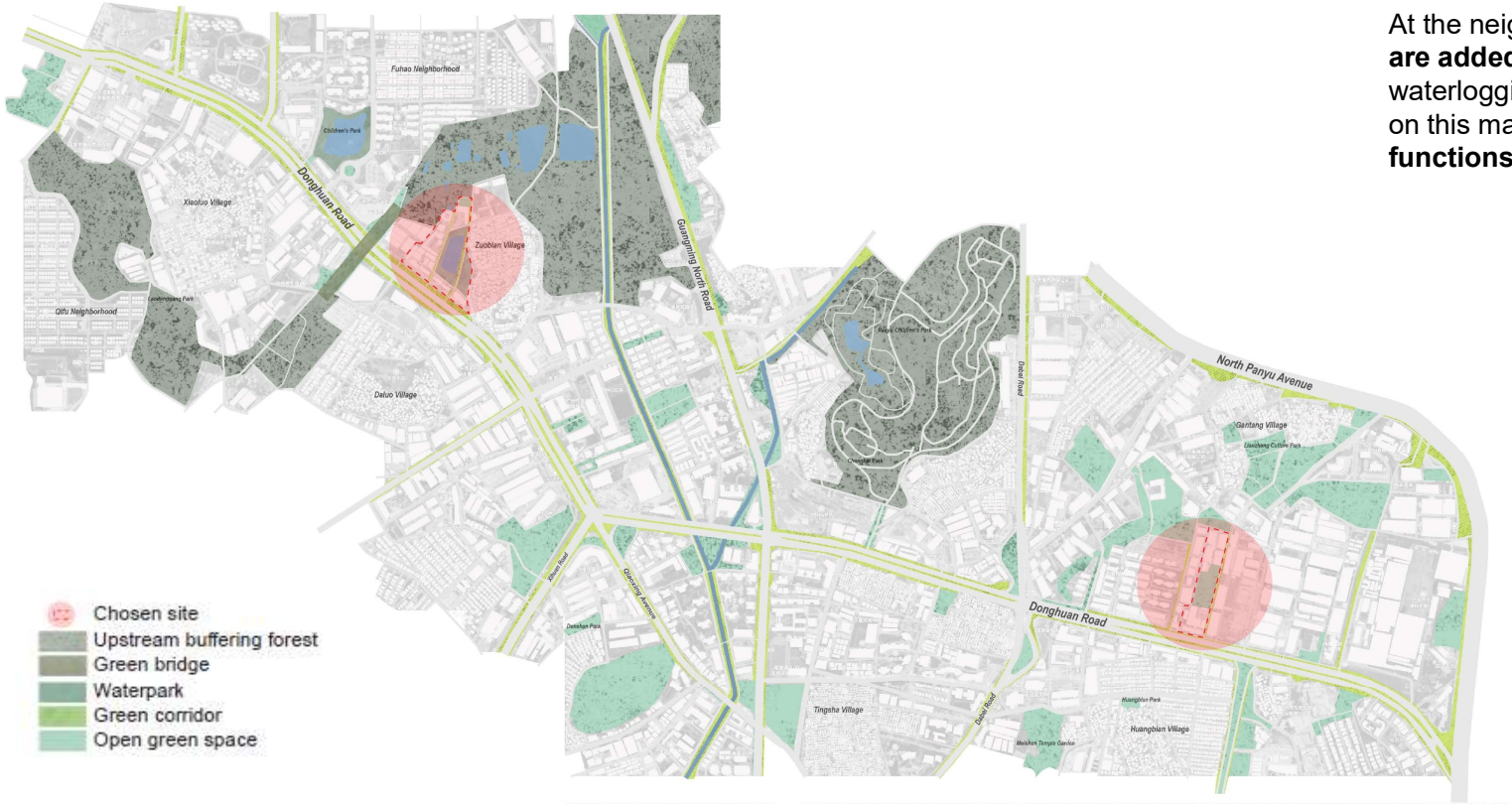
The green spaces in the new green-blue structure can be divided **into five categories related to their water functions** in the green-blue structure.

Expanded Green-Blue structure with water flow

After using the new green-blue structure, **the drainage direction** in this area has changed. The drainage problem that caused waterlogging was solved.

Vision

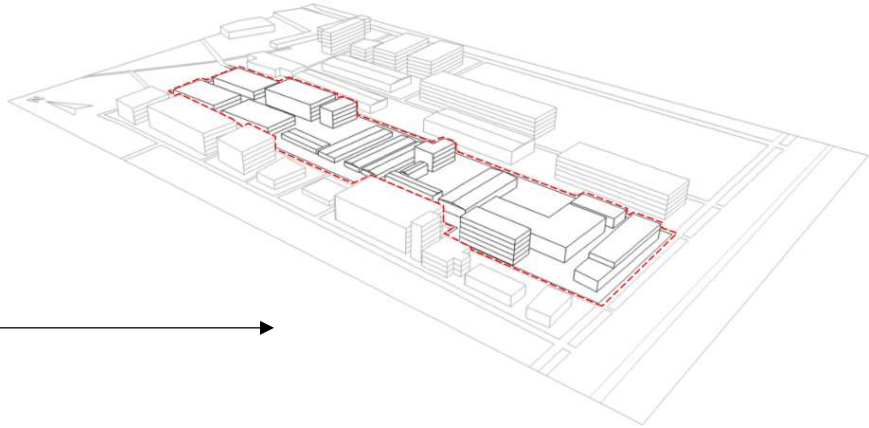
Chosen site



At the neighborhood scale, some **green and blue spaces are added** to build the green-blue structure and solve waterlogging problem. The chosen sites which are shown on this map are **different types** with **different water functions**.

Micro Scale- Chosen site

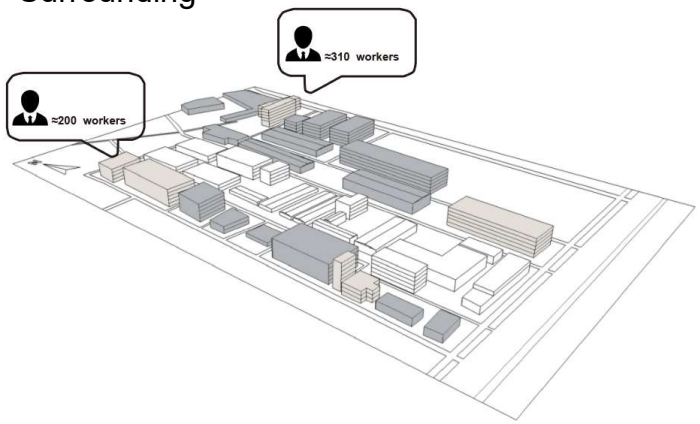
Green typology- Open green space



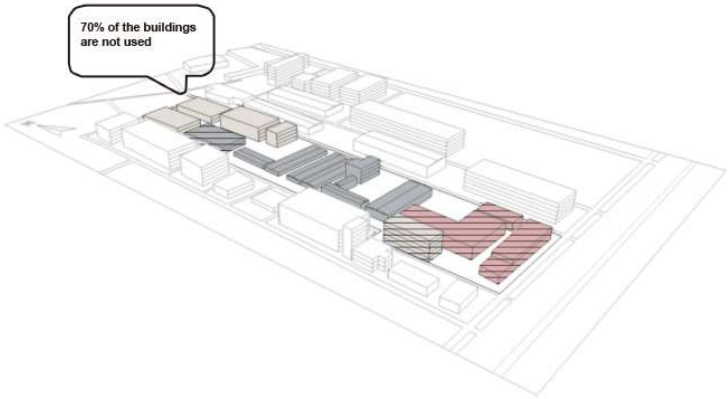
Public green space is one of the important elements of green-blue structure. They can **collect and purify rainwater** by plants based on their requests and they are entertainment places for the residents.

Site analysis

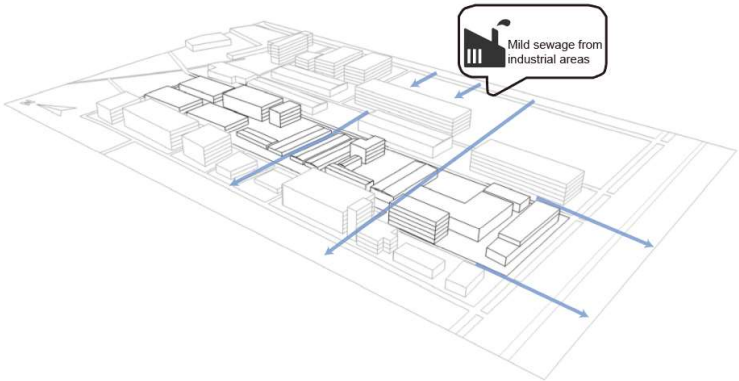
Surrounding



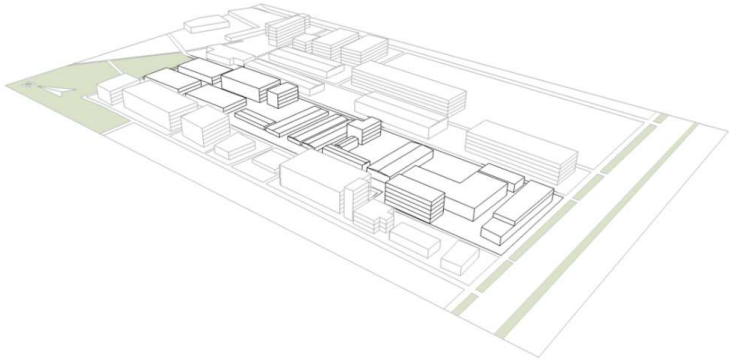
Inside



Waterlogging and water flow

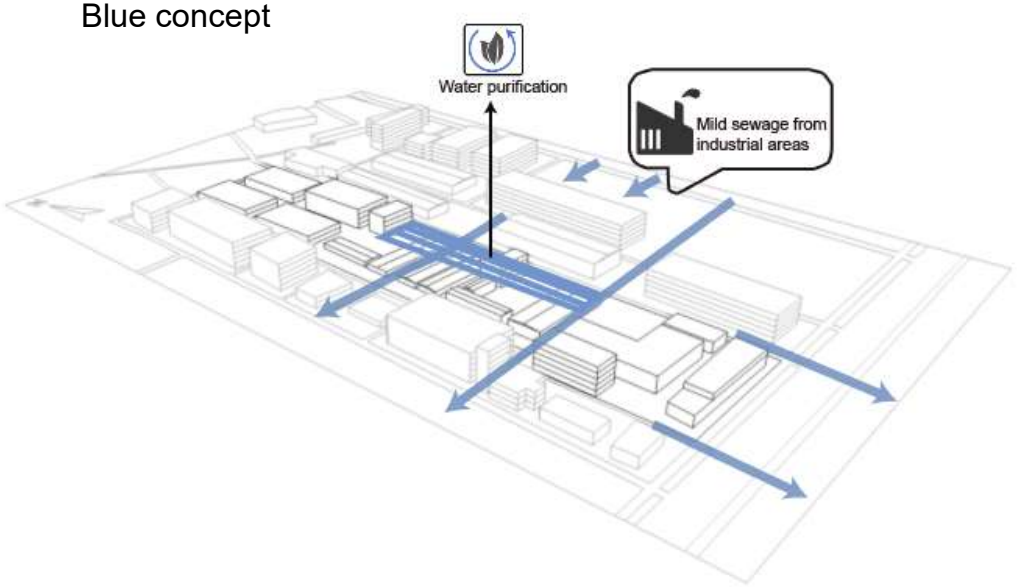


Existing green space



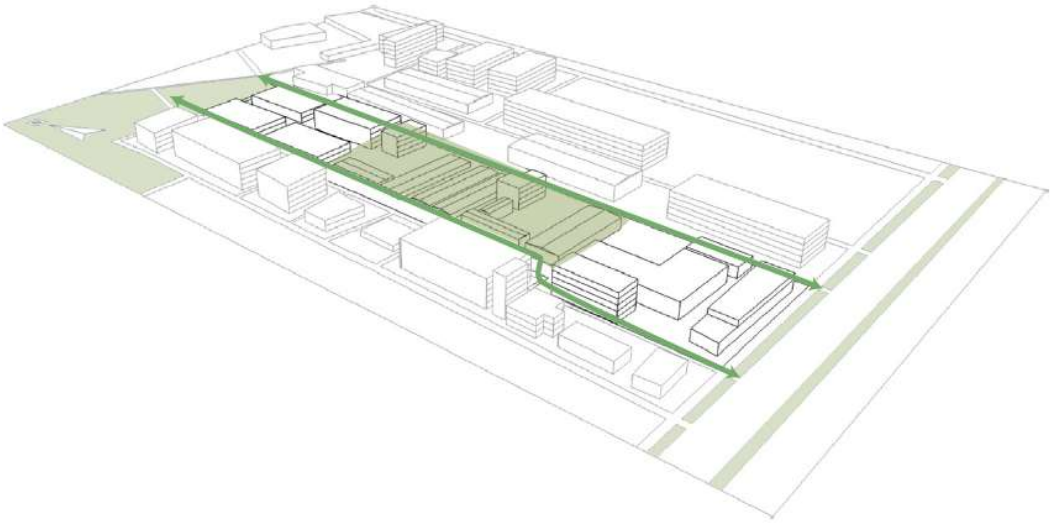
Design concept

Blue concept



Increase the water purification area to treat the ground sewage flowing from the factory.

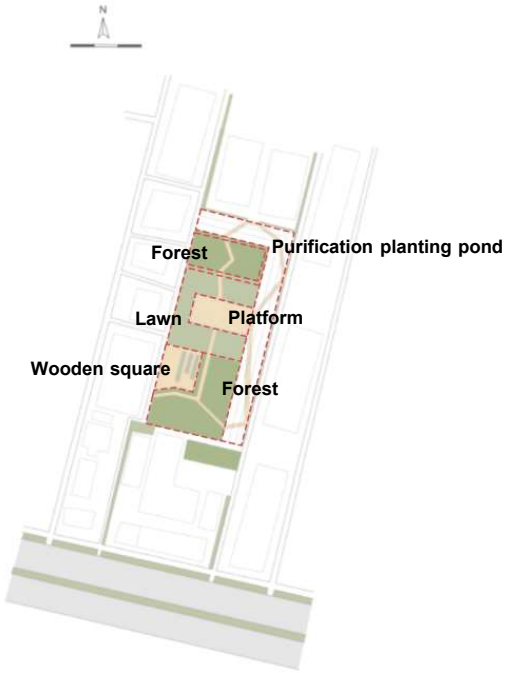
Green concept



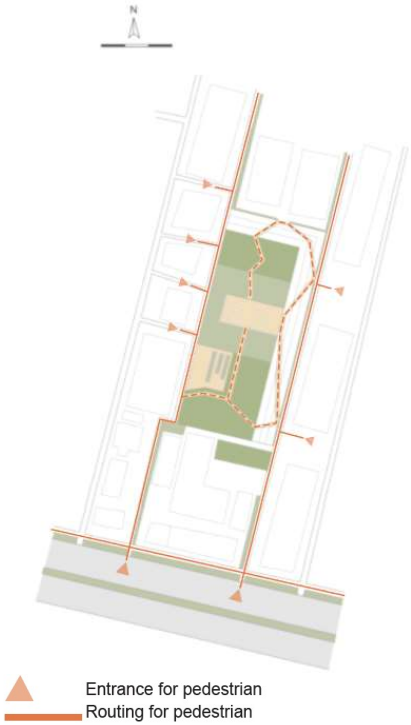
Increase the connection between green spaces.

Spatial design

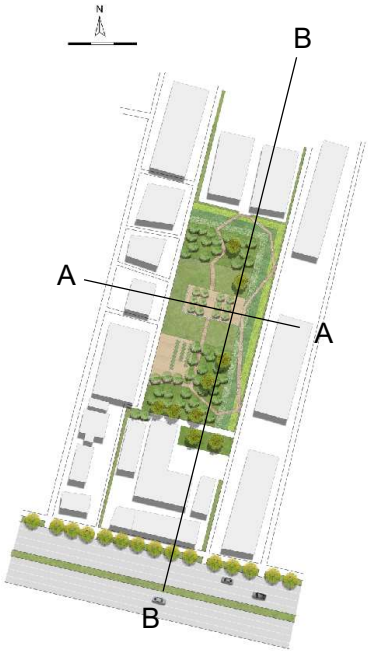
Spatial function



Routing

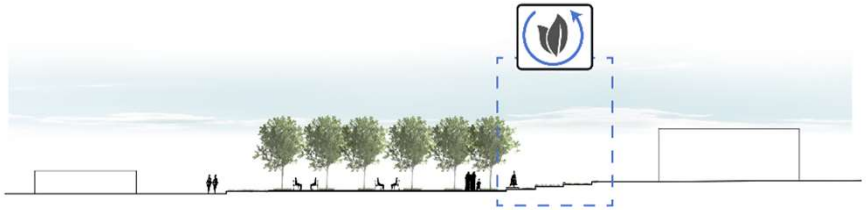


Spatial design



Section with water strategy

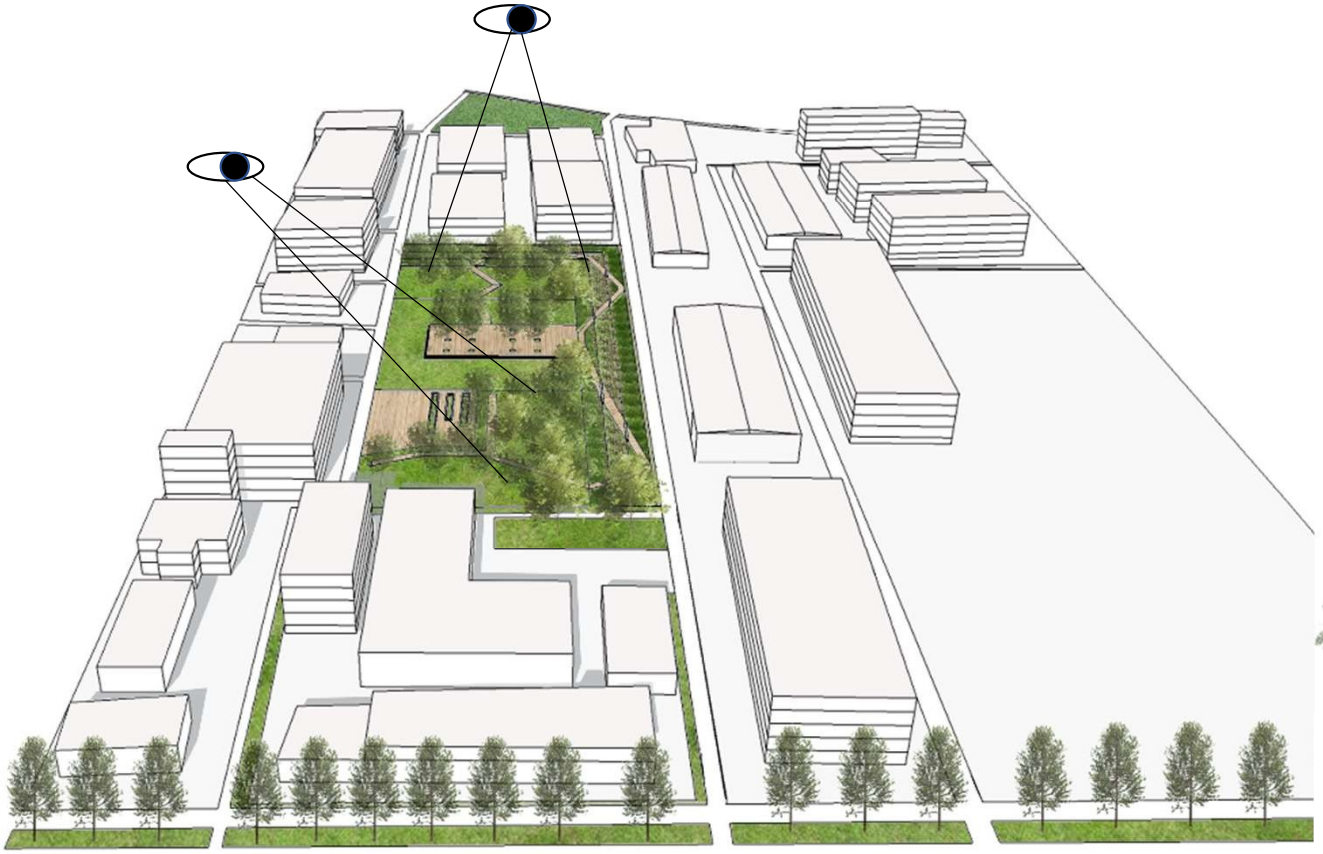
Section A-A



Detail of the purification planting pond

Section B-B

Spatial design



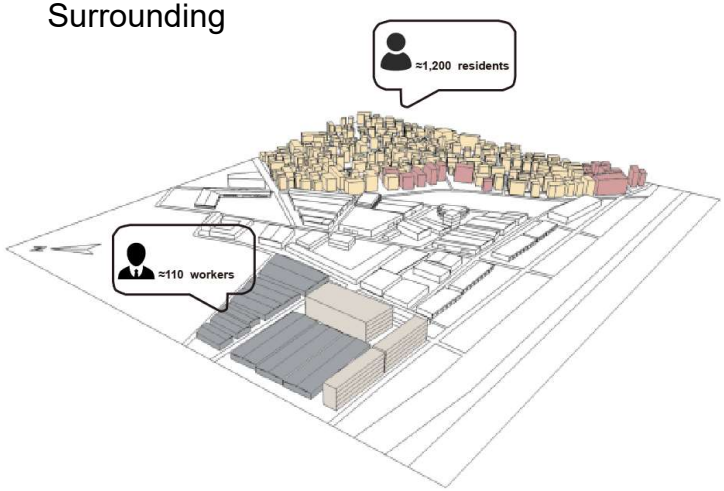
Eye-level Perspective

Green typology- Waterpark

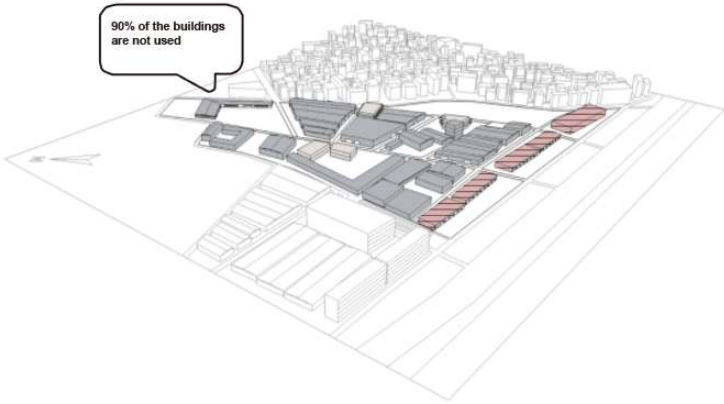
The water park can be used as a **public space** for residents' activities while being able to **store rainfall**. Because of the difference in the amount of rainwater collected, it can form various spaces and landscape views.

Site analysis

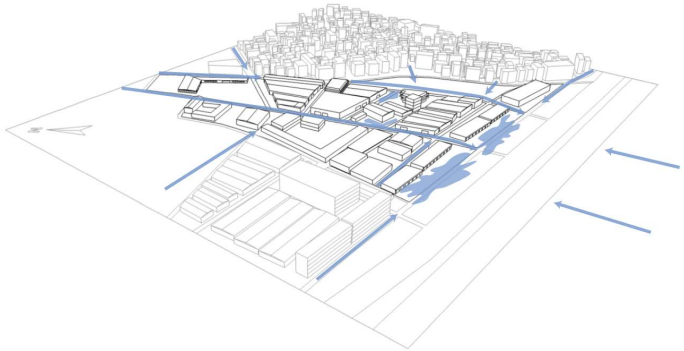
Surrounding



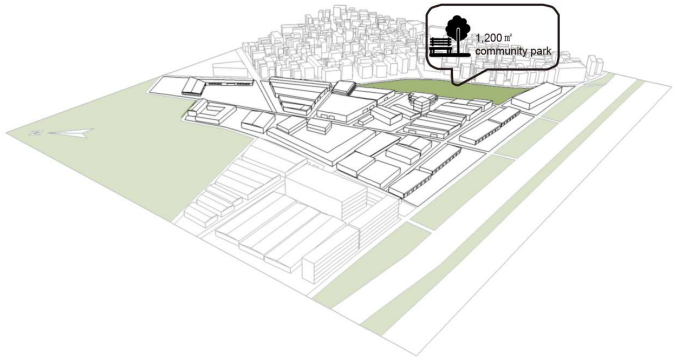
Inside



Waterlogging and water flow

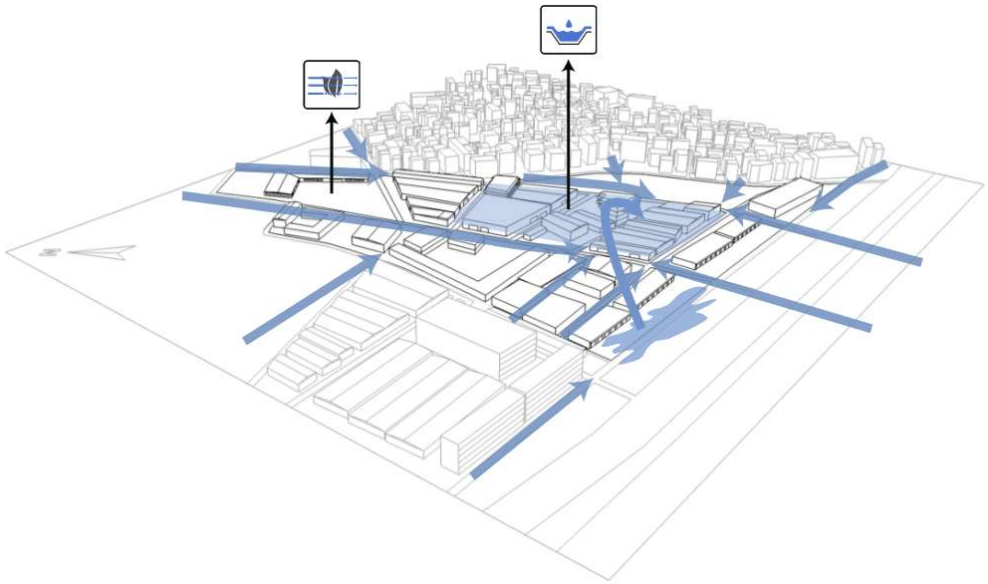


Existing green space



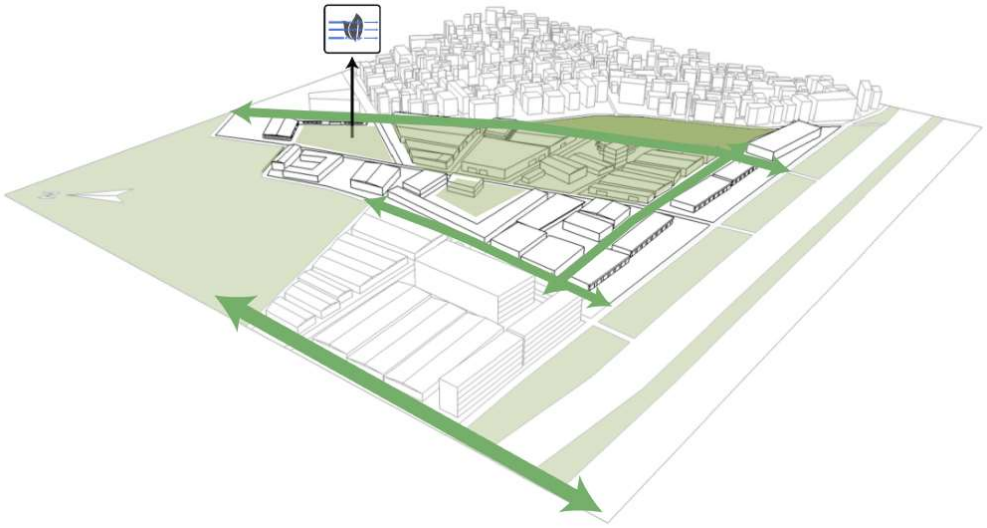
Design concept

Blue concept



Slow down runoff on the upstream area.
Increase the water storage area to alleviate the waterlogging problem.

Green concept

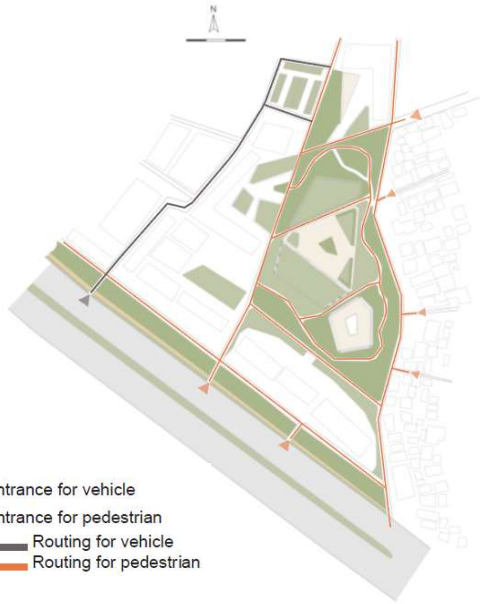


Increase (open) green space for the local residents.
Increase the connection between green spaces.

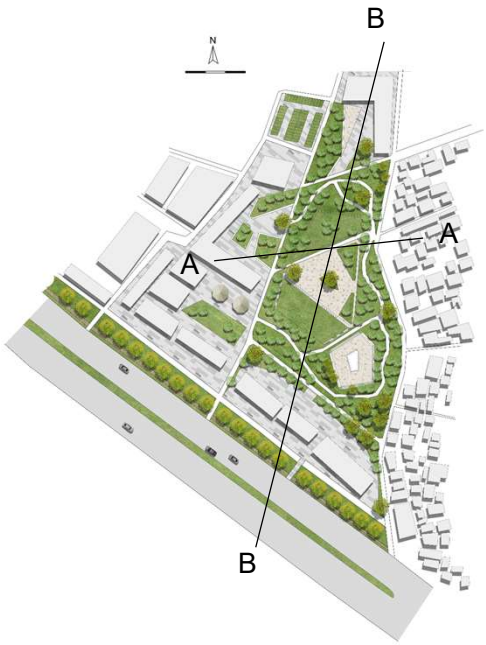
Spatial design

Spatial function

Routing

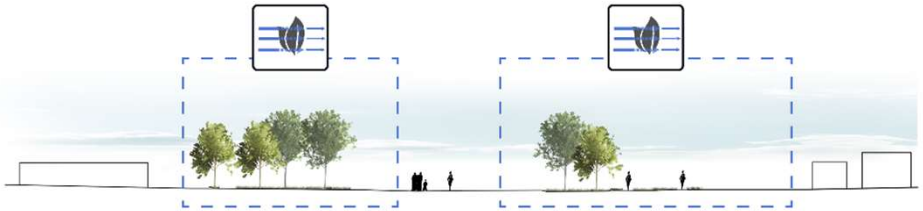


Spatial design

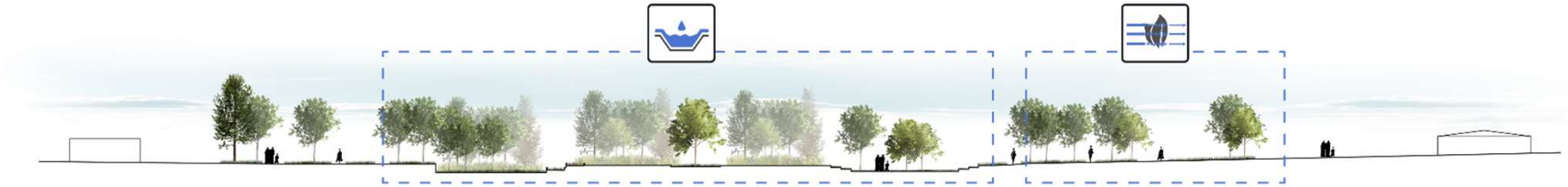


Section with water strategy

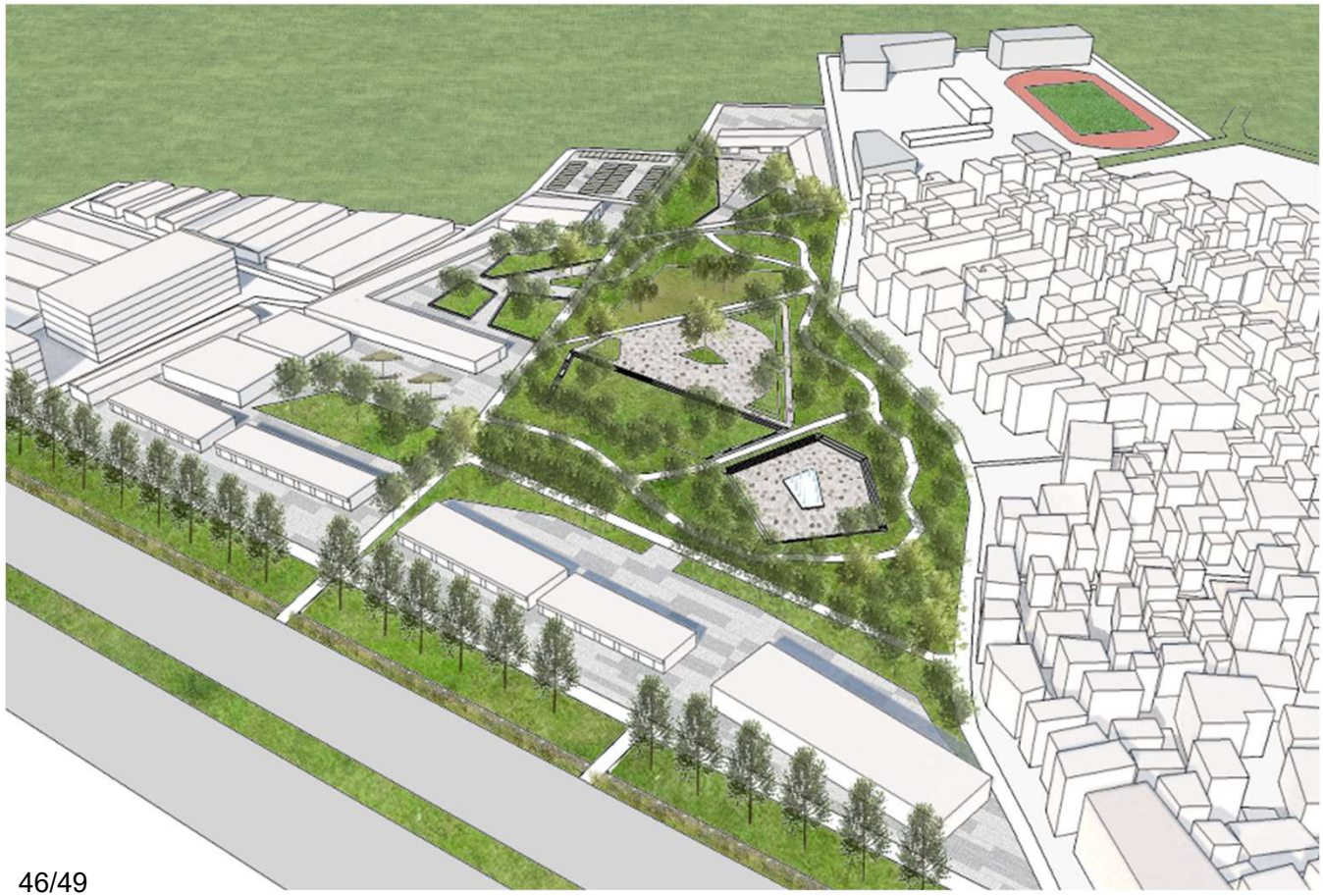
Section A-A



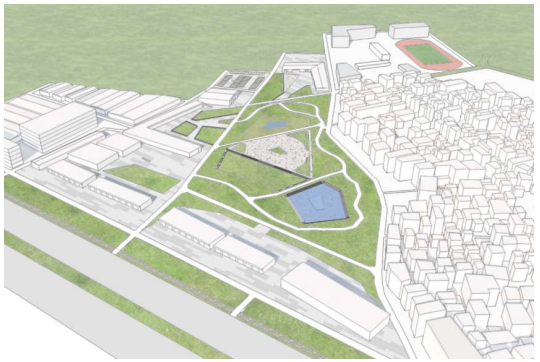
Section B-B

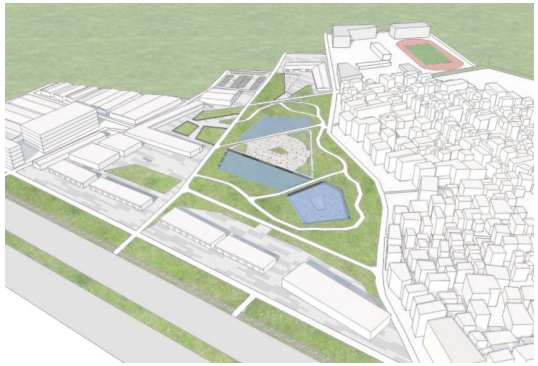


Spatial design

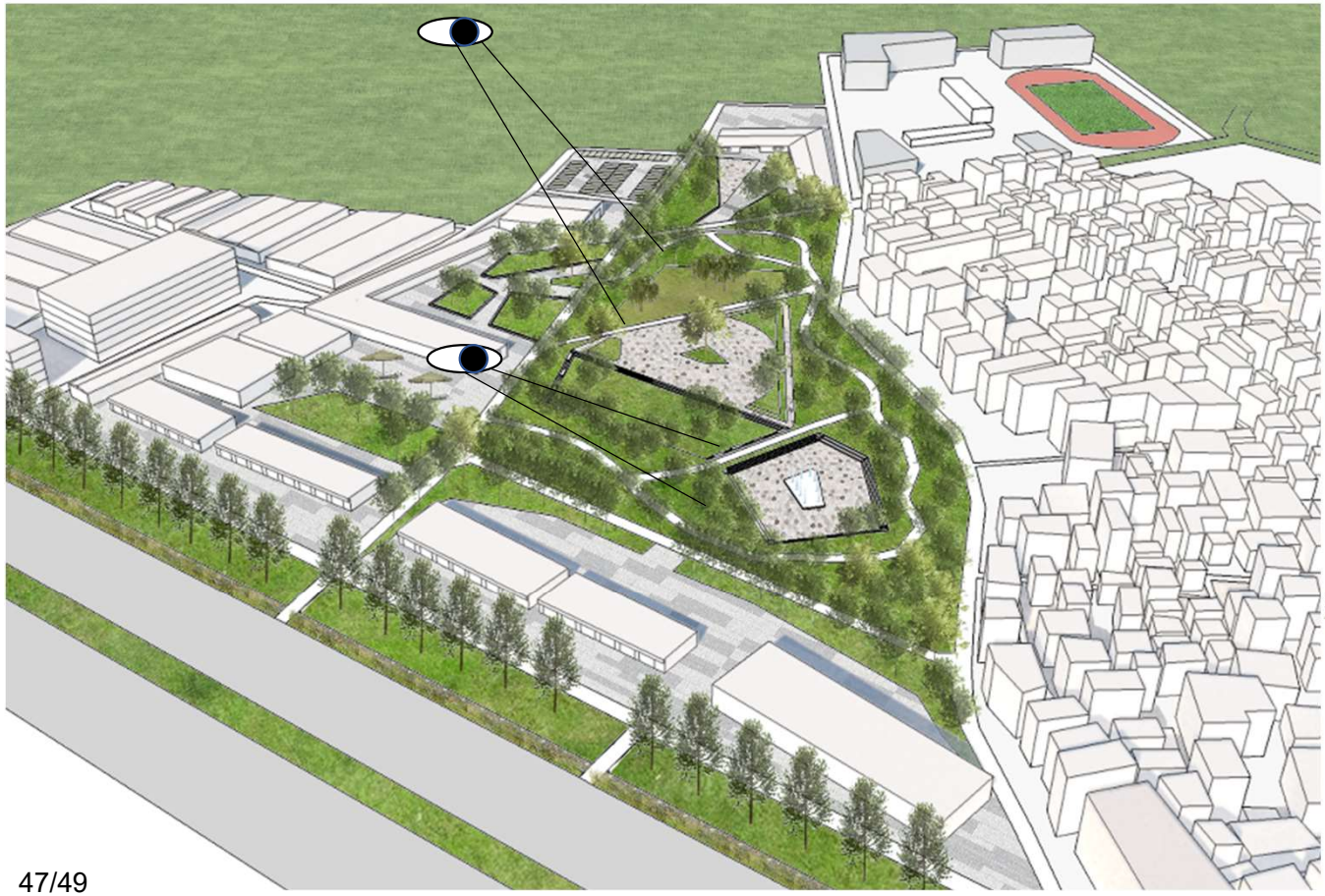


Flooding area





Spatial design



Eye-level Perspective

Vision

Reflection

Sub Questions	Theoretical Approach	Reflection
How to improve the sponge capacity of the city?	Case study - Copenhagen drainage and corrosion prevention Plan	Increasing green spaces and water bodies by **reusing left-over buffer spaces and former industrial areas** **Four water strategies**
How can industrial transformation support to resolve the waterlogging problem?	Literature - *"Performance Evaluation-oriented" Thoughts on the Integration and Transformation of Low-Efficiency Village-level Industrial Parks: Taking Guangzhou as an Example*	Reclamation of (functional conversion) former industrial sites, which are **located in the high density urban area or close to roads**
How can a landscape approach be used to improve the sponge capacity of the city?	Landscape as infrastructure Green-Blue infrastructure	Creating **connected Green-Blue structure**
How can the new green and blue infrastructure improve the living quality of the city districts?	Case study	When designing chosen sites, creating green spaces into **public spaces**, not only the water machine.

Thank you!