Reviving Ponds in the Urban Network

Towards Resilient Water Landscapes for Taoyuan county

Circular Water Story Lab
Yi-Tang, Kao
1st mentor- Inge Bobbink
2cd mentor -Cinco Yu

2021/06/29

Understand

Recognize

Compose

Reflect

Understand

Recognize
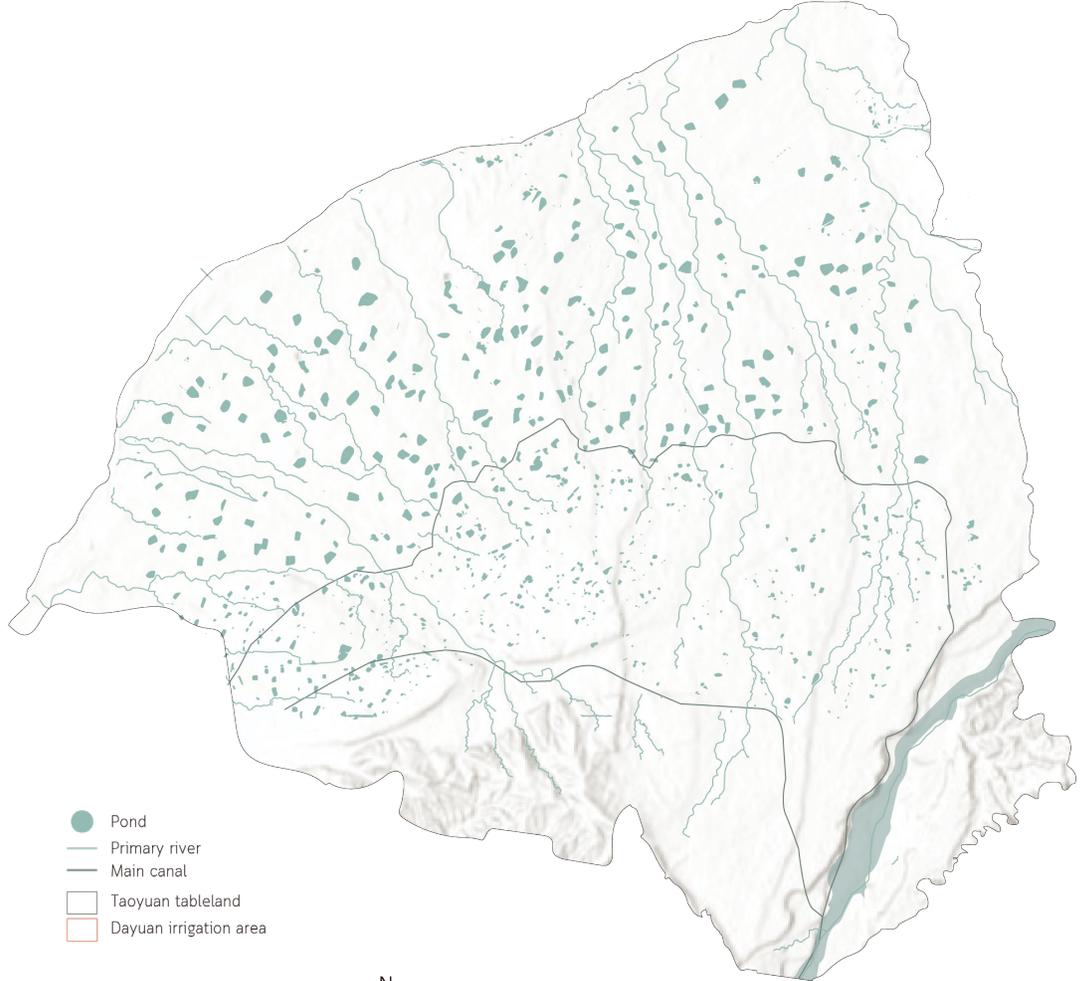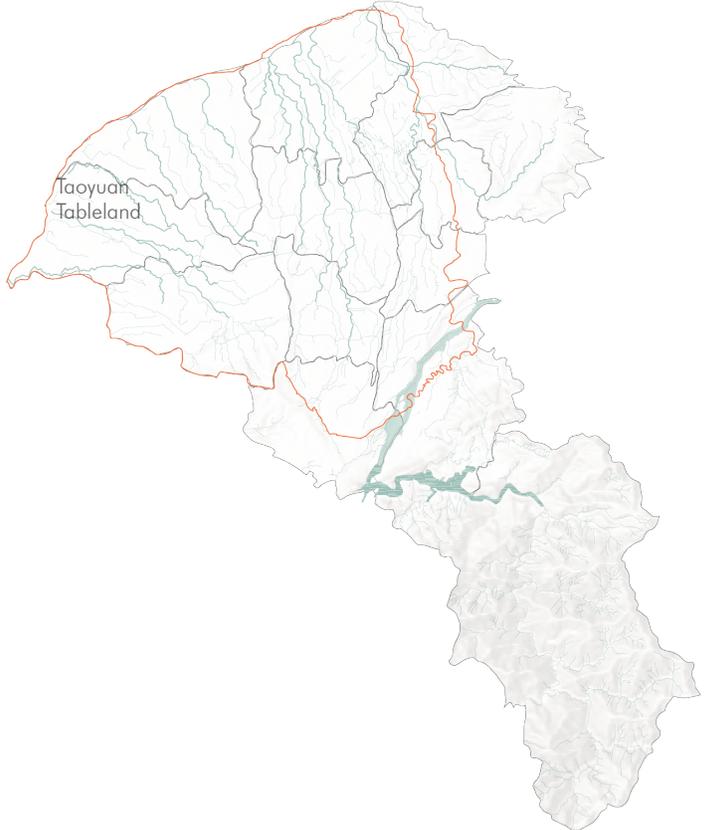
Compose

Refelct

Pond landscape

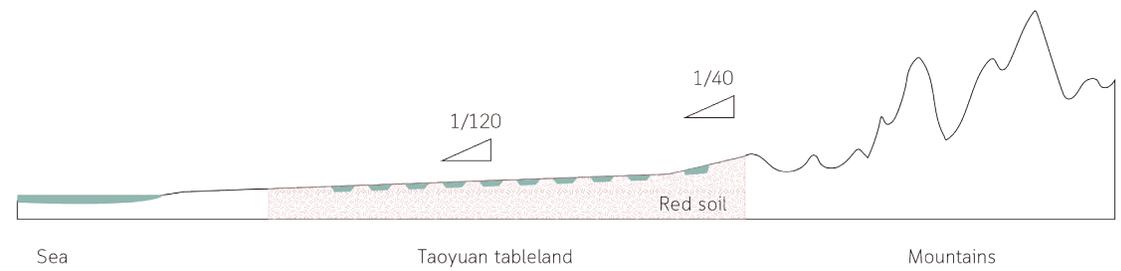Source: Center for Geographic Information Science, 2016

Taoyuan
Tableland

Taoyuan
county

Pond
Primary river
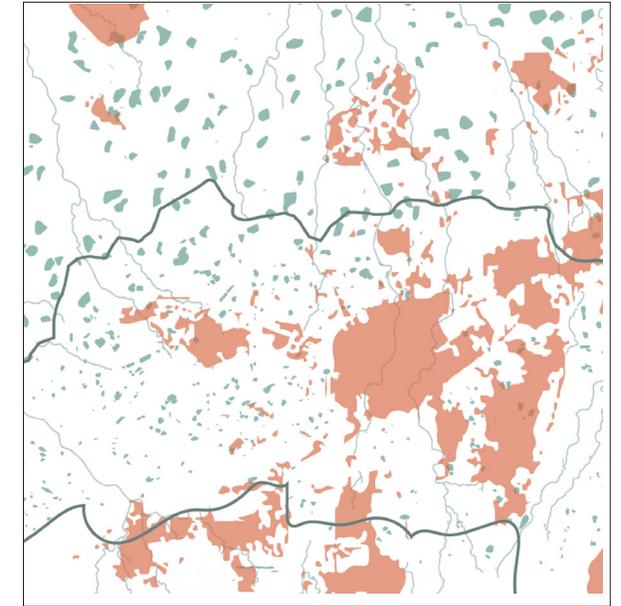Main canal
Taoyuan tableland
Dayuan irrigation area

0   3   6 km

N

Mysterious landscape

Topographic and geological conditions

Sea

Red soil

Pond

Reservior

0   5

1/120

1/40

Red soil

Sea   Taoyuan tableland   Mountains

The farm pond irrigation system

Taoyuan main canal
system (1925)

Shih-Men main
canal system
(1956)

Shih-Men
Reservoir

Flow
Reservior
Primary rivers
Ponds
Tao-Yuan main canal
Tao-Yuan branch canal
Shih-Men main canal
Shih-Men branch canal
Tableland area

0   5

Main canal connects with ponds   Reservoir

7/86
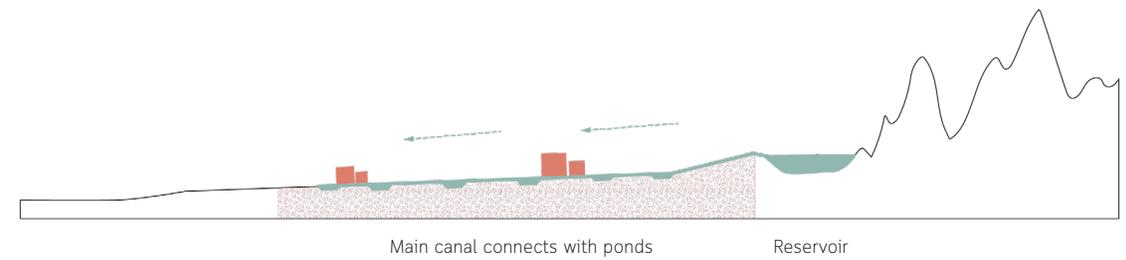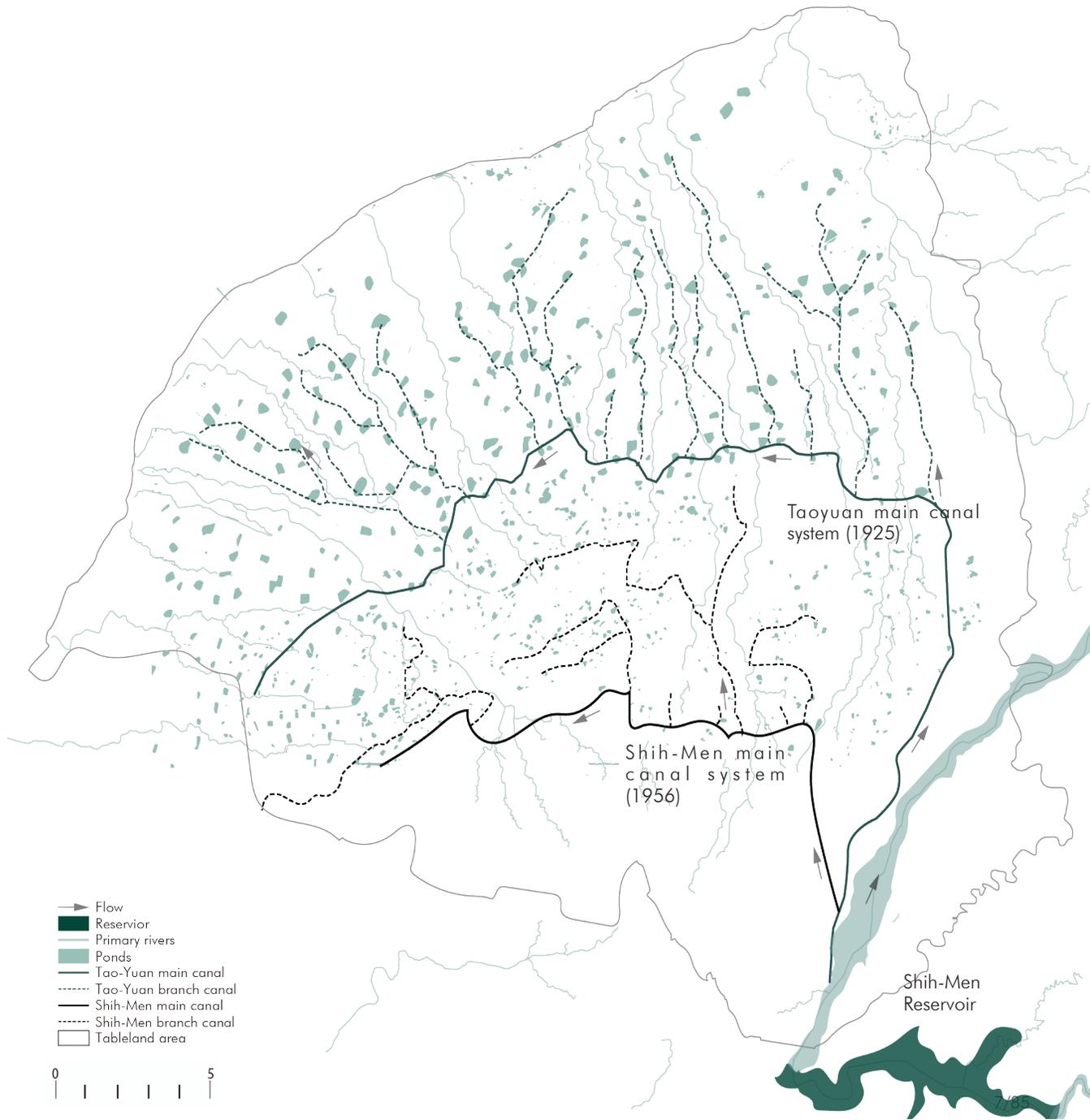
Landscape transformation

Pond
Building
Primary river
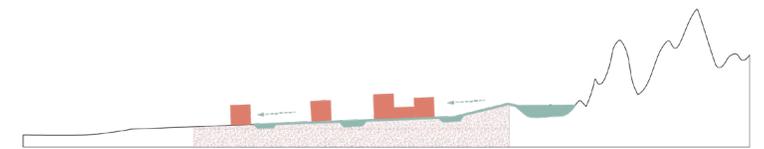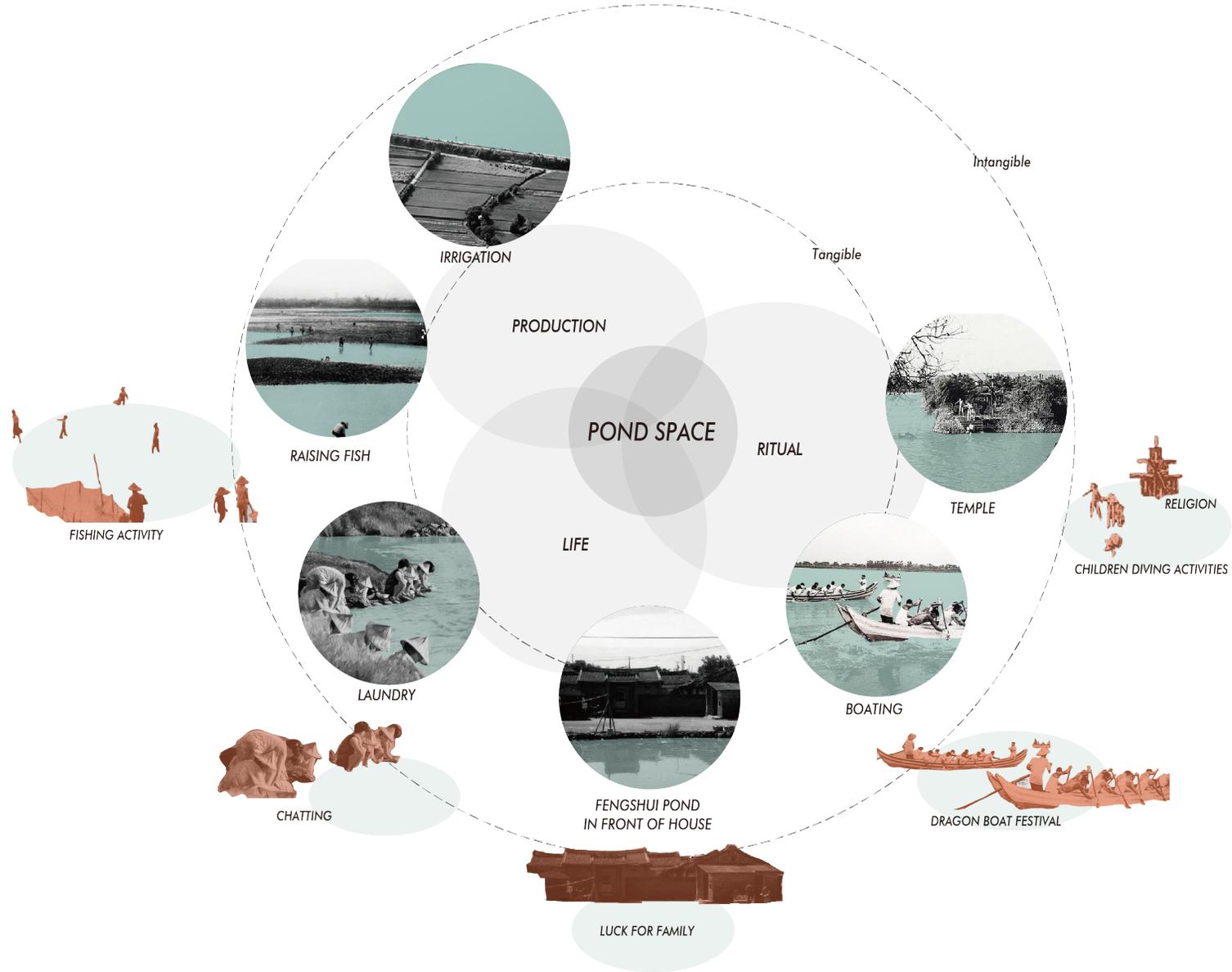Main canal
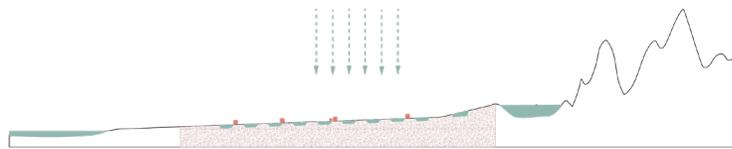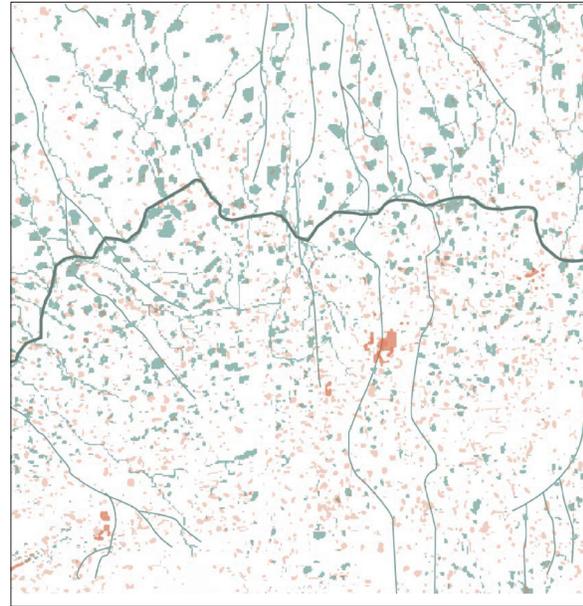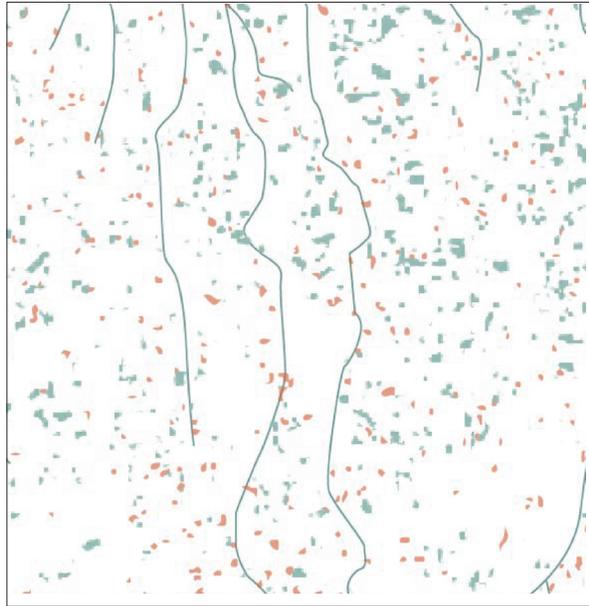
1906
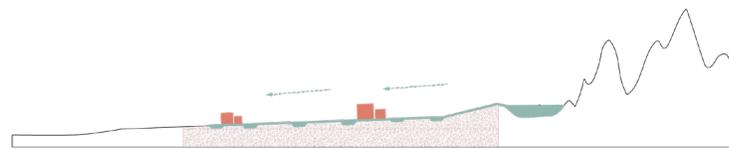
1960

2020

1 Pond from small to larger
2 Pond from individual to connect
3 Pond from excavating to refilling

IRRIGATION

RAISING FISH

FISHING ACTIVITY

PRODUCTION

Intangible

Tangible

POND SPACE

RITUAL

TEMPLE

RELIGION

CHILDREN DIVING ACTIVITIES

LIFE

LAUNDRY

BOATING

CHATTING

FENGSHUI POND
IN FRONT OF HOUSE

DRAGON BOAT FESTIVAL

LUCK FOR FAMILY

Current pondscape

Less diverse

Pond Disappearance

Rapid Urban Expansion
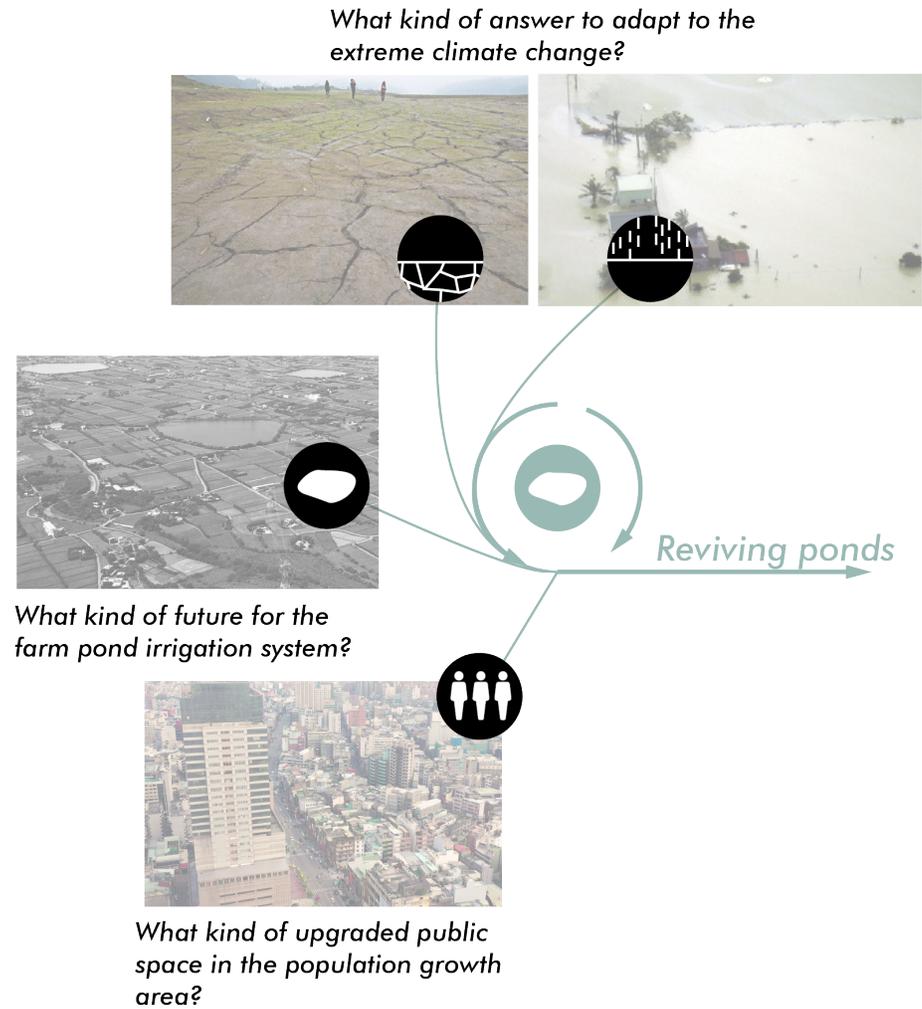
Vlnerability to climate change

Only left 16% of ponds
compared to 1904

6.5 times of population
compared to 1960

Wet season rainfall will
increase by 14% to 20% and
decrease in dry season

What kind of answer to adapt to the extreme climate change?

What kind of future for the farm pond irrigation system?

Reviving ponds

What kind of upgraded public space in the population growth area?

It led to the problem statement of this thesis as follow:

"Ponds used to be the center of People's lives, but now it's left in the corner or even disappear. As facing future challenges, it is needed to take ponds back. Through reviving ponds, the city can be more robust."
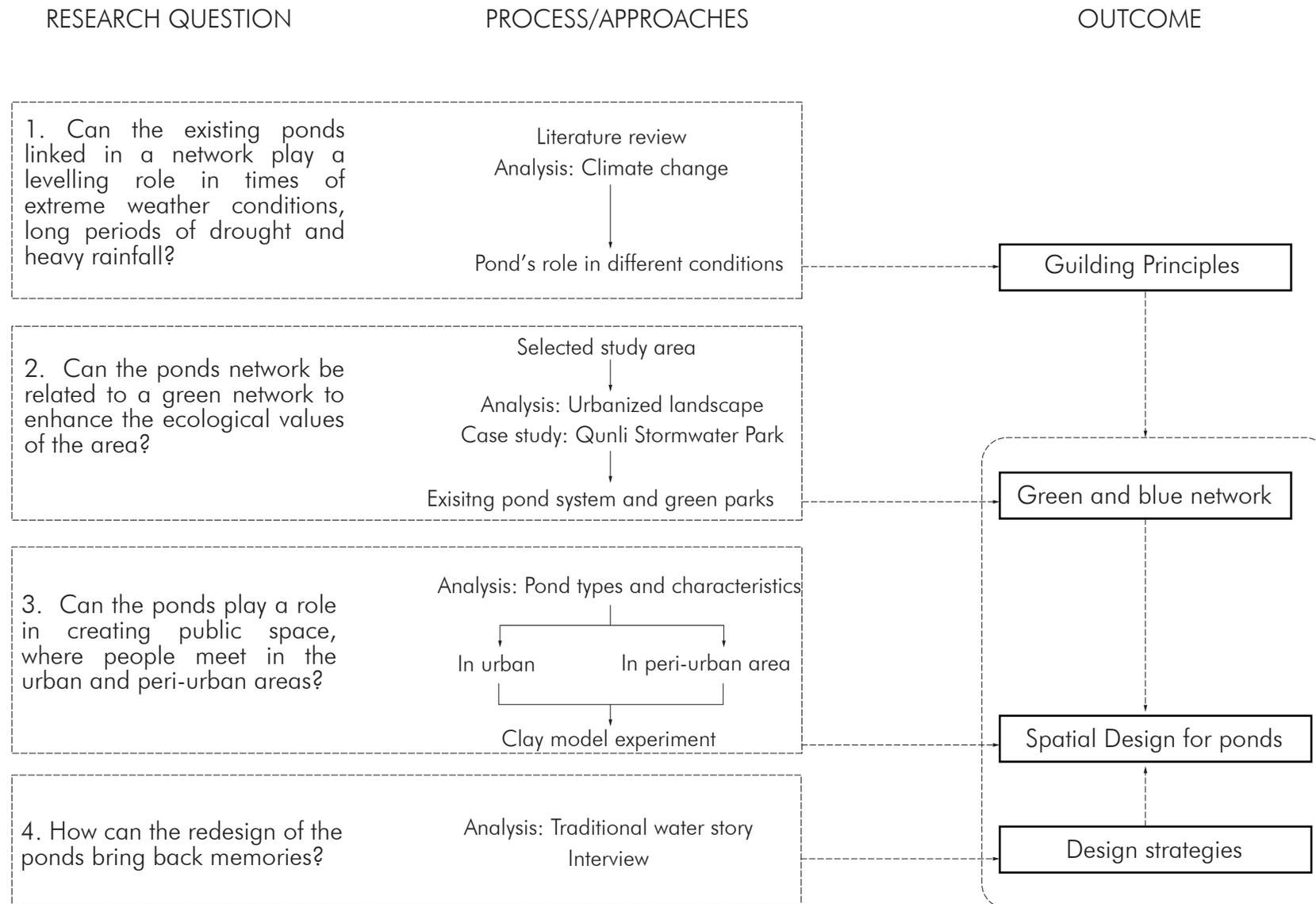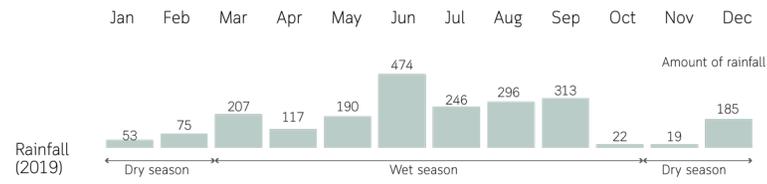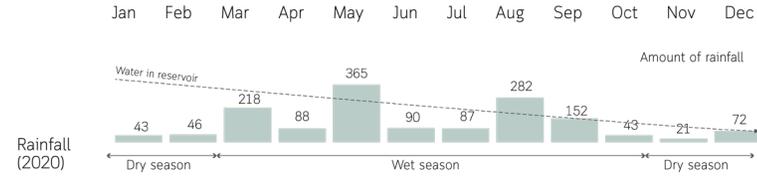
Understand

Recognize

Compose

Reflect

Research question

"
How to incorporate the existing ponds of Taoyuan County to make the area more climate adaptive and enhance the public space?
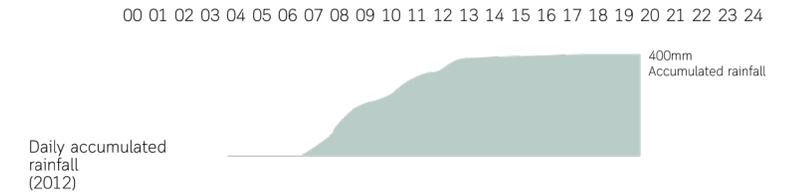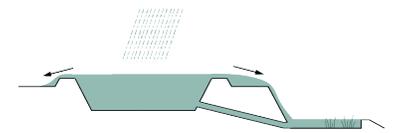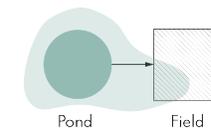"

RESEARCH QUESTION   PROCESS/APPROACHES   OUTCOME

1. Can the existing ponds
linked in a network play a
levelling role in times of
extreme weather conditions,
long periods of drought and
heavy rainfall?

Literature review
Analysis: Climate change

Pond's role in different conditions ┄┄┄┄ Guilding Principles

2. Can the ponds network be
related to a green network to
enhance the ecological values
of the area?

Selected study area

Analysis: Urbanized landscape
Case study: Qunli Stormwater Park

Exisitng pond system and green parks ┄┄┄┄ Green and blue network

3. Can the ponds play a role
in creating public space,
where people meet in the
urban and peri-urban areas?

Analysis: Pond types and characteristics

In urban   In peri-urban area

Clay model experiment ┄┄┄┄ Spatial Design for ponds

4. How can the redesign of the
ponds bring back memories?

Analysis: Traditional water story
Interview

┄┄┄┄ Design strategies

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Amount of rainfall

474

207
190
117   246 296 313
75
53   22   19   185

Rainfall
(2019)

Dry season   Wet season   Dry season

NORMALCY

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Amount of rainfall

Water in reservoir
365
218   282
88   152
43 46   90   87   43   21   72

Rainfall
(2020)

Dry season   Wet season   Dry season

DROUGHT

00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

400mm
Accumulated rainfall

Daily accumulated
rainfall
(2012)

FLOOD

Pond   Field

Water
purification
plant   Pond   Field

Pond   Field

Selected area

2040
Taoyuan Aerotropolis
Value-added agriculture

2020
High speed rail
Taoyuan station district

2036

The highway Zhongli and
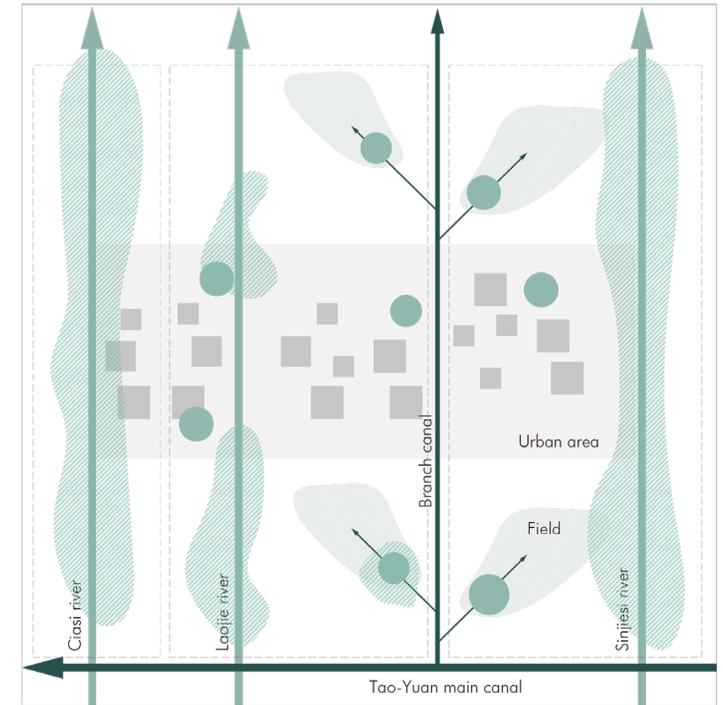interchange Special district plan

The projected population in the area will reach 60,000
by 2036.

0   0.5   1km   N

Irrigation and the canal network
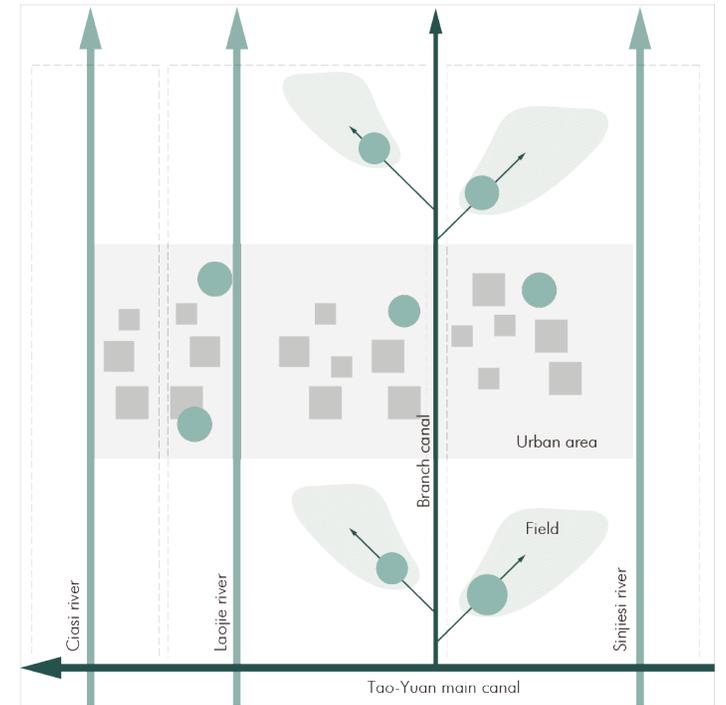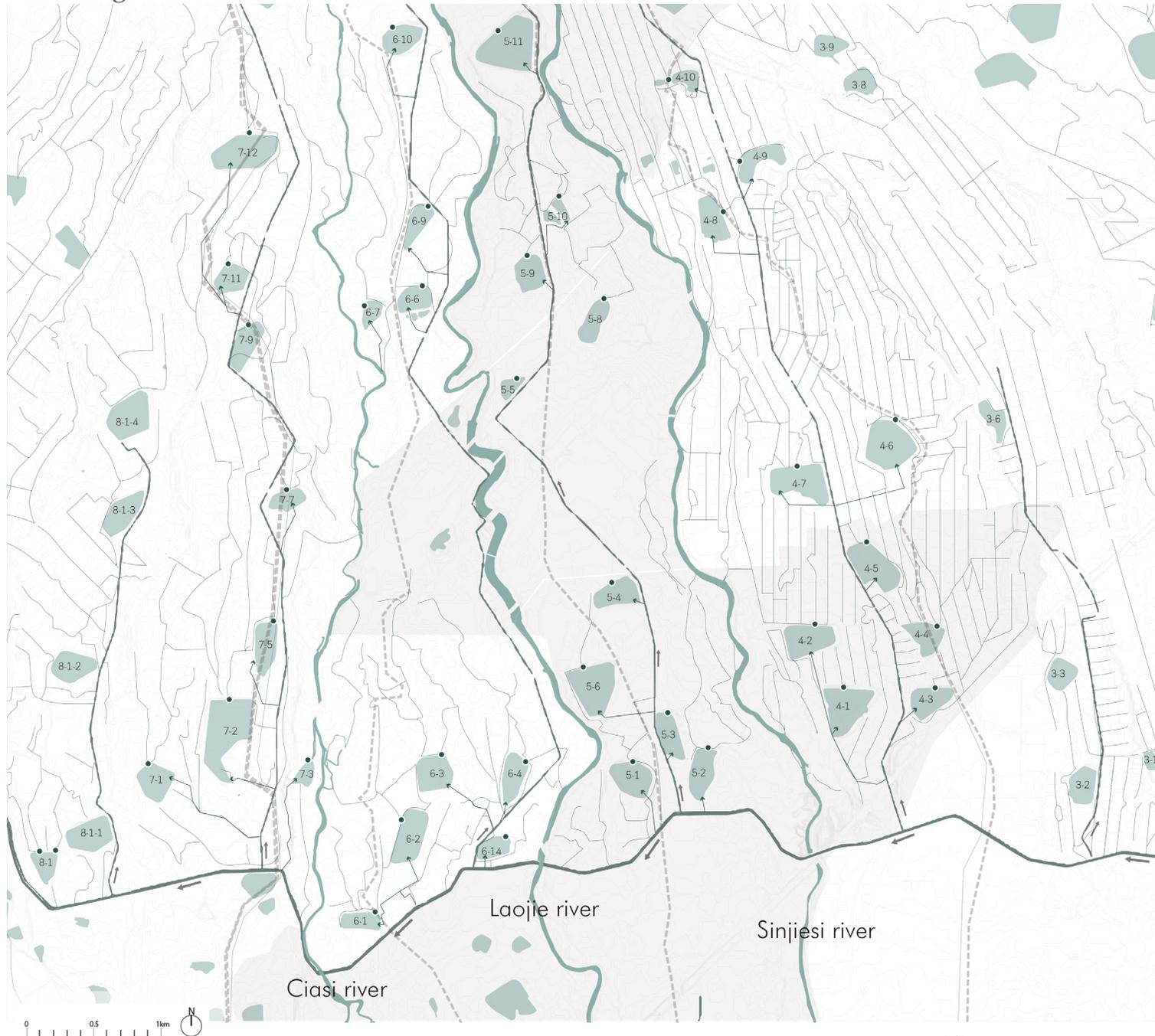
6-10
5-11
3-9
4-10
3-8
7-12
4-9
6-9
5-10
4-8
7-11
6-7 6-6
7-9
5-9
7-7
5-8
5-5
8-1-4
3-6
4-6
8-1-3
4-7
7-5
4-5
8-1-2
5-4
3-3
7-2
4-2 4-4
5-6 4-1 4-3
7-1 7-3
5-3
8-1-1
6-3 6-4 5-1 5-2
3-2
8-1
6-2
6-14
6-1

Laojie river

Sinjiesi river

Ciasi river

0   0.5   1km   N

18/85

Ciasi river
Laojie river
Branch canal
Urban area
Field
Sinjiesi river
Tao-Yuan main canal
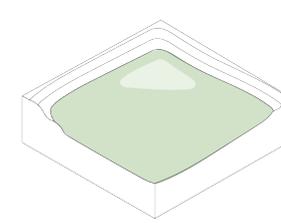
Flow
Primary rivers
Ponds
Outlet
Tao-Yuan primary canal
Tao-Yuan secondary canal
Tao-Yuan tertiary canal
Ditches
Drainage catchment area
Fields
Project focused area

Potential inundation
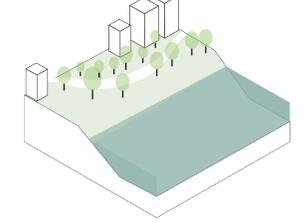

Ciasi river

Laojie river

Sinjiesi river

Ciasi river

Laojie river

Branch canal

Urban area

Field

Sinjiesi river

Tao-Yuan main canal

0   0.5   1km   N
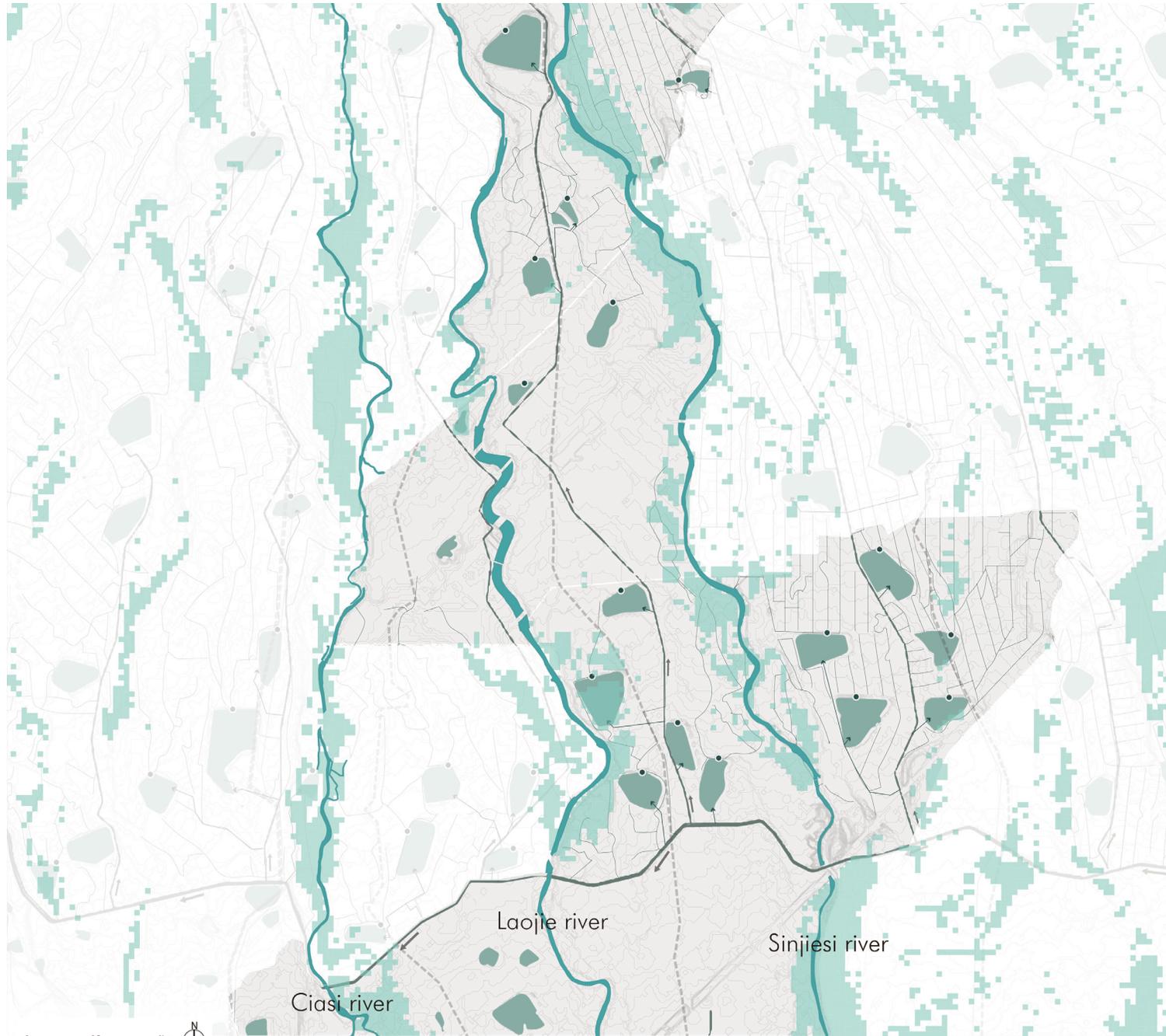
Flow
Primary rivers
Ponds
Outlet
Tao-Yuan primary canal
Tao-Yuan secondary canal
Tao-Yuan tertiary canal
Ditches
Drainage catchment area
Fields
Project focused area
24hr, 500mm
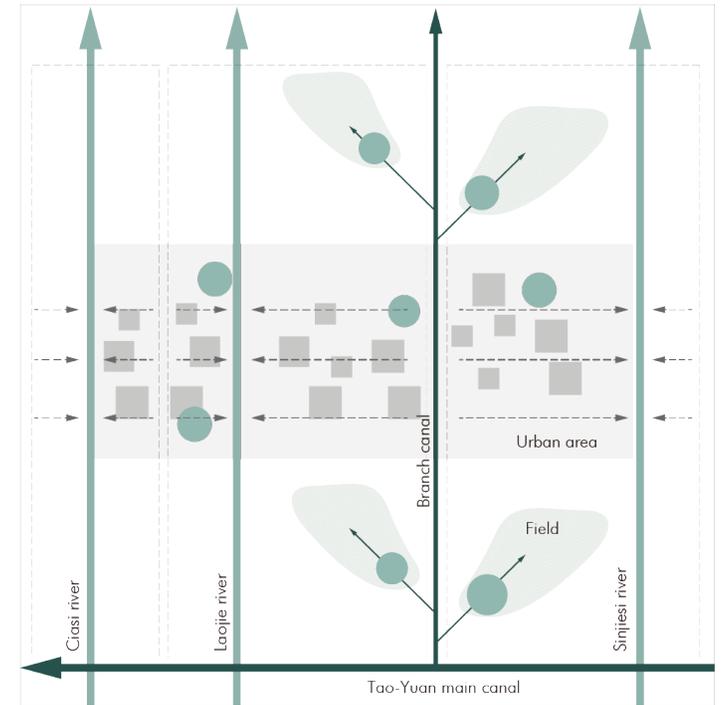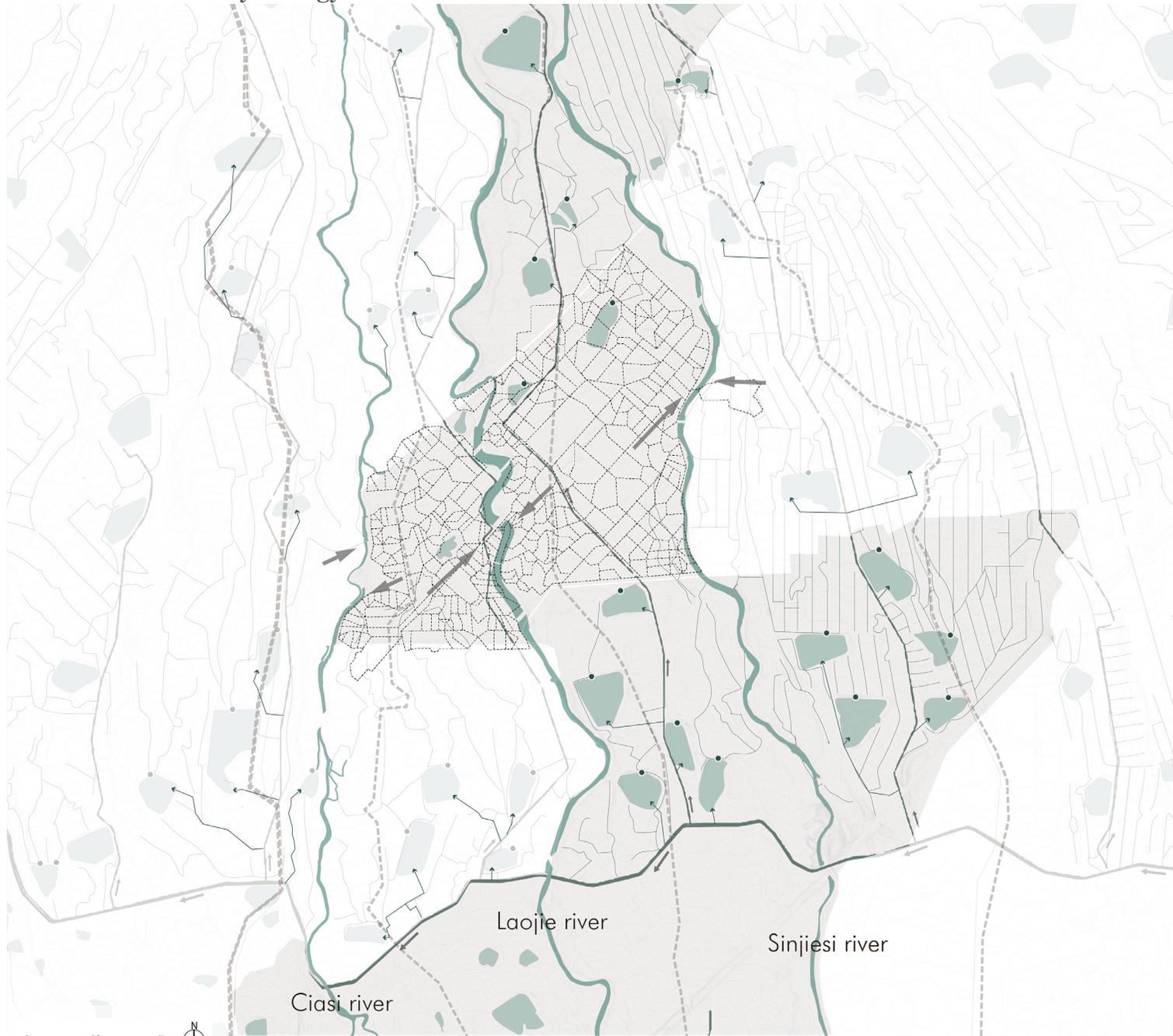
Disturbance hydrology

Flow
Primary rivers
Ponds
Outlet
Tao-Yuan primary canal
Tao-Yuan secondary canal
Tao-Yuan tertiary canal
Ditches
Drainage catchment area
Fields
Project focused area

Ciasi river
Laojie river
Sinjiesi river

Branch canal
Urban area
Field
Tao-Yuan main canal

Fragmentation of urban green space

- Community park
- Baseball field
- River park
- Pond park
- Green field
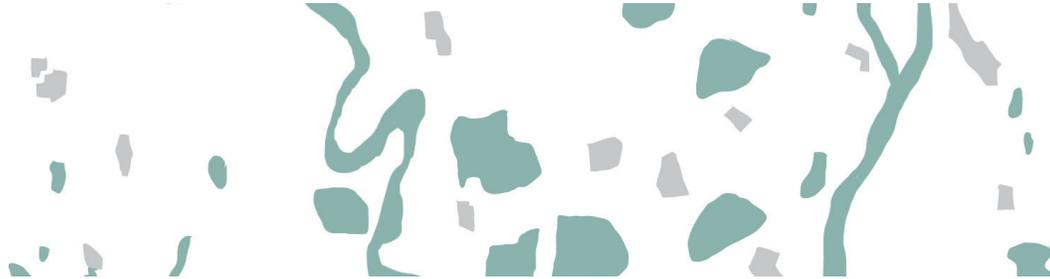- Pocket park/Playground
- Farm field
- Primary rivers
- Ponds

0   0.5   1km   N
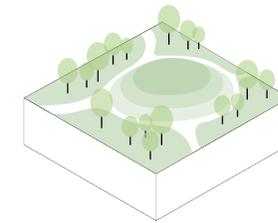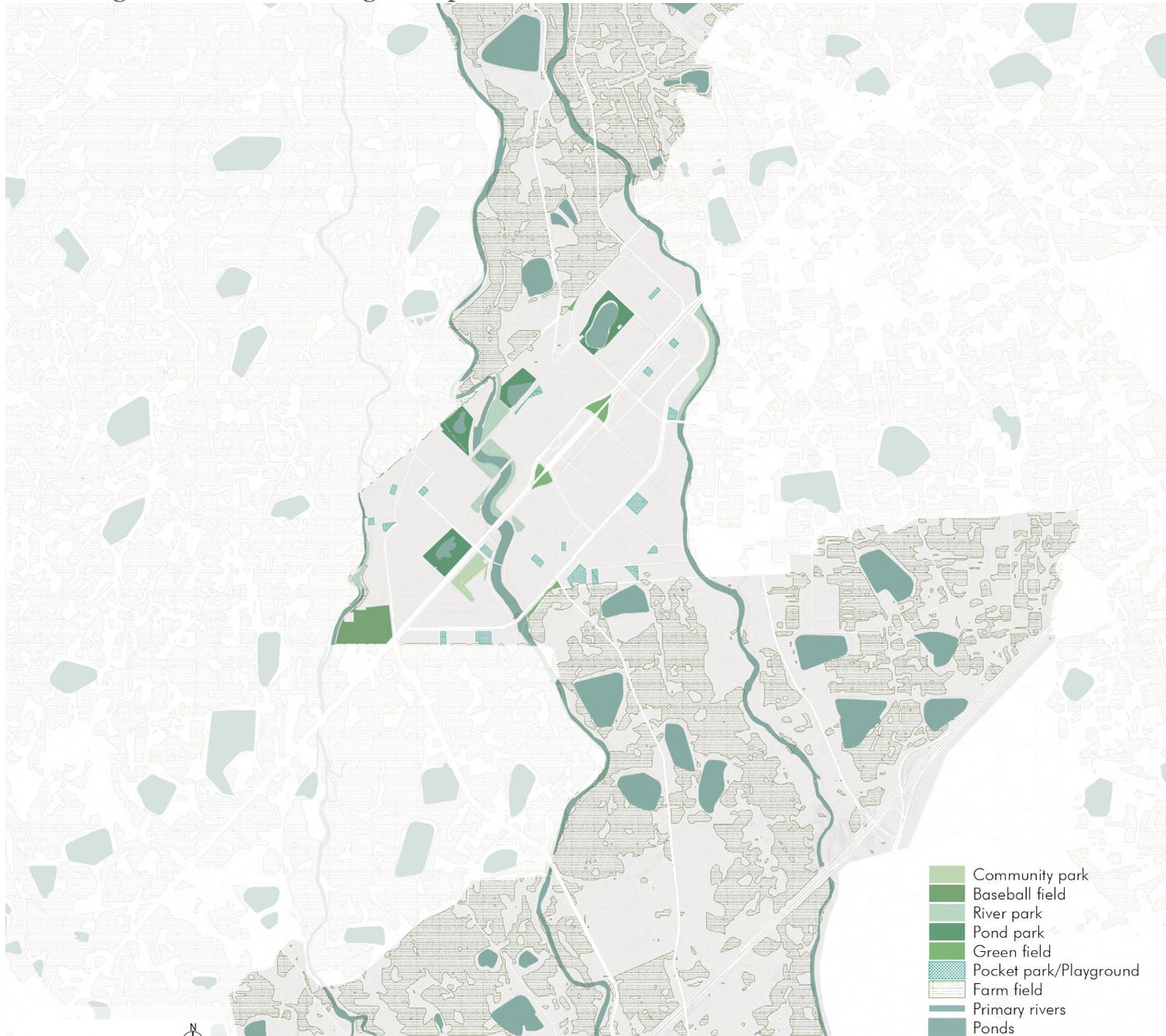
Community park

Baseball field
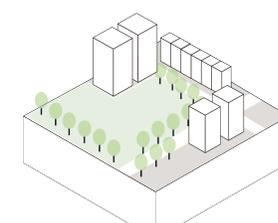
River park

Green field
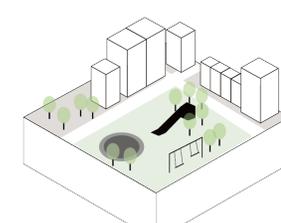
Pocket park/Playground

Pond park

Understand

Recognize

Compose

Reflect

Compose
Concept

PAST-1904

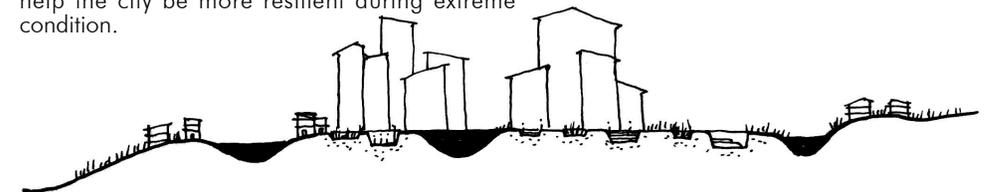Numerous ponds surrounded by the dispersed settlement in the argriculture age.

NOW-2020

Through urbanization, many ponds have been filled in for construction.
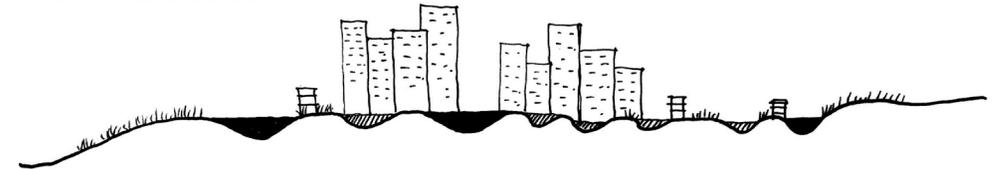
PROPOSED

Explore more space for water in the urban area help the city be more resilient during extreme condition.
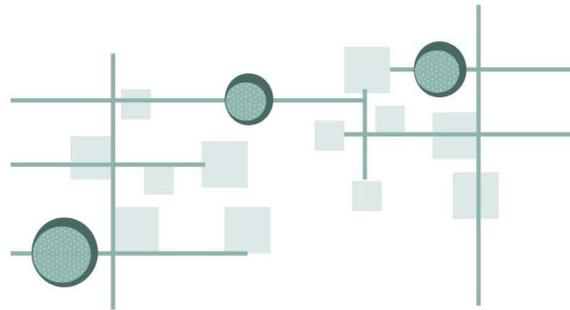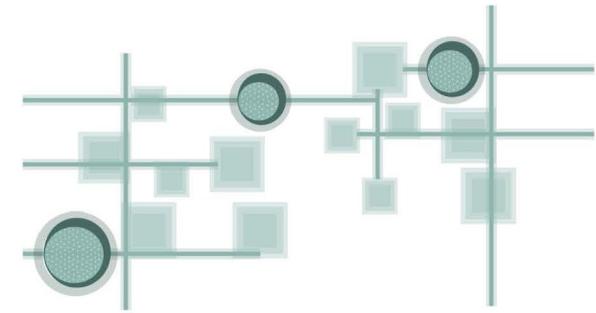
Three principles addressing pond landscape
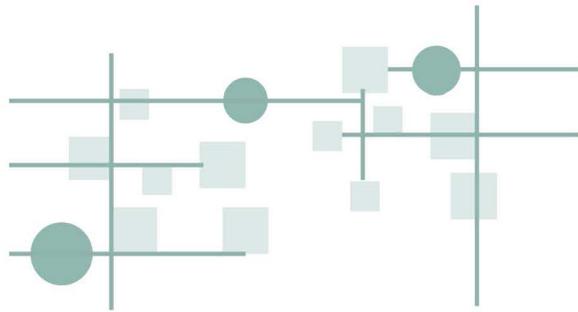
Robust

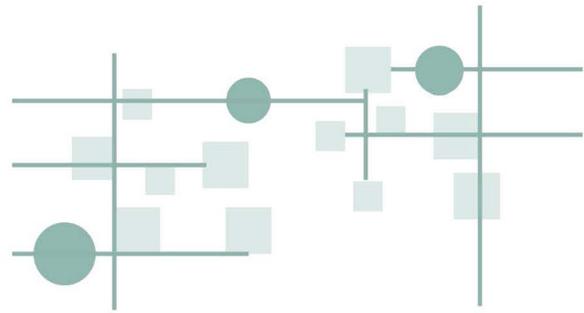Construction of the well-conceived pond and
urban green and blue network

Reflective

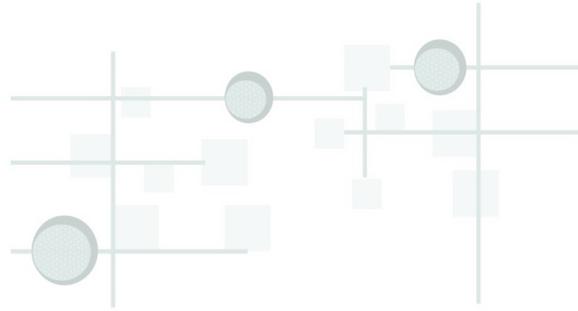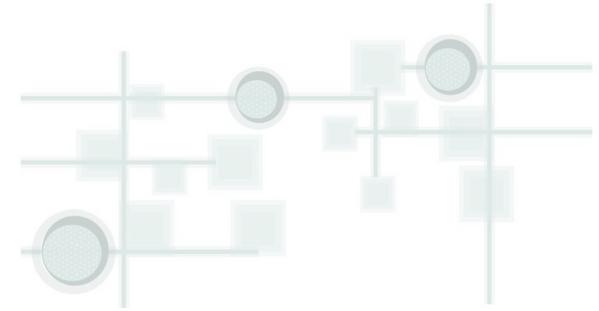Transform the past pond culture into new
design decision

Flexible

Ability to adapt to changing circumstances

Robust

Construction of the well-conceived pond and
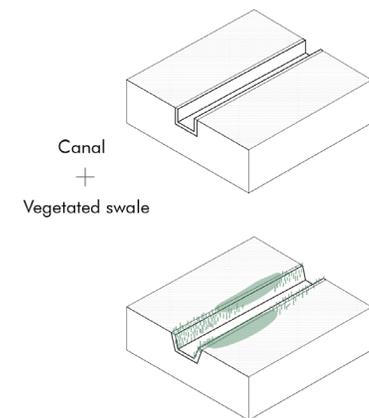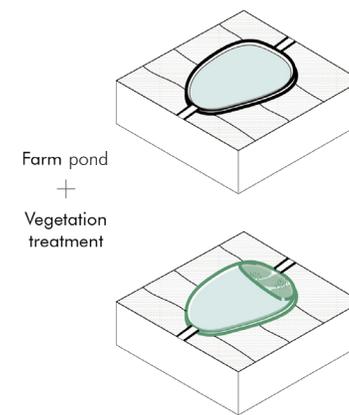urban green and blue network

Reflective

Transform the past pond culture into new
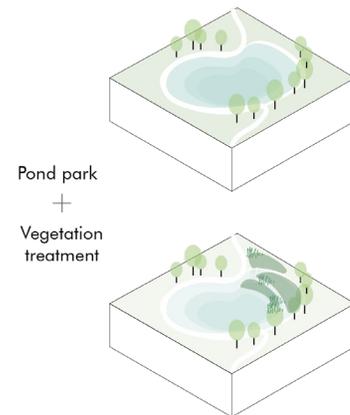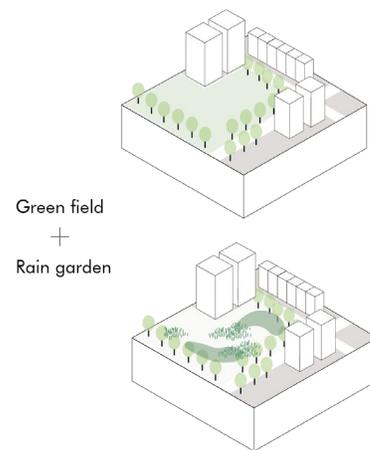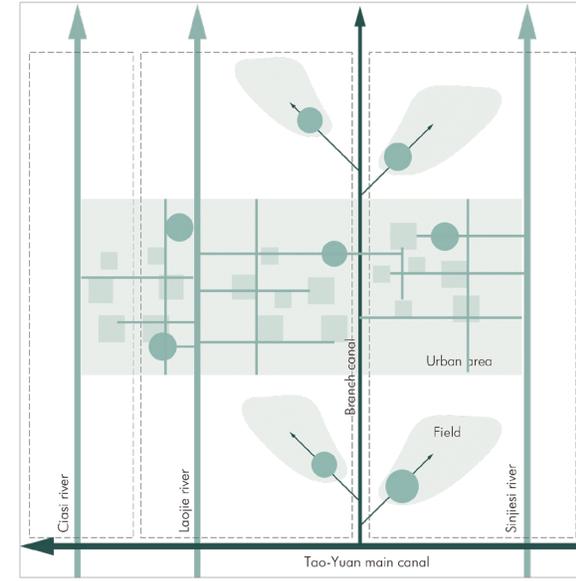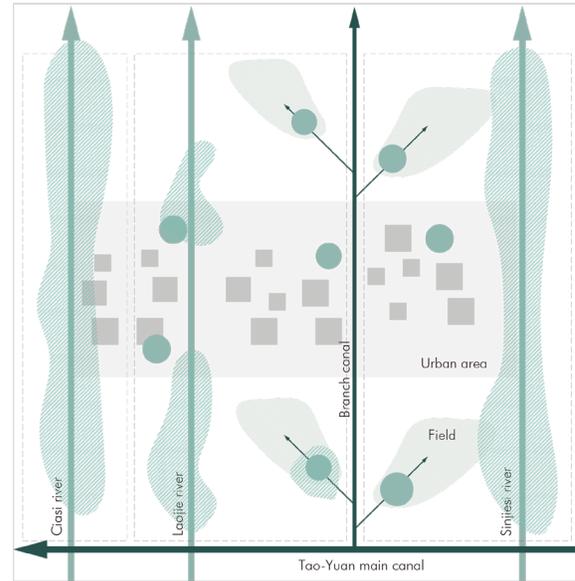design decision

Flexible

Ability to adapt to changing circumstances

Compose
Robust-water system and model

Ciasi river · Laojie river · Branch canal · Urban area · Field · Sinjiesi river · Tao-Yuan main canal

Ciasi river · Laojie river · Branch canal · Urban area · Field · Sinjiesi river · Tao-Yuan main canal

Green field
+
Rain garden

Pond park
+
Vegetation treatment

Road
+
Vegetated swale

Farm pond
+
Vegetation treatment
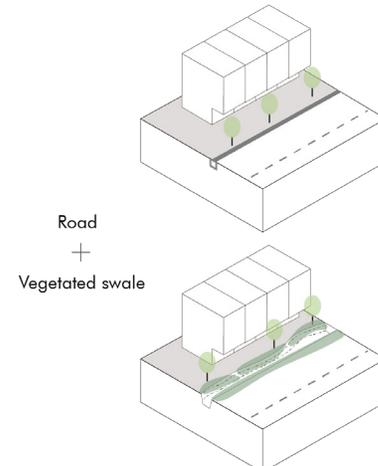
Canal
+
Vegetated swale

Robust-Drought
clean and capture system
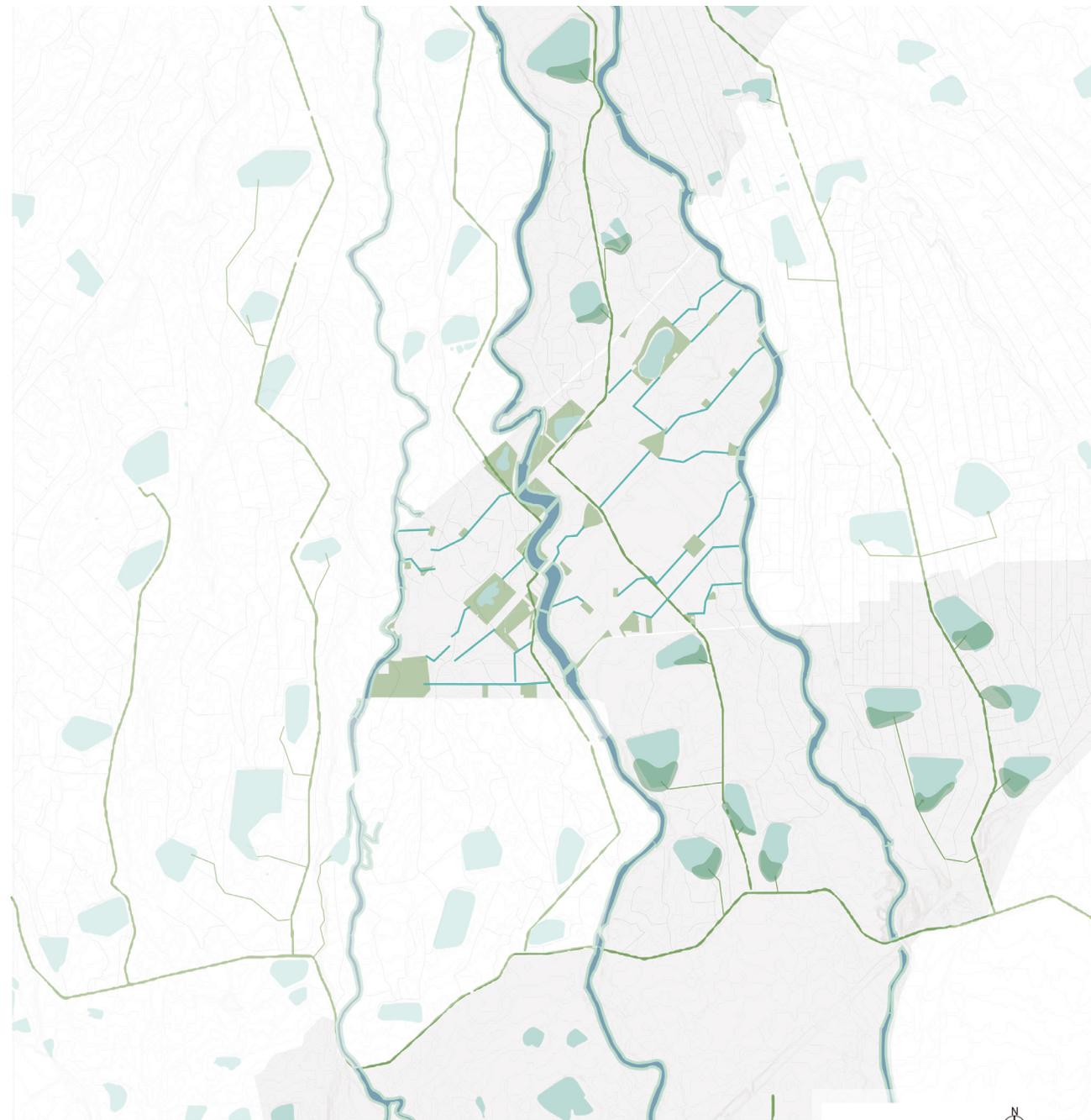
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Water in reservoir

365

218

282

152

88

90

87

43

46

43

21

72

← Dry season → ← Wet season → ← Dry season →

Clean   **Capture**
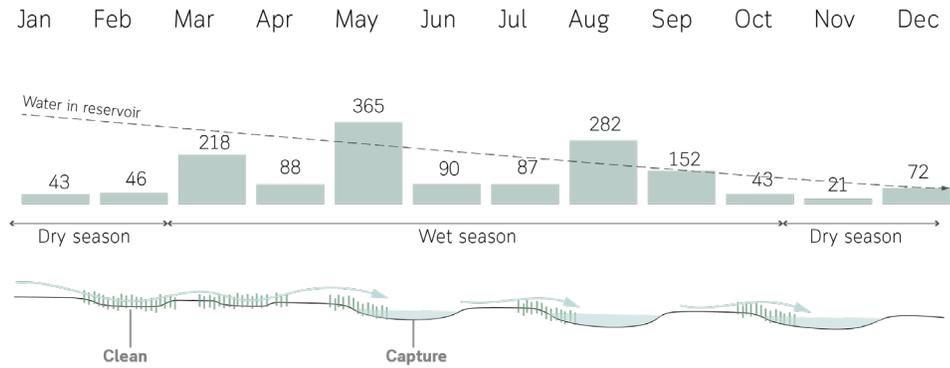
Drought attention (long-term)

Road
+vegetated swale

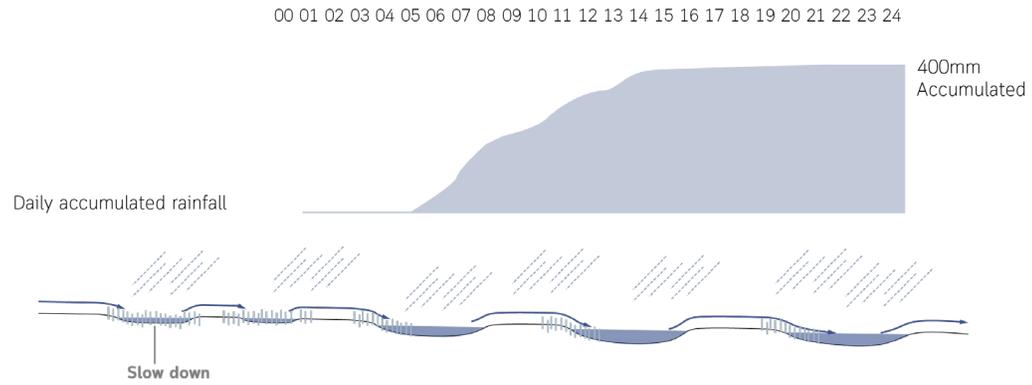Pond park
+vegetation treatment

Park
+rain garden

Canal
+vegetated swale

Farm pond
+vegetation treatment

Water supply

0   0.5   1km   N
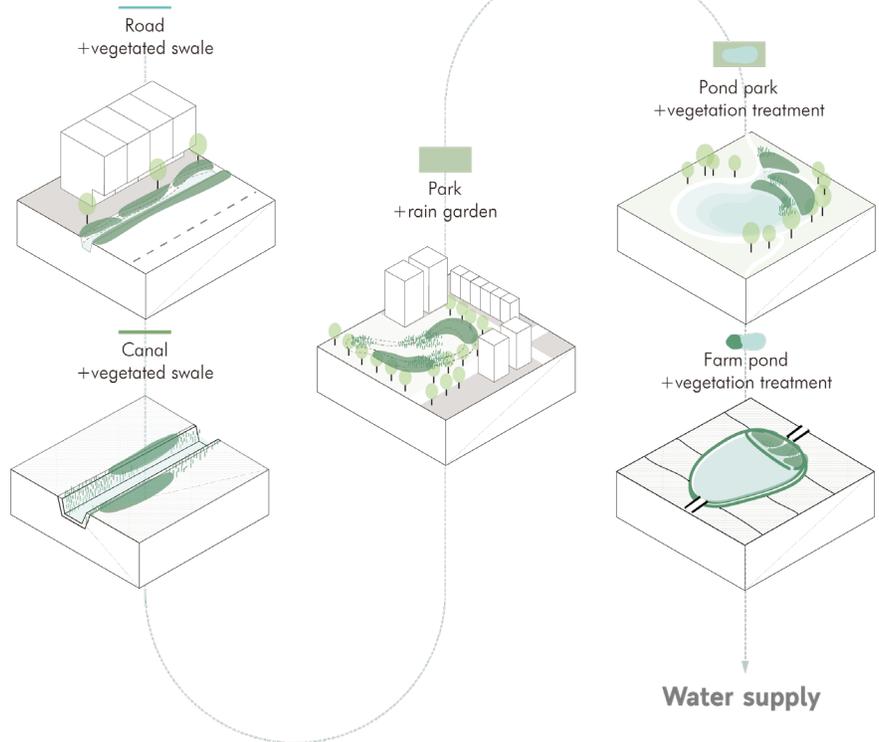
Robust- Flood
Slow down system

00 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

400mm
Accumulated

Daily accumulated rainfall

Slow down

Flood attention (short-term)

Road
+vegetated swale

Pond park
+vegetation treatment

Park
+rain garden

Canal
+vegetated swale

Farm pond
+vegetation treatment

Run off

rainfall

0   0.5   1km

N
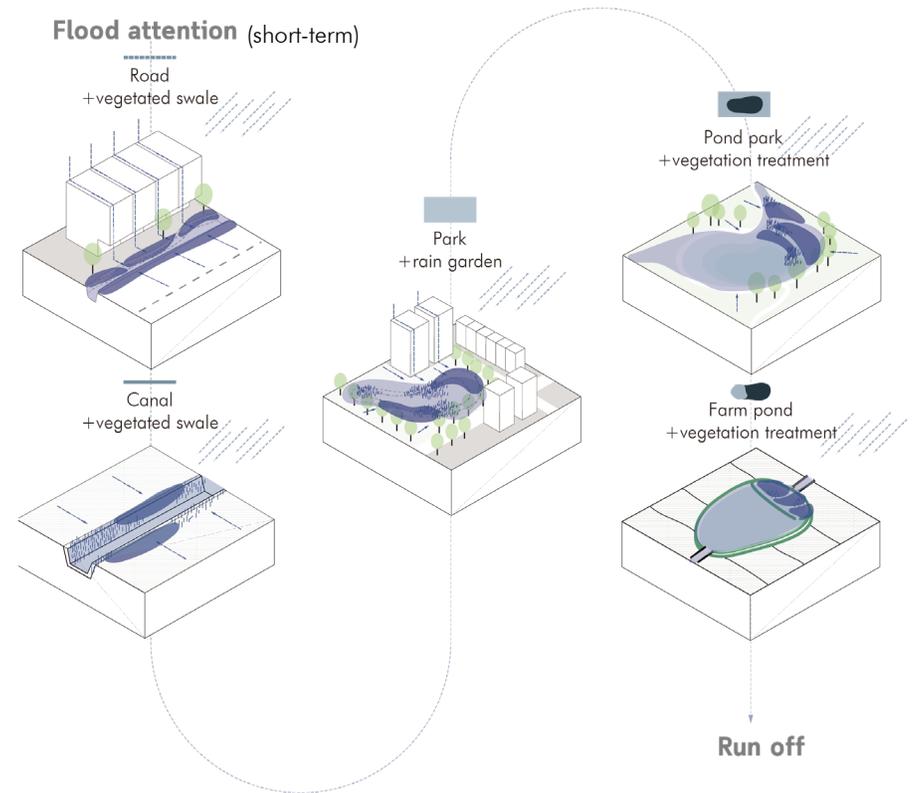
Design
Robust- Green and blue network
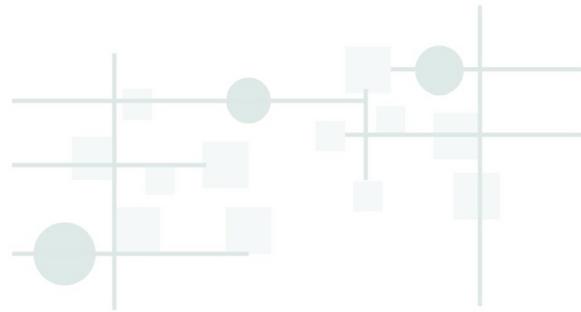
1 Taoyuan main canal
2 Sinjiesi river
3 Laojie river
4 Ciasi river
5 Vegetated farm pond
6 Pond walking trail
7 Rain garden park
8 Green street
9 Vegetated urban pond park
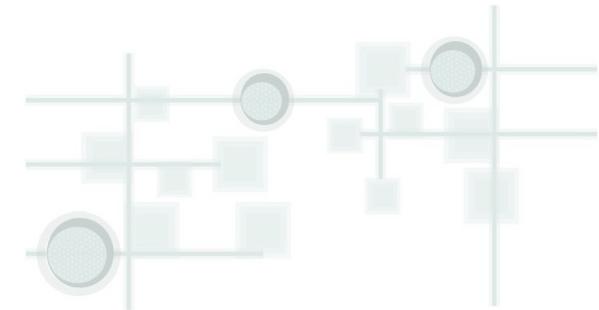10 Riverfront green space

Robust

Reflective

Flexible

Construction of the well-conceived pond and
urban green and blue network
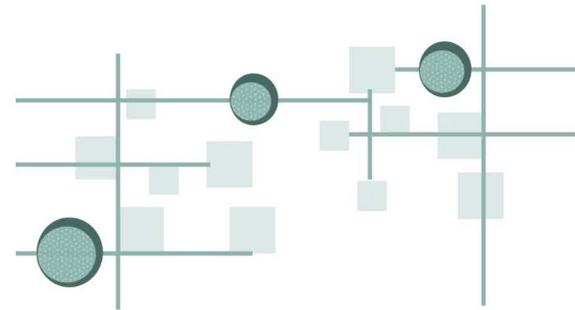
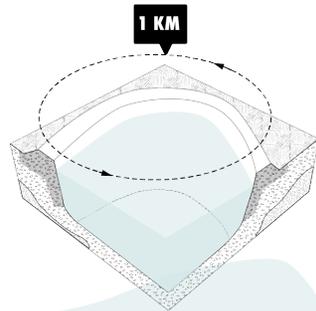Transform the past pond culture into new
design decision

Ability to adapt to changing circumstances

1   HUANG,SING-LONG
(70-Year-Old)
*Committee member, Tao-yuan*
Irrigation Association

The pond has been multi-functional, such as a park, flood detention, and so on. For example, besides my house, the pond has transformed into a park that walks for **a round of 1km.**
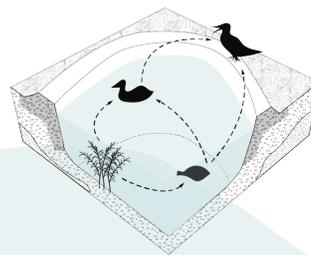

3 JHANG,SU-JHEN
(50-Year-Old)
Local people used to live beside the ponds.

I miss the space where I can **play in the water and the pollution-free water quality.**
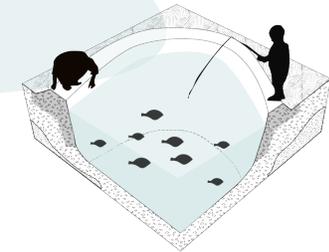
2 HU,JIN-SHU(60-Year-Old)
Group leader of pond (7-13/7-14), Tao-yuan Irrigation Association/ Owner of fishing pond
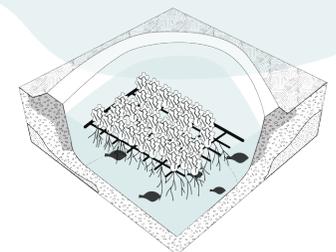
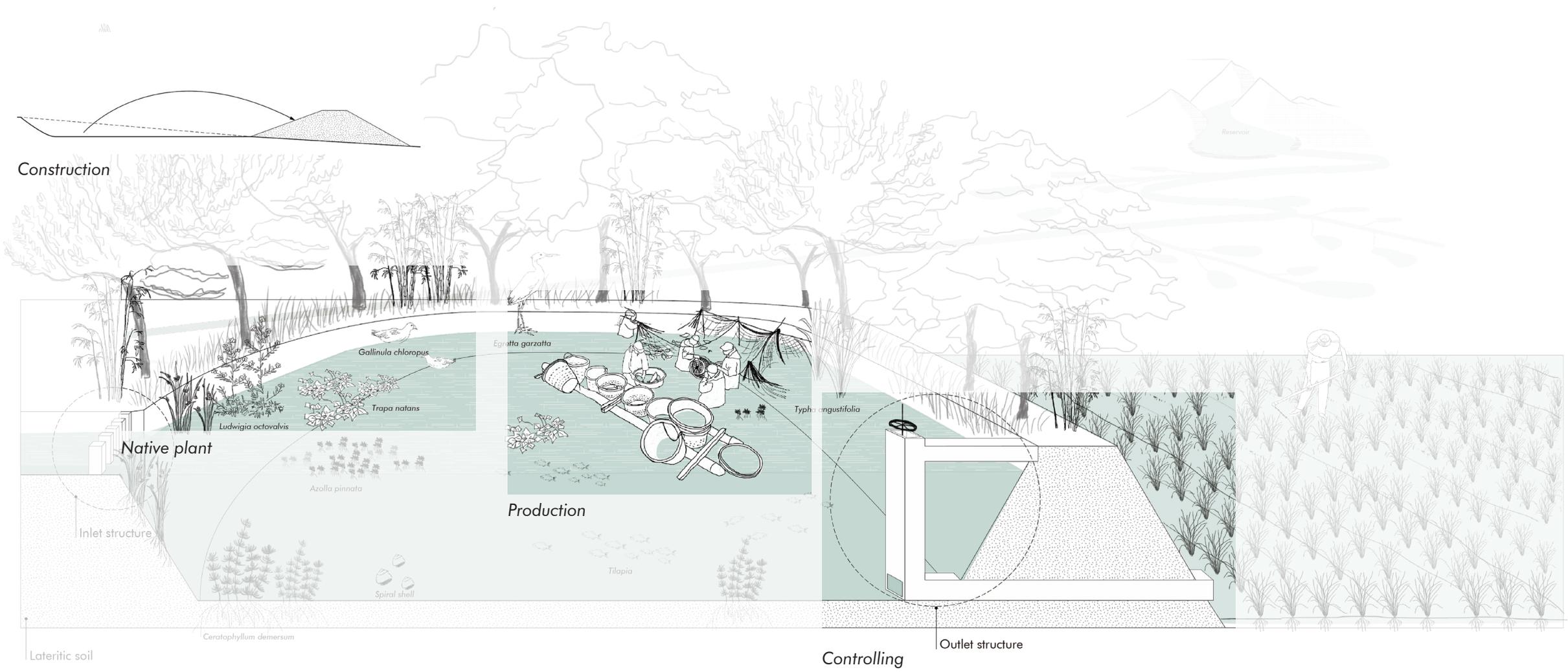If we want to have a successful farming system, **the balance of the pond's food chain must be important.**

4 KAO,XING-HUANG
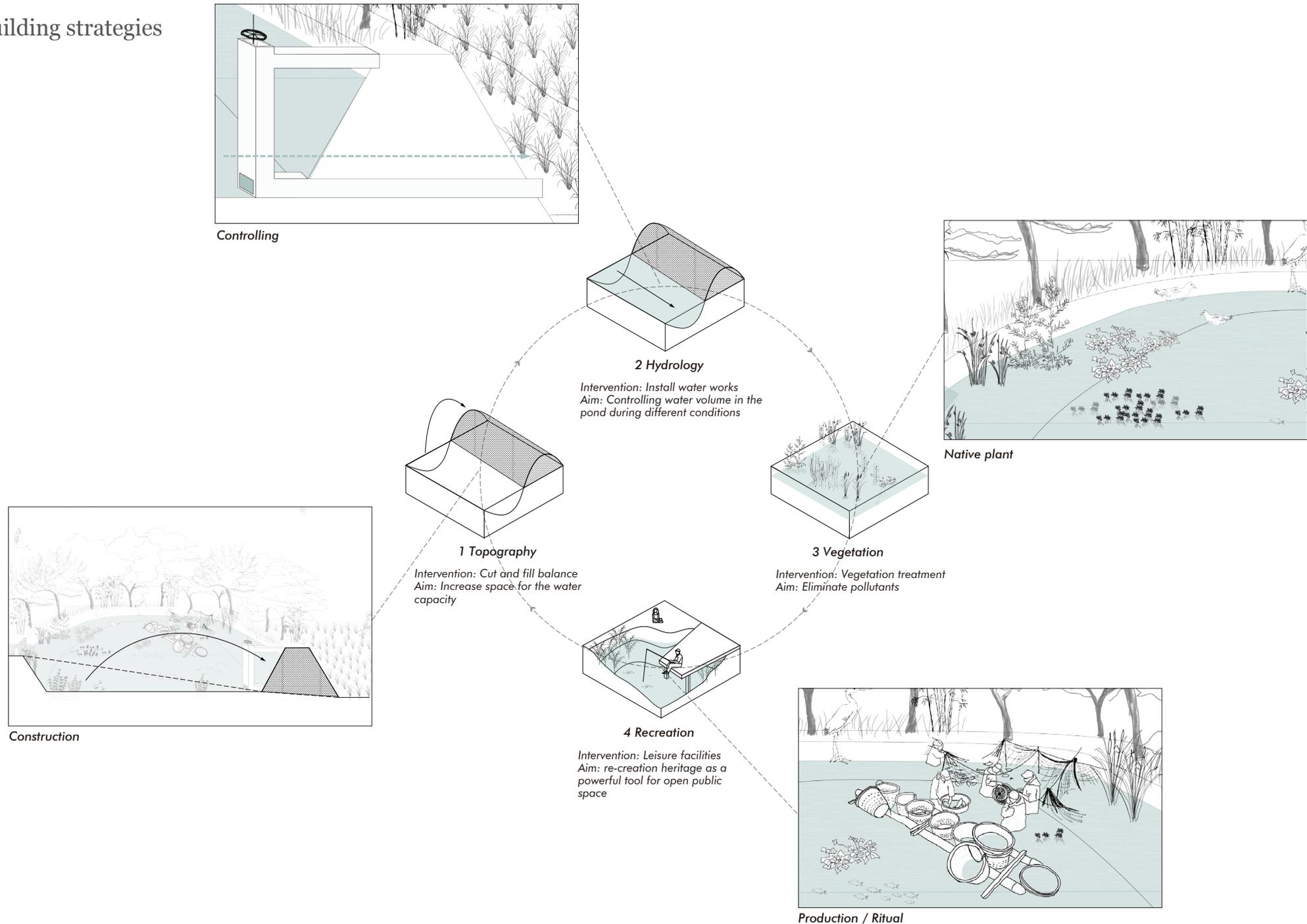*(50-Year-Old)*
Local people used to live beside the ponds.

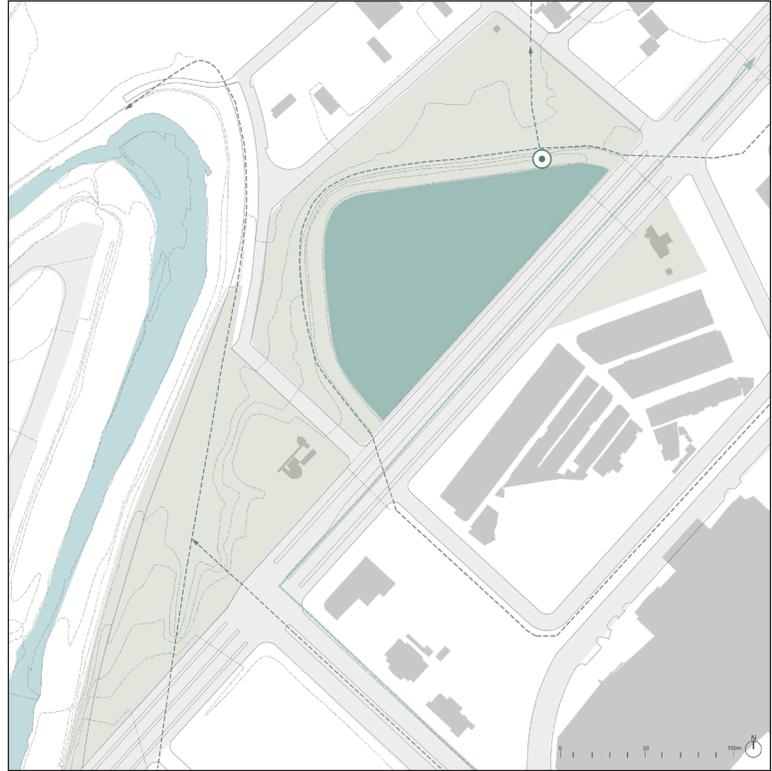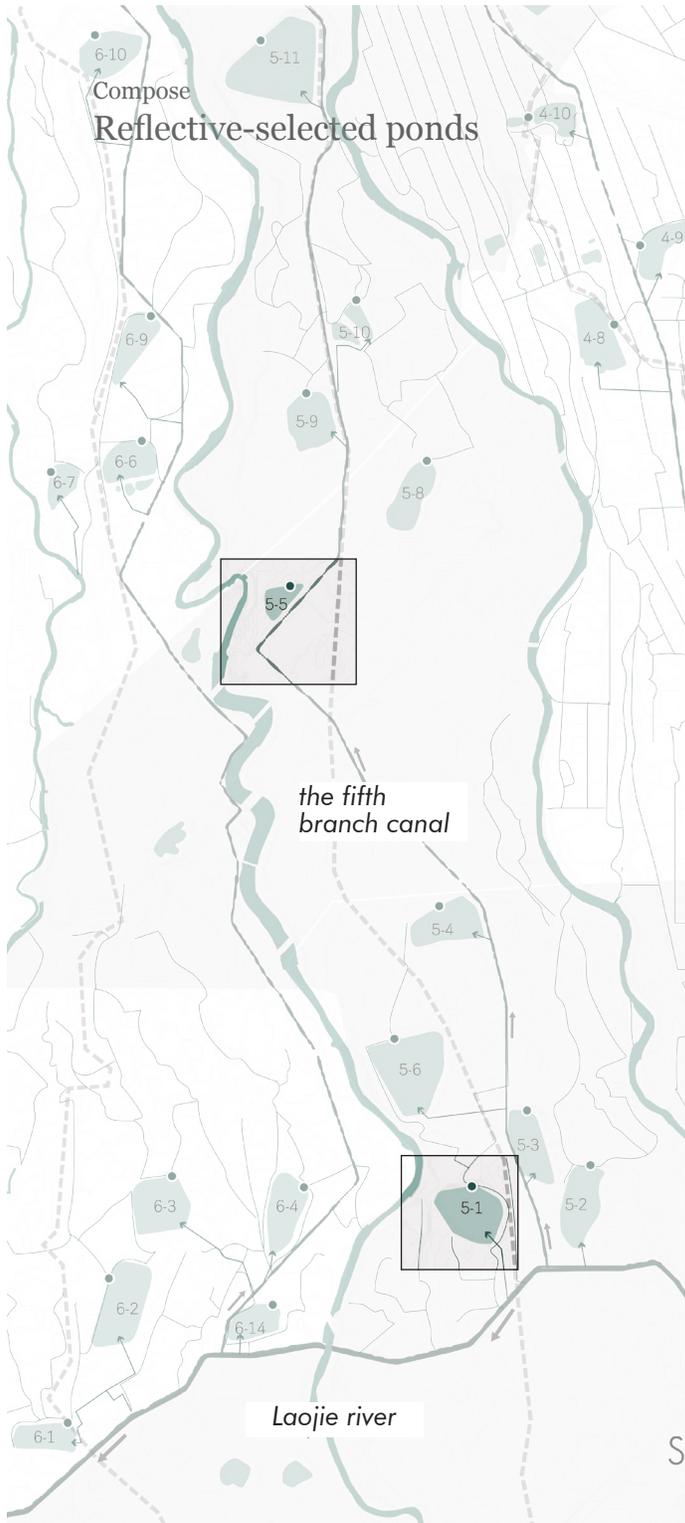**Aquaponics** might be a new opportunity for reviving ponds.

Reflective-Pond elements

Construction

Native plant

Inlet structure

Lateritic soil

Gallinula chloropus

Egratta garzatta

Ludwigia octovalvis

Trapa natans

Azolla pinnata

Ceratophyllum demersum

Spiral shell

Tilapia

Typha angustifolia

Production

Outlet structure

Controlling

Reservoir

Reflective-guilding strategies

Controlling

2 Hydrology

Intervention: Install water works
Aim: Controlling water volume in the pond during different conditions

Native plant

1 Topography

Intervention: Cut and fill balance
Aim: Increase space for the water capacity

3 Vegetation

Intervention: Vegetation treatment
Aim: Eliminate pollutants

Construction

4 Recreation

Intervention: Leisure facilities
Aim: re-creation heritage as a powerful tool for open public space

Production / Ritual

Reflective-selected ponds

6-10
5-11
4-10
4-9
6-9
5-10
4-8
6-6
6-7
5-9
5-8
5-5

*the fifth
branch canal*

5-4
5-6
5-3
6-3   6-4   5-1   5-2
6-2
6-14

Laojie river

No. 5-5 (in urban area)

Construction time: 1800s
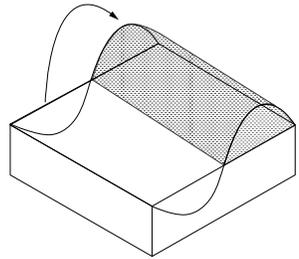Land use zoning: Urban park (start from 2018)
Water area: 3.45 ha

No. 5-1 (in peri-urban area)

Construction time: 1800s
Land use zoning: Agriculture
Water area: 6.6 ha

Reflective-comparison

| River | Trees and paths | Road | Trees and paths | Dyke | Pond | Dyke | Trees and paths | Road | Residential buildings |

Lateritic

Gravel bed

No. 5-5 (in urban area)

| Vegetable field | Tree wall/Dike | Pond | Tree wall | Three-story house | Road | Factory |

Ditch

Lateritic

Gravel bed

No. 5-1 (in peri-urban area)
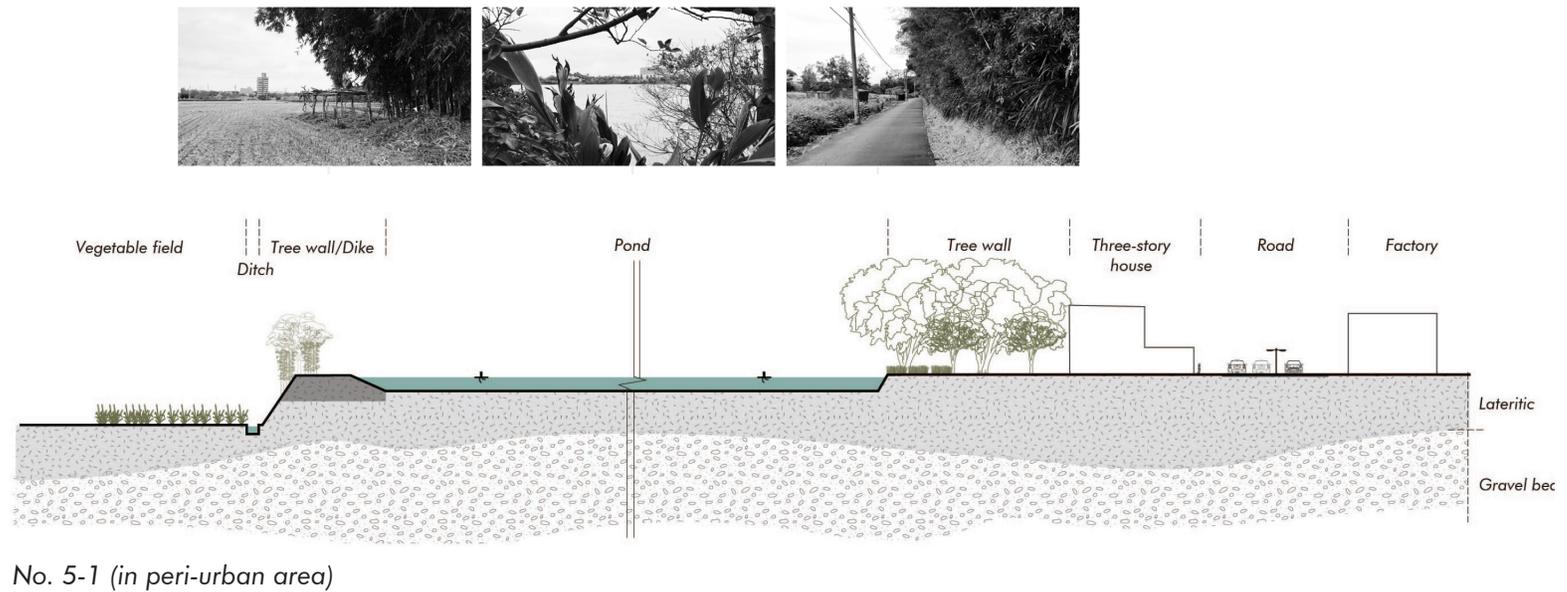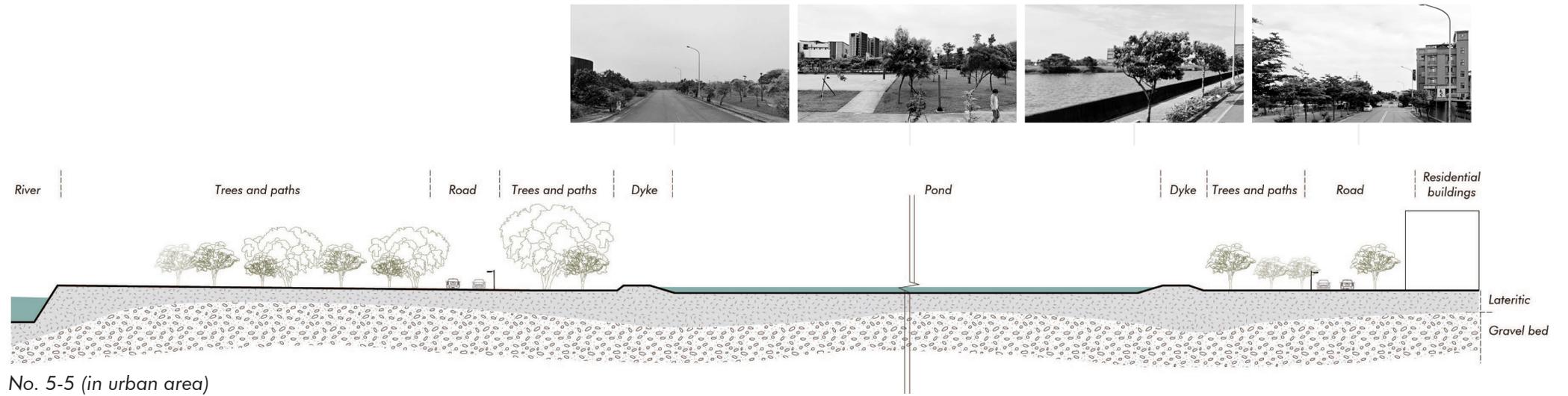
Form testing

1 Topography

Intervention: Cut and fill balance
Aim: Increase space for the water capacity

Test 1

Two ponds with one treatment wetland

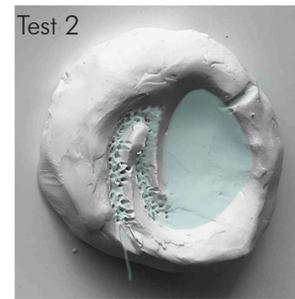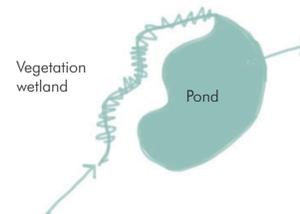
Pond

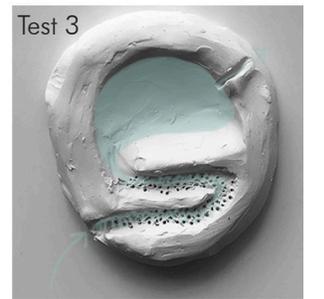Vegetation wetland
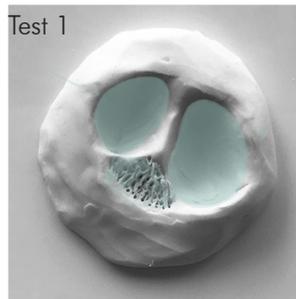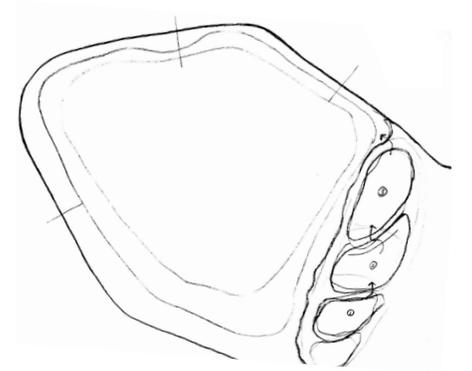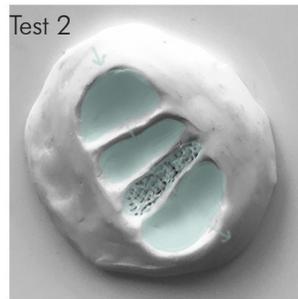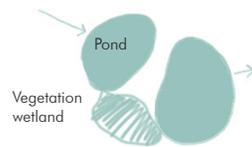
Test 2

Three ponds with one treatment wetland
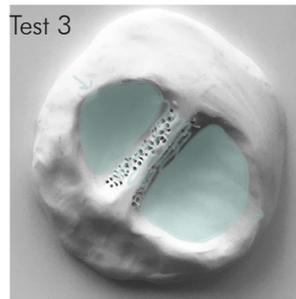
Test 3

Two ponds with one treatment wetland in the embankment
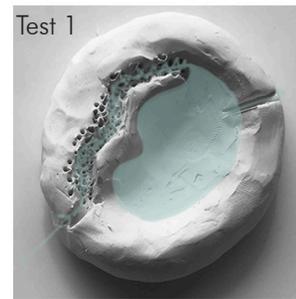
Test 1

Straight form of vegetation wetland in the west of pond
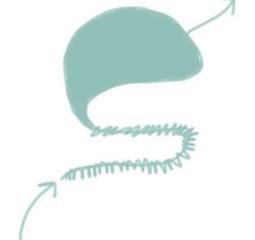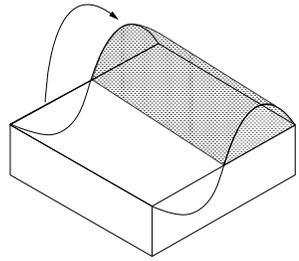

Vegetation wetland

Pond

Test 2

Sinuous form of vegetation wetland in the west of pond

Test 3
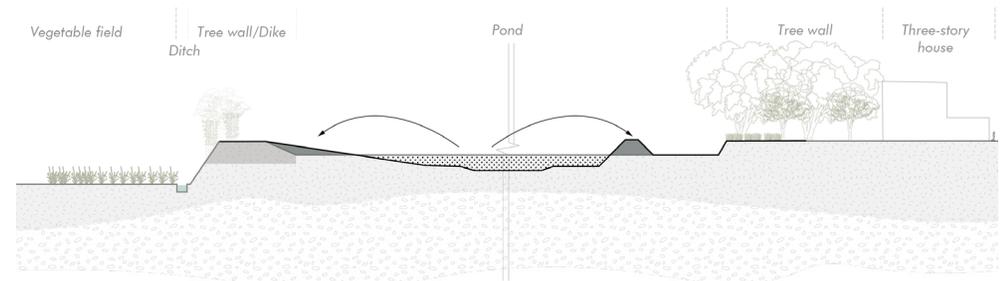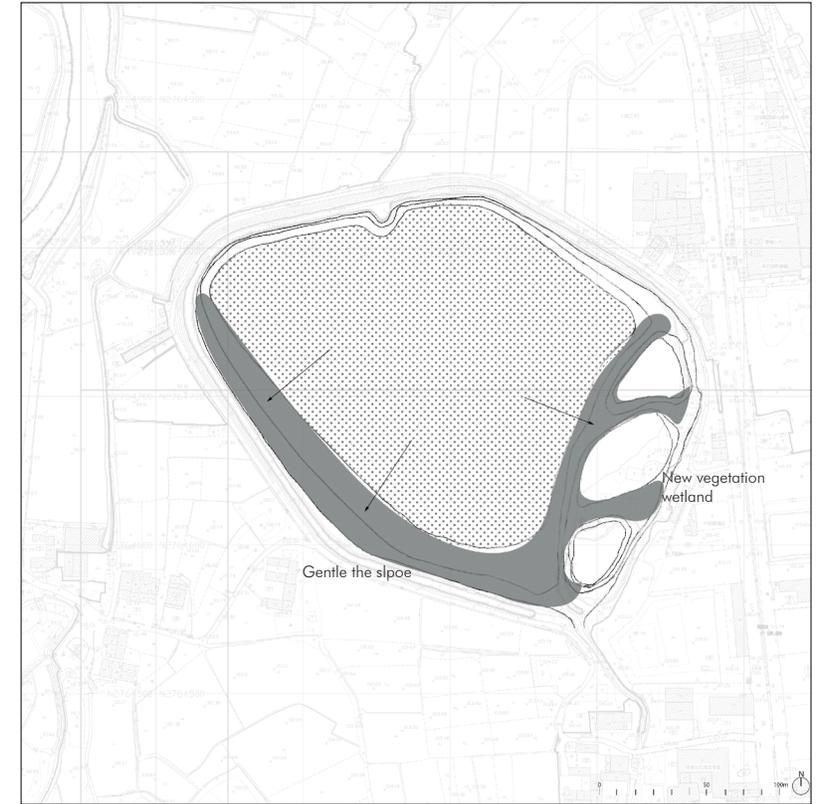

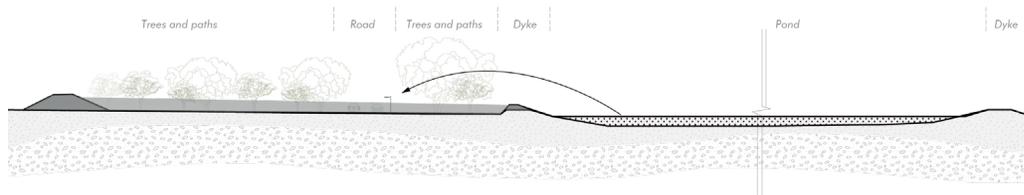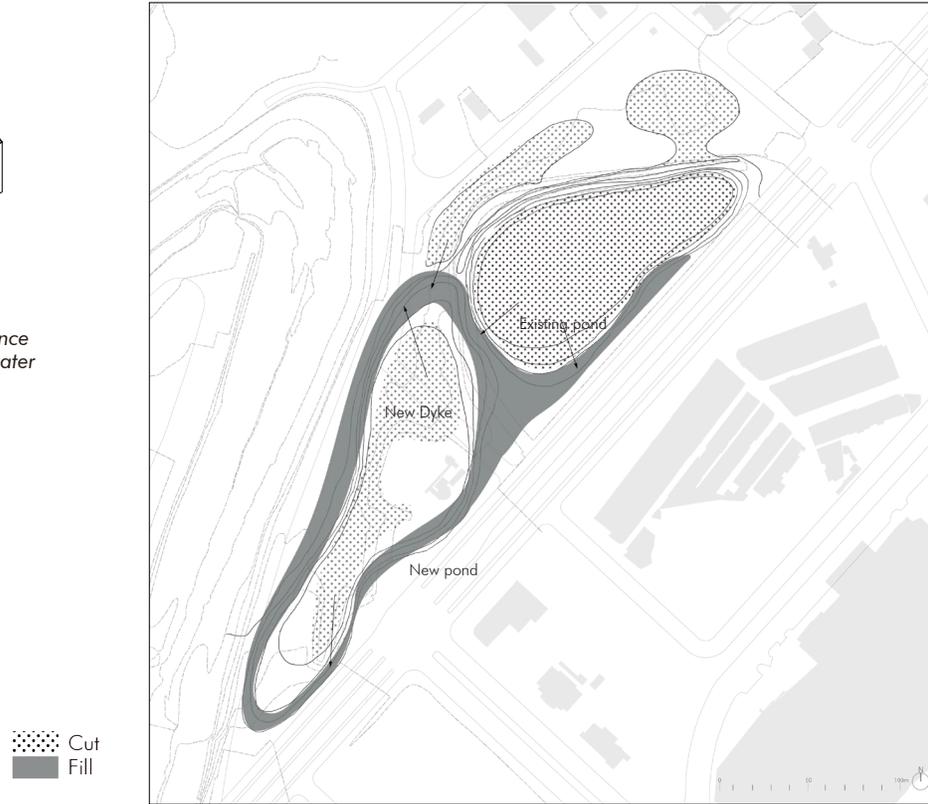Sinuous form of vegetation wetland in the south of pond
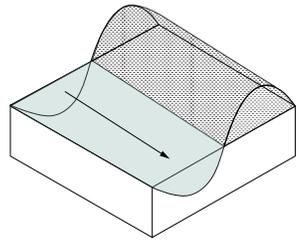
Reflective-topography

1 Topography

Intervention: Cut and fill balance
Aim: Increase space for the water capacity

Existing pond

New Dyke

New pond

Cut
Fill

New vegetation wetland

Gentle the slpoe

Trees and paths | Road | Trees and paths | Dyke | Pond | Dyke
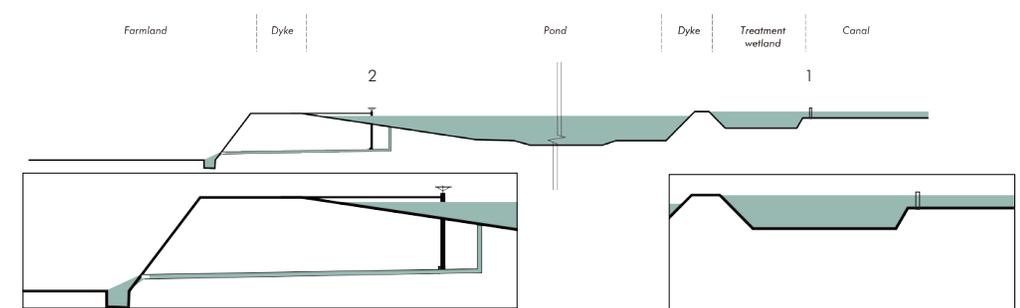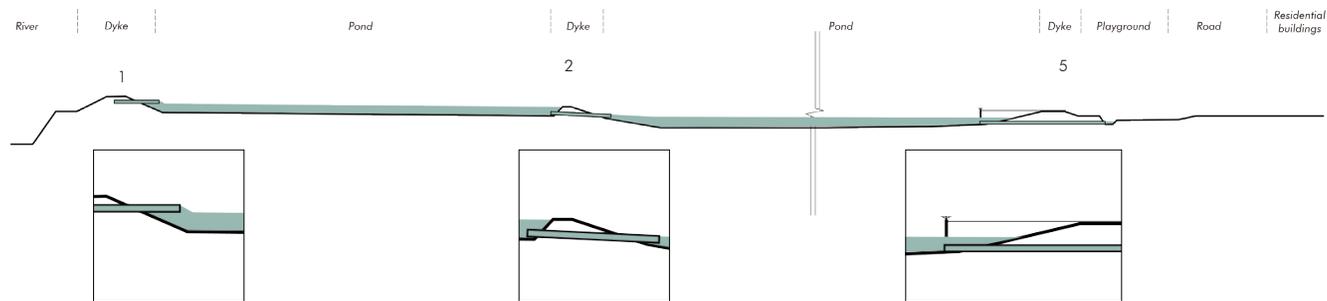
Vegetable field | Tree wall/Dike | Pond | Tree wall | Three-story house
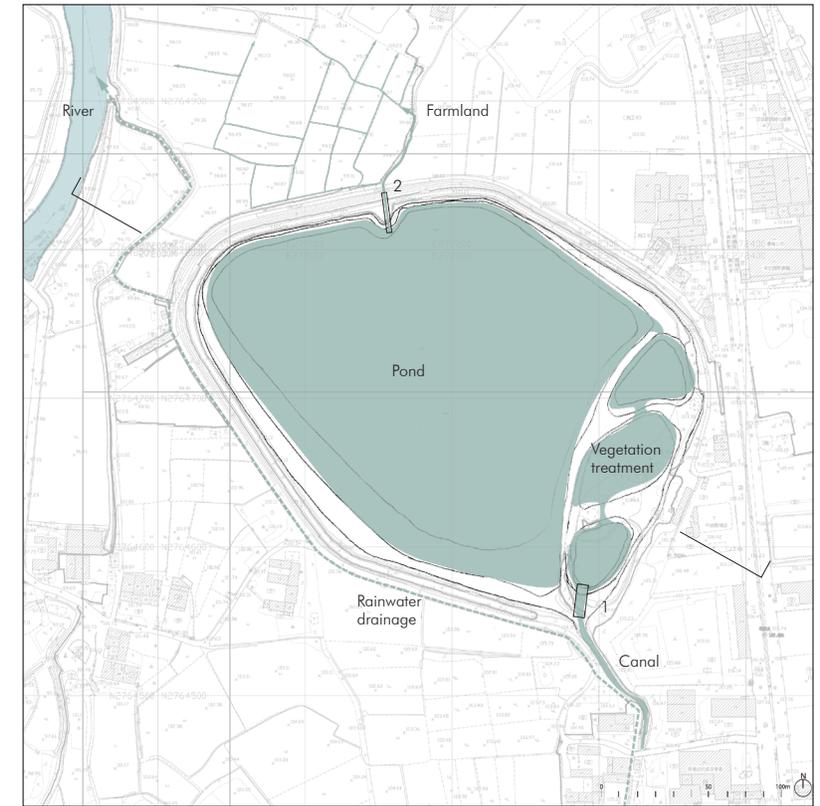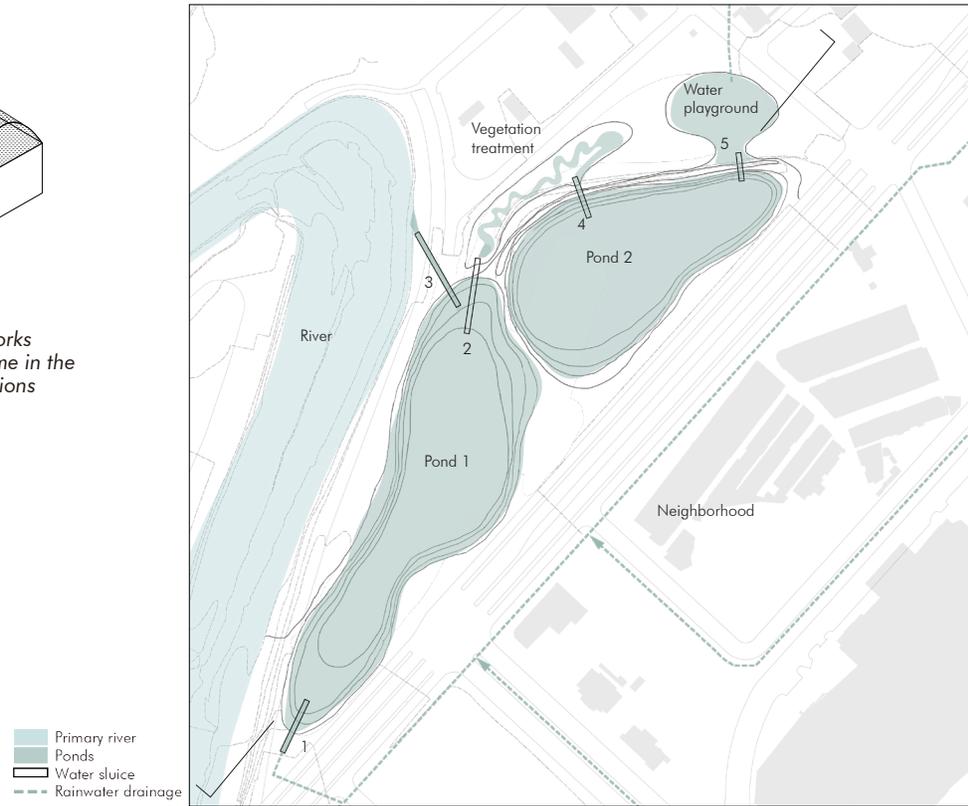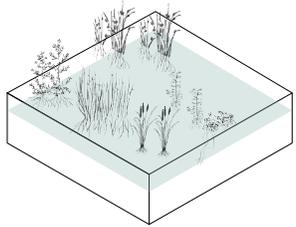Ditch

Compose
Reflective-Hydrology

2 Hydrology

Intervention: Install water works
Aim: Controlling water volume in the pond during different conditions

Primary river
Ponds
Water sluice
Rainwater drainage

Vegetation treatment

Water playground

Pond 2

River

Pond 1

Neighborhood

River

Farmland

Pond

Vegetation treatment

Rainwater drainage

Canal

River | Dyke | Pond | Dyke | Pond | Dyke | Playground | Road | Residential buildings

1

2

5

Farmland | Dyke | Pond | Dyke | Treatment wetland | Canal

2

1

Compose
Reflective-vegetation

Typha angustifolia
香蒲

Common philydrum
田蔥

Schoenoplectus mucronatus
水毛花

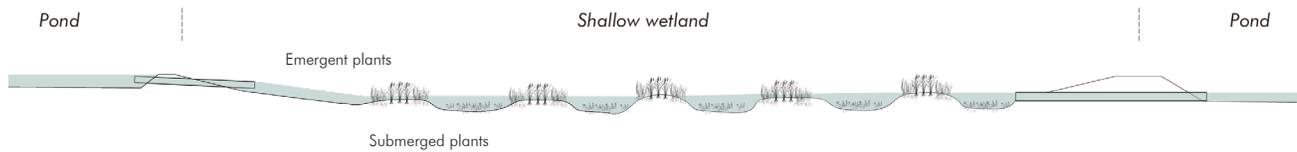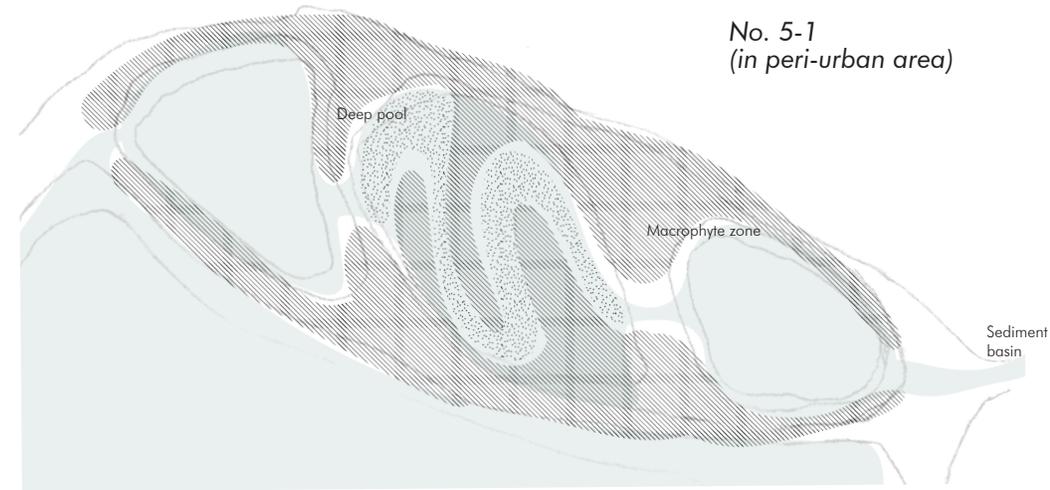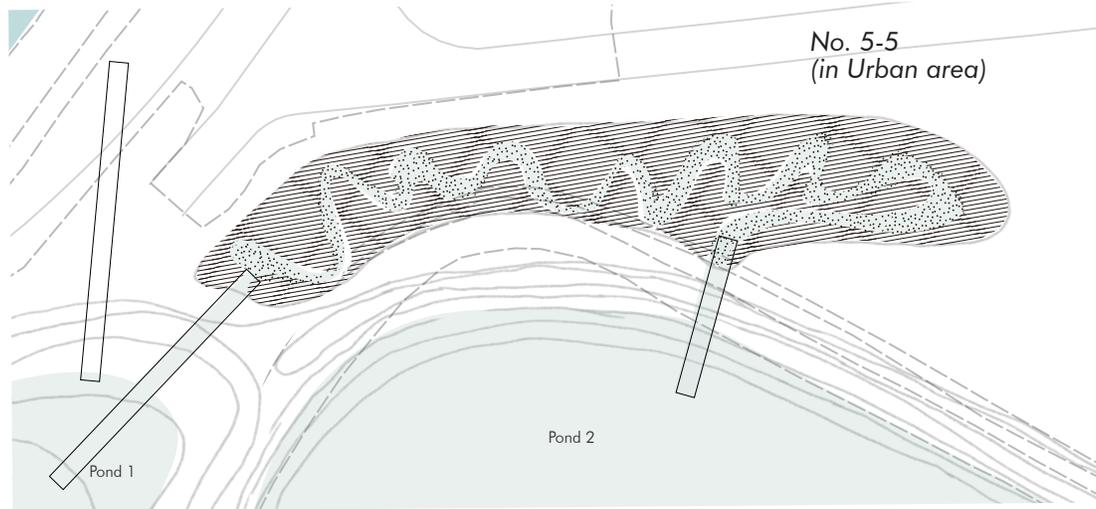Utricularia aurea Lour.
黃花狸藻

Ceratophyllum demersum
金魚藻

Aoyuanensis.
桃園石龍尾

Emergent plants

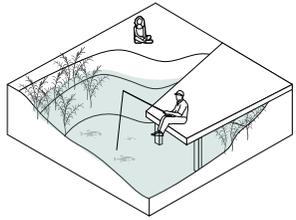*Submerged plants*

3 Vegetation

Intervention: Vegetation Treatment
Aim: Eliminate pollutants

No. 5-5
(in Urban area)

Pond 2

Pond 1

No. 5-1
(in peri-urban area)

Deep pool

Macrophyte zone

Sediment basin

Pond | *Shallow wetland* | *Pond*

Emergent plants

Submerged plants

Pond | *Free water surface wetland* | *Irrigation canal*

deep pool | *macrophyte zone* | *sediment basin*
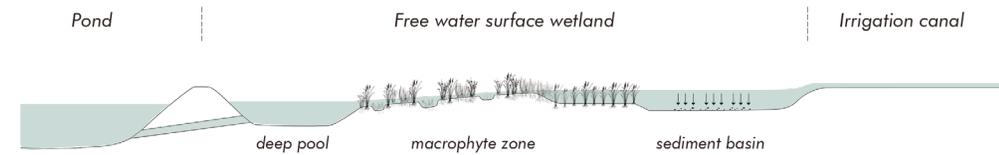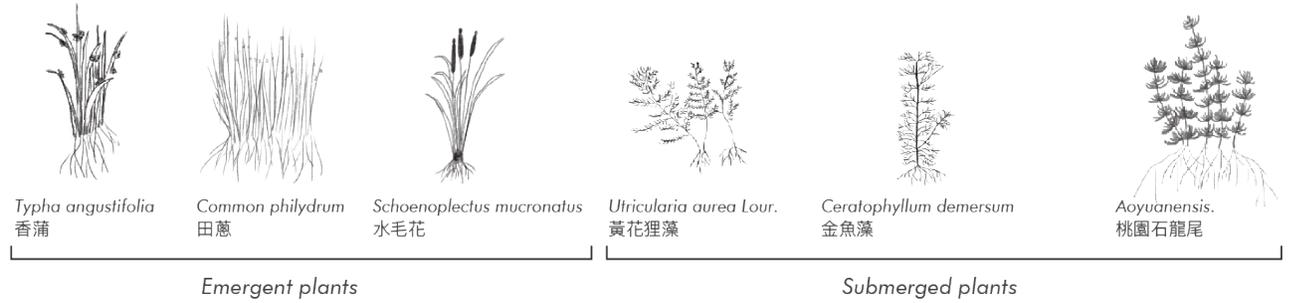
Reflective-recreation

4 Recreation

Intervention: Leisure facilities
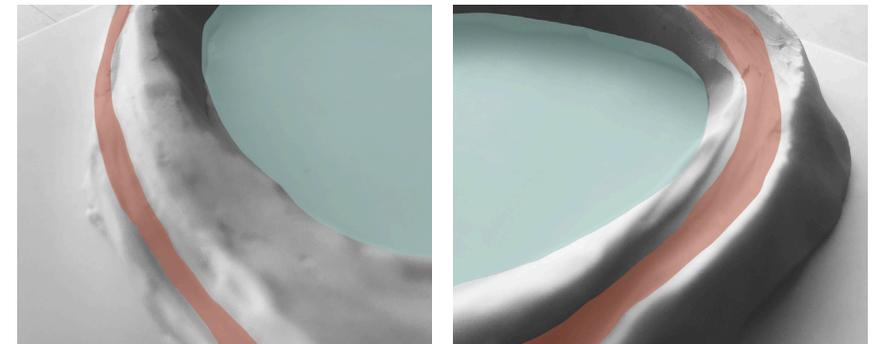*Aim: re-creation heritage as a powerful tool for open public space*

Wooden deck

Observation deck

Observation deck
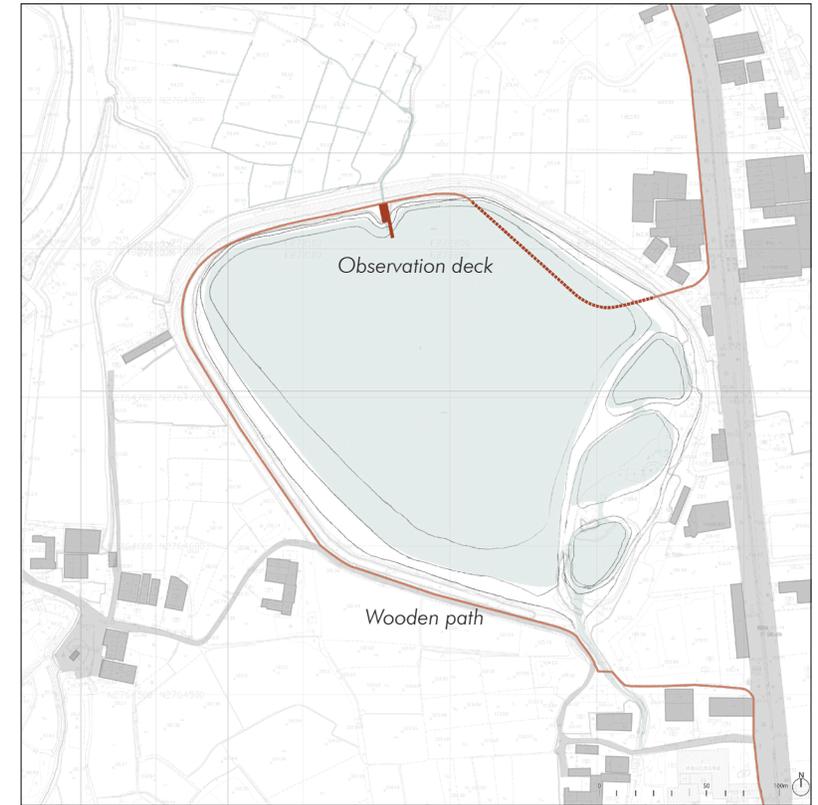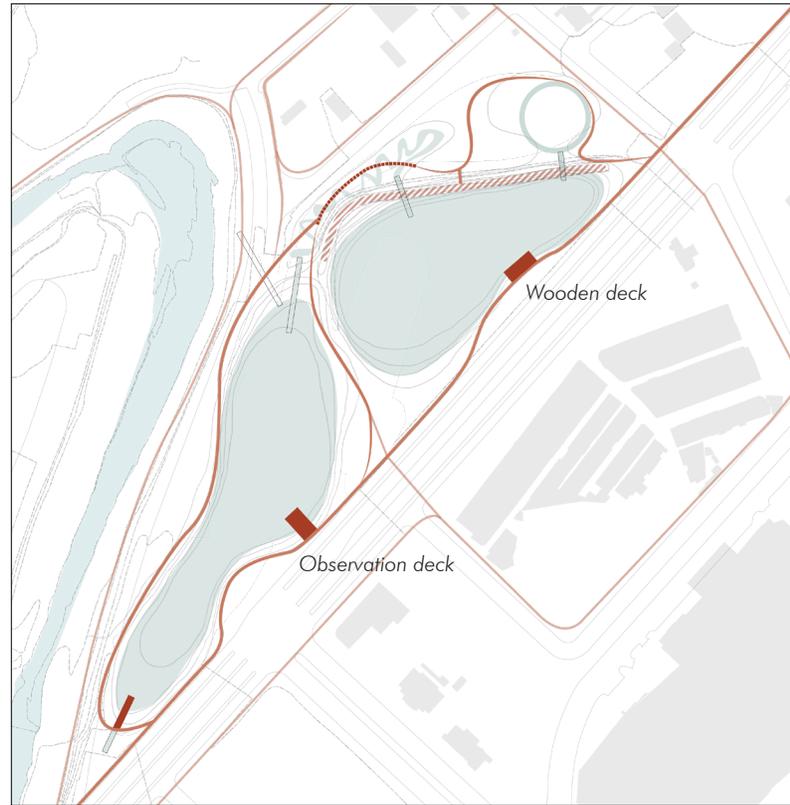
Wooden path
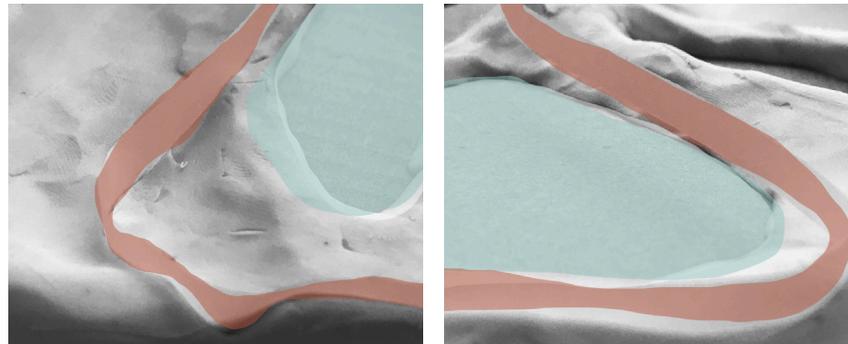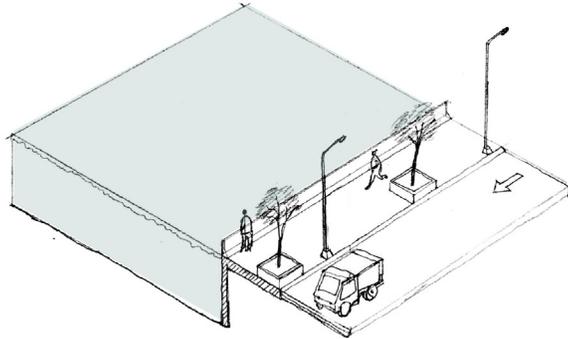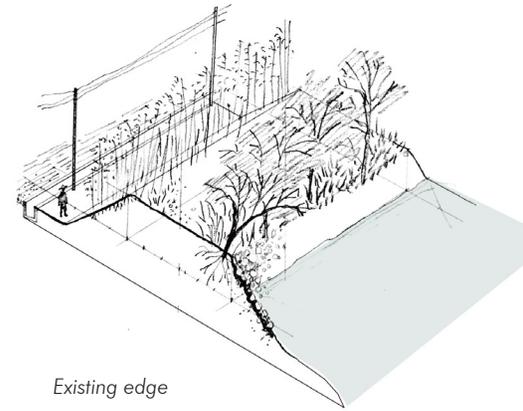
Reflective-recreation

Existing edge

Existing edge

Green
mound

Road

Floating
wetland

Path

Ecotone

Pathway

Water sluice
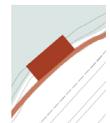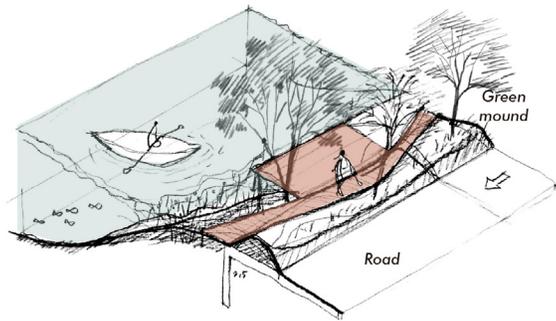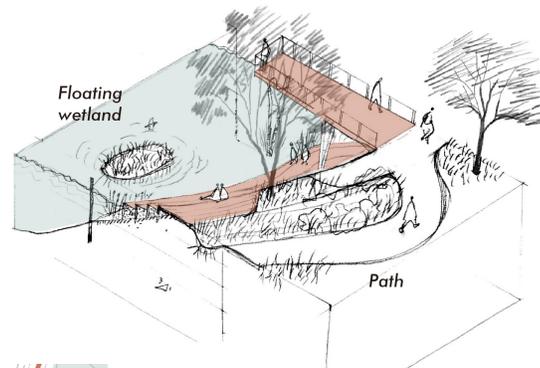
Wooden deck
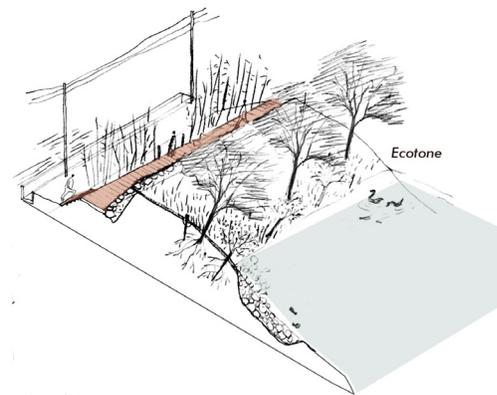
Observation deck

Wooden path

Observation deck
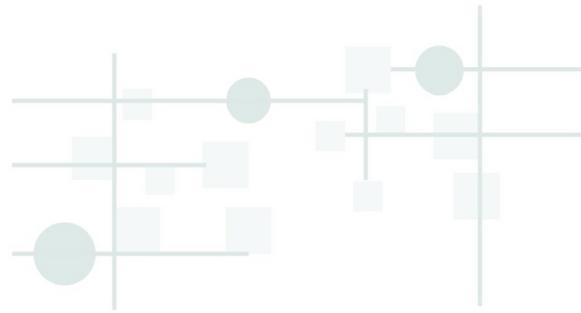
Residential zone

Residential zone

Water playground

Shallow wetland

Commercial zone

Wooden deck

Sluice

Residential zone

Laojie river

Wooden deck

Footbridge

Residential zone

Observation deck

School

0   50   100m

N

Sluice

Observation deck

Walking path

Fishing house

Free water surface system

Ecotone

Settlement

Farmland

Footbridge

Green canal

0   50   100m

N

Robust

Reflective

Flexible

Construction of the well-conceived pond and urban green and blue network

Transform the past pond culture into new design decision

Ability to adapt to changing circumstances

Flexible-Dry and wet

Flood

Rainfall(mm)

3500

3000

2500 — average precipitation

2000

1500

1000

1960　　　　　1990　　　　　2019

High flow year

Low flow year

Drought

Wet

Dry .
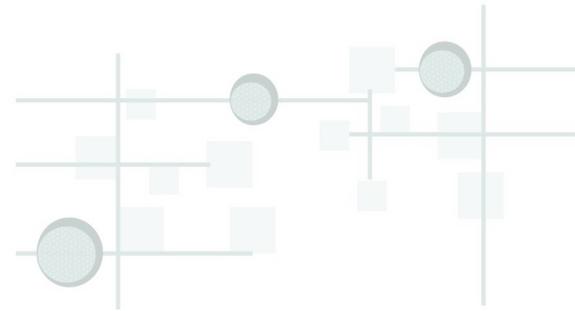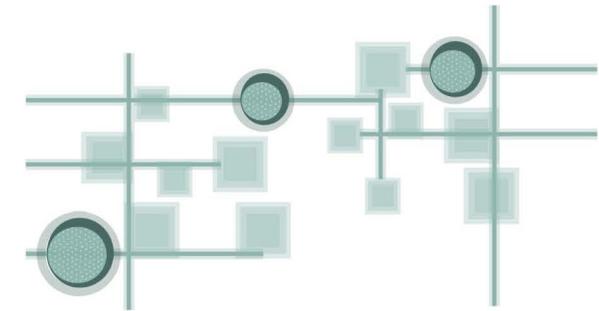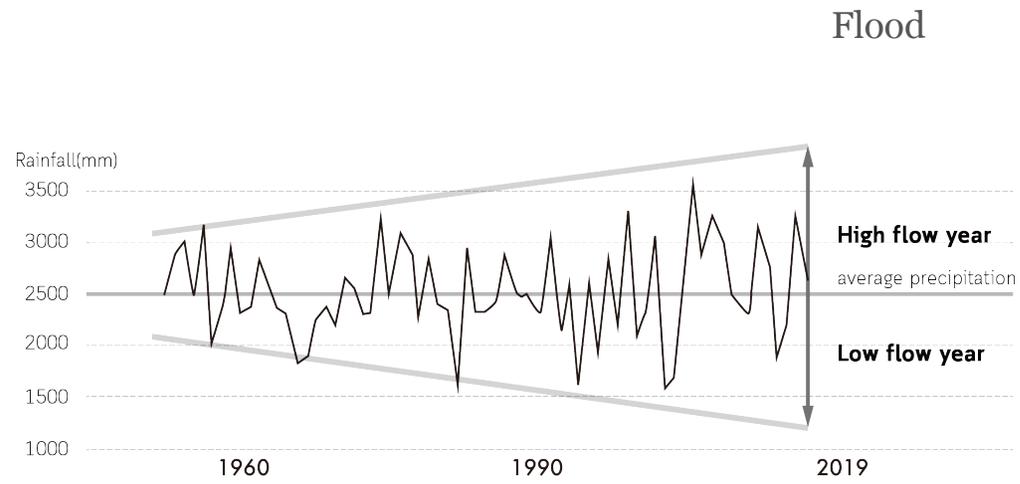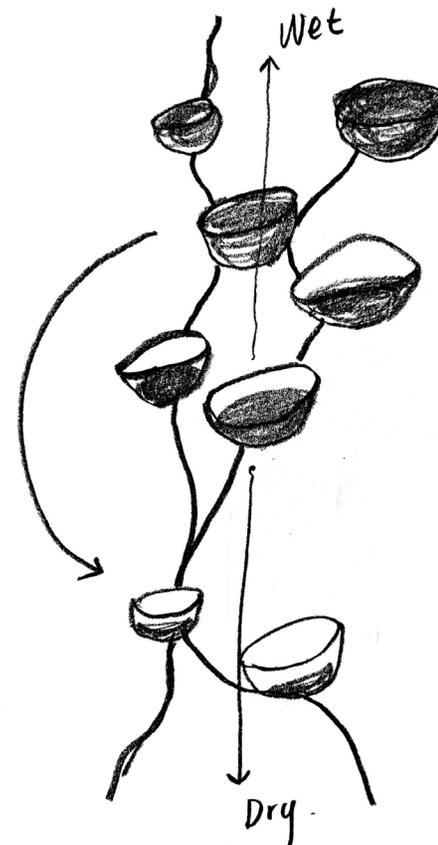
Flexible–Urban pond: Adapt to three situations

Daily

Dry

Wet

Dyke   Pond 1   Dyke   Pond 2   Dyke   Playground
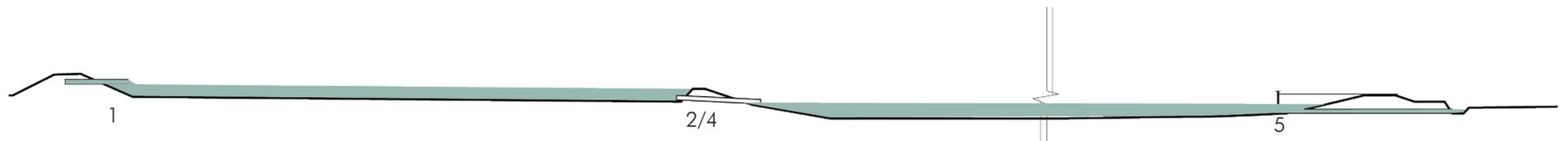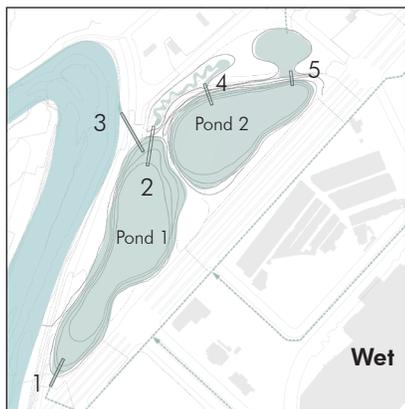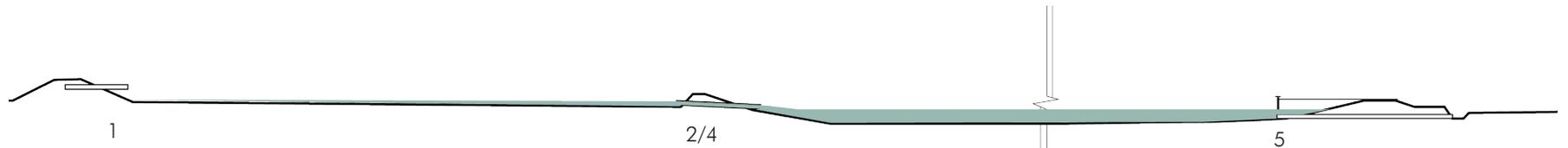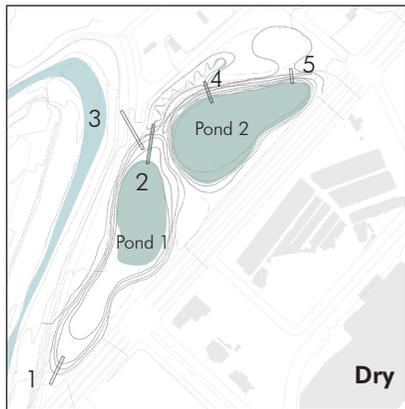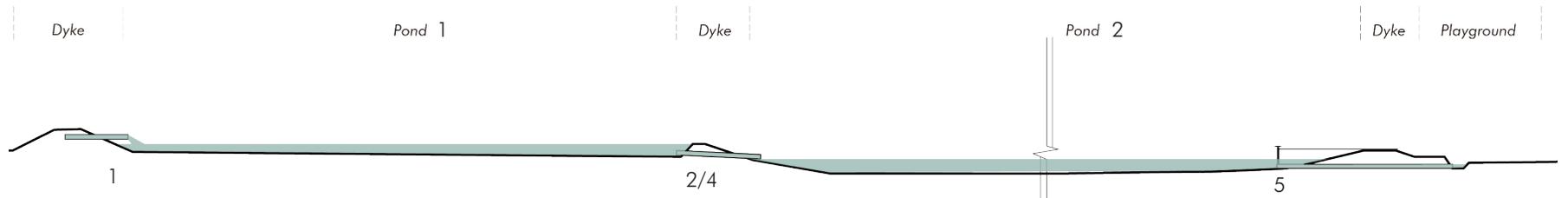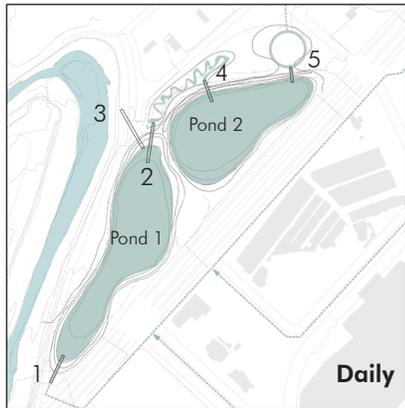
Flexible–Peri-urban pond: Adapt to three situations

Farmland   Dyke   Pond   Dyke   Treatment   Canal
                                                                          wetland

Daily

Dry

Wet
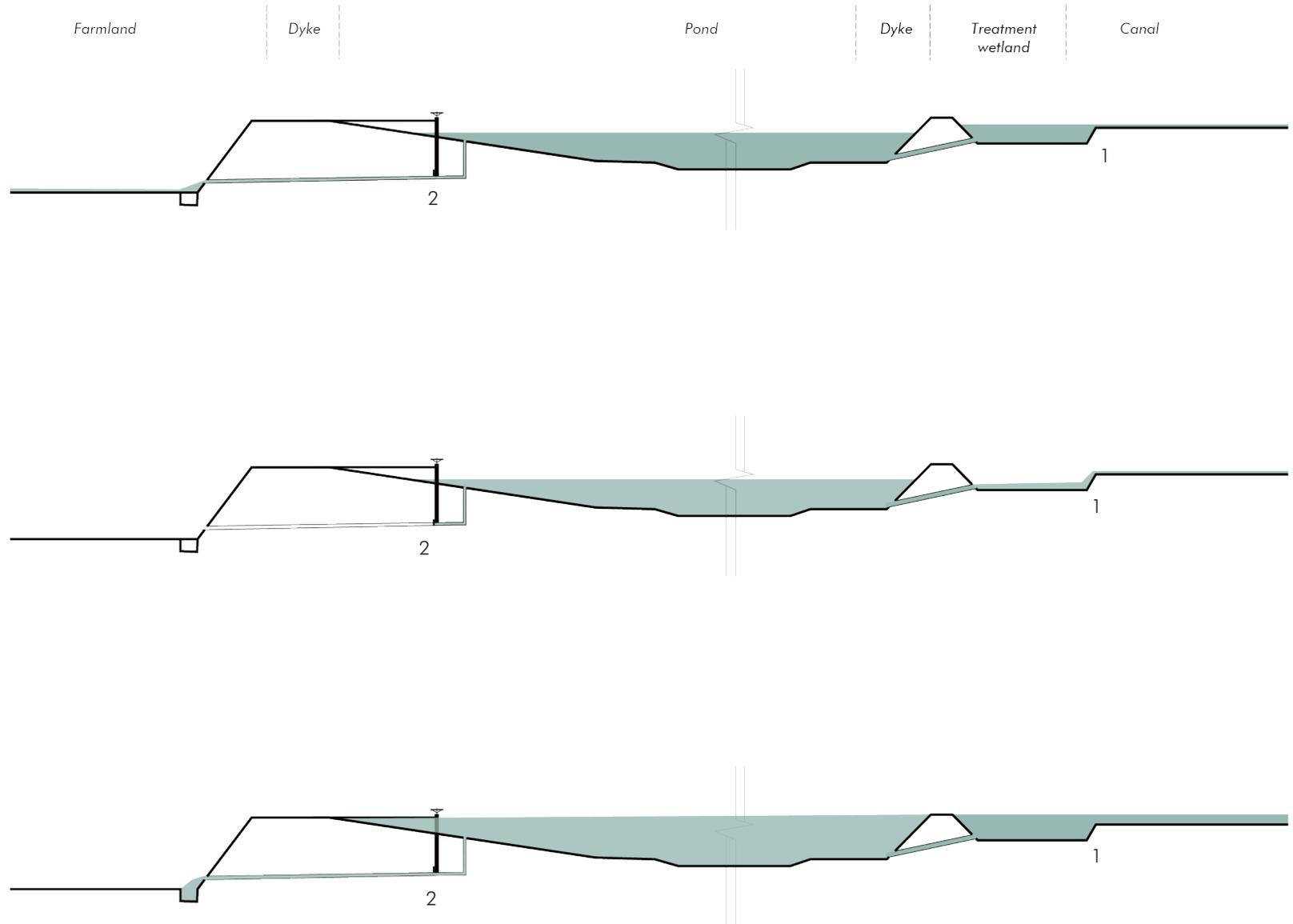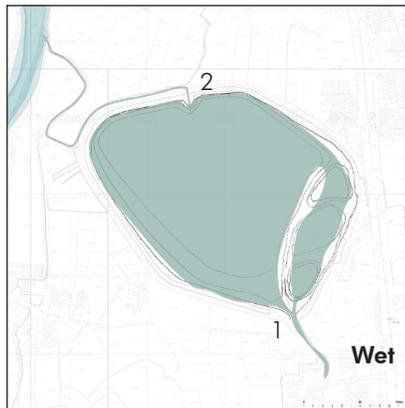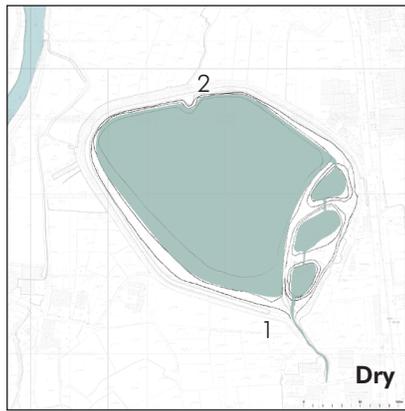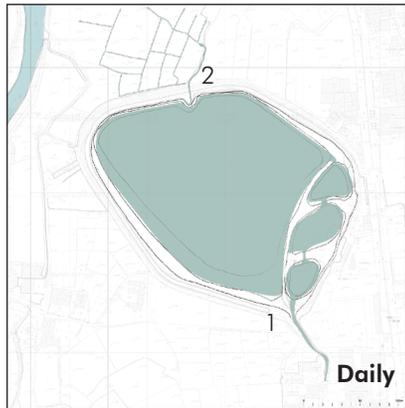
Flexible–Urban area-urban pond and neighborhood
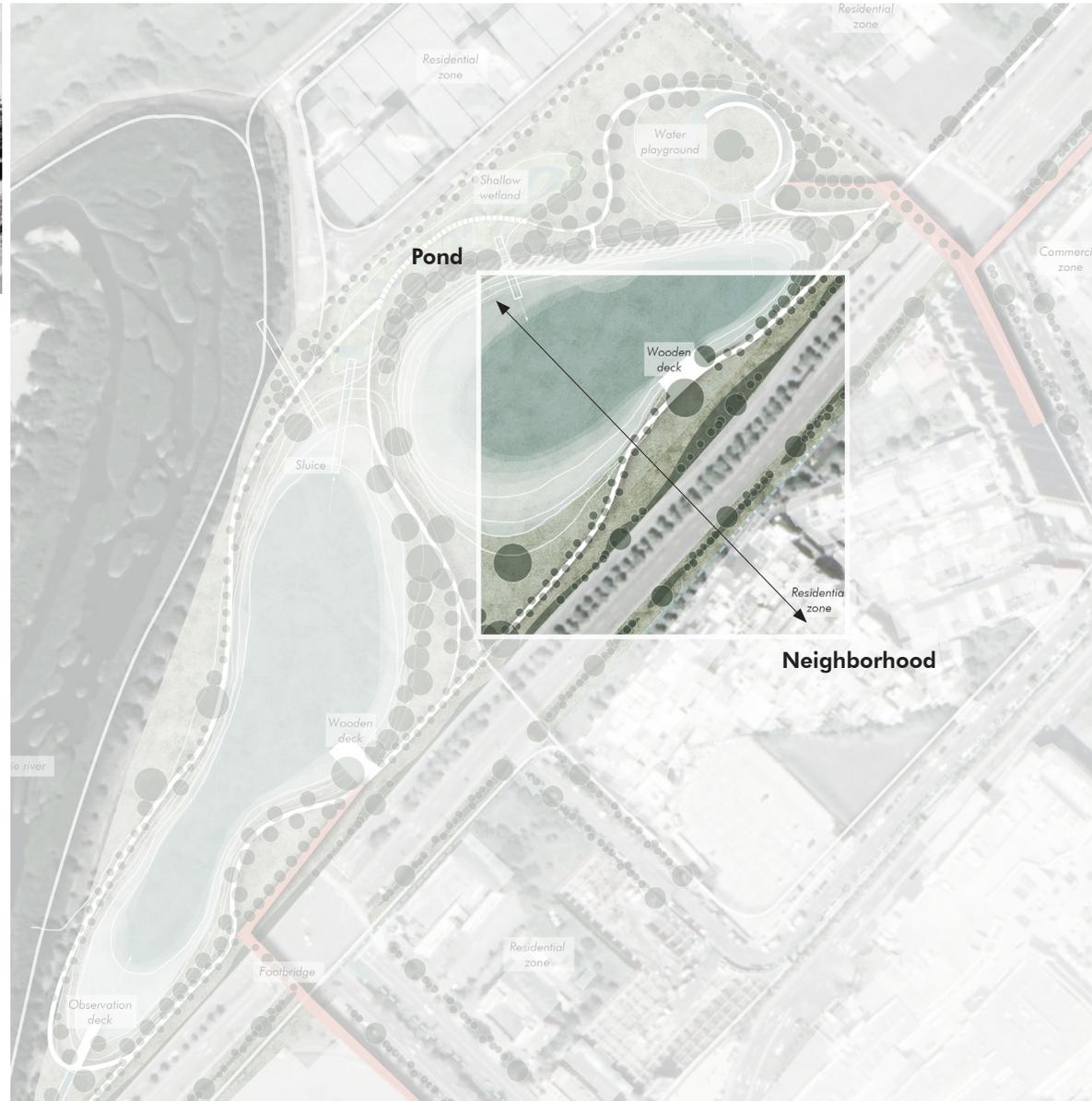
Flexible–Urban area-existing conditon

Exisitng ground line

Flexible-Dry
Urban area-Green infrastructure
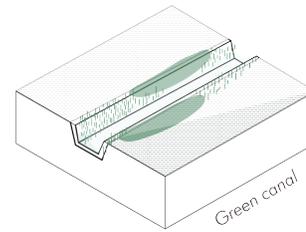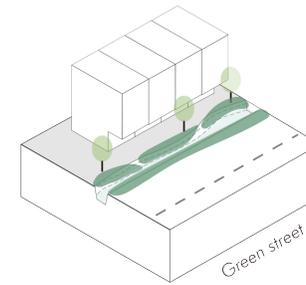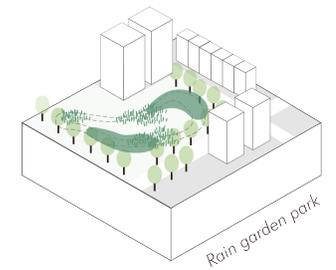
Planted zone in urban pond

Urban pond

Green canal

Taoyuan main canal

Green street

Street drainage

Rain garden park

Green field

Existing ground line

Wetland

Vegetated swale

Bioretention cell

Rain Garden

Residential buildings

Urban Pond

Green pathway

Green street

Rain garden park

Flexible-Wet
Urban area-blue infrastructure

Planted zone in urban pond

Green canal

Green street

Rain garden park

Existing ground line

Wetland

Vegetated swale

Bioretention cell

Rain Garden

Stormwater runoff

Urban Pond

Green pathway

Green street

Rain garden park

Residential buildings

0   5M

Flexible-Dry

Vernacular landscape in the urban pond

Pavilion

1.5 km

Green mound

Wooden deck

Existing ground line

Wetland

Vegetated swale

Urban Pond

Green pathway

Flexible-Wet

Vernacular landscape in the urban pond

Wetland plants

Floating / Submerged plants

Wetland plants

Wetland

Vegetated swale

Exisitng ground line

Submerged plants

Urban Pond

Green pathway

Flexible-Dry
Vernacular landscape in the urban pond

Vegetated swale

Underground rain drainage

Taoyuan main canal

Bioretention cell

Rain Garden

Wooden platform

hway

Green street

Rain garden park

Residential buildings

0   5M

Flexible-Wet
Vernacular landscape in the urban pond

Vegetated swale

Bioretention cell

Rain Garden

Stormwater
runoff

hway

Green street

Rain garden park

Residential
buildings

0   5M

Flexible–Pri-urban area- pond and farmland

Pond

Fishing house

Free water surface system

Ecotone

Settlement
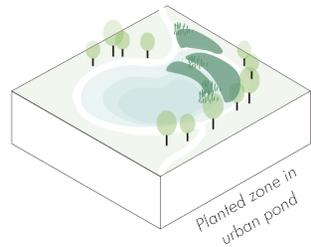
Farmland

Farmland

Footbridge

Green canal
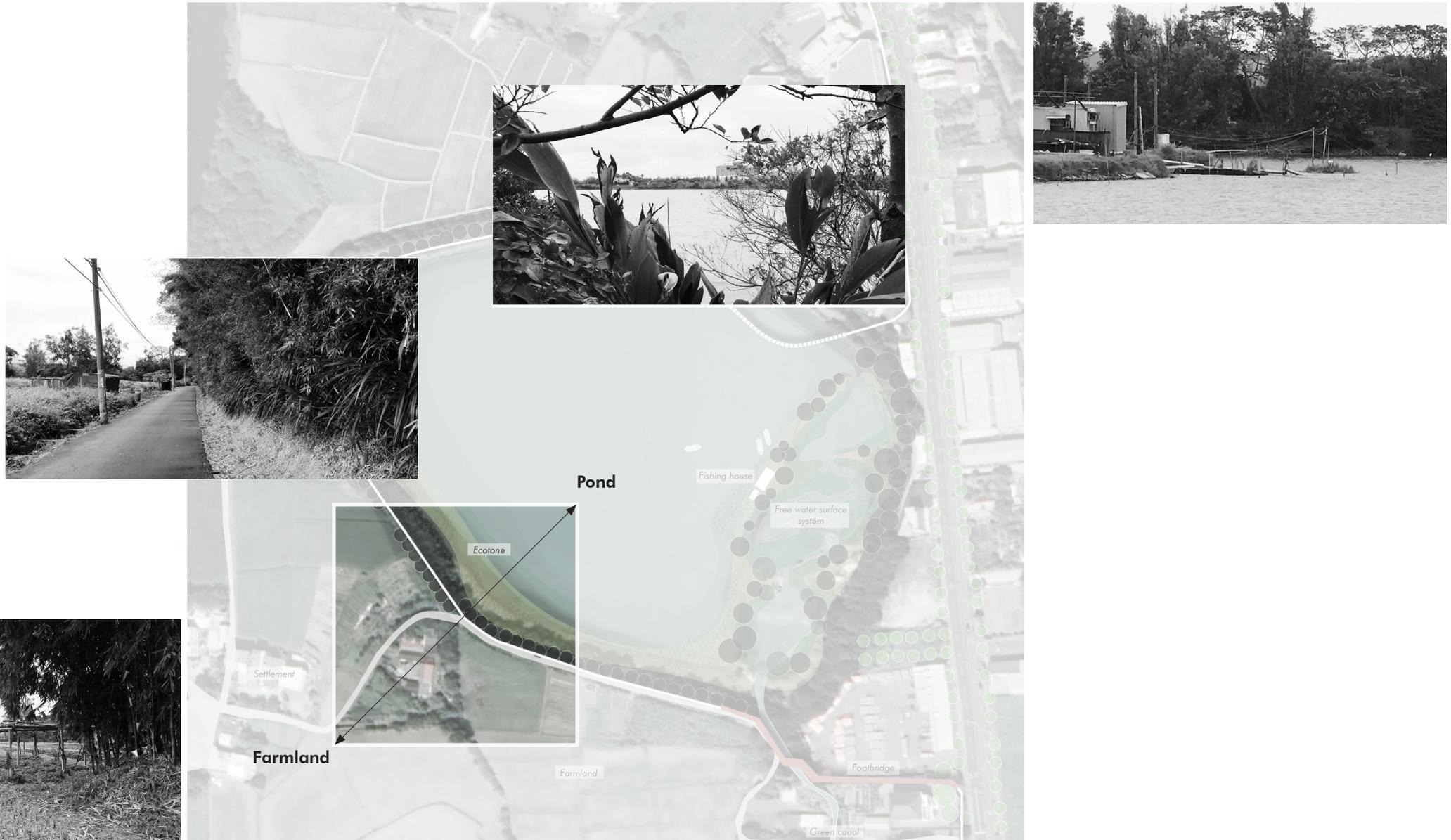
Compose
Flexible—Peri-urban area-existing conditon

Exisitng ground line

Flexible-Dry
Peri-urban-Green infrastructure

Canal

Farm pond

Filter strip

Vegetated swale

Retaining wall

Wetland plants

Floating / Submerged plants

Submerged plants

Wetland

Exisitng ground line

Farmland

Green pathway

Dyke

Pond

0   5M
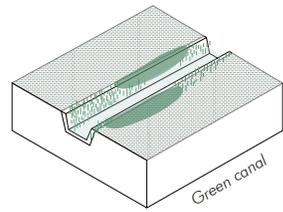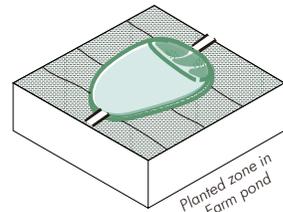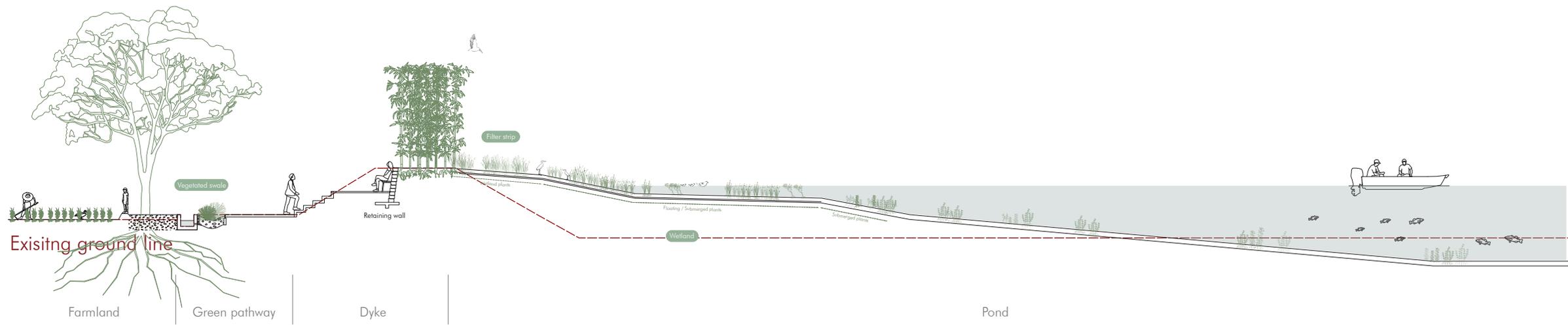
Flexible-Wet
Peri-urban -Blue infrastructure

Vegetated swale

Stormwater runoff

Retaining wall

Filter strip

Emergent plants

Floating / Submerged plants

Submerged plants

Wetland

Farmland

Green pathway

Dyke

Pond

0   5M

Flexible-Dry

Vernacular landscape in the peri-urban pond

Retaining wall

1 km

Filter strip

Vegetated swale

Wetland plants

Floating / Submerged plants

Retaining wall
with seats

Submerged plants

Wetland

Exisitng ground line

Farmland

Green pathway

Dyke

Flexible-Wet
Vernacular landscape in the peri-urban pond

Vegetated swale

Stormwater runoff

Vegetated swale

Stormwater runoff

Retaining wall

Filter strip

Wetland plants

Floating / Submerged plants

Submerged plants

Wetland

Farmland

Green pathway

Dyke

Flexible-Dry

Vernacular landscape in the peri-urban pond

Filter strip

Wetland plants

Floating / Submerged plants

Filter strip

Wetland plants

Floating / Submerged plants

Submerged plants

Wetland

Pond

Compose
Flexible-Wet
Vernacular landscape in the peri-urban pond

Filter strip

Wetland plants

Floating / Submerged plants

Submerged plants

Wetland
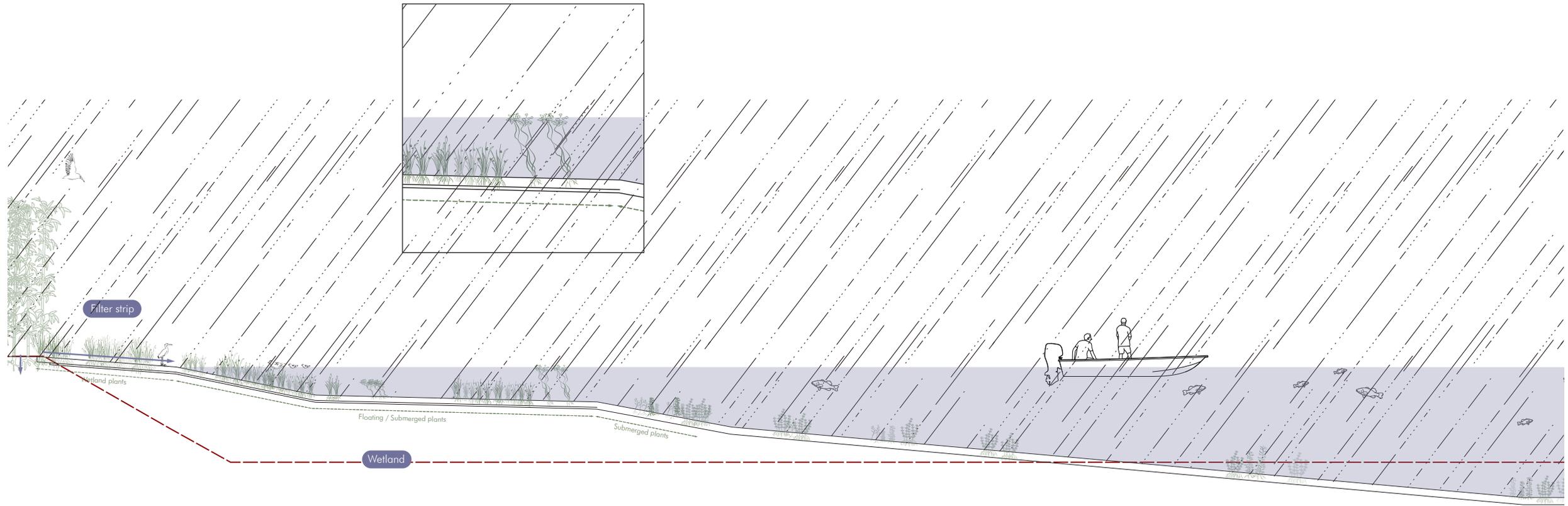
Pond

Compose

Flexible

Urban area-Bridge in between of two ponds

Flexible
Urban area-A simple idea of the bridge

Flexible–Urban area/Bridge in between of two ponds

Platform

Framing from the window

Semitransparent texture

Daily scene

Flexible–Urban area/ Bridge in between of two ponds

Daily scene

Flexible–Urban area/ Bridge in between of two ponds

Gutter on the bridge

Wet scene

Flexible–Urban area/ Bridge in between of two ponds

Wet scene

Flexible–Urban area/ Bridge in between of two ponds

Open the door

Dry scene

Flexible-Urban area/Bridge in between of two ponds

Dry scene

Flexible
Peri-urban area- the bridge framing the water sluice
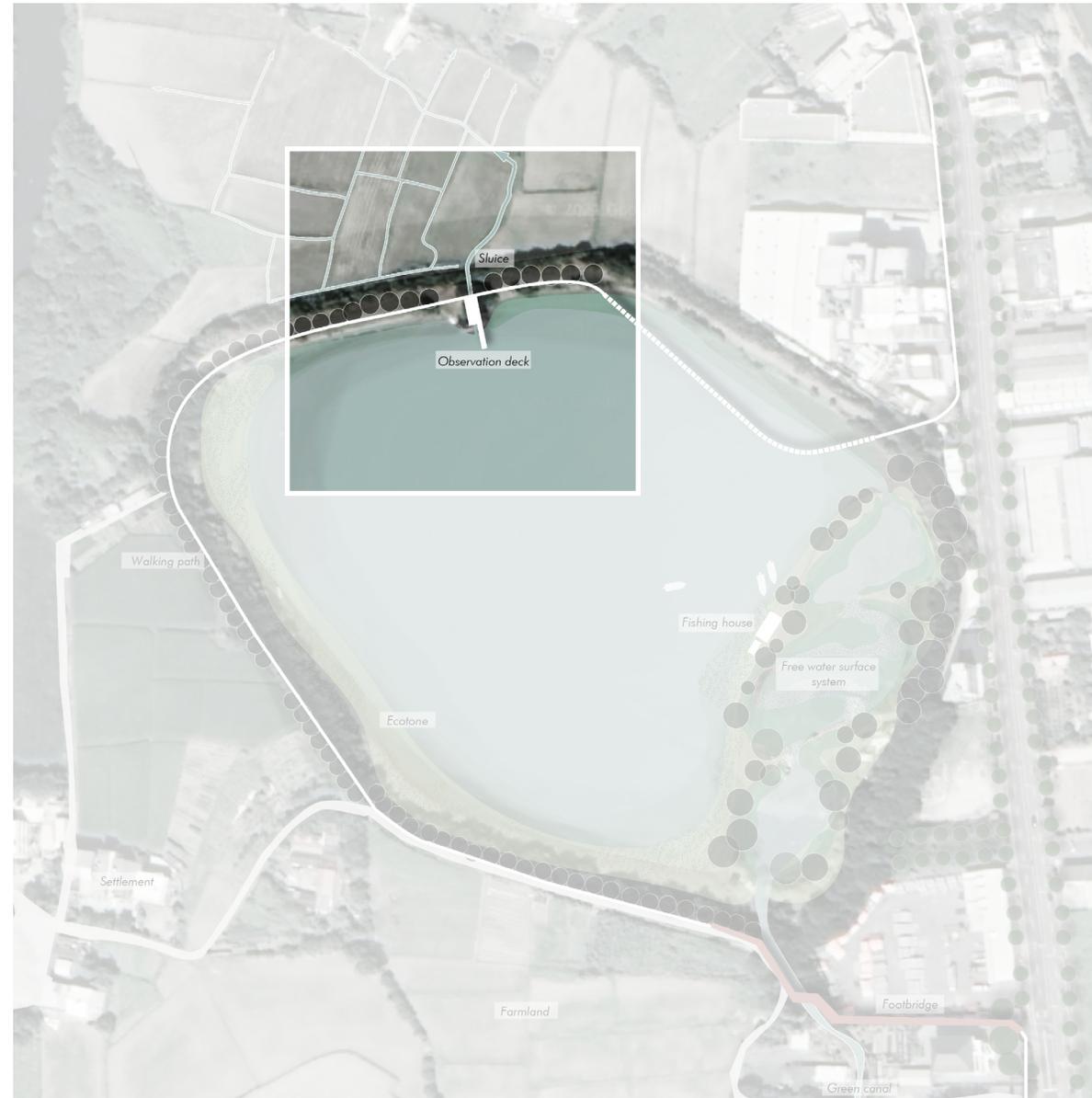
Compose
Flexible–Peri-urban area
A simple idea of a bridge framing the water sluice

Flexible–Peri-urban area/a bridge framing the water sluice

View point

Water level
measurement

Wooden deck

Running path

Daily scene

Flexible–Peri-urban area/a bridge framing the water sluice

Daily scene

Flexible–Peri-urban area/a bridge framing the water sluice

*Taking advantage of high water level
to harvest fishes*

Wet scene

Flexible–Peri-urban area/a bridge framing the water sluice

Wet scene

Flexible–Peri-urban area/a bridge framing the water sluice
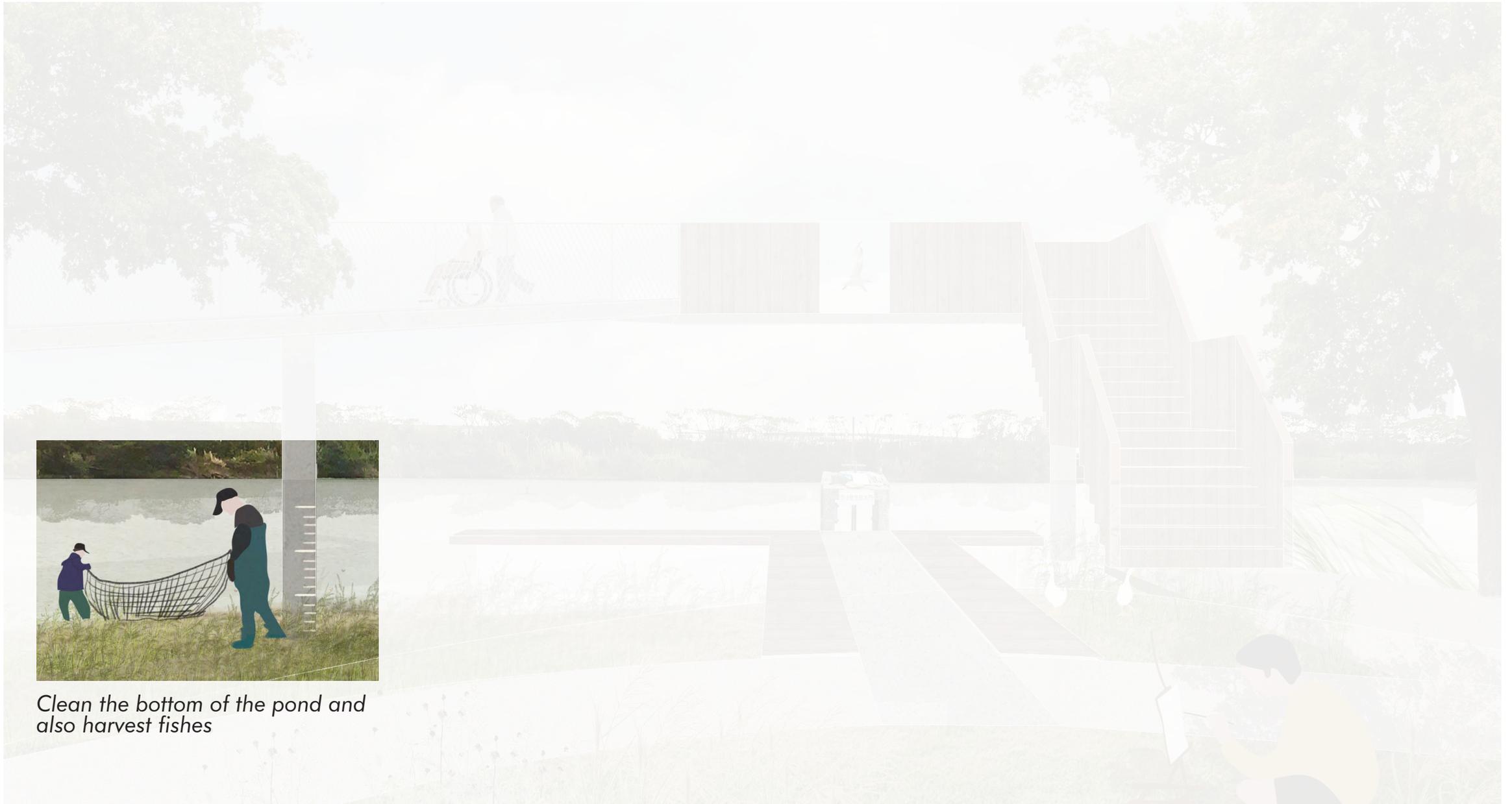
Clean the bottom of the pond and also harvest fishes

Dry scene

Flexible–Peri-urban area/a bridge framing the water sluice

Dry scene

Conlusion

RESILIENT
POND
LANDSCAPE

DOMAINS   CLIMATE   PUBLIC SPACE
           ADAPTATION

ROBUST   REFLECTIVE   FLEXIBLE

DESIGN
PRINCIPLES

DESIGN
STRATEGIES

TOPOGRAPHY	HYDROLOGY		VEGETATION	RECREATION		
	RETENTION	DETENTION	INFITRATION	WILDLIFE HABITATE	URBAN ACTIVITIES	PUBLIC ACCESS
USAGE						
Pond in urban area	◯	●	◯	◯	●	●
Pond in peri-urban area	●	◯	●	●	◯	◯
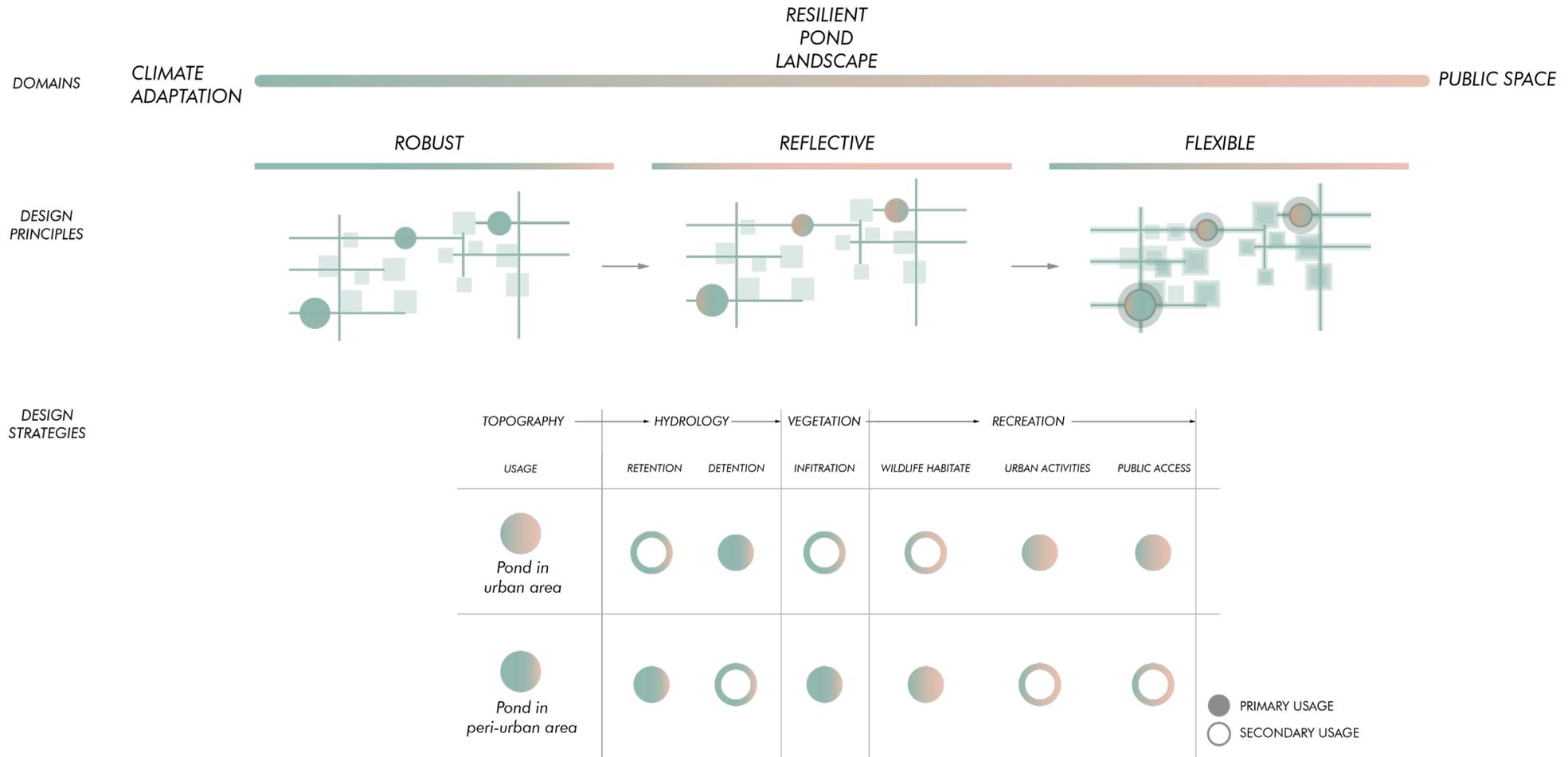
● PRIMARY USAGE
◯ SECONDARY USAGE
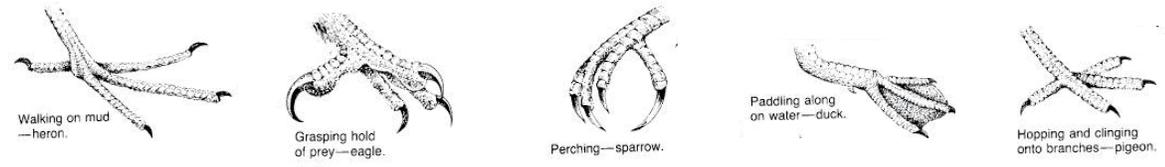
Pond adaptation

Bird claw adaptations.

Source: downloaded from lansingwbu.blogspot.com

Pond
No.5-1

	Enlarge pond size	Improve water quality	Adapt to drought	Adapt to flood
Irrigate farmland	Water storage	Build a treatment wetland	Stop irrigate and store water	Release water to the river

Build a pond

	Build community	Water storage	Adapt to drought	Adapt to flood
	Fill half of pond	Construct a new pond(1)	Keep one pond for store water	Pond(1) can release water to the river
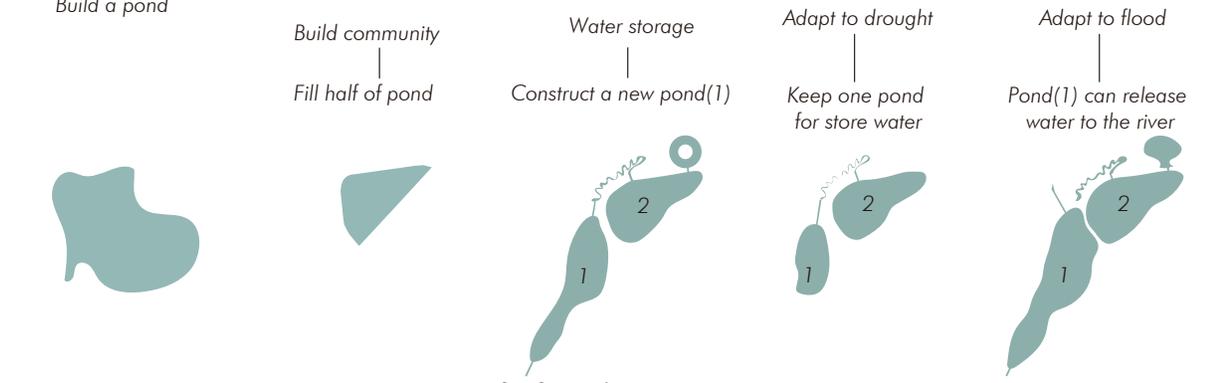
Pond
No.5-5

Pond adaptations.

Understand

Recognize

Compose

Reflect

Design evaluation

The 100 resilient Cities

7 Characteristics of Resilient Cities

Robust   Resourceful   Redundant   Reflective   Inclusive   Flexible   Integrated

3 Design principles

Robust   Reflective   Flexible

4 Design strategies

1 Topography   2 Hydrology   3 Vegetation   4 Recreation
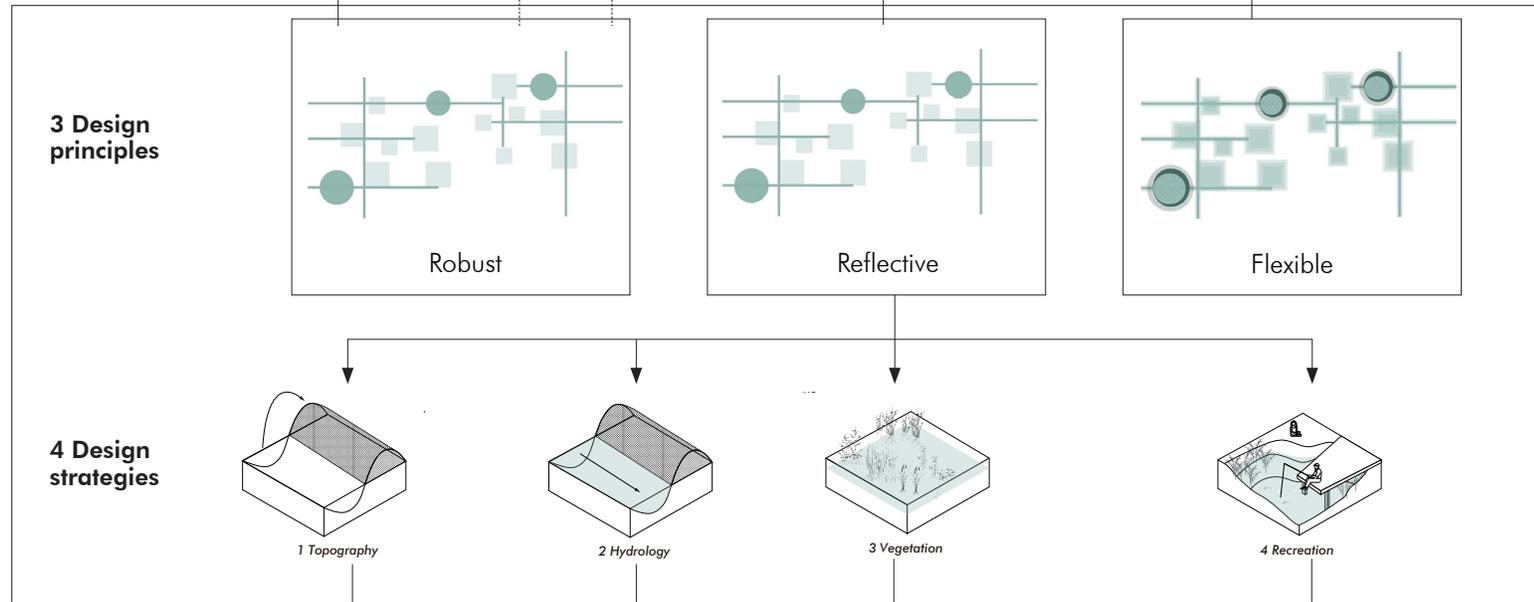
Ecological infrastructure

3 Landscape categories

1Abiotic processes are mainly dealing with water management.

2 Biotic processes conserve native species/biodiversity.

3 Cultural and landscape 'security patterns' (SP) protect and re-creation heritage as a powerful tool for open public space.

Direct relation

Indirect relation

Way of working

Leisure
+
Storm water storage

PARK IN URBAN AREA
↳ Vegetated Detention Basin

drainage
↳ Vegetated swale

Green area in URBAN
↳ constructed wetland

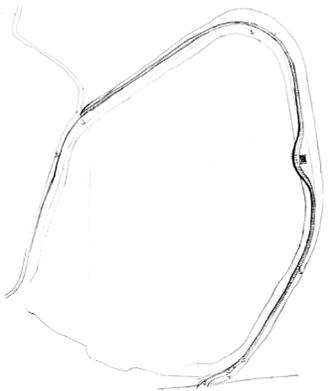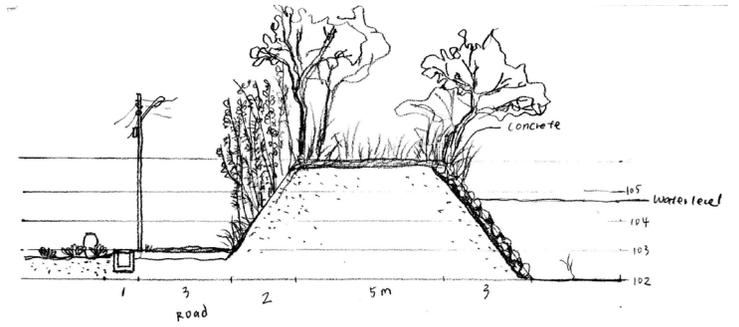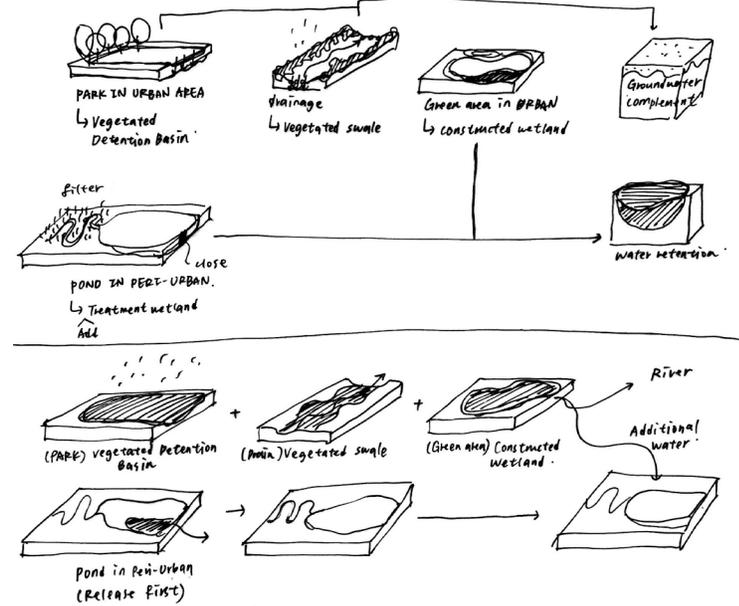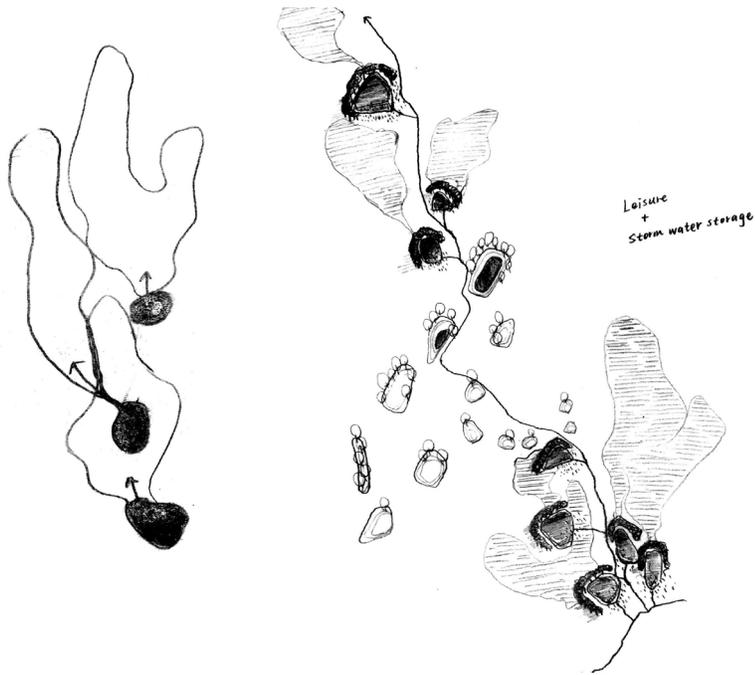Groundwater complement

filter
close

POND IN PERI-URBAN.
↳ Treatment wetland
Add

water retention

(PARK) Vegetated Detention Basin + (Drain) Vegetated swale + (Green area) Constructed wetland → River

Additional water

Pond in Peri-Urban (Release first)

concrete

105 water level
104
103
102

1
road
2
5m
3

pipe over flow

Farm pond | Urban park as pond | Treatment pond

path | plaza (rest) | playground

Cut & Fill | waterworks | gravity flow | Red clay soil | Native plant

Limitation of the project：The knowledge of water management

The must fun: Challenging of rethinking the value of pond system

The must meaningful : Deep understanding of my own hometown's water system

Photo credit: Philip Howard

Designers make the space, but people create the magic of space.

The pond of wonders

        are for living and dreaming .

Thank you for listening!