Presented at the: Advancing Urban Sustainability in China and the United States ,American Academy of Sciences, 2019.2.16

Nature-based Solutions and Their Performance

Sponge City and Holistic Solutions Inspired by Ancient Wisdom

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&
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Challenges:

Climate Change +

Over 80% of the Chinese cities suffer air pollution

Flood: annual flood damage cost 100 billion US $

Draught: 400 of 662 cities in shortage of water

Pollution: 75% of the nation’s surface, 64％ of underground water

Habitat loss: 50% wetland disappeared in 50 years

Rich wisdom in dealing with the changing environment

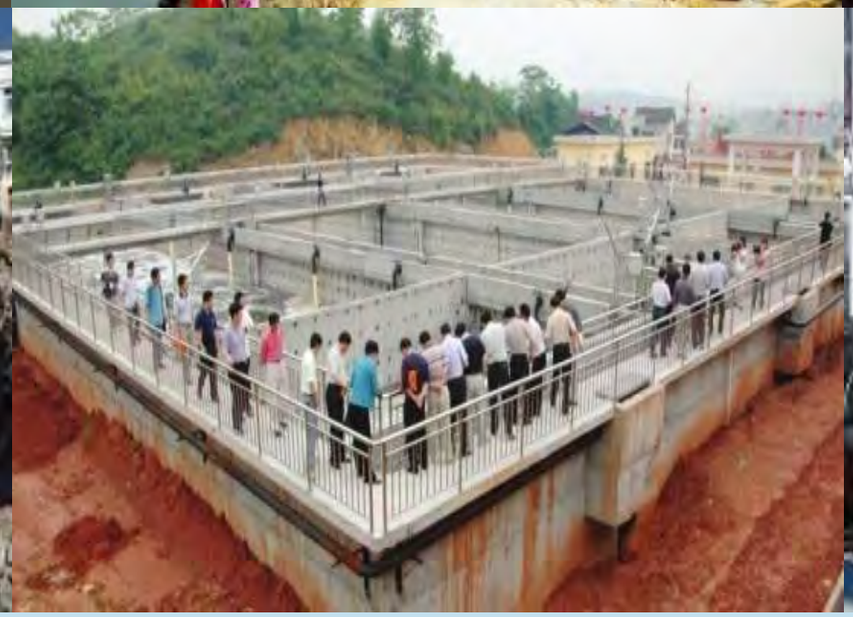
are in the stock in those cultures that survived the vagarious nature over thousands of years in general, and the aqua-culture evolved under the monsoon climate in particular.

But such wisdom are usually buried under layers of modern industrial technology or ignored.

Yet the single-goal minded grey infrastructure built with industrial technology simply lacks resiliency and, in many cases, not sustainable!



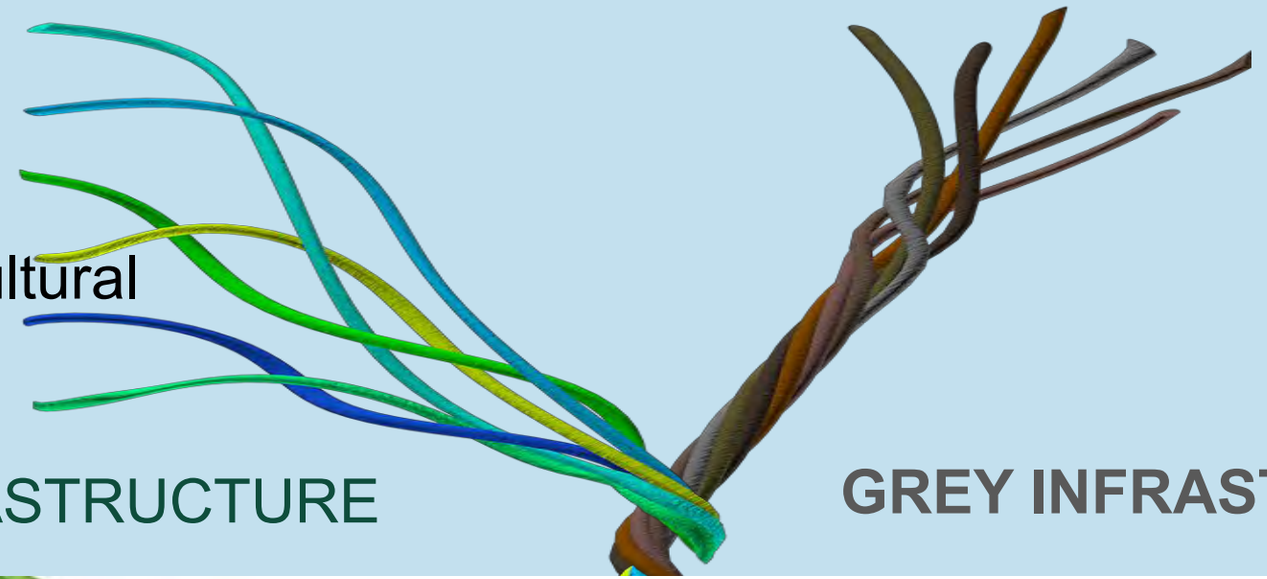





The alternative solutions:

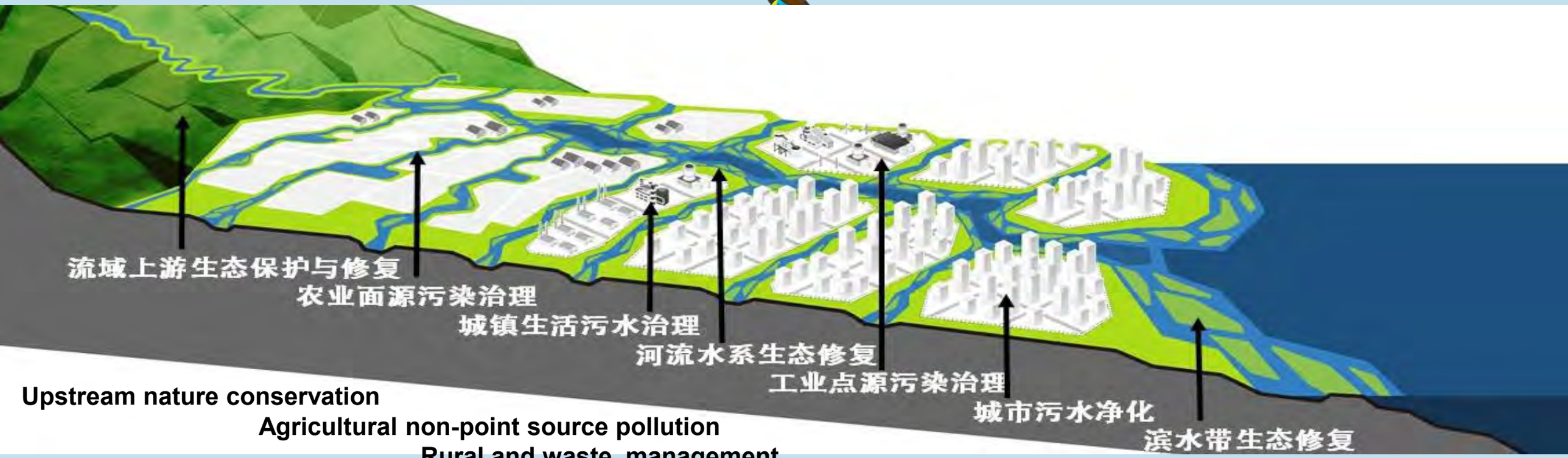
After so much suffering, it is time now to revive the ancient wisdom to develop the nature-based and holist solutions: ecological infrastructure（green infrastructure） that are critical for securing ecosystems services

Provision
Regulation
Life supporting
Spiritual and cultural services



GREEN INFRASTRUCTURE

GREY INFRASTRUCTURE



Upstream nature conservation
Agricultural non-point source pollution
Rural and waste management
River system restoration
Industrial pollution treatment
Urban sewage treatment
Costal area restoration

Three Key Challenges

1.Planning Challenge:

Space are limited, how can we use minimum space to plan the most efficient ecological infrastructure ---A spatial gaming between nature and development

2.Desing and engineering challenge: nature-based solutions and ancient wisdom might not be efficient, nor standardized for modern engineering, how can we strengthen their performance, and make them standardized for modern practice

3. Change of policies: change of values, policies, education and whole knowledge system--- an intellectual revolution, a new civilization

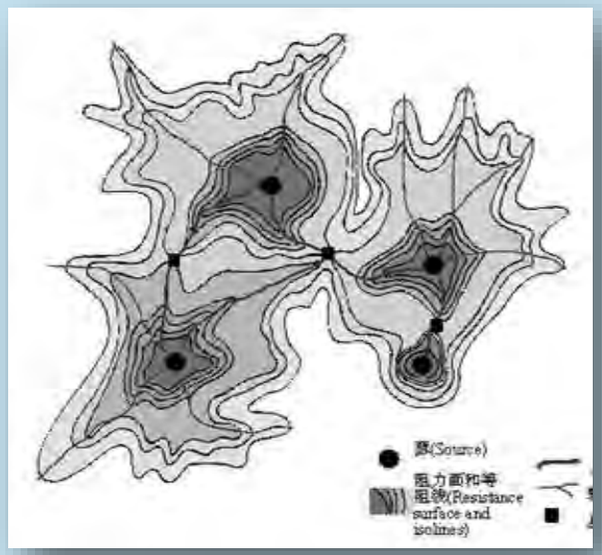
Three levels of action

1. Planning Ecological Infrastructure across scales
2. Design and engineering to create ecological infrastructure
3. Campaign for policy changes

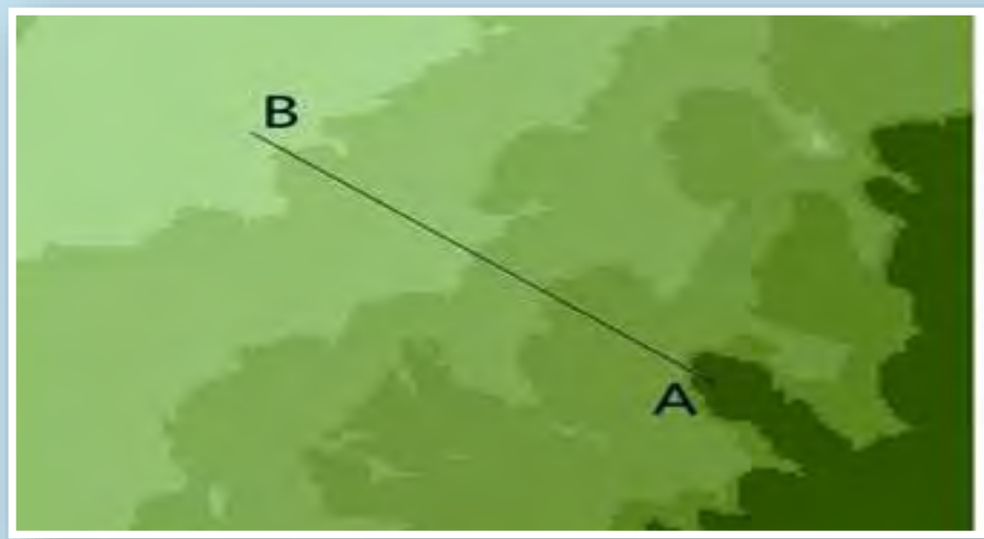
Action Elevel-1 Planning green infrastructure across scales

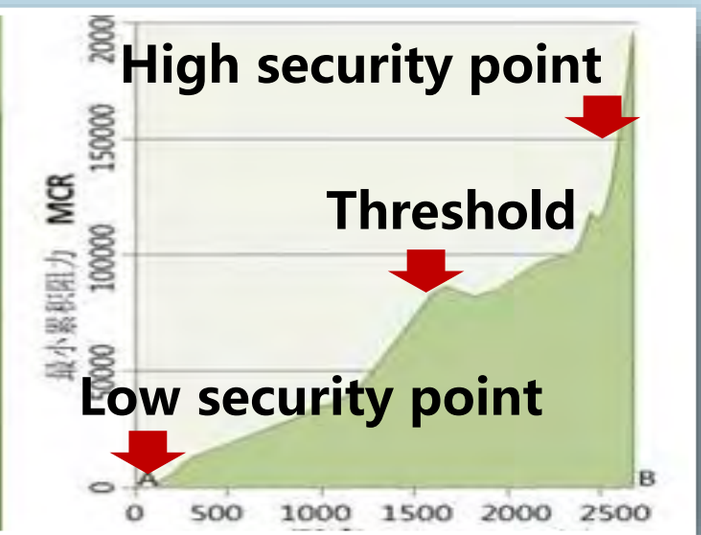
Methodology

Identifying the ecological security patterns based on the spatial analysis and modeling of the ecological processes



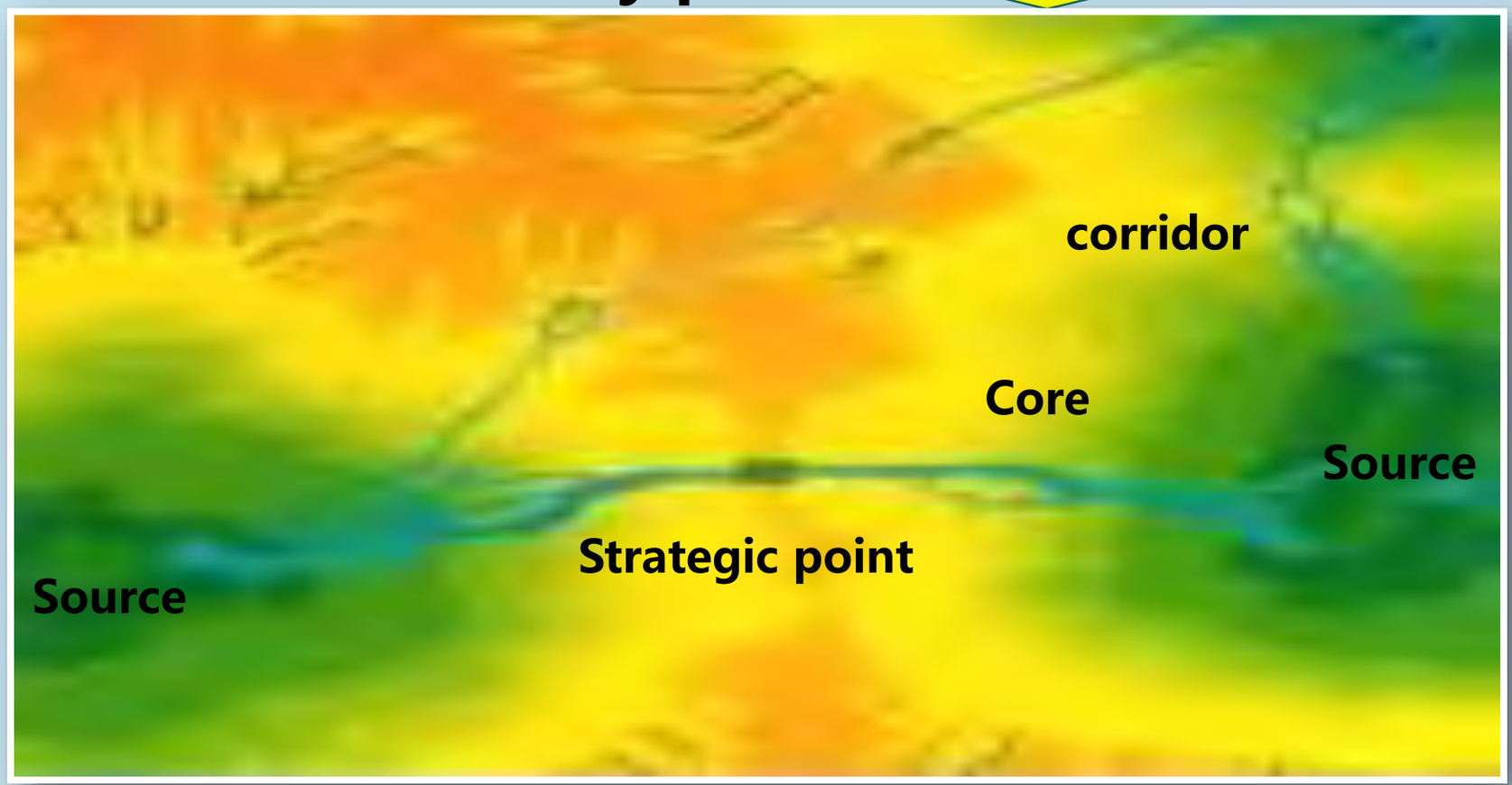
Potential surface



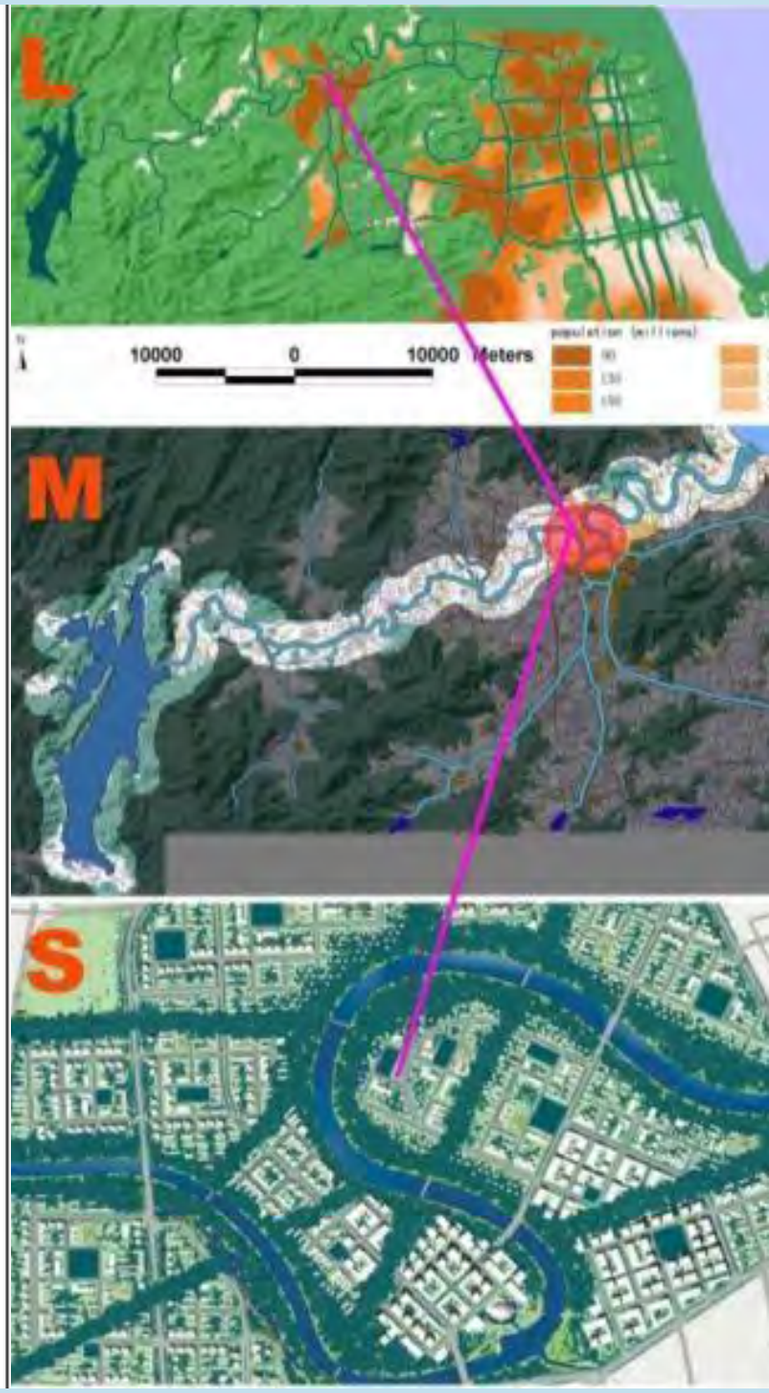


Security point

Security pattern



National Integrated Ecological Security Pattern



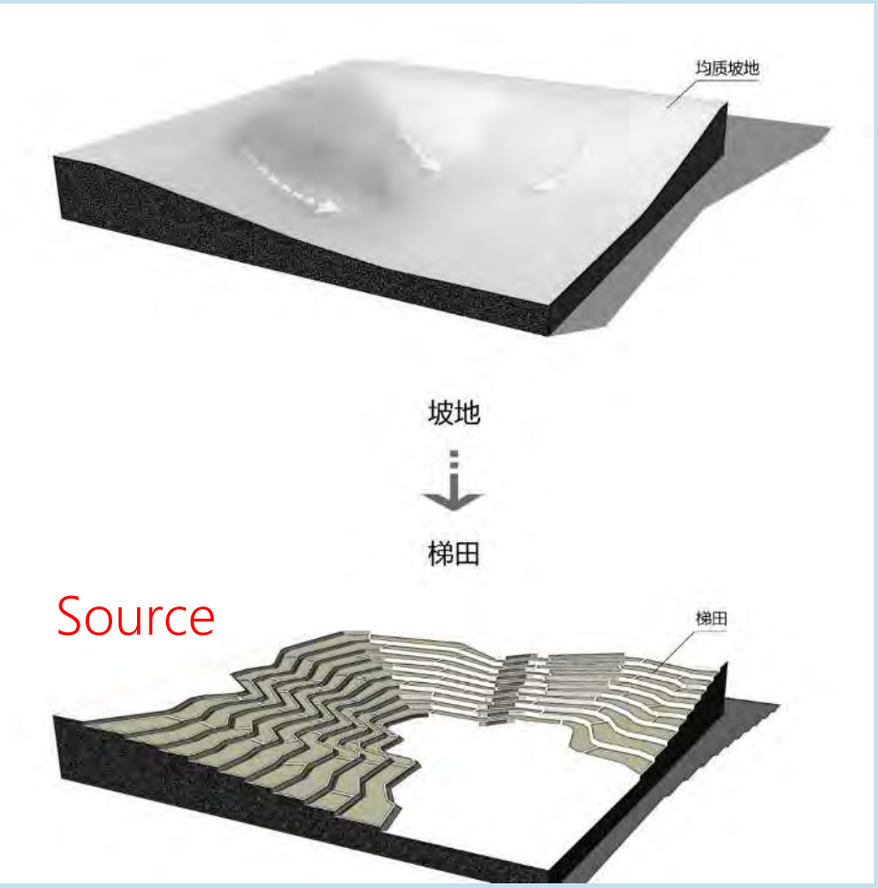
Action Level-2 Design and engineering:

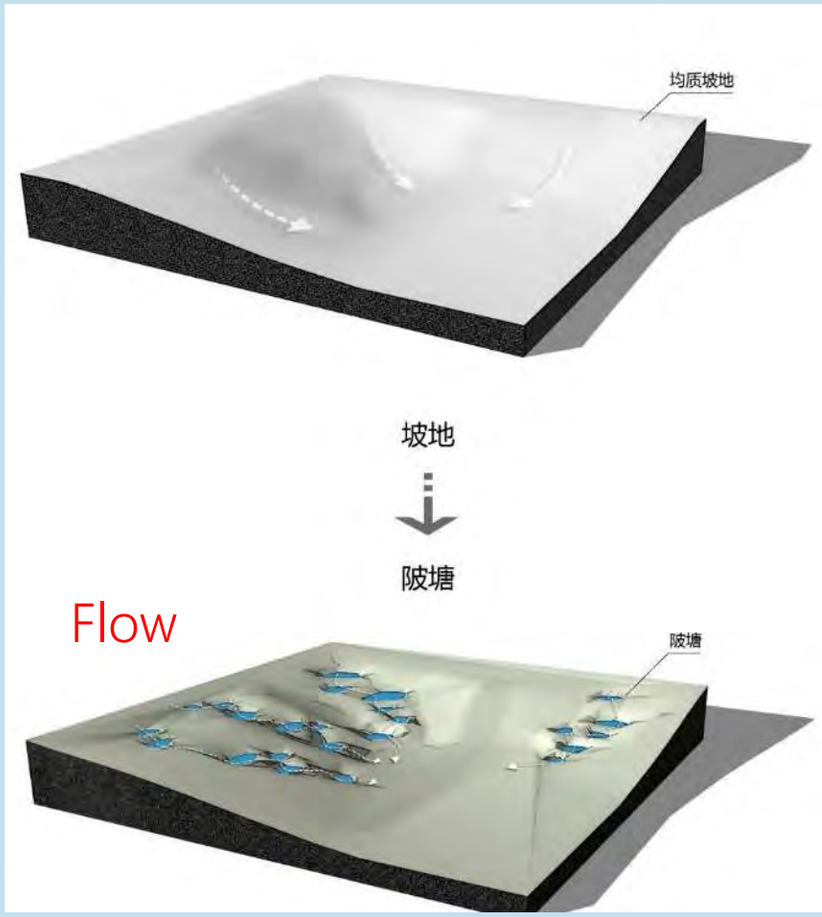
Create nature-based engineering models inspired by ancient wisdom

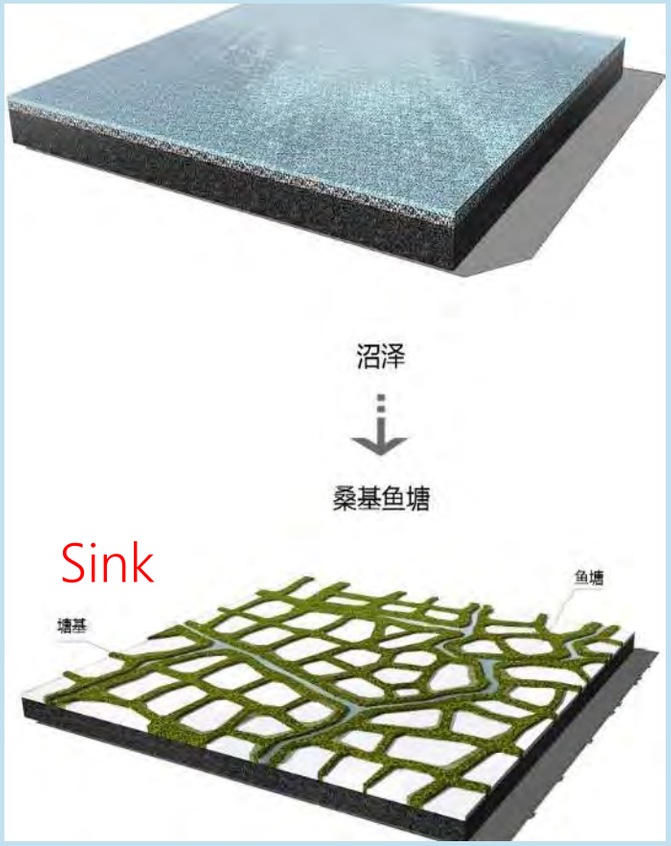
The terrace module

Pond module

Pond-dyke module





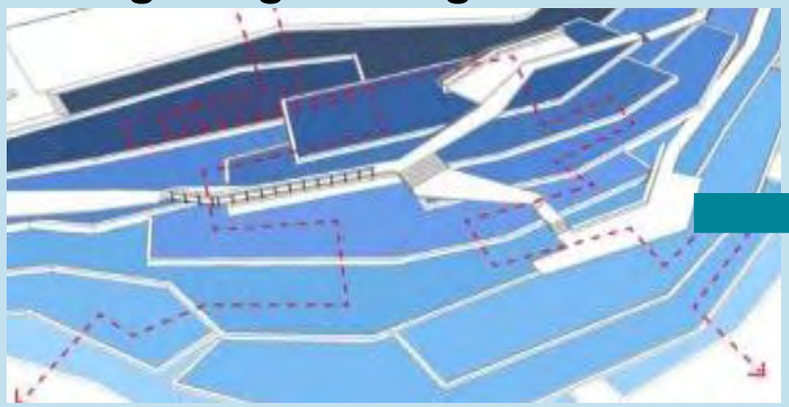


Methodology

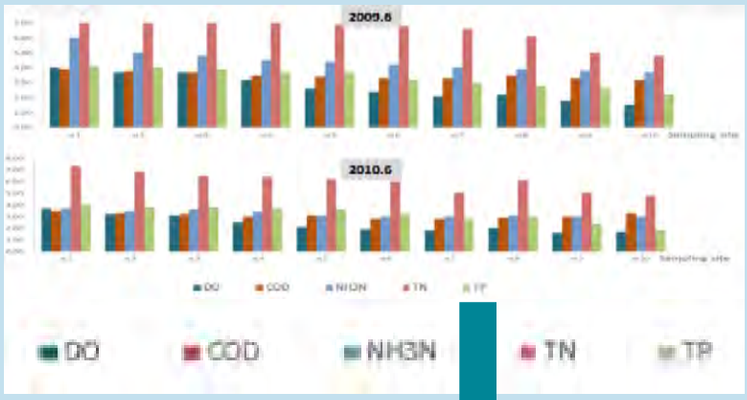
Inspired by the ancient farming wisdom, replicable module have been developed to solve the climate change+ problems at a massive scale in an inexpensive way.

Traditional wisdom

Design engineering module



Post operational test



Replicable modules

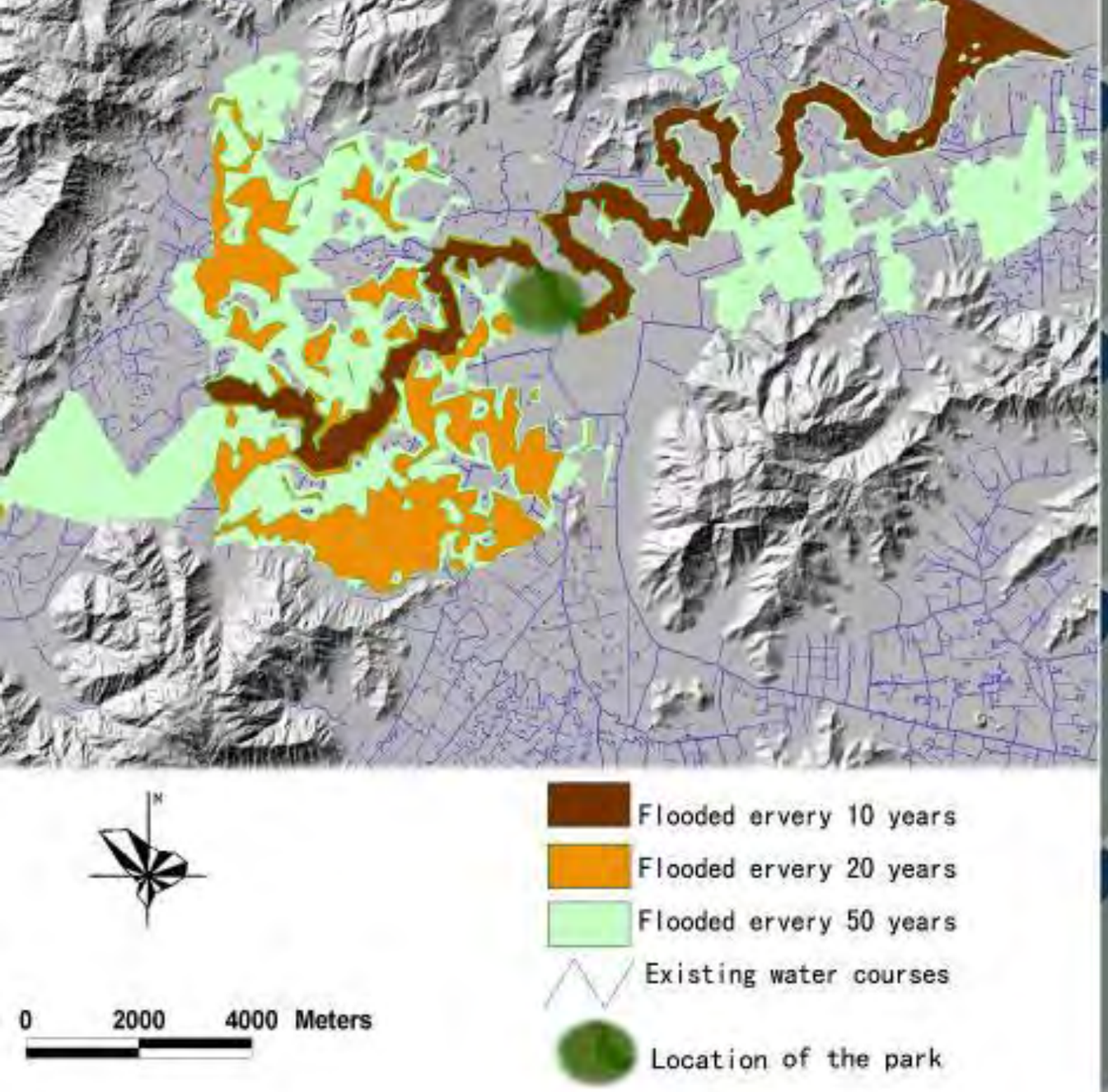
Modern ecological engineering

Design modules that are replicable at massive scale

For over 20 years, we have tested and built over 500 projects in 200 plus cities and showcased numerous replicable models for healing and transforming our land at various scales

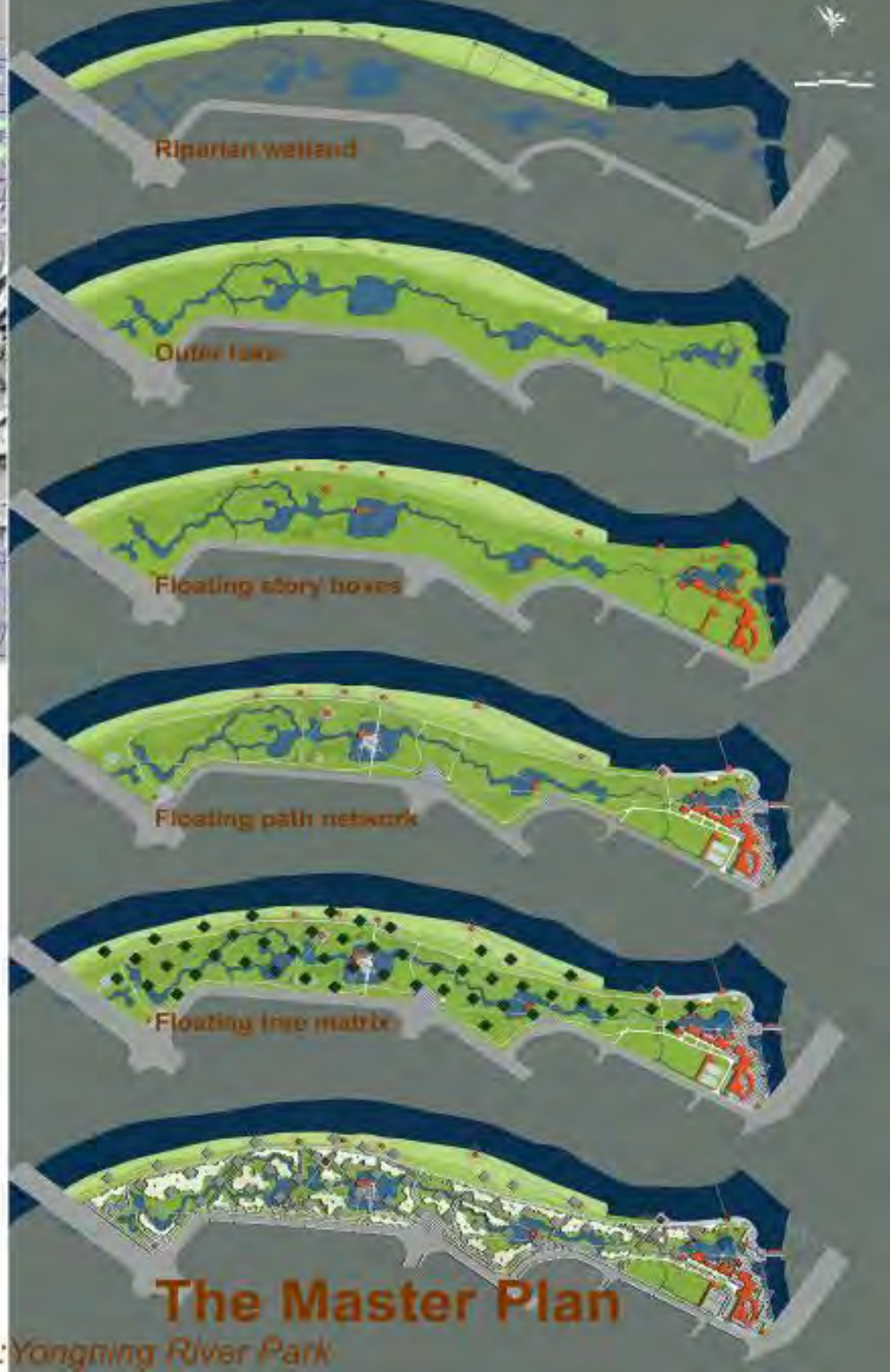
- # #1 Make friends with Floods
- ## Turn grey infrastructure into green
- **100$ billion lost,10 million people affected each year.**
- **All Rivers in China are dammed and channelized with concrete flood walls, what is the alternative?**

Number of dames (height>15m)
World total: 49,697
China: 25,800
USA: 8,724



The ecological approach for storm water management was proposed by the landscape architect as an alternative to the commonly used concrete embankment and channelization. This proposal was finally been accepted. As a result, the former engineering approach was stopped, and the concrete lined river was to be ecologically recovered. The Yongning River Park was, therefore, set up an example for ecological recovering of the whole river.

Flood Analysis



The Master Plan

The Floating Gardens: Yongning River Park

Designed experiment: Yongning Park, Zhejiang, China, 2003

This project demonstrates an ecological approach to flood control and storm water management, while also educating people about alternative solutions to flood control beyond engineering.

Designed experiment: Yanweizhou, Jinhua, Zhejiang Province

20 Year Flood

Dry season

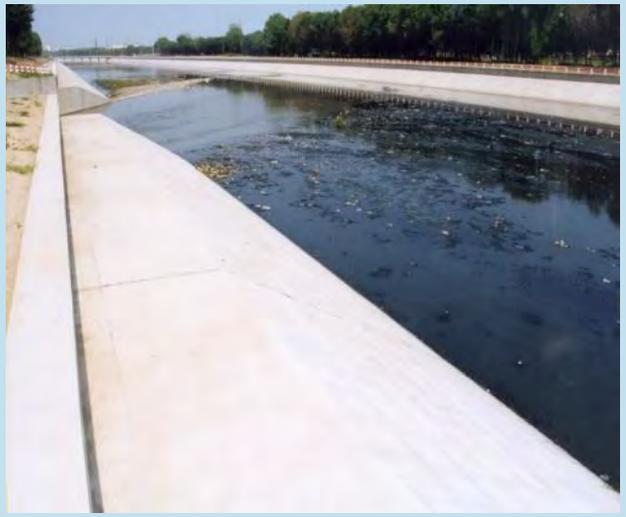
An aerial view of the park during the dry season, note the lush tall grasses covering the terraces on the embankment. The terraces are enriched by silt deposited during the flood season (view is toward the west, photo: September, 2016)

Performance test:

Such kind of ecological embankment can reduce peak flow at more than half of the flow at the basin's outlet. The maximum daily peak reduction rate can reach **53%-63%.**

How much can be changed if natured based solution is to be implemented nation wide

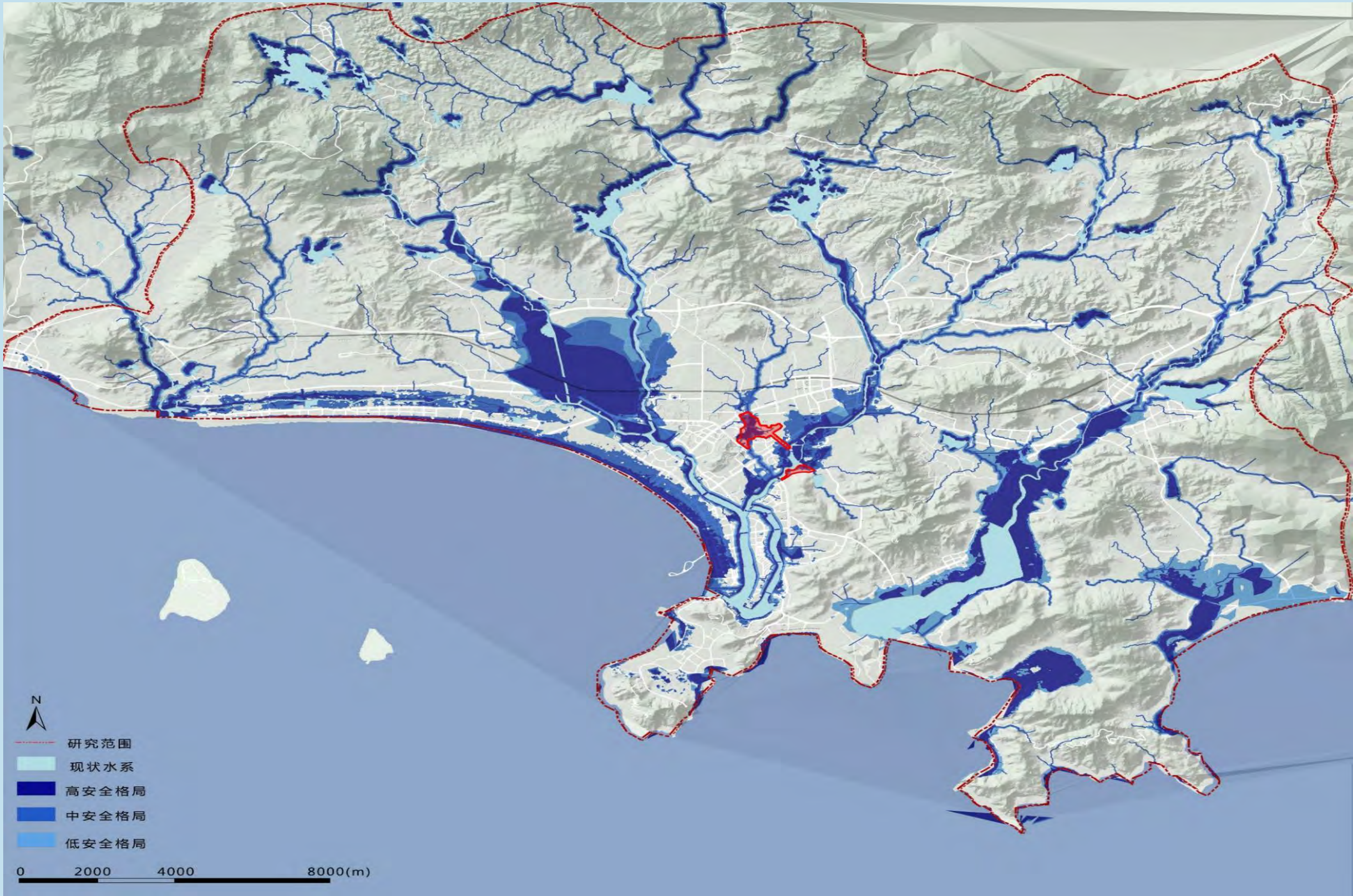
?



#2 Green Sponge for water resilient City

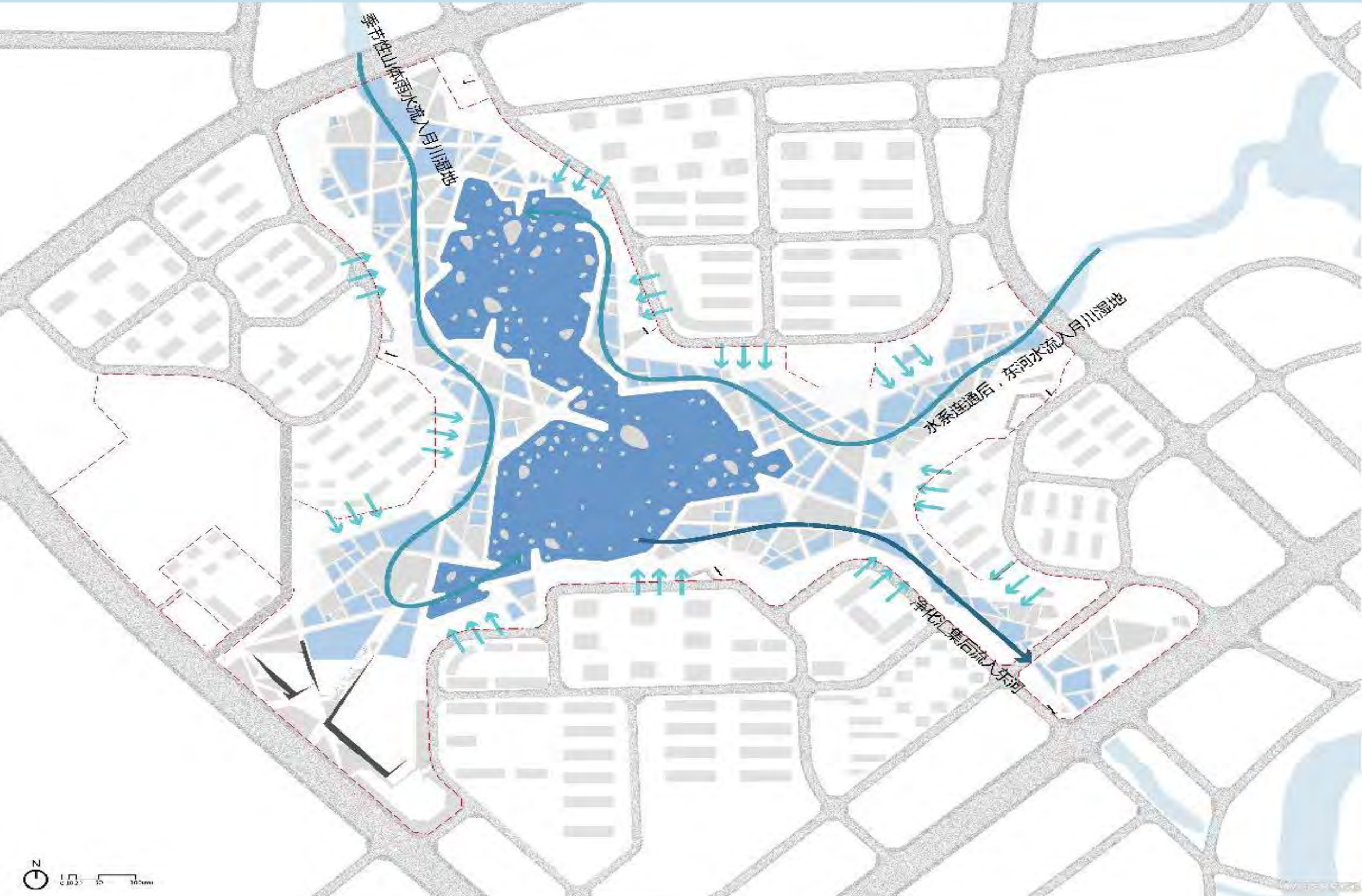
Sanya, Hainan Island, The First Official Demonstrative project of Sponge City and Ecological Restoration Movement in China

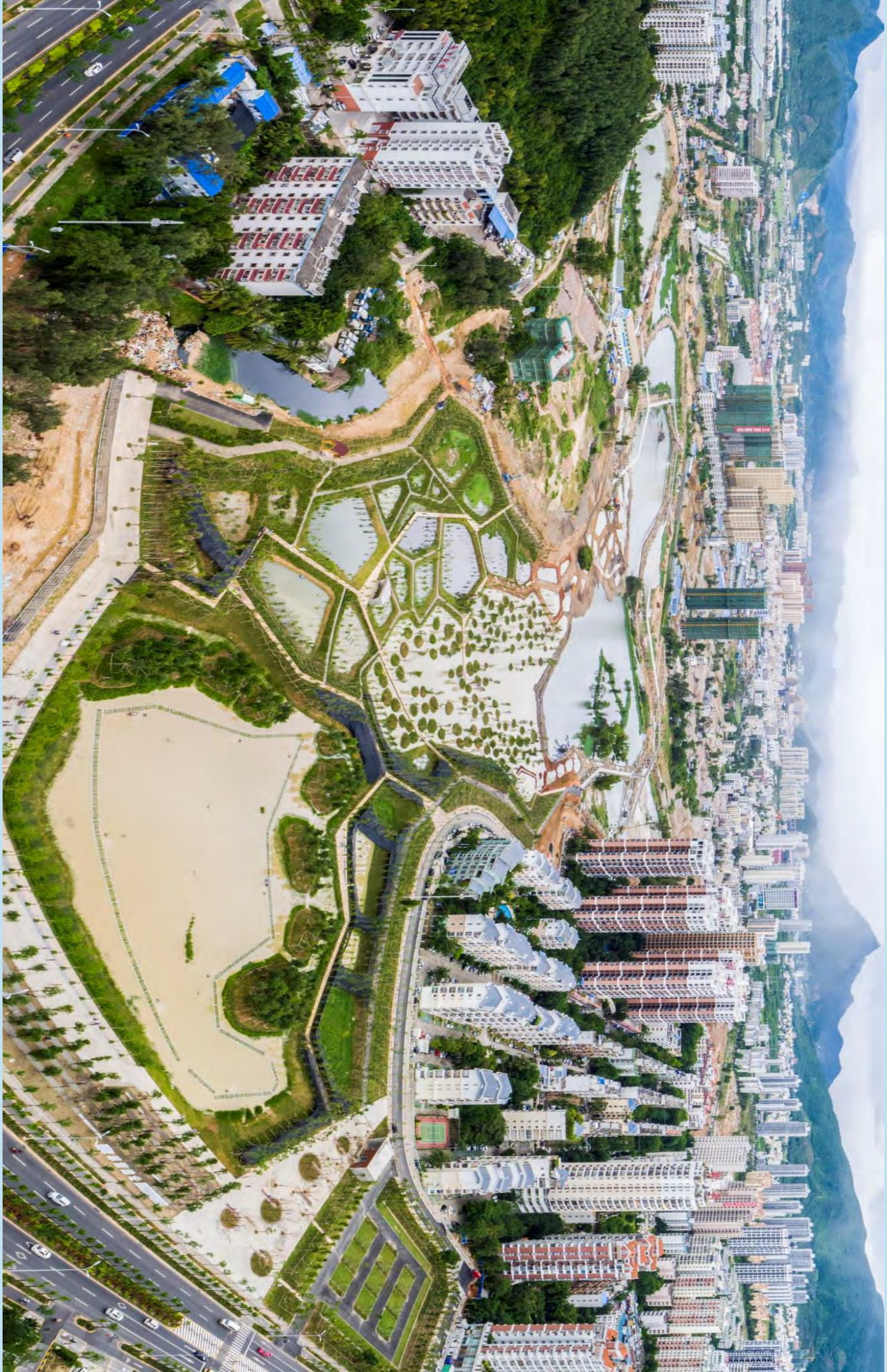
Action level 1 Planning a green sponge system



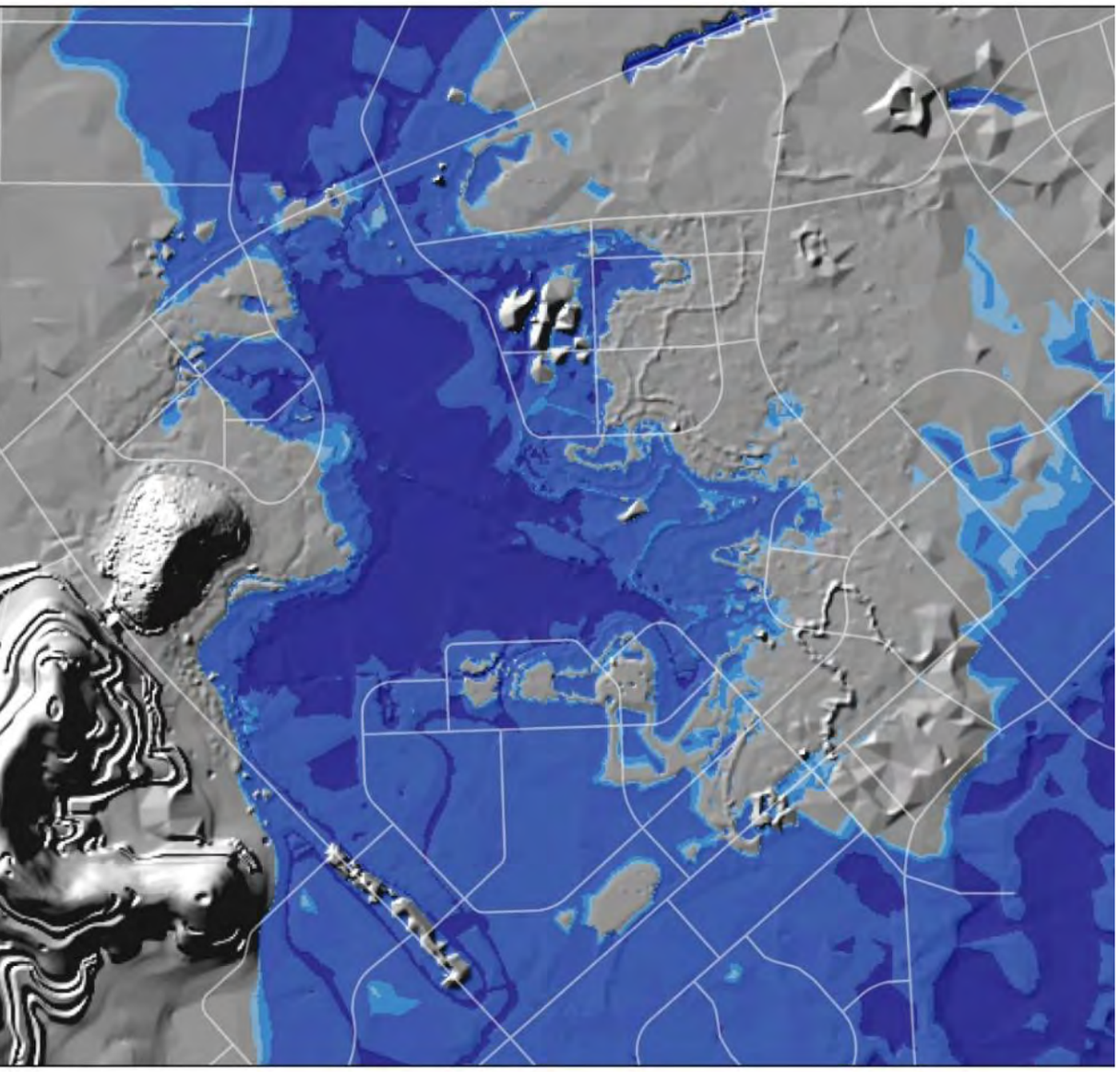
Action level 2
Creating Green Sponge

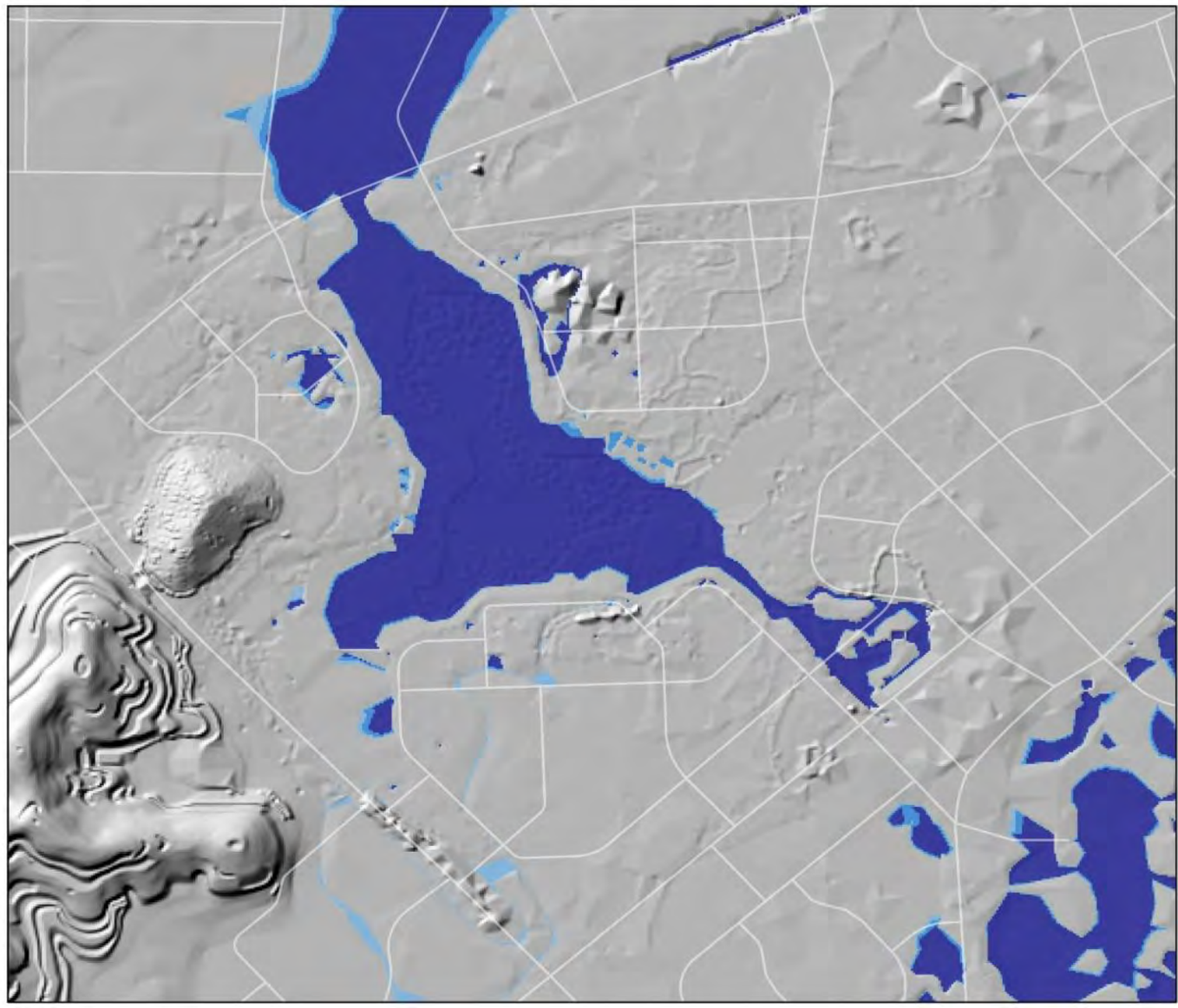
The revival of ancient wisdom: The pond and dyke system





Performance test





BEFORE

AFTER

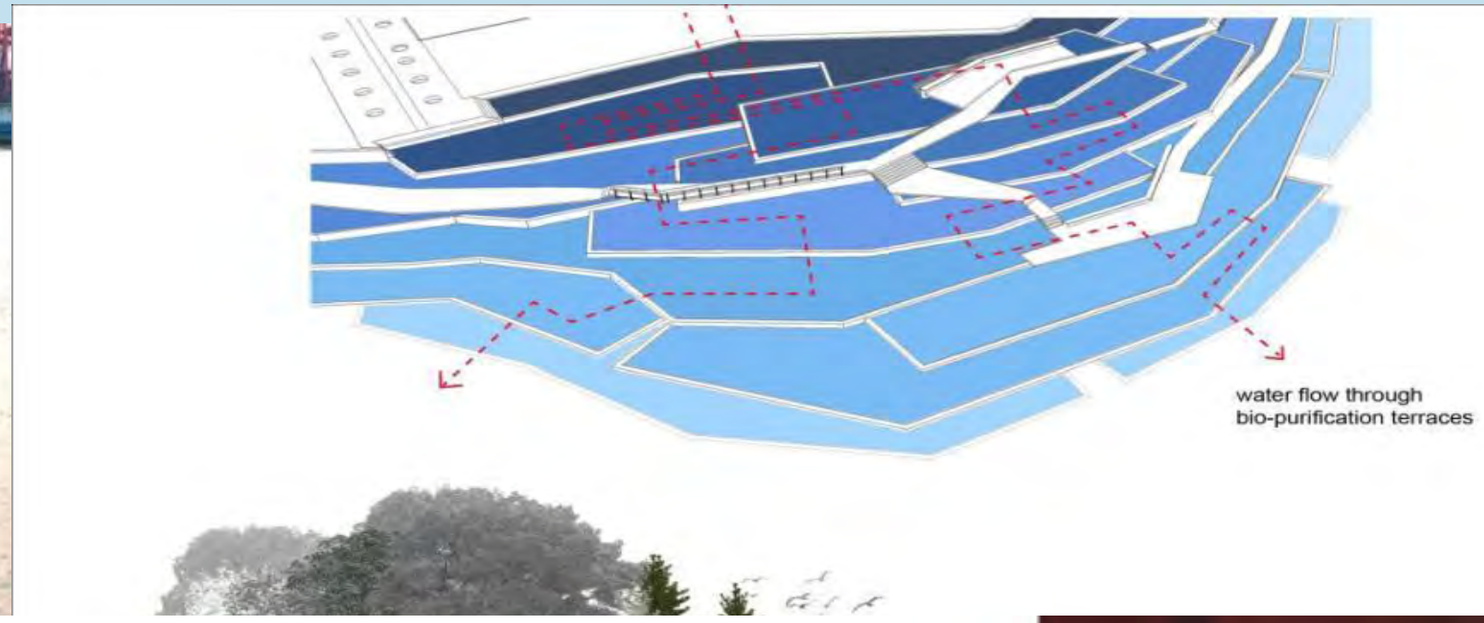
3 Water Cleansing: Landscape as living system

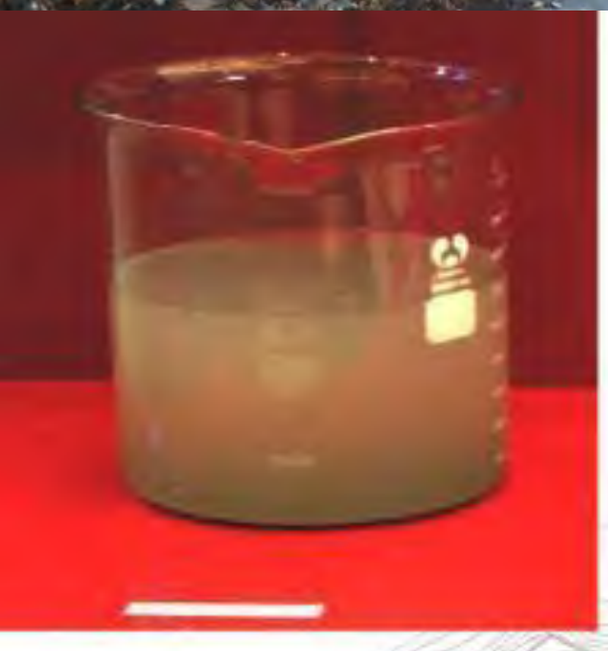
Looking for the Affordable and fast solution to urban water issue

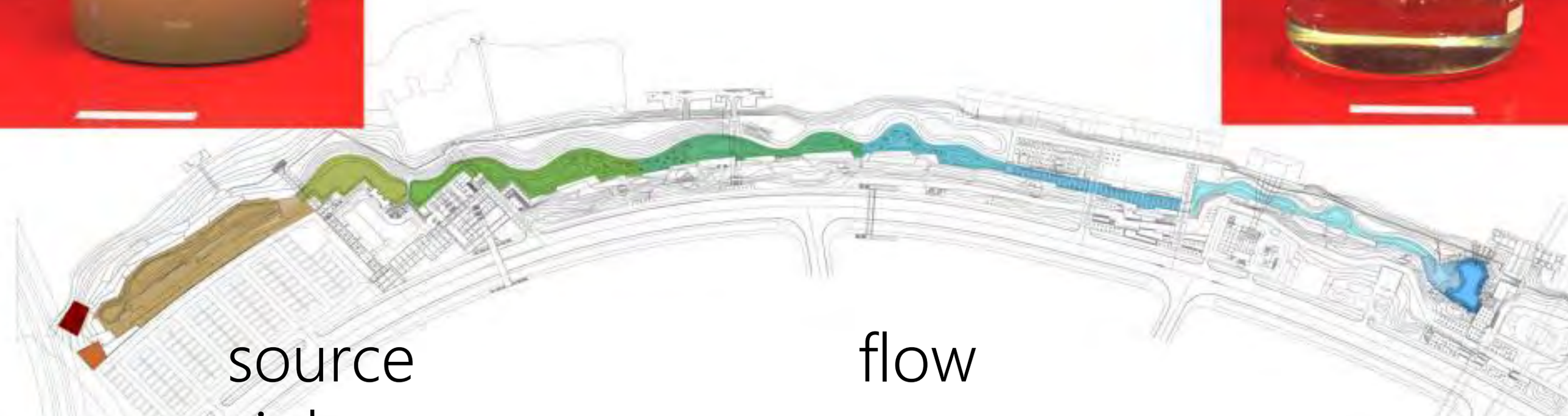
75% surface water contaminated in China

85% sewage water untreated global wise （Bangladesh）

Shanghai Houtan, 2009

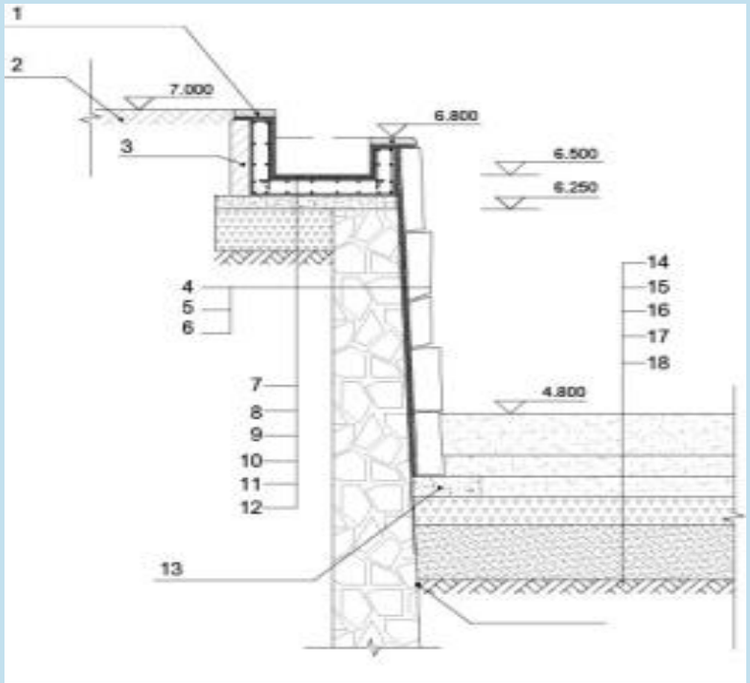






source

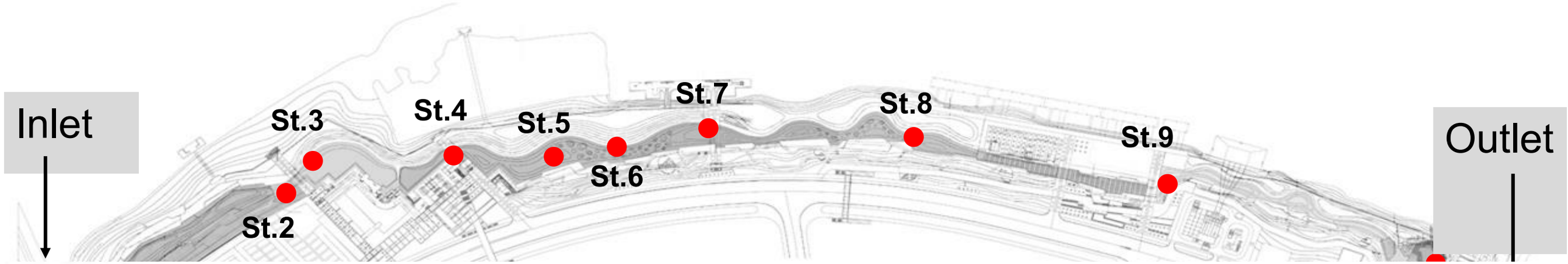
flow

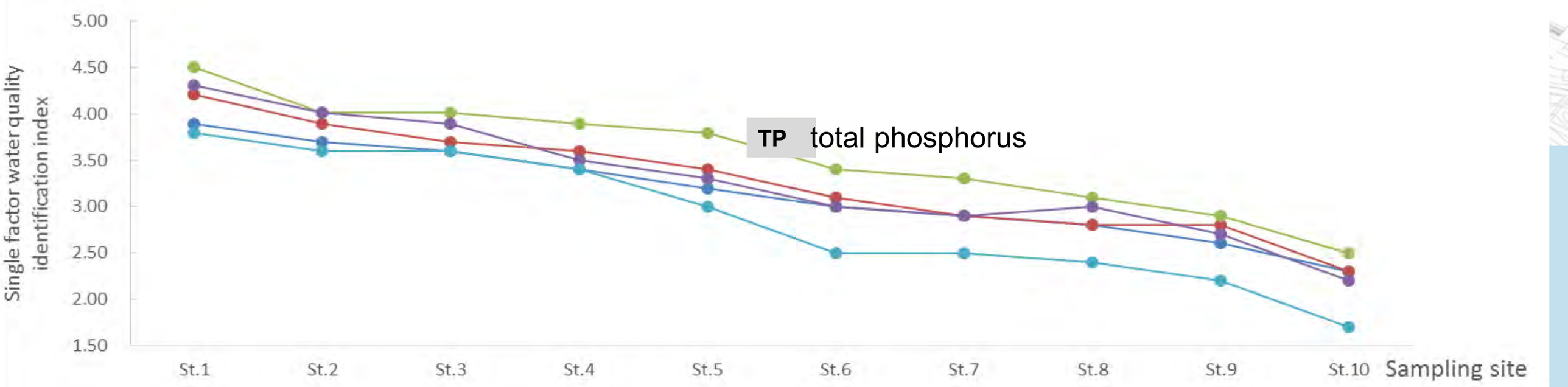


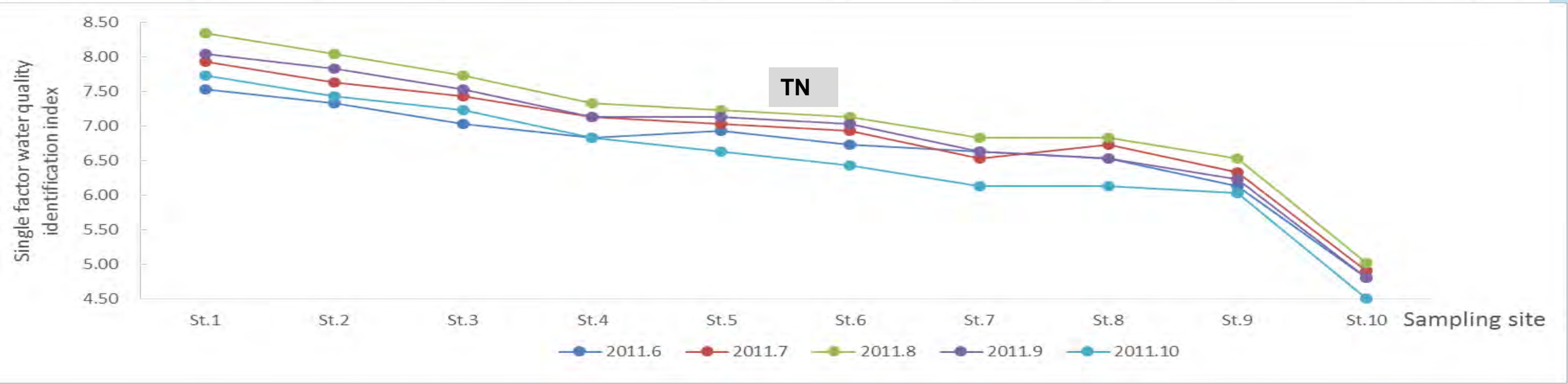
Source

Performance test:

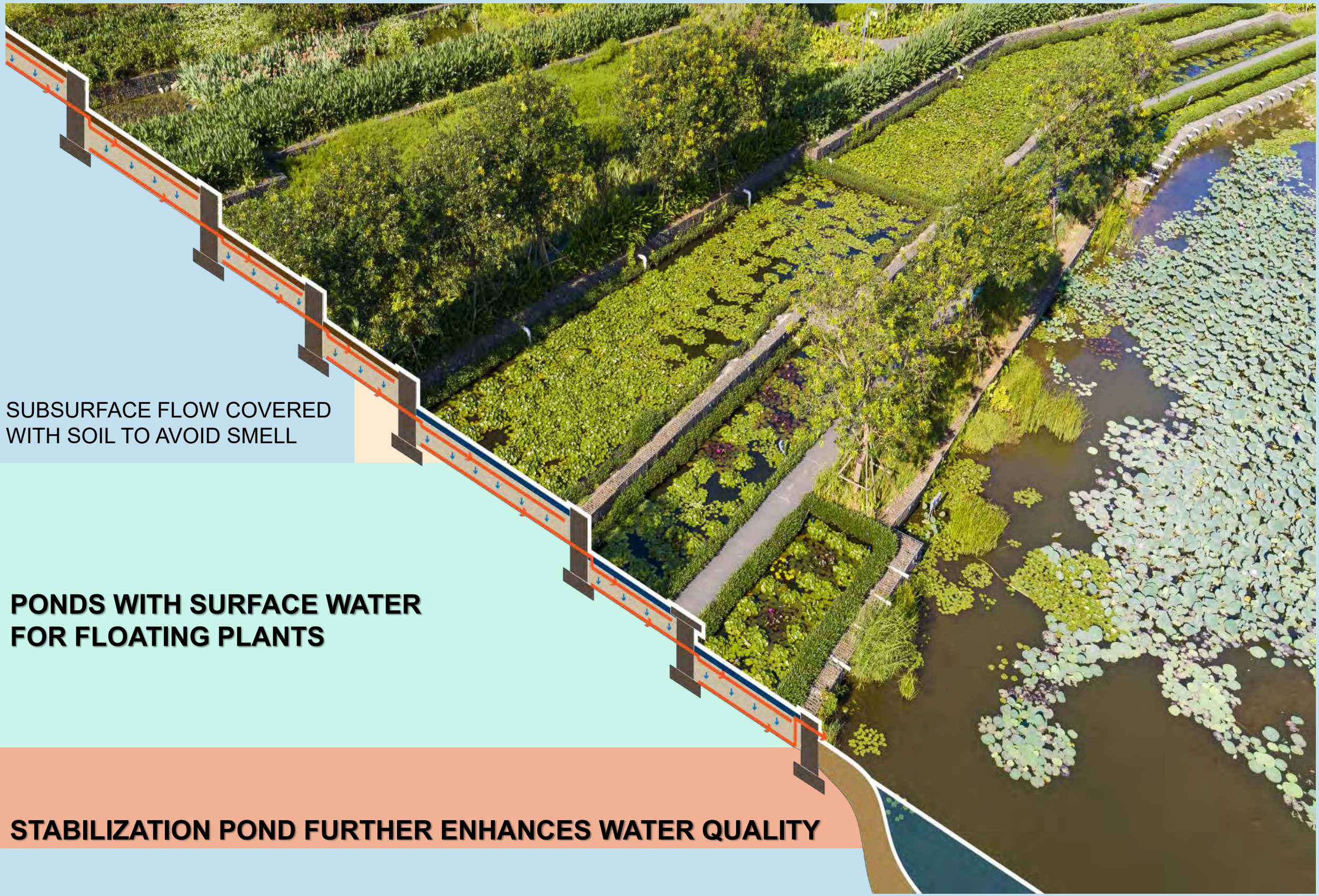
10 hectares., 1700 m long, producing 2400 cubic meter of water per day, water for 5000 people







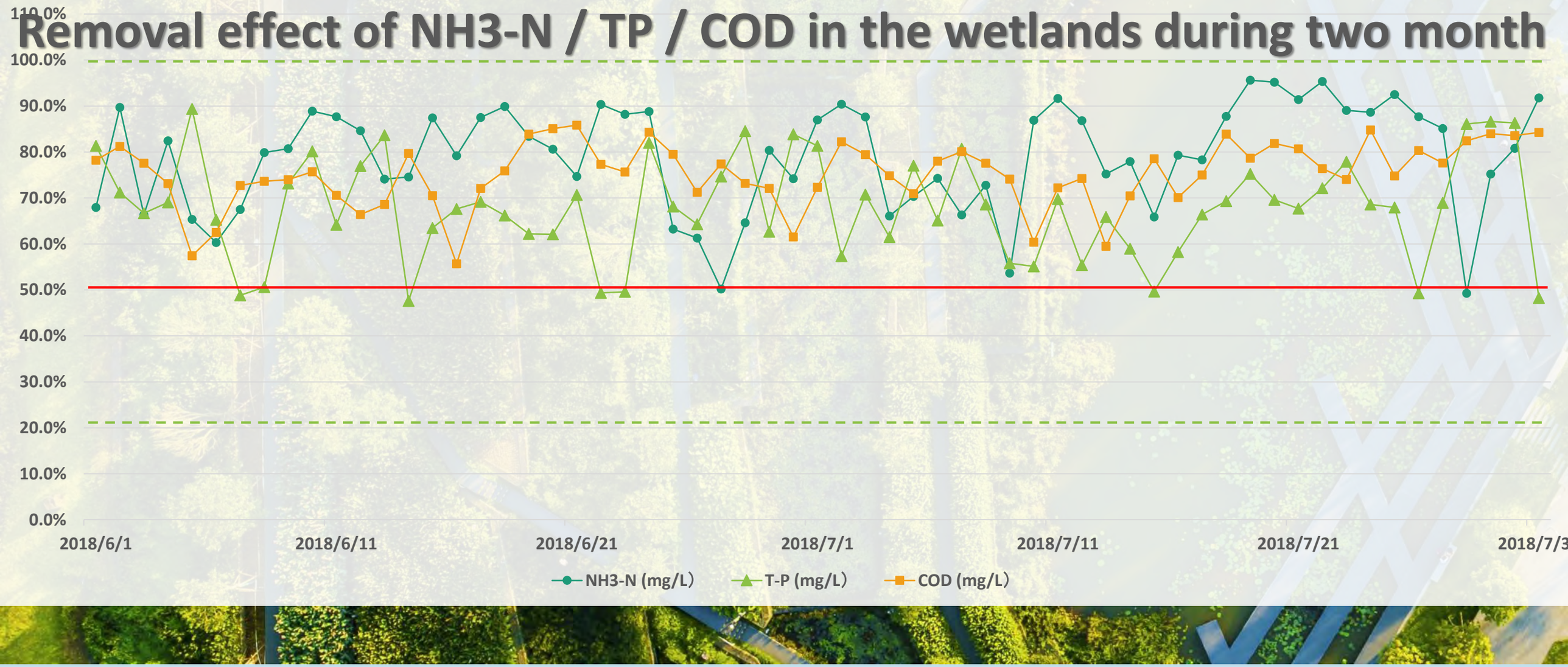
Model Replicated: Meshe River, Haikou, 2017



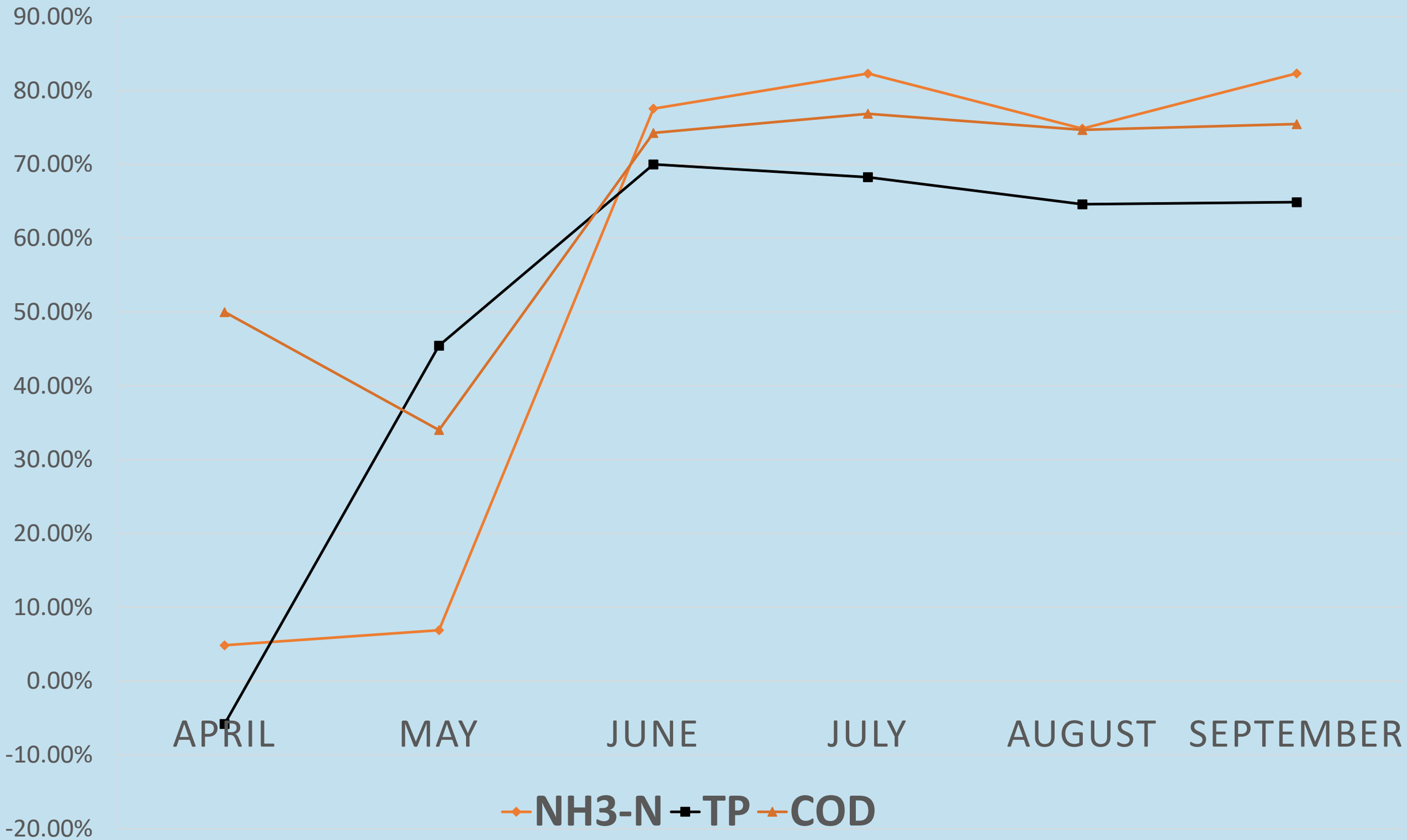
**PONDS WITH SURFACE WATER
FOR FLOATING PLANTS**

STABILIZATION POND FURTHER ENHANCES WATER QUALITY

Performance test



Removal effect and cumulative removal rate of nutrients



Looking forward….

75% surface water contaminated nationwide

85% sewage water untreated global wise

Taihu, 2445 Square Kilometers, East China

Designed ecologies of Taihu Post-Industrial Agricultural Landscape

An designed experiment: Zengshan Park, Suzhou

Bohai Sea，770，000 square kilometers

An designed experiment: Qinhuangdao Beach restoration

Before

Before

During construction

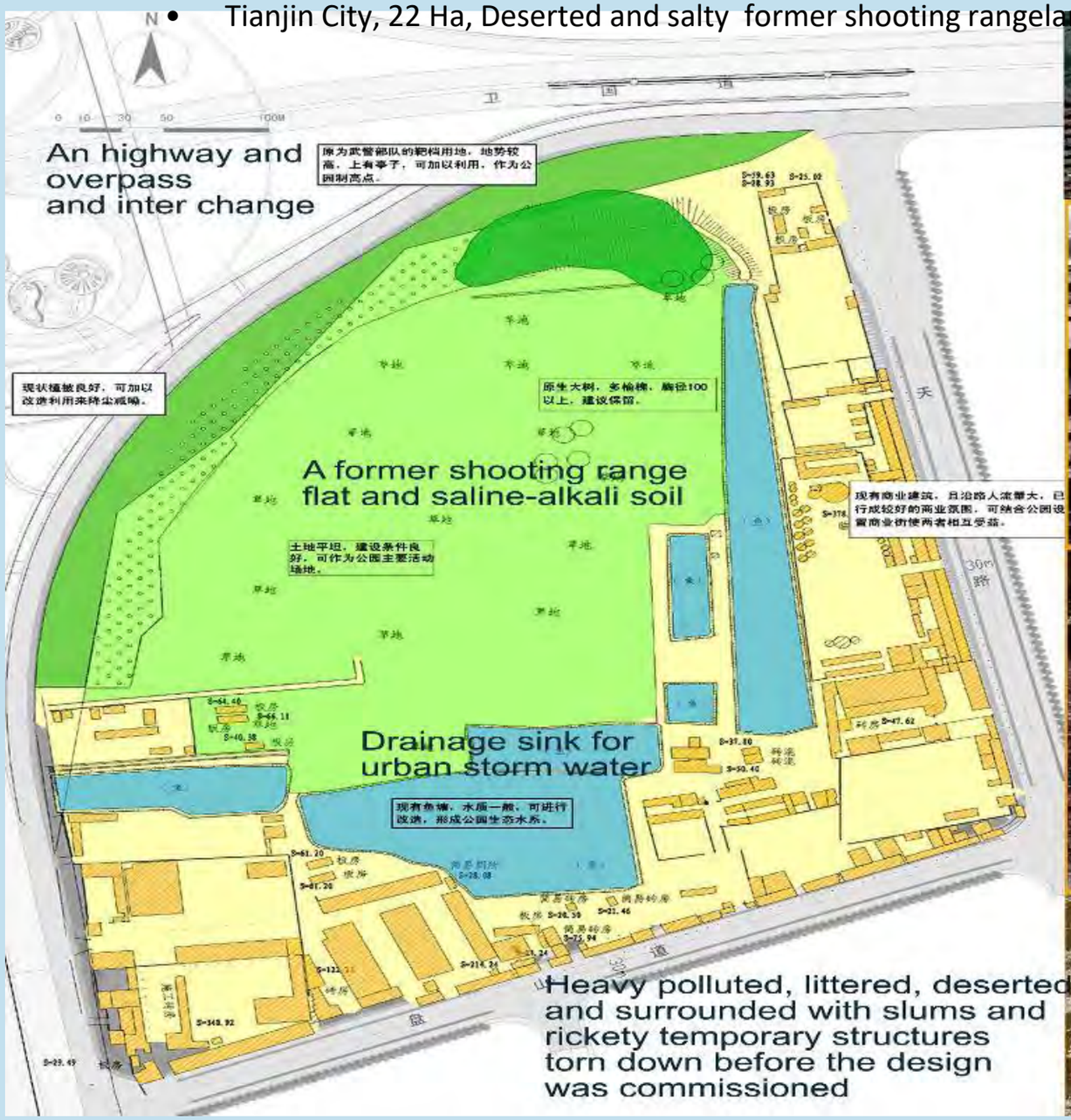
4 Soil remediation and habitat restoration

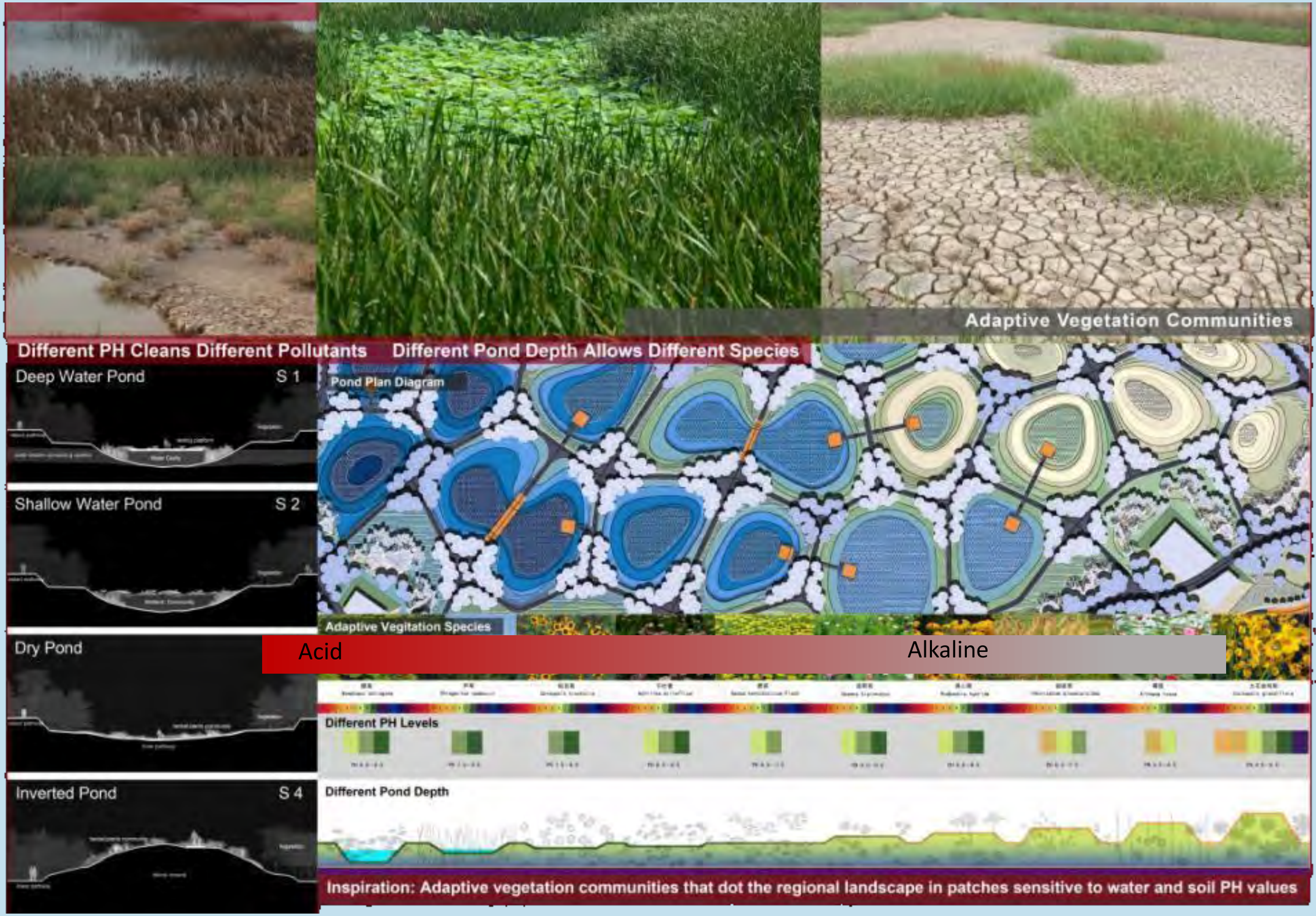
Let Nature do the work: Tianjin Qiaoyuan Park, 2008

60% of urban soil is contaminated in China, convention solution is usually very expensive, what is the alternative?

50% of wetland habitat disappeared in the last 50 years, how can we rehabilitate the large brown field in China

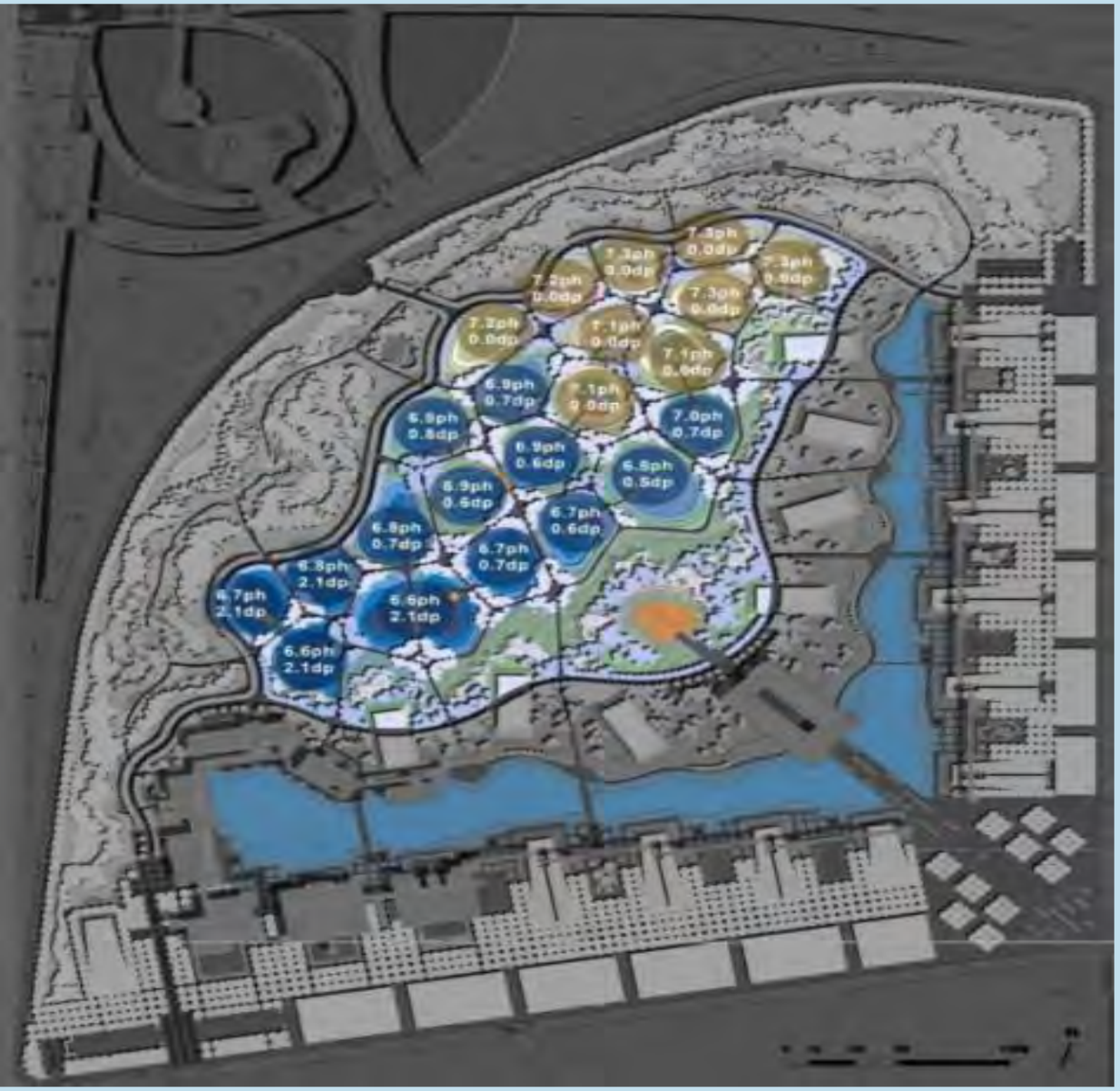
- Tianjin City, 22 Ha, Deserted and salty former shooting rangeland

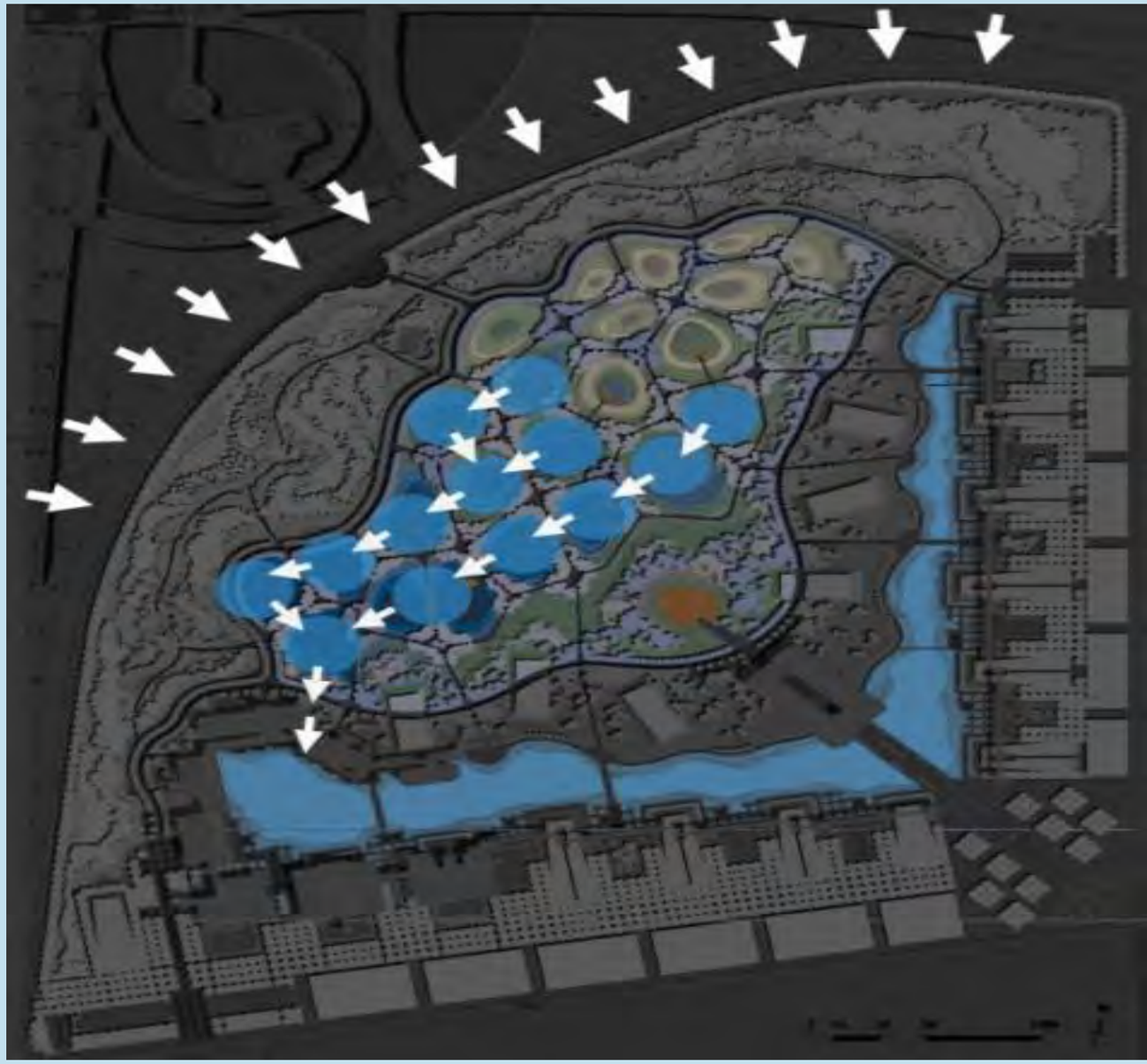




PH value management

Management of PH and water

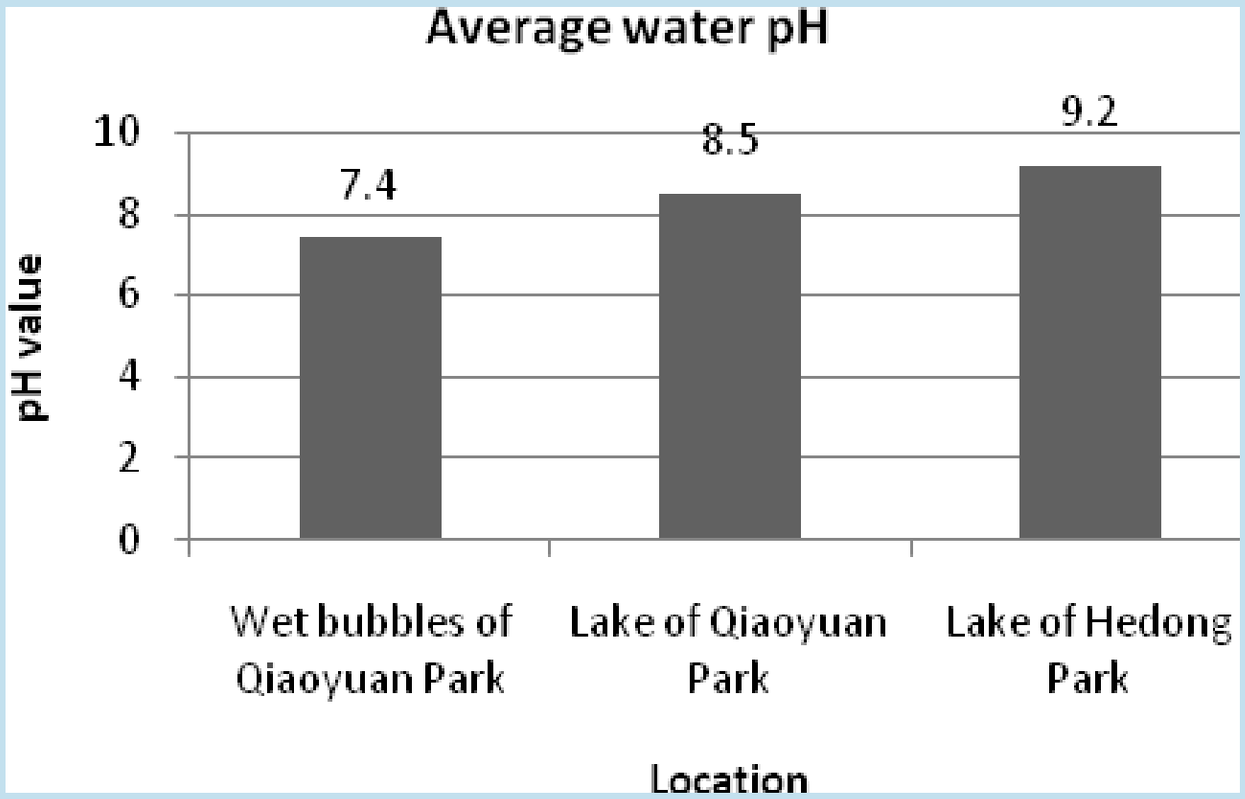


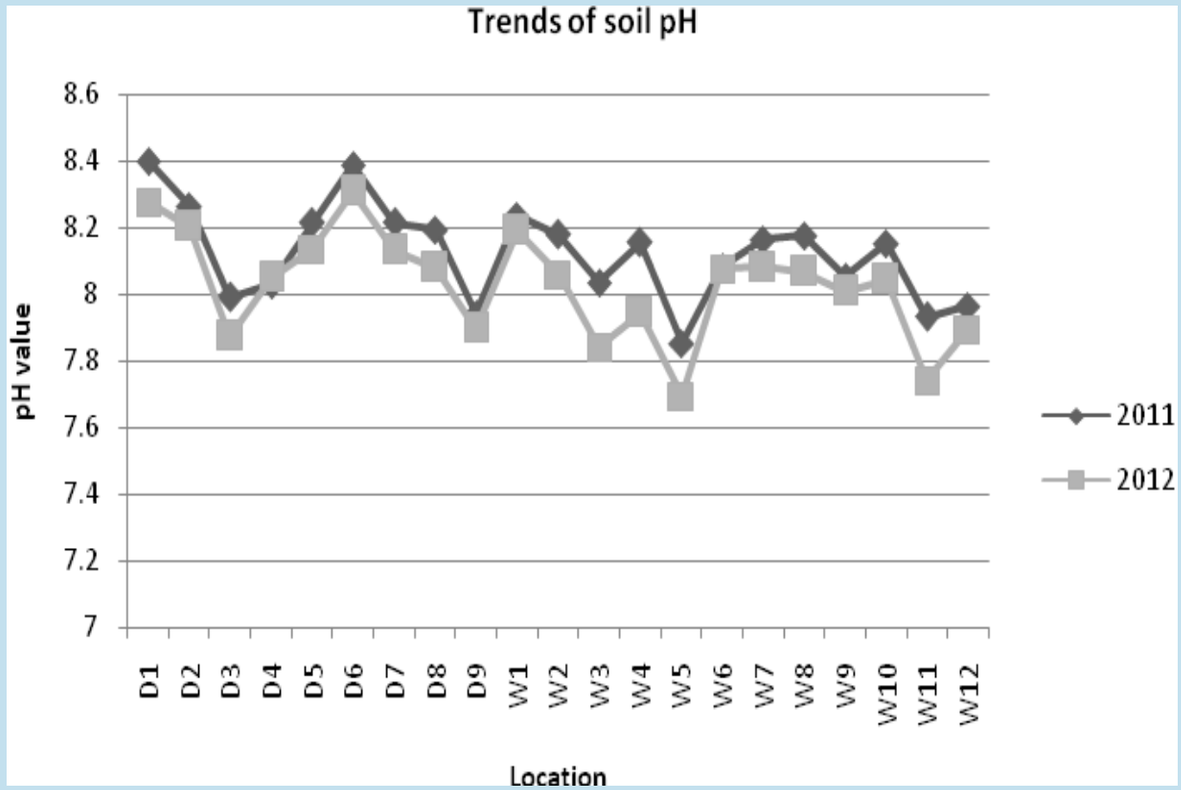


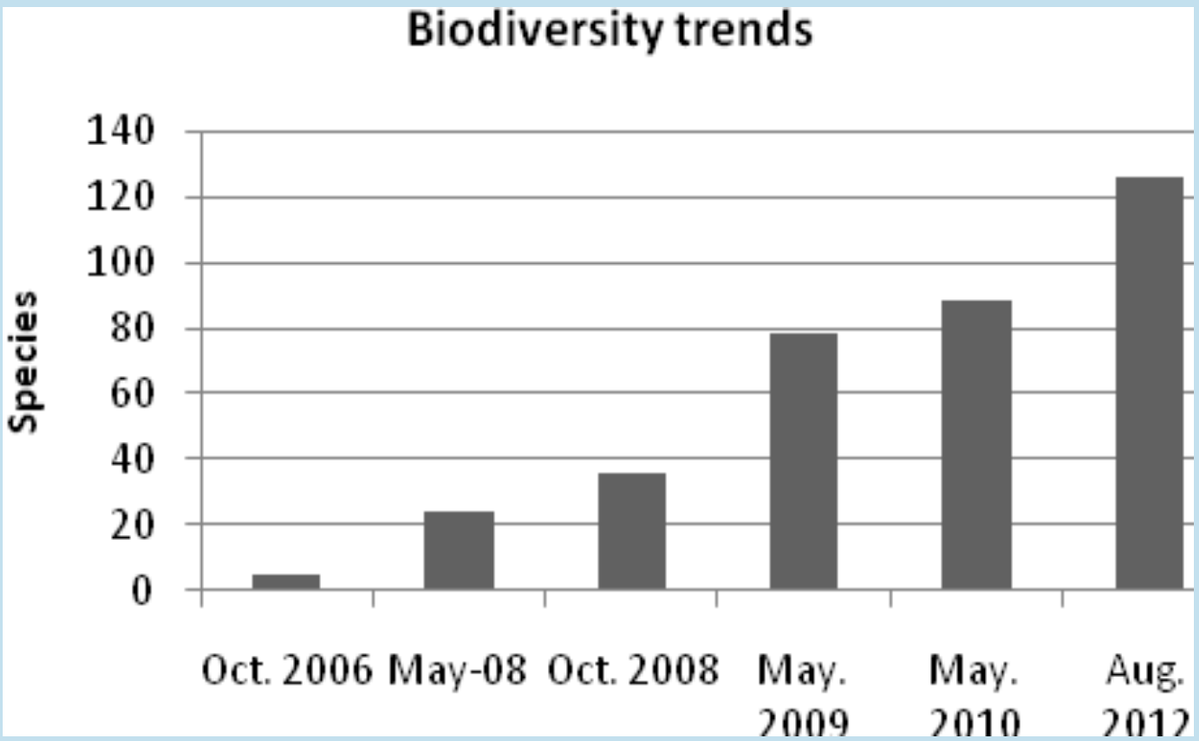
PH Values

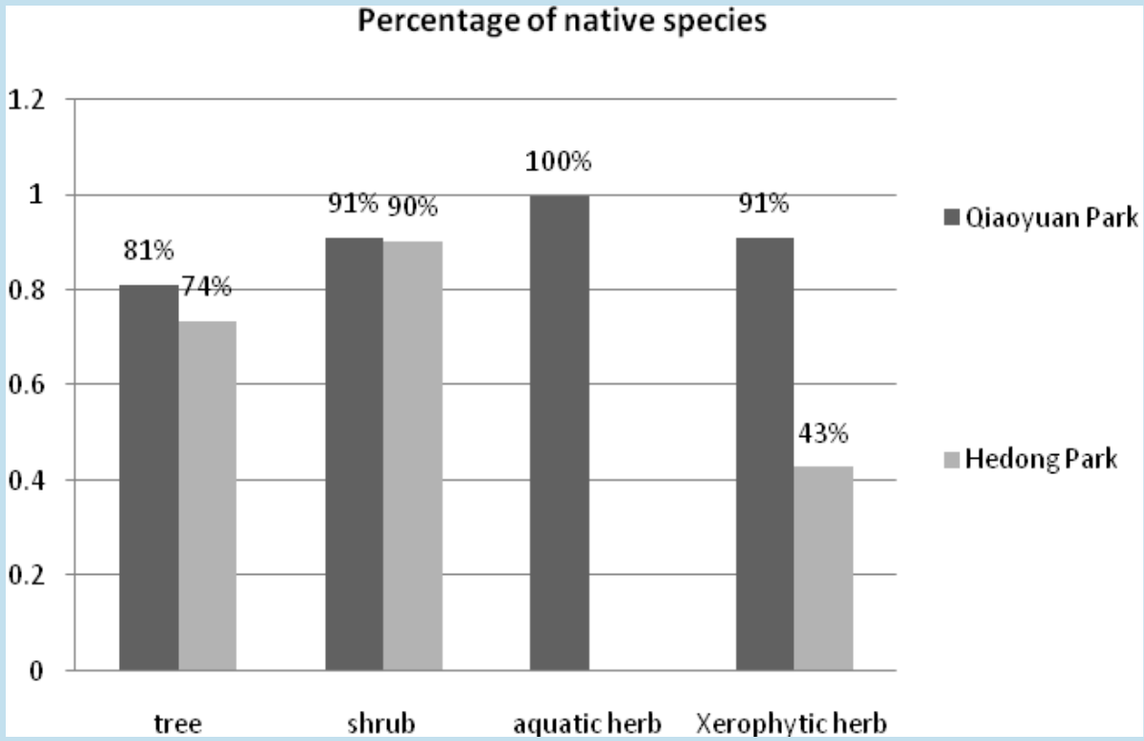
Water Flow

Water and Soil remediation service in Qiaoyuan Park



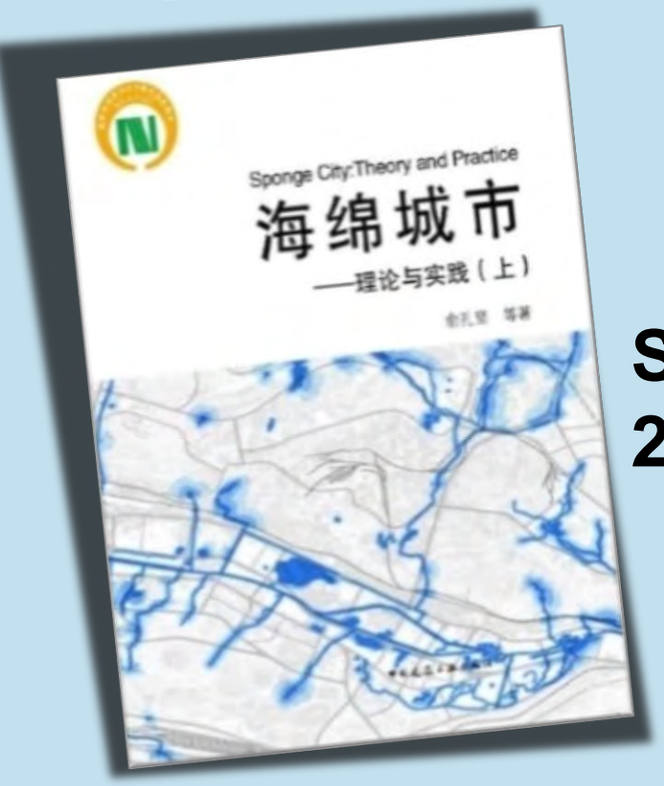






Action Elevel-3 Change of policies

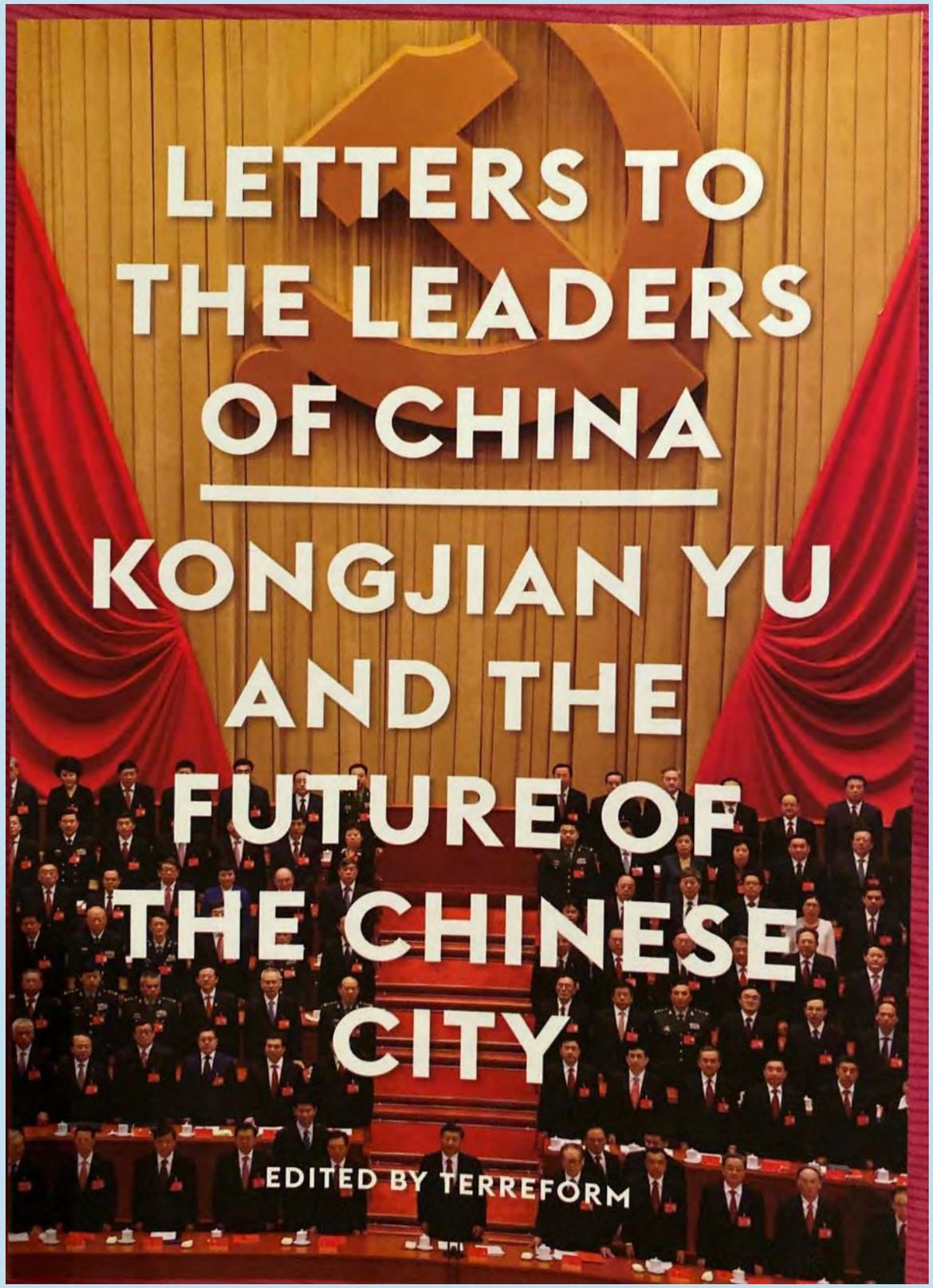
Beyond Sciences and practices, begin with political campaign and change of polices



Sponge City
2003-2015

Letters to mayors
1998-2003

Negative Planning
2003-2005



Proposal to the primer and virtually initiated the process of national security pattern planning and management

请张平同志酌处。

温家宝　2006年02月25日

光焘同志：北京大学俞孔坚教授致信家宝同志，建议开展“国土生态安全格局与乡土遗产景观网络”建设和建立“大运河国家遗产与生态廊道”。其基本观点是，在我国现代化进程，特别是构建和谐社会的历史进程中，要重视和保护作为民族精神、民族信仰、民族文化重要载体的乡土遗产景观：大运河则是其典型代表。这件事涉及国土、水利、环保、文化等多个部门。但究其内涵，似还应由建设部门牵头。现将家宝同志的批示和俞孔坚教授的来信转请您阅研。建议责成有关同志研究并提出工作方案。结果望告。

张平　2006年02月26日

请保兴同志阅处，按张平同志批示要求提出意见，报告

领导批示	
督办事项或文件名称	家宝同志在俞孔坚教授《关于尽快开展“国土生态安全与乡土遗产景观网络”建设和建立“大运河国家遗产与生态廊道”的建议》上的批示（国务院收文传2048号，部国秘件52
交办时间	2006年 03月 01日
要求办结时间	2006年04月01日

人民日报 情况汇编

（第 300 期）

内参部编　2006年3月1日

结合新农村建设北大学者提出

加强国土生态安全与乡土遗产景观保护

本刊讯　（记者赵永新）北京大学博士生导师，景观设

Four state regulations have since been issued by the State Council to safeguard the national ecological security

《关于划定并严守生态保护红线的若干意见》，2017年2月

Protection of Ecological Redlines

《“十三五”生态环境保护规划》的通知，2016年12月

The Thirteenth Five-year ecological and environmental protection, ”The protection of national security pattern as the main goal”

《全国国土规划纲要（2016—2030年》，2017年2月

Guidelines for National Land Planning

《全国主体功能区规划》，2010年12月

The National Land Use Zoning

明确提出构建国家生态安全格局为主要目标。

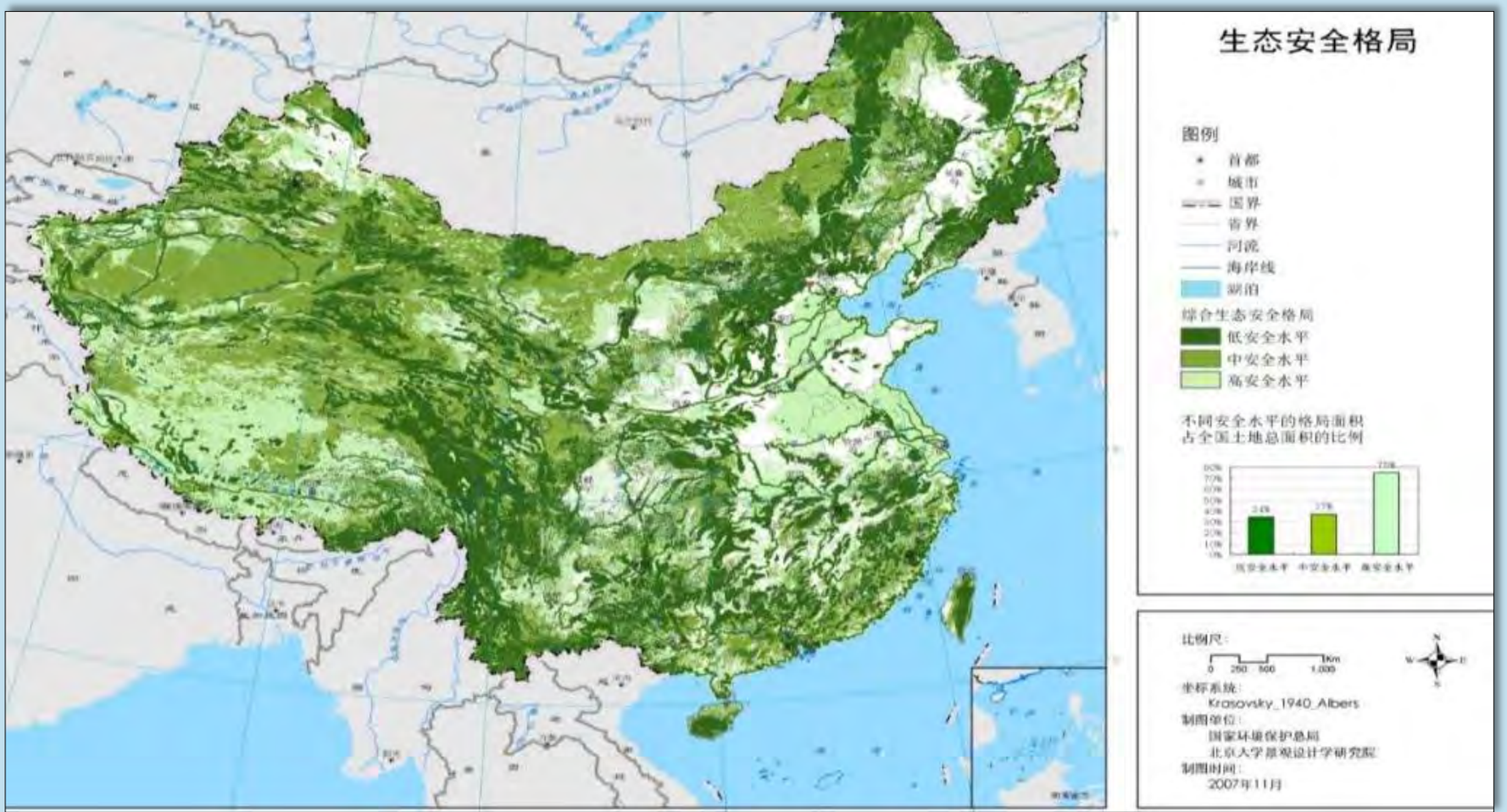
“全面划定生态保护红线，管控要求得到落实，国家生态安全格局总体形成”

Conclusion: An era of new civilization

More than ever, it is clear that we need a paradigm shift in planning and designing our city to adapt the changing climate and solving the multiple urban ecological issues.

Such a shift calls for a rethinking of the way we build our cities based on industrial technologies,

and calls for the revival of the ancient wisdom of survival: The nature-based solution.



Three aspects of challenges and gaps of research:

1. How can we change the mind set and policy and code system: from grey to green, the decision making and policy aspect
2. How to testify the performance of nature-based solutions: the aspect of science
3. How to standardize the nature-based solutions and how to legalize them for large scale practice: the business and practice aspect

Thank you!