

# REGENERATION OF LANDMARK "LAKE PARK"

WATER ECOLOGICAL RESTORATION DESIGN OF SHANGHAI LUXUN PARK

## PROJECT STATEMENT

The water body ecological restoration design of Shanghai Luxun Park is a re-practice of the micro-transformation of the park's ecological environment in the urban context. Built in 1901, Luxun Park is the first sports park in Chinese modern history and a major historical and cultural site protected at the national level. In 1959, the park was expanded, with new artificial lakes and large rockeries. Through the renovation and construction in the last half-century, Luxun Park turns out to be a commemorative comprehensive park combining both British Natural Landscape Gardens with Chinese Traditional Gardening Art.

The waterscape of Luxun Park is 3.6 hectares, accounting for 15.7% of the total area of the park. In the process of rapid urbanization, local surface runoff is directly discharged into the water body of the park, breaking the ecological balance and leading to a deterioration of water quality. Aiming at improving the water quality, renovating the park landscape, improving the living environment and restoring the ecological balance, the design team innovated an "underwater forest" system to create a self-circulating micro-ecology to achieve long-term water purification effect with low maintenance.

## PROJECT NARRATIVE AND CONTENTS

### DESIGN STRATEGY

Faced with complex site conditions and technical construction challenges, the design team accessed current conditions via ecological environment quality, ecological stress level and ecological species composition. With the goal of "low cost, high efficiency and long-term stability", a unique design strategy was adopted. It was guided by an "underwater forest system" and "ecological manipulation" and employed green infrastructure facilities to store rainwater and achieve sustainability. This project created a high-quality waterscape and improved residents’ living environment by enriching aquatic diversity, purifying water, repairing revetment and creating enclosed spaces. These innovative construction techniques highly reduced the conventional negative construction impact on urban traffic.

### RAINWATER STORAGE

Tian'ai Lake is the lowest point of Luxun park, taking responsibility for storing rainwater runoff from adjacent areas by improving the overflow level and storage capacity. As the design opened up the lake and the underground water reservoir of the Hongkou Gymnasium on the east side, during the dry season, the rainwater runoff of the gymnasium could supply water for the lake. While during the rainy season, the two rainwater storages work together to reduce the flooding risk. Besides, a temporary dam was set up to further adjust the overflow elevation of the lake body, increasing the emergency storage capacity and reducing the flooding hazard in the surrounding areas.

### WATER QUALITY IMPROVEMENT

#### Rainwater treatment wetland system

Smart technology was employed to monitor water volume and water quality at drainage pipelines. The wetland filtered the polluted rainwater and reduced the pollutants running into the lake. As the rainwater stop time increases in the wetland, the plants and associated biofilms reduce the levels of pollutants including fecal bacteria, metals, nitrogen and phosphorus, and sediment. Water pollution got controlled at the source.

### SUSTAINABLE SELF-PURIFIED WATER CIRCULATION

Efficient water circulation could provide a habitat for aerobic microorganisms to accelerate the degradation of water pollutants. To realize water circulation in the park, the design team designed a waterfall using the existing rockery to add more oxygen to the water physically and keep the water running into the meandering stream. To improve the fluidity of the water body and improve the water body exchange speed at the calm and large surface of the lake, the design team designed a landscape fountain combined with the underwater push flow equipment to form a directional flow. Eventually, the artificial lake became an urban green infrastructure with a high-efficient self-purification function.

### UNDERWATER FOREST SYSTEM

The design team considered building a three-dimensional ecological environment restoration system by reestablishing the underwater ecology system, improving water clarity, and reducing eutrophication. Through investigation and experimental data, 11 high-carbon-fixing species and 10 new aquatic animals were planted underwater, constructing a complete underwater forest system increasing the food chain and biodiversity with aquatic plants, benthic animals, zooplankton, carnivorous fish, and microorganisms. This project successfully reduced 591.17kg/a nitrogen a year and 25.94kg/a phosphorus a year. The water quality has been improved by 50%, and the clarity of the water body has been increased from 0.2m to more than 1.5m.

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## **ROCKERY RESTORATION AND SPACE MAKING**

The design team repaired the damaged aging rockeries through new technics. As some rockeries were hard to reach and access the structure information, the team utilized 3D scanning and digital modeling to manufacture customized supporting steel structures. By reinforcing the structure and adding lighting and ventilation systems, restored rockeries met the demand for emergency shelters. Local materials and decorative concrete technology ensured the looking of repaired parts match the original appearance of rockeries. Adding the raft and strip foundation, the restored rockeries met the standard settlement requirements while providing attractive views and quiet waterside spaces with new waterfall and water curtain cave features.

## **CONSTRUCTION MANAGEMENT**

One of the biggest construction challenges was to minimize the impact on the subway tunnel underneath the park. The ground stress will be released due to the excavation of water and silt, which could upward deformation and segment stagger for the existing tunnels. To minimize the impact of construction on tunnels and maintain the subway transportation operation during the construction period, the design team worked with the construction firm and other experts to formulate a plan that used the capacity differences of different lakes to balance the load pressure. The flexible use of construction with and without water in the lake minimized the subway transportation operation. After finished lakebed construction and desilting, a number of submerged plants were increased to maintain the load pressure as before.

## **DESIGN IMPACT**

As China's first sports park and Shanghai's important historical and cultural site, Luxun Park is a meaningful place for residents. This Water Ecological Restoration Design integrates the landscape composition techniques of traditional Chinese gardens, modern concrete techniques, and water ecological restoration technologies. It provides a refreshing look at Luxun Park. The local ecological environment and the living environment get improved with high-quality supporting services provided at the same time. The restored Park continues to provide beautiful and picturesque landscapes for residents and tourists with clean and clear water.

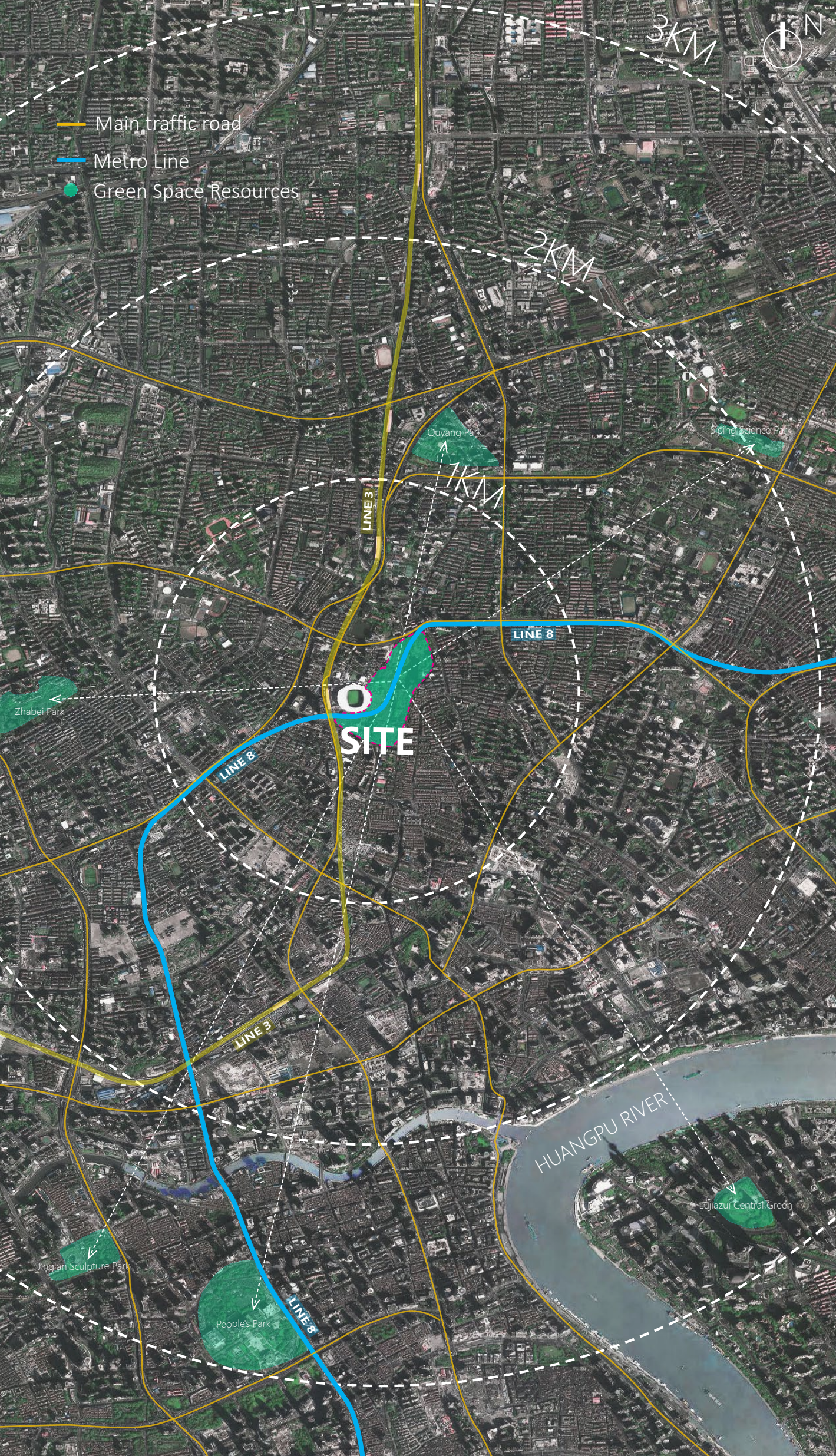


# LANDMARK "LAKE PARK"

The design for water body eco-restoration in LuXun Park is a re-practice of micro-transformation of the park's eco-environment in the urban context.







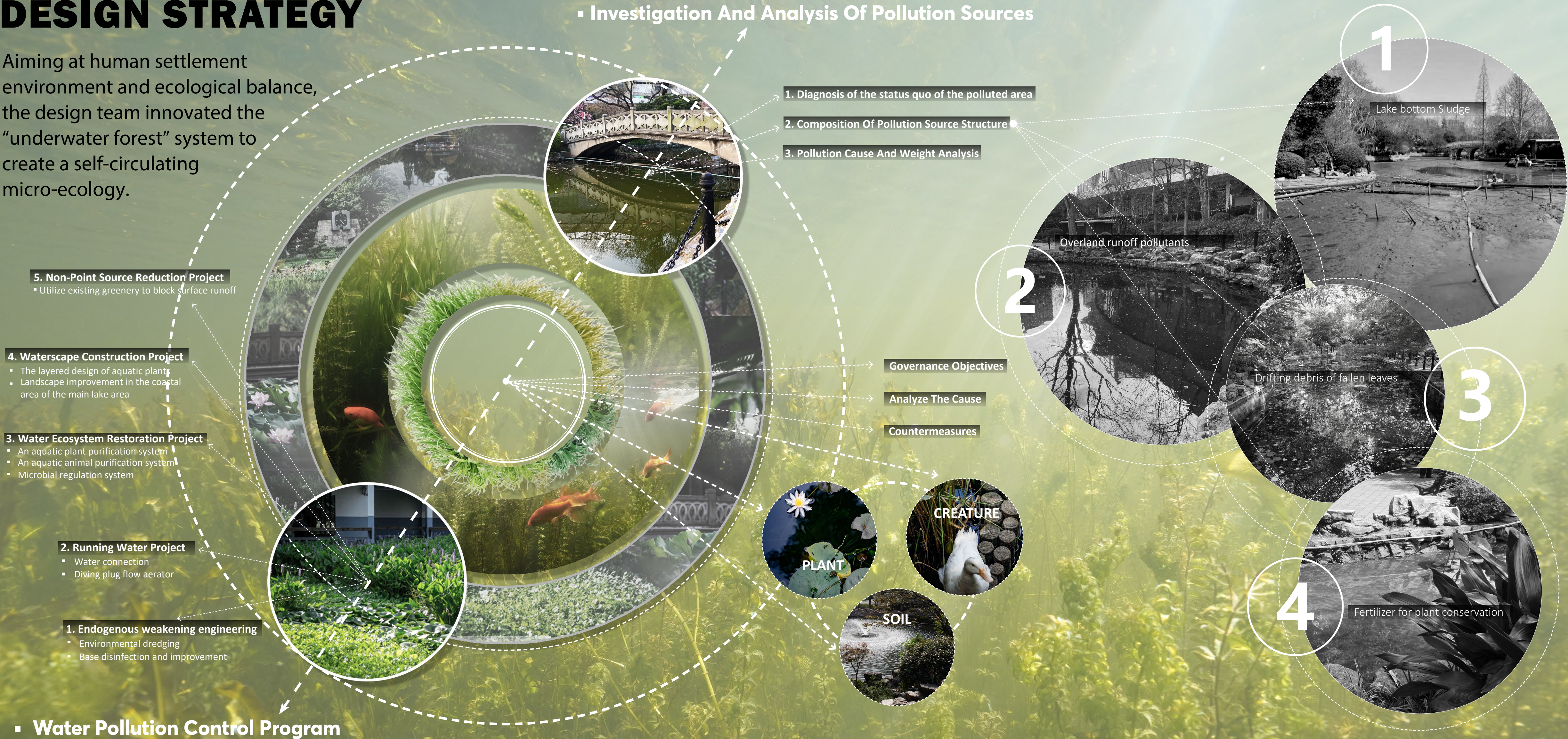
## MASTER PLAN

Aiming at human settlement environment and ecological balance, the design team innovated the “underwater forest” system to create a self-circulating micro-ecology.



# DESIGN STRATEGY

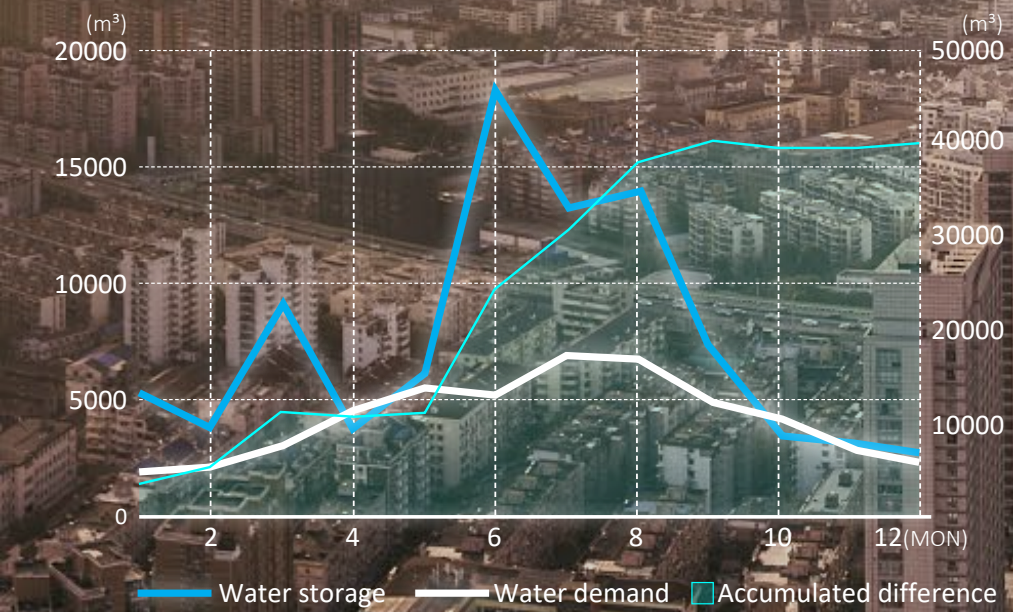
Aiming at human settlement environment and ecological balance, the design team innovated the “underwater forest” system to create a self-circulating micro-ecology.



## Water Pollution Control Program



Aiming at human settlement environment and ecological balance, the design team innovated the "underwater forest" system to create a self-circulating micro-ecology.



**58%**

Plant irrigation  
23287.5 $m^3$ /year

Available for reuse  
40150.2 $m^3$ /year

The resource utilization rate reached 58%, meeting the technical standards.

Rain

**WET SEASON**

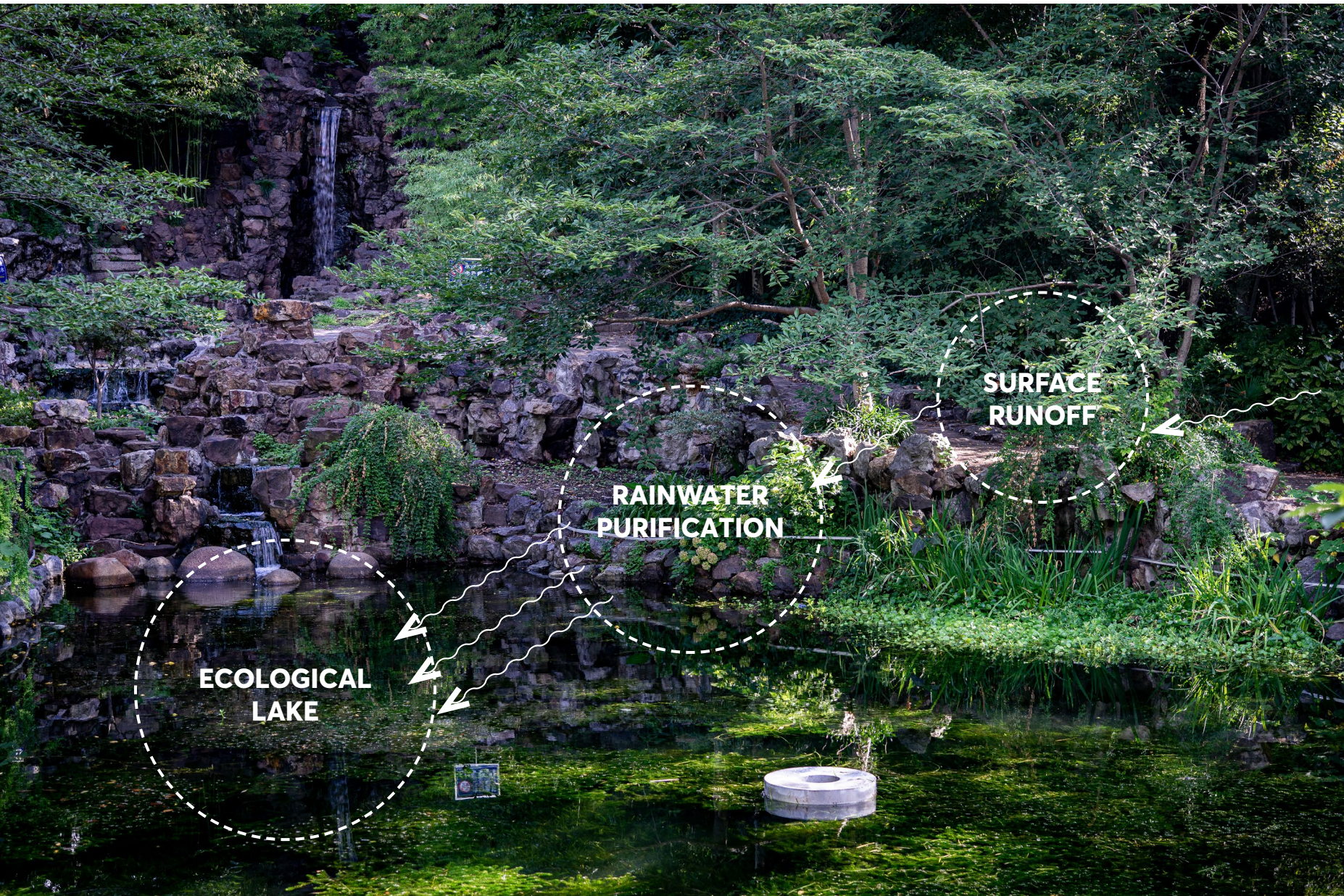
Lake water as a supplement to rainwater storage in the gymnasium

**DRY SEASON**

Utilize the collected rainwater from the gymnasium to replenish water for the lake

## SPONGE-STYLE RAINWATER STORAGE REGULATION INTERACTING WITH THE ARCHITECTURE





# WATER QUALITY IMPROVEMENT

A scheme has been structured through links of “pollution control at source--sewage interception in the process-self-purification at the terminal”.







Increased oxygen

40%

Meandering streams reduce flow and increase negative oxygen levels

Oxygenation & purification

Oxygenation

Falls

Cascade water drop

Rockery reservoir

Calm water

Oxygen burst equipment

River

Meandering streams reduce flow and increase negative oxygen levels

Pumping

Self purification of running water

Push flow of underwater power equipment

# WATER QUALITY IMPROVEMENT

The team conducted to optimize the height of the waterfall, comprehensively considering water quality, water yield and water treatment requirement.



## 11 NEW AQUATIC PLANTS



WATER LILY  
(YELLOW FLOWER)



WATER LILY  
(PINK FLOWER)



EVERGREEN IRIS



THALIA  
DEALBATA



CYPERUS  
ALTERNIFOLIUS



YELLOW-  
FLOWERED IRIS



EVERGREEN  
DWARF WEED

## WATER QUALITY IMPROVEMENT

11 carbon-fixing species and 10 new aquatic animals underwater were added to purify water, renovate landscape and restore eco-balance cost-efficiently. This project successfully reduced 591.17kg nitrogen and 25.94kg phosphorus a year. The water quality has been improved by 50%.

[reduced  
**591.17kg** nitrogen a year]

[reduced  
**25.94kg** phosphorus a year]

[Increased transparency  
**1.5M**]

[water quality improvement  
**50%**]

PRODUCER



DECOMPOSER



CONSUMER



## 10 NEW AQUATIC ANIMALS



BLACK  
CARP



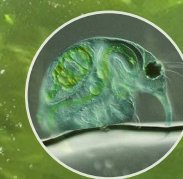
SNAKEHEAD



ELOPICHTHY  
BAMBUSA



FRESHWATER  
SHRIMP



DAPHNIA  
MAGNA



BELLAMYA  
PURIFICATA



BELLAMYA  
AERUGINOSA



ANODONTA



HYRIOPSIS  
CUMINGII



CORBICULA  
FLUMINEA





RIVER STONE REVETMENT



STEPPED REVETMENT



AQUATIC PLANT REVETMENT



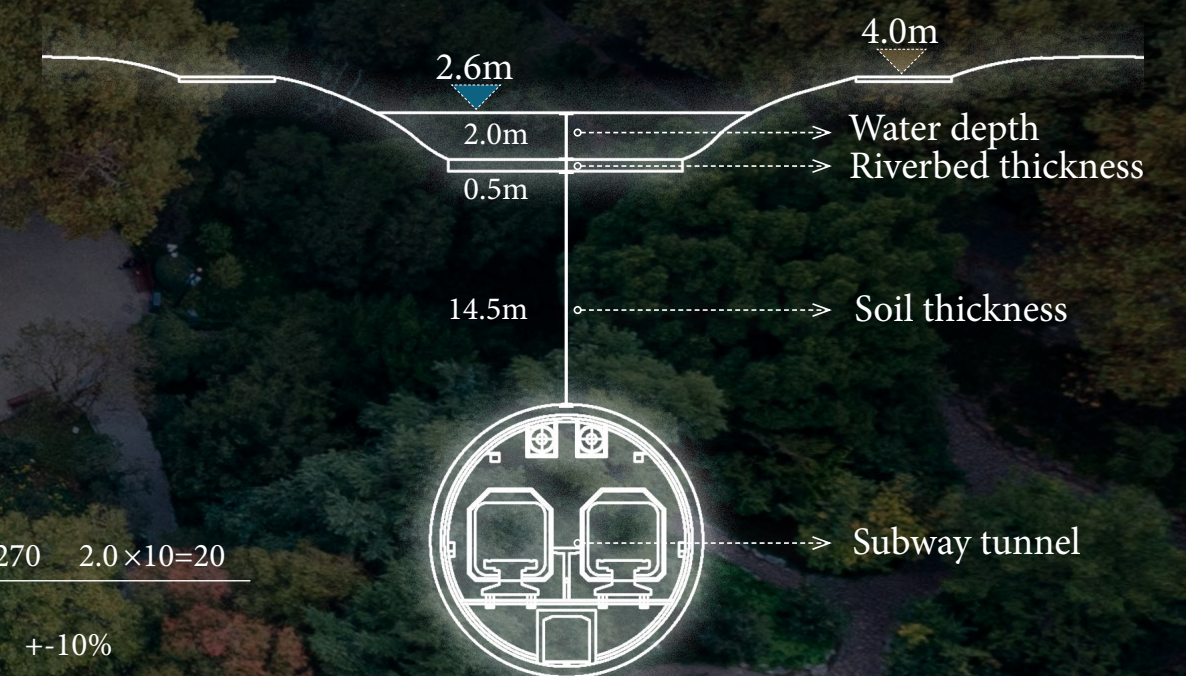
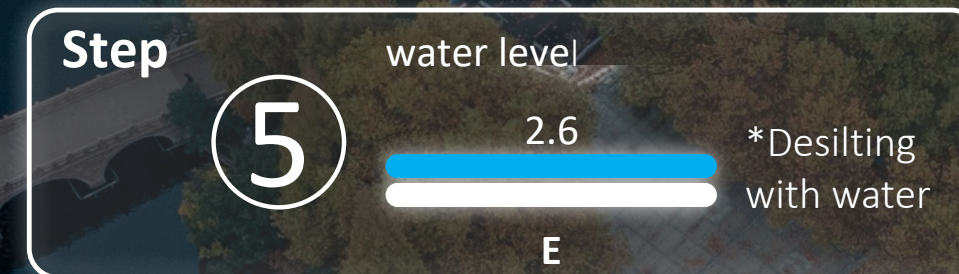
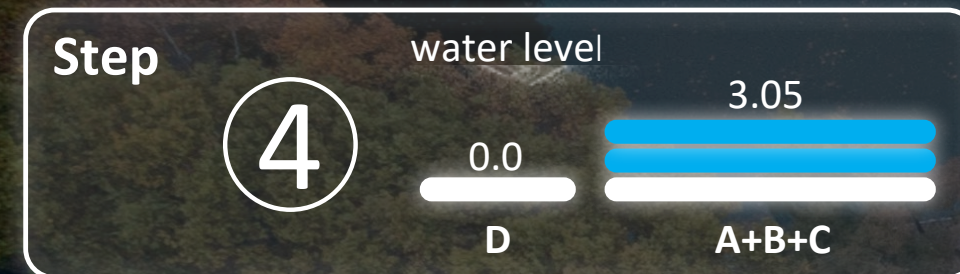
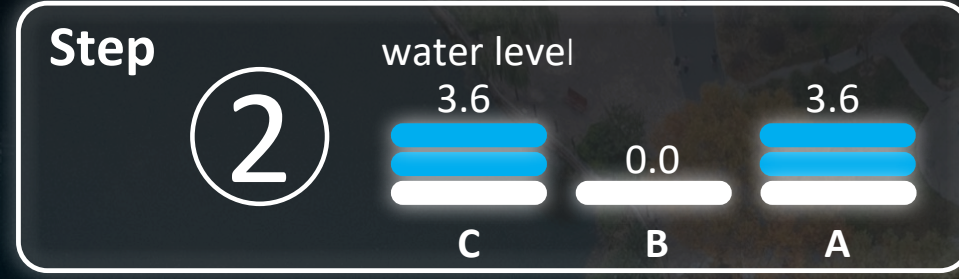
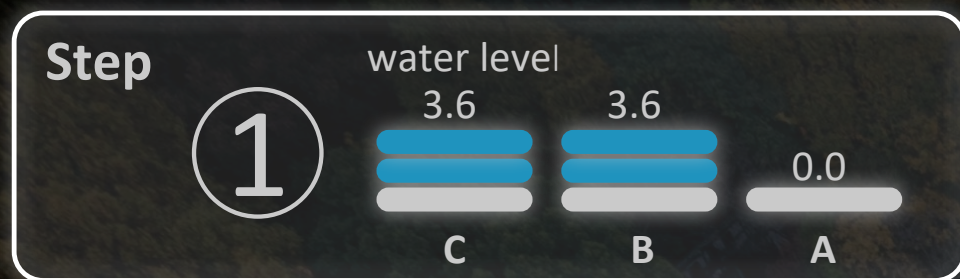
PLATFORM REVETMENT



## ROCKERY RESTORATION AND LANDSCAPE SPACE CREATION

After comparing the structural schemes, the design team adopted the scheme which enables the restoration of rockeries to meet standard settlement requirements.

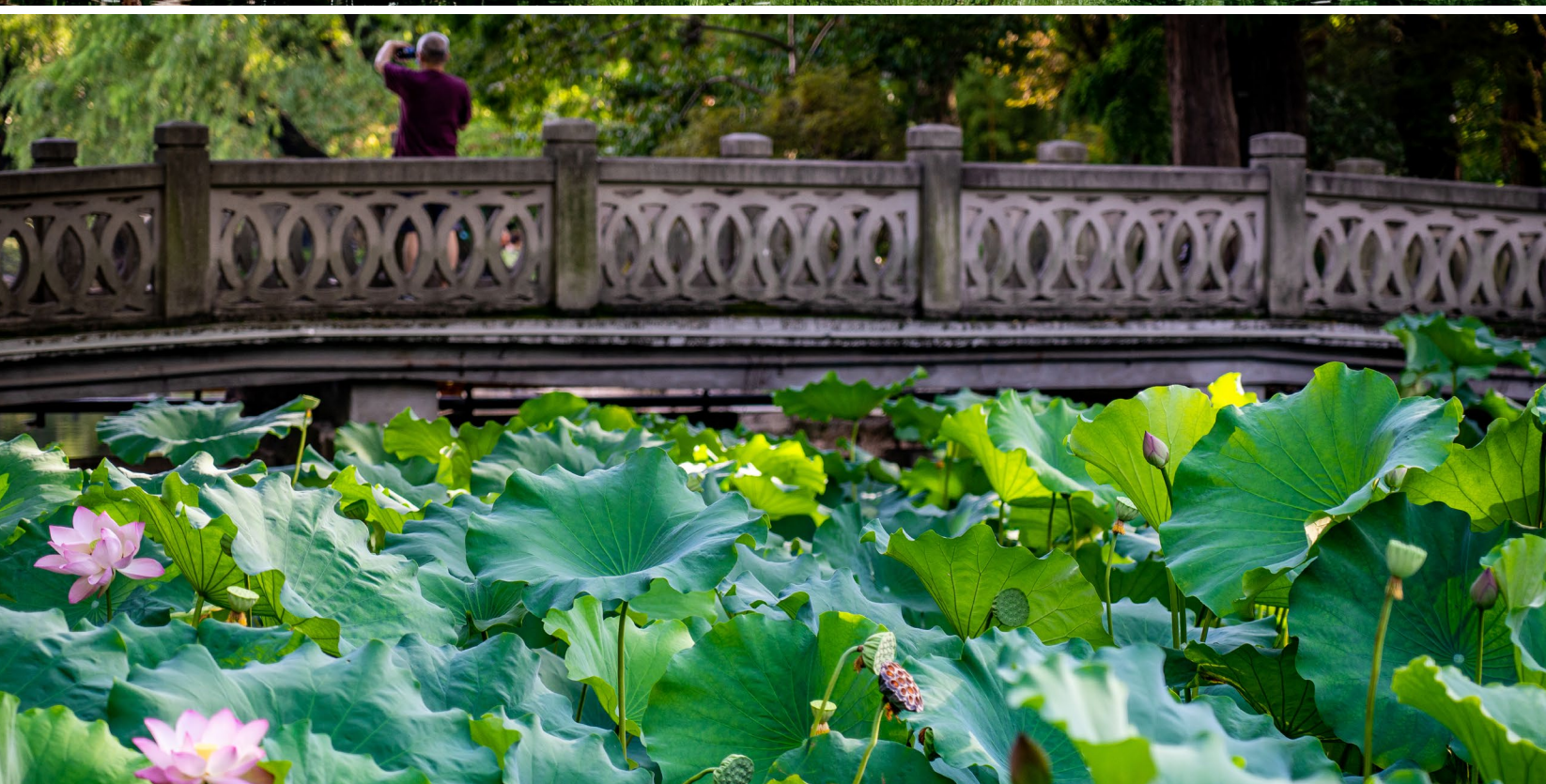
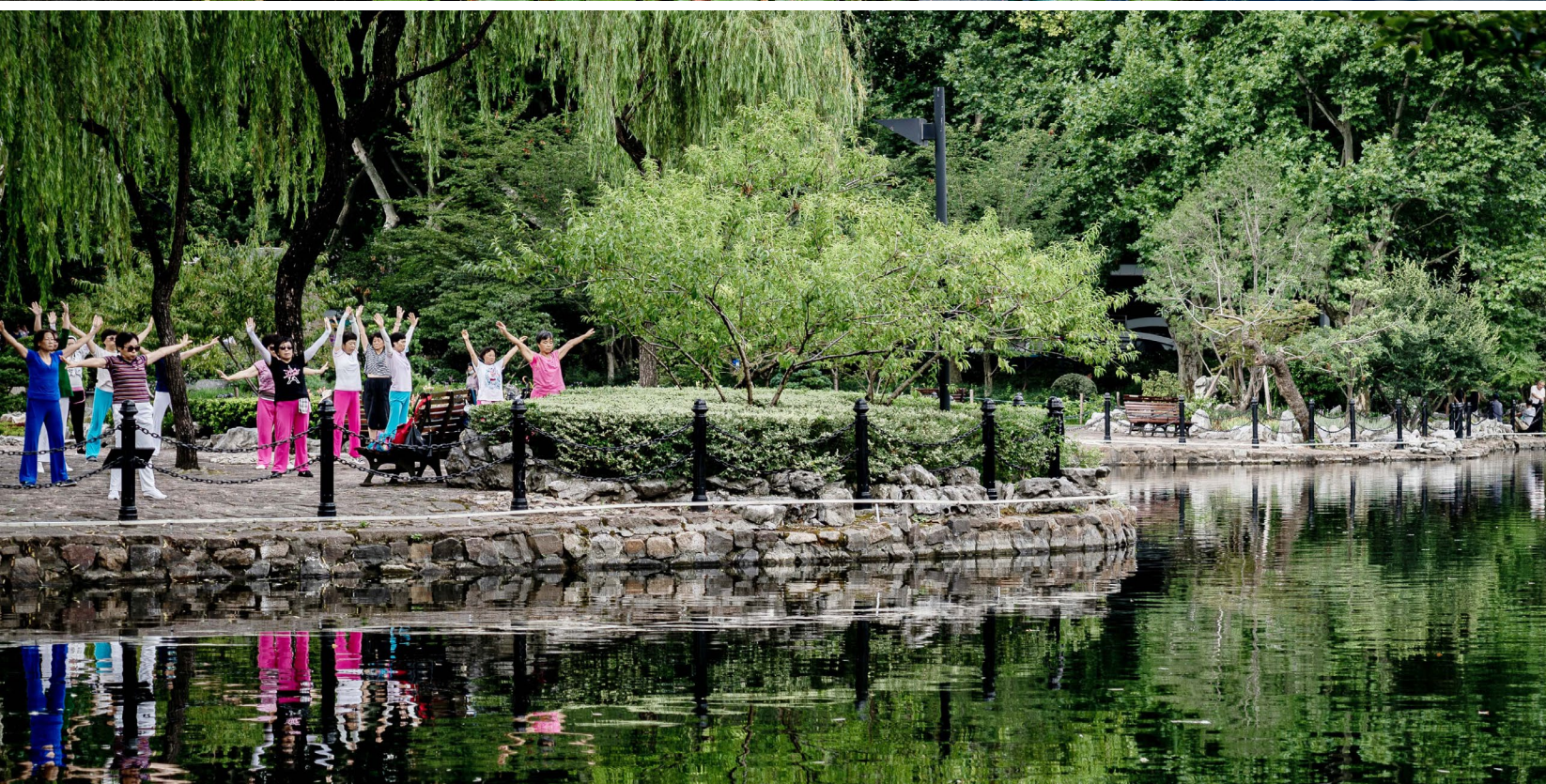




$(14.5+0.5) \times 18 = 270$   $2.0 \times 10 = 20$   
290KN/  $m^2$   
Limits 300KN/  $m^2$   $\pm 10\%$   
 $2.0 \times 10 = 20$   $0.5 \times 18 = 9$   
 $29 < 10\% \times 300$   
Constant water level : 2.6 m  
Maximum water level limit: 3.8m

**INNOVATIVE CONSTRUCTION MANAGEMENT BY BALANCING  
THE DYNAMIC PRESSURE FROM THE SUBWAY SYSTEM UNDERNEATH**





## SOCIAL BENEFIT

The restored park with clean and clear water continues to provide beautiful and picturesque landscapes for the locals and tourists.







## **SOCIAL BENEFIT**

The traditional Chinese gardens, modern techniques and water ecological restoration technologies were integrated into a fresh Shanghai Luxun Park.