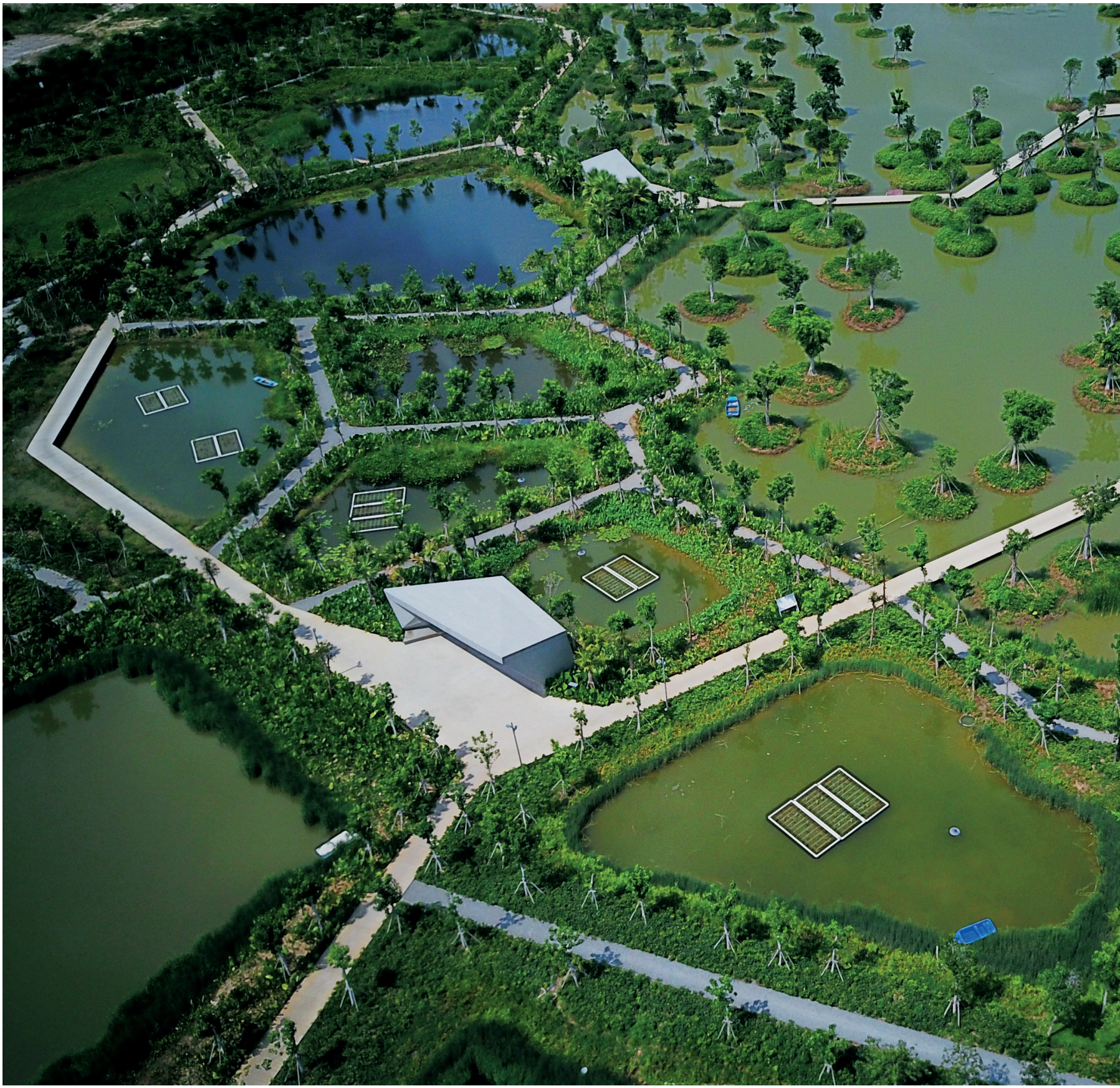

1. 东岸湿地公园示范区航拍

1. Aerial view of the demonstration area of Dong'an Wetland Park

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从棚户区的灰色地带到新城区的韧性湿地
——海南三亚东岸湿地公园

FROM AN IGNORED GREY PLACE TO A RESILIENT URBAN WETLAND — DONG'AN WETLAND PARK IN SANYA, HAINAN PROVINCE

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1 项目背景

经过短短30年的发展，三亚已然从一个小渔村发展成为了一座国际化热带滨海旅游城市。随着城市的快速扩张，三亚在高速发展的同时也留下了很多“伤疤”——违章建筑随处可见，环境污染问题突出。其中，东岸湿地所在地块即为体现这种“城市伤疤”的典型区域。

位于月川新城片区的东岸湿地原为城市中的一片低洼农田，随着城市的建设发展，原有的水系格局被人为改变，周边径流在此汇集，形成了一片次生湿地，同时也是上游抱坡溪与三亚东河的连接通道。然而，在长期的城镇化影响下，原有的自然乡村、田园风光被随意搭建的棚户区逐渐蚕食；由于泥沙淤积、围湖造地等原因，湿地水面不断缩减，尤其是与三亚东河相连处仅剩下一条6m宽的涵道，无法满足排洪需求。每遇台风暴雨，该区域就会出现局地内涝。同时，由于周边居民生活污水和农业养殖废水直接排入湿地，造成水体严重污染至发黑发臭。东岸湿地及周边区域因此成为了市民避而远之的灰色地带。

2015年，中国住房和城乡建设部将三亚

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摘要

由于东岸湿地在三亚海绵城市系统中占据着至关重要的生态区位，东岸湿地公园项目被列为第一批“双城”“双修”重点项目。作为城市雨洪管理中的重要节点，东岸湿地公园的设计期望在促进水循环、净化水质、调蓄雨洪旱涝的同时，融合休闲游憩综合功能。设计运用陂塘湿地、水上森林、台田菜园、环形游步道等韧性景观元素，实现了修复场地生态、构建海绵设施的目标，并成为了白鹭新的栖息家园、孩子们的自然学校，以及市民回归乡愁体验的新乐园。

关键词
双城双修；韧性海绵；栖息地；生物多样性；乡愁

ABSTRACT

The Dong'an Wetland was designated as the site for one of Sanya's first pilot projects of urban environmental remediation and ecological restoration because of its key position in the regional ecological pattern, especially for urban stormwater management. The project aims at integrating leisure and recreational functions with landscape elements including ponds, forest on water, terraced vegetable garden, and trail loop, while promoting water circulation, improving water quality, and retaining rainwater and regulating water reuse, acting as a resilient urban sponge for rainwater management. The newly built project transforms an ignored grey place into a new home for egrets, an outdoor classroom for children's nature education, and a destination for citizens to evoke their memories.

KEY WORDS
Sponge City Construction and Underground Corridor-System Construction; Urban Environmental Remediation and Ecological Restoration; Resilient Sponge; Habitat; Biodiversity; Nostalgia

整理、译 田乐
EDITED AND TRANSLATED BY Tina TIAN

项目地址：
三亚市月川新城区
项目面积：
66.77hm^2
项目委托：
三亚市园林环卫管理局
景观设计：
北京土人城市规划设计有限公司
首席设计师：
俞孔坚
项目负责人：
俞文宇、拜真
设计团队：
王欣、林国雄、张喻、郑军彦、宋嘉、吴帆、张建乔、周洲、王予非、李飞、王芳、董恬祎
设计时间：
2015年8月~2016年1月
建成时间：
2016年12月（示范区）

LOCATION:
Yuechuan New Town District, Sanya
AREA (SIZE):
66.77 hm^2
CLIENT:
Bureau of Urban Park and Environmental Administration of the Sanya City
LANDSCAPE ARCHITECTURE:
Turenscape
CHIEF DESIGNER:
Kongjian Yu
PROJECT MANAGERS:
Wenyu Yu, Zhen Bai
PROJECT TEAM:
Xin Wang, Guoxiong Lin, Yu Zhang, Junyan Zheng, Jia Song, Fan Wu,Jian qiao Zhang, Zhou Zhou, Yufei Wang, Fei Li, Fang Wang, Tianyi Dong
DESIGN PERIOD:
August 2015 to January 2016
COMPLETION TIME:
December 2016 (Demonstration Area)

2-1. 改造前场地中的违章建筑物
2-2. 改造前场地中的黑臭水体
3. 原状场地中的散耕菜田承载着当地居民的记忆。

2-1. The squatter-houses and other illegal constructs on the site before the restoration.
2-2. Before the restoration, the water body was heavily polluted.
3. Most of the existing land area was occupied with scattered small vegetable fields that reflected the collective memory of neighboring residents.

列为全国首个生态修复、城市修补试点城市和全国首个海绵城市与地下管廊建设综合试点城市。由于东岸湿地在三亚海绵城市系统中占据着至关重要的生态区位，东岸湿地公园项目被列为第一批“双城”“双修”重点项目。

2 设计目标与挑战

作为城市雨洪管理中的重要节点，东岸湿地公园的设计期望在促进水循环、净化水质、调蓄雨洪旱涝的同时，融合休闲游憩综合功能。

项目占地面积约66.77hm^2，力求以生产性湿地为基底，打造具备多重功能的综合性城市湿地公园：1）实现行洪排涝功能，以50年一遇暴雨防洪标准设计；2）修复湿地系统，并将其构建为可吸纳城市雨洪的韧性“海绵”，成为“三亚绿肾”；3）为市民提供公共休闲、娱乐、游憩场所；4）营造多样的生物栖息地，以及能够体现三亚本土特色、融合文化教育意义的旅游目的地。方案需要应对的挑战包括：

1）雨洪安全威胁：现状排洪涵道截面只有6m×4m，排洪能力严重不足（不满足5年一遇暴雨防洪标准）；

2）水质污染：水体污染严重，经检测水质为劣Ⅳ类；

3）栖息地模式单一，生物多样性低：现状场地水域几乎全部被水葫芦（*Eichhornia crassipes*）覆盖侵占，陆地则多为市民散耕的菜田；

4）场地连接性不足：由于水体阻隔，周


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2-1


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2-2

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3

边被割裂的片区间缺乏联系；

5）乡愁缺失：快速的城市发展使城市用地不断被钢筋混凝土建筑及道路所占据，留给城市居民的绿地越来越少，场地周边居民拥抱青山、绿水、田园的愿望迫切而强烈。

3 设计策略

3.1 构建城市中的绿色海绵系统

设计首先疏浚了水系，以扩大容量、增强雨洪滞纳能力，使湿地日常蓄水量达到30万立方米；在50年一遇洪峰条件下，调蓄洪水量将达到83万立方米，能够真正形成一块水域面积达27.5hm^{2}的韧性“海绵”；同时将原来6m宽的涵道开挖为宽40m、总长750m的人工河道，并与东河相连，以在更大尺度上缓解区域水患。

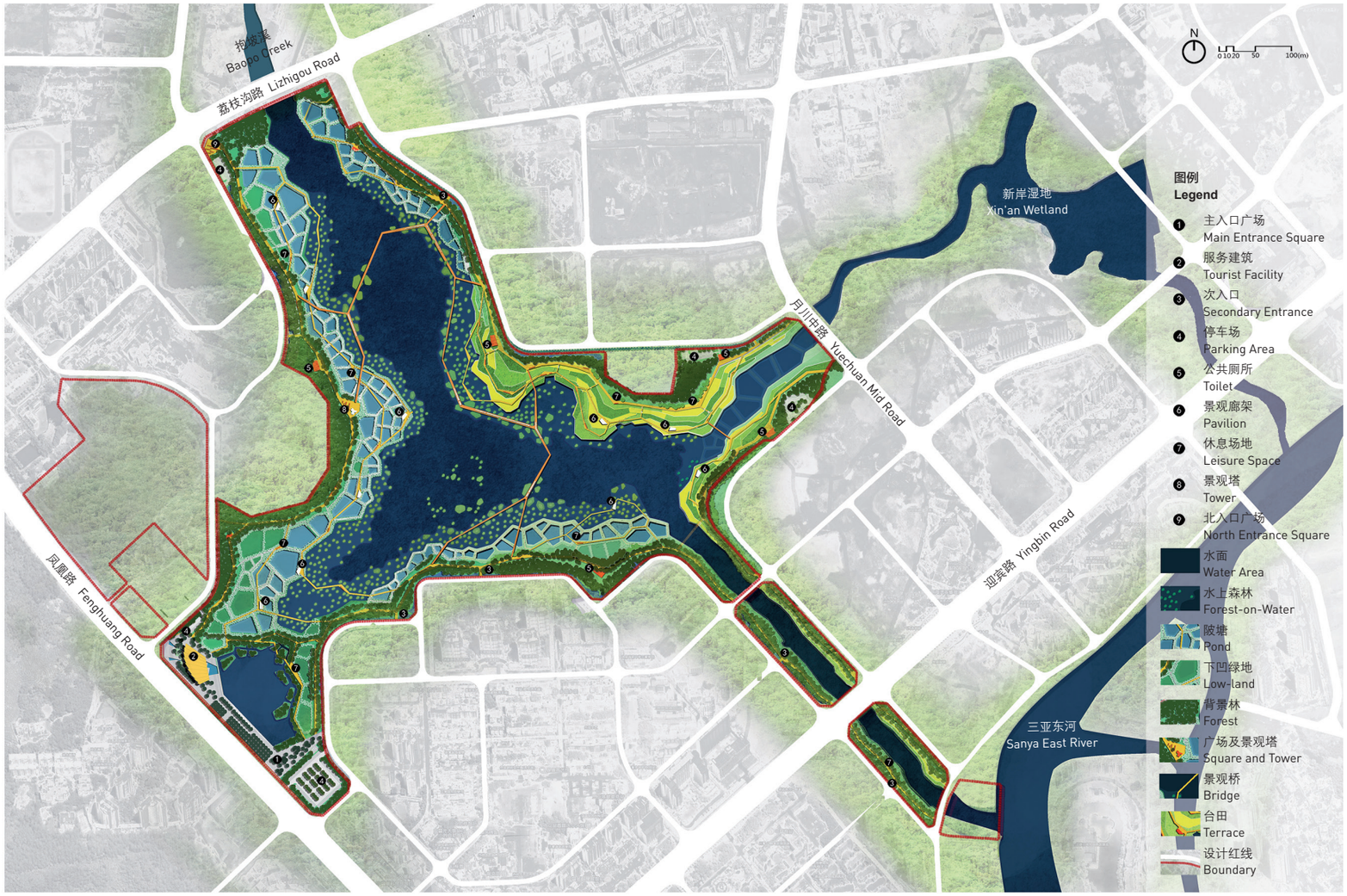
三亚雨旱季分布极其鲜明，旱季蒸发量巨大，雨季降水集中。为长期保证园内水体的水质和水量，设计团队还建立了一套韧性蓄水系统——将湿地公园的边界打造成陂塘。“在中国，陂塘是古人为了解决干旱季节的农业灌溉问题，在自然湖泽的基础上利用起伏的山势围堤筑坝，进而形成的一种农田水利设施。”[1]这种人工修筑的中小型水体的主要作用是蓄水和灌溉，并兼具水产养殖功能。在雨季可以蓄水，在旱季可以为农业生产提供水源，且在水土保持方面也可以起到调节作用。

方案利用公园边界现有分散的鱼塘设计了一系列陂塘，在雨季可以储水，旱季可以变成下凹绿地；雨水首先进入陂塘进行沉淀，水中污染物可以被湿地植物及微生物吸附和吸收，以初步净化雨水；多余的雨水通过陂塘的原位净化后溢流进入中央湖区，可保证中央湖区作为主要体验区的水景效果。同时对场地周边主要污染源进行管控，使之不再直接排入湿地。

3.2 修复栖息地

在尽可能保留原有林地的基础上，依据当地已有的自然肌理，围绕湿地新增林地、种植特色果树的陂塘、湖面滩涂、岛屿、农田等栖息地，以丰富湿地生态系统，重建鱼游虾嬉、鹭鸟翱翔的多样栖息环境。根据场地生态基底及现状条件，设计将湿地公园分为4个区域：

1）水上森林保护区：白鹭（*Egretta garzetta*和*Egretta intermedia*）是三亚地区标志性物种，它们一般栖息于近水林区，习惯与人保持一定的距离；但由于人的惊扰且缺乏适宜的栖息地，导致场地内白鹭较少。设计根据鹭鸟的栖息地需求，为鸟类设计了觅食区、营巢区和缓冲区，并划分出不影响白鹭栖息的游人活动区；设计保留场地中较大面积的集水区作为中央湖区，并在湖区边界区域设置了600余座大小不一的榕树岛，形成“水上森林”景观。根据三亚的气候条



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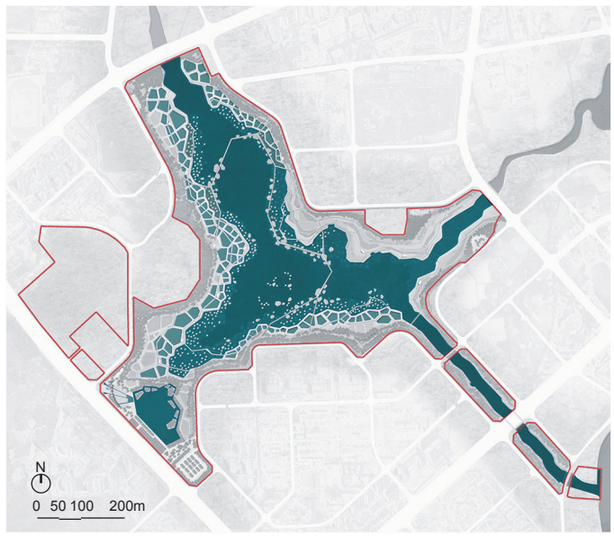

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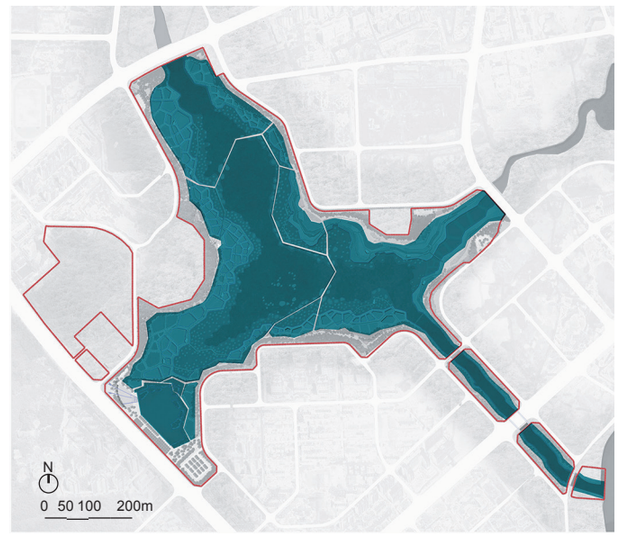
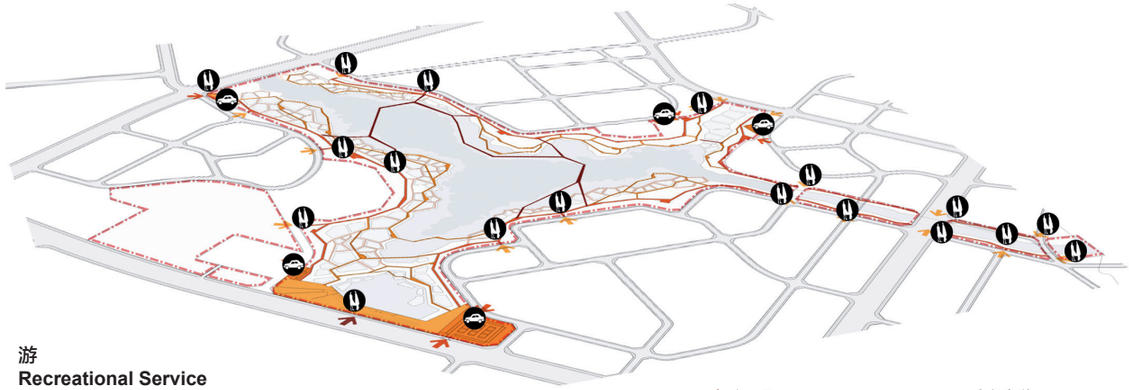


5-2

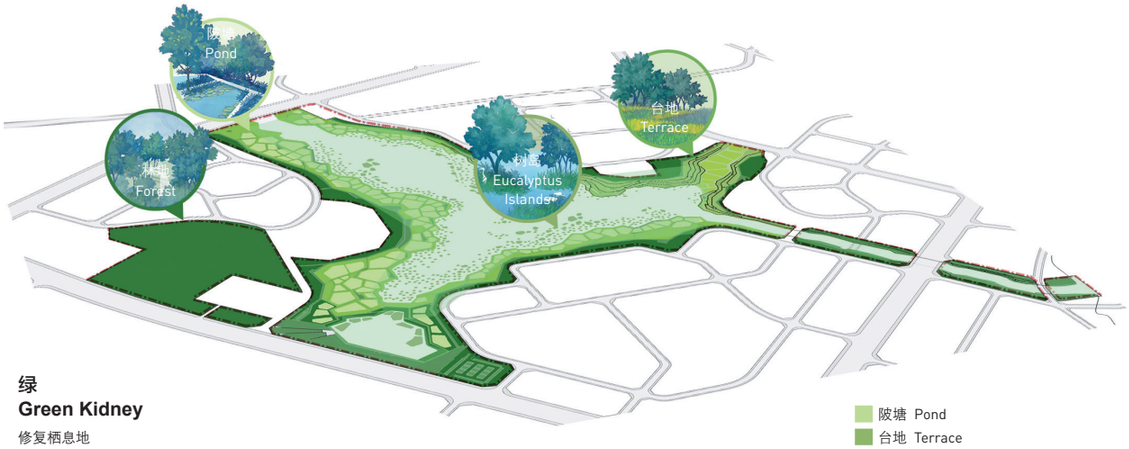
4. 东岸湿地公园设计总平面图
5. 公园常水位（图5-1）与50年一遇暴雨条件下（图5-2）的水位变化示意图
6. 设计策略

4. Master plan of Dong'an Wetland Park
5. The ordinary water level (Fig. 5-1) and the water level in a 50-year storm (Fig. 5-2)
6. Design strategies



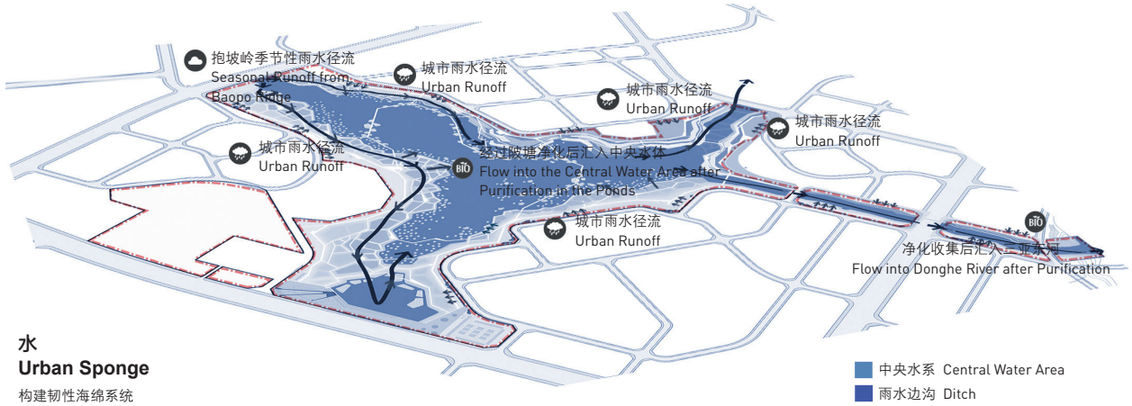
游
Recreational Service
连接场地，再塑乡愁
Improving the Connectivity of the Site and Recalling Nostalgia

主入口 Main Entrance
次入口 Secondary Entrance
景观桥 Bridge
栈道 Boardwalk
自行车道 Bicycling Trail
停车场 Parking Area
小广场 Small Square
设计红线 Boundary



绿
Green Kidney
修复栖息地
Habitat Restoration

陂塘 Pond
台地 Terrace
树岛 Eucalyptus Islands
林地 Forest
设计红线 Boundary



水
Urban Sponge
构建韧性海绵系统
Creating an Urban Green Sponge

中央水系 Central Water Area
雨水边沟 Ditch
陂塘 Pond
汇水路径 Water Flow Route
汇水方向 Water Flow Direction
设计红线 Boundary

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6

件，设计特意选用了耐湿性较好的乡土树种小叶榕（*Ficus microcarpa*）作为“水上森林”的主要树种，同时搭配其他乡土水生植物以丰富淡水湿地植被群落。这不仅为白鹭等鸟类及蛙类、蛇类等动物提供了繁衍生息的场所，也为在水中栈道上行走的游人提供了独特的游赏体验。

2）陂塘果园区：在场地西侧边界设置不同大小的陂塘。塘与塘之间相连，形成一个完整的储水与净化体系，不仅改善了水质，也有利于水生动植物及微生物生长；同时在塘梗上栽植三亚当地特有的果树，形成具有鲜明热带特色的“果基陂塘”景观。

3）乐活田园区：场地北侧及东侧与中央湖区水面有较大高差，设计采用台地的方式解决高差，并在台地上种植生产性乡土植物，以再现农耕田园的场地记忆。

4）山体保护区：场地西南侧为天然山体，植被良好。设计对其进行最小干预，该区域以保护为主。

3.3 连接场地，再塑乡愁

设计构建起一个集自行车道、亲水栈道、田埂步道、空中栈桥于一体的慢行系统，穿越公园林地、湿地、台田菜园等区域，以圈层结构的环形游步道串联起周边社区：外层为环湖慢行道，其连接东河，并融入三亚城市慢行系统中；中层为游憩步道，穿越陂塘和台田菜园区，使市民在游园过程中更加深切地体会到场地的历史记忆；内层为景观栈桥，其在水上森林间穿插蜿蜒，形成一道靓丽的风景，更为游人提供了极具特色的景观体验。三条步道系统可供城市居民在公园中欣赏自然之美、体验农耕生活。在50年一遇暴雨条件下，外层环湖慢行道及内层栈桥仍满足安全通行需求。

4 建成后绩效与评估

历经几个月的有序施工，东岸湿地公园示范区现已完工，周边区域内涝问题得以缓解，公园水质改善成效显著，水体明显清透，已能看见畅游的蝌蚪和

小鱼。慈姑（*Sagittaria sagittifolia*）、千屈菜（*Lythrum salicaria*）、睡莲（*Nymphaea*）等湿地植物迎来了它们的第一次花期，海芋（*Alocasia macrorrhiza*）、春羽（*Philodenron selloum*）等已绿意盎然。陂塘里蛙声连片，部分建设完成的水上森林已经可以看到白鹭的身影。入口广场到处可以看到集会、健身、跳舞的市民，陂塘的田埂路上随处可见孩子嬉笑跑闹的身影，游人借助亲水栈道近距离亲水，空中栈道也成为了周边居民夜晚健身、观景的好去处。修复后的东岸湿地公园正在成为城市雨洪的韧性湿地、白鹭新的栖息家园、孩子们的自然学校，以及市民回归乡愁体验的乐园。**LAF**

7. 2016年12月初建成的公园示范区

7. In December 2016, the demonstration area was built and open to the public.

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1 Project Background

After 30 years of urbanization, Sanya, once a small fishing villiage, has turned into an international destination for tropical coastal tourism. However, the rapid unplanned urban growth has resulted in the problems of environmental degradation and disordered construction that are commonly found in the city. The site of Dong'an Wetland was one of such places.

Located in the Yuechuan New Town of the city, Dong'an Wetland was a low-lying farmland before it turned into a deuterogenous wetland not only gathering the runoff from the surrounding urban development but also acting as a water corridor connecting the Baopo Creek and Sanya East River. However, as the long-term urbanization, the original natural countryside scenery had been gradually replaced by squatter-houses and other illegal constructs. The surface of wetland was continuously shrinking due to siltation and land reclamation, and the junction-duct connecting the Donghe River remained only 6 meters wide. Storms often occurred on the site due to the low discharging capacity. At the same time, the water body was heavily polluted caused by the direct discharge of domestic sewage and aquacultural wastewater from the vicinities. Thus, the Dong'an wetlands and surrounding areas became a grey area ignored by the citizens.

In 2015, the Ministry of Housing and Urban-Rural Development listed Sanya as the nation's first pilot city for urban environmental remediation and ecological restoration, and the first pilot city for sponge city and underground corridor-system construction. The Dong'an Wetland was designated as the site for one of Sanya's first pilot projects of urban environmental remediation and ecological restoration because of its key position in the regional ecological pattern, especially for urban stormwater management.

2 Objectives and Challenges

The project aims at integrating leisure and recreational functions with landscape elements, while promoting water circulation, improving water quality, and retaining rainwater and regulating water reuse.

Covering an area of about 66.77 hm^2, the project is designed to build a multi-functional, productive urban wetland park: 1) To improve the flood discharging capacity withstanding 50-year storm events; 2) To reintroduce a wetland system that serves as a resilient "sponge" for urban rainwater management and a "green kidney" for the city; 3) To provide citizens with public leisure and recreational places; 4) To create a destination that provides diverse habitats and cultural and educational programs. However, the design team faced a plenty of challenges on site, including:

1) Stormwater threat: the cross section of the existing duct was 6 m × 4 m and the flood discharge capacity did not meet the standard of withstanding five-year storm events;

2) Water pollution: the water body was heavily polluted and the water quality declined to Class IV;

3) Lack of habitats and biodiversity: the existing water area was almost fully covered by *Eichhornia crassipes*, and most of the land area was occupied with scattered small vegetable fields;

4) Poor on-site connectivity: the surrounding neighborhoods were separated by the water body, lacking physical and social connectivity;

5) Absence of nostalgia: rapid urban development has replaced natural lands with concrete buildings and roads, and

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fewer and fewer green areas could be seen in the city. The neighboring residents now show an urgent and strong desire to embrace natural sceneries and a healthy lifestyle.

3 Design Strategies

3.1 A Green Sponge System in the City

In the design, the water system was dredged to enhance detention and discharging capacity of the site, increasing the daily storage capacity to 300,000 m^3. In 50-year storm events, the storage capacity would reach 830,000 m^3, forming a "sponge" with a water area of 27.5 hm^2. In addition, the existing duct is widened into a constructed channel with a width of 40 m and a total length of 750 m, which connects with the Donghe River to mitigate

9 © 拜其

floods in a larger scale.

The seasonal change in Sanya is clear: in dry seasons the evaporation is extremely high while raining a lot in monsoon days. To maintain the waterscapes in the park, the design also establishes a resilient water storage system by introducing a series of ponds around the boundary of the wetland park. "In ancient China, irrigating-pond as an agricultural facility was widely used for irrigation and water conservation. Most of such ponds were built combining with local terrains and water networks."[1] In forms of dams or dykes, those small- or medium-sized water bodies can collect and retain rainwater in wet seasons and provide water for irrigation in dry days, not only establishing productive landscapes, but also performing water regulation services.

On the site, the series of ponds are created on the basis of the existing abandoned fishing ponds scattering around the border of the park. These ponds are allowed to be inundated in storms and turn into concave green areas during dry seasons. Before being discharged into the municipal rainwater drainage system, the rainwater would be detained in the ponds for sedimentation and the pollutants can be adsorbed by aquatic plants and microorganisms. Meanwhile, overflow runs into the Central Lake area (a main experience zone) that ensures the operation of the waterscape. At the same time, the major pollution sources around the site are controlled and no longer directly discharged into the wetland.

3.2 Habitat Restoration

By preserving the existing natural setting, especially the groves, as much as possible, the design establishes various habitats around the wetlands, in forms of forests, fruit-tree-dyke ponds, tidal

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8. “水上森林”航拍
9. 组成“水上森林”的榕树岛及湿地植物
10. 穿梭于“水上森林”间的栈道
11. 游人在“水上森林”中体验游赏

8. Aerial view of the Forest-on-Water
9. The Forest-on-Water formed with Banyan islands and other aquatic plants
10. The boardwalk meandering in the Forest-on-Water
11. Visitors enjoying the landscape of the Forest-on-Water

marsh, small islands, farmlands, etc., creating new homes for fishes, shrimps, egrets, and other wild animals. Four zones are designed in the park:

1) Forest-on-Water Protection Zone: Egret (*Egretta garzetta and Egretta intermedia*) is an emblematic species in Sanya. Egrets are commonly found in riparian forest, living in a certain distance from humans. Due to human disturbances and the lack of suitable habitats, less and less egrets were found in the region. The design introduces new habitats for egrets and other waterfowls by establishing feeding areas, nesting areas, and buffer areas, to minimize human disturbance. The design also preserves a large area of the existing catchment in the center of the site and turns it into a lake area. In addition, over 600 Banyan islands are designed around the lake to form a scenery of "forest on water." *Ficus microcarpa* and other native species are used to establish rich freshwater wetland vegetation communities, not only providing habitats for wild animals such as birds, frogs, and snakes, but also offering visitors a unique boardwalk-walking experience on the water.

2) Orchard-Pond Zone: a series of ponds in different sizes are designed in the west of the site, which are interlinked to form a water storage and purification system that not only improves the water quality but also facilitates the growth of aquatic plants and microorganisms. Native fruit trees are planted on the dykes to create a distinctive tropical landscape.

3) Agricultural Experience Zone: since there is a big height difference with the Central Lake area, in the north and the east side of the site, a terrace landscape is adopted and productive native vegetation

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12. 公园陂塘系统航拍
13. 公园入口的陂塘长满了湿地植物并迎来了花期
14. 陂塘果树间的碎石小路为游人提供了便捷的游赏路线和丰富的景观体验
15. 游客在陂塘果树间散步游赏

12. Aerial view of the pond network
13. The aquatic plants grow vibrantly and have flowered.
14. The crushed-stone path in the Orchard-Pond Zone provides a shortcut and diverse landscape experience.
15. Visitors walking on the dykes in the Orchard-Pond

are planted to reappear the collective memory of farming activities.

4) Mountain Protection Zone: the natural hilly terrain and lush vegetation in the southwest of the site are preserved well. The area is designed as a protection zone and only minimum interventions are introduced.

3.3 Improving the Connectivity of the Site and Recalling Nostalgia

A trail network is established that links the forests, wetlands, terraced fields of the site and connects the neighborhoods surrounded through a combination of bicycle paths, boardwalks, paths on dyke, and elevated trails. The trail network

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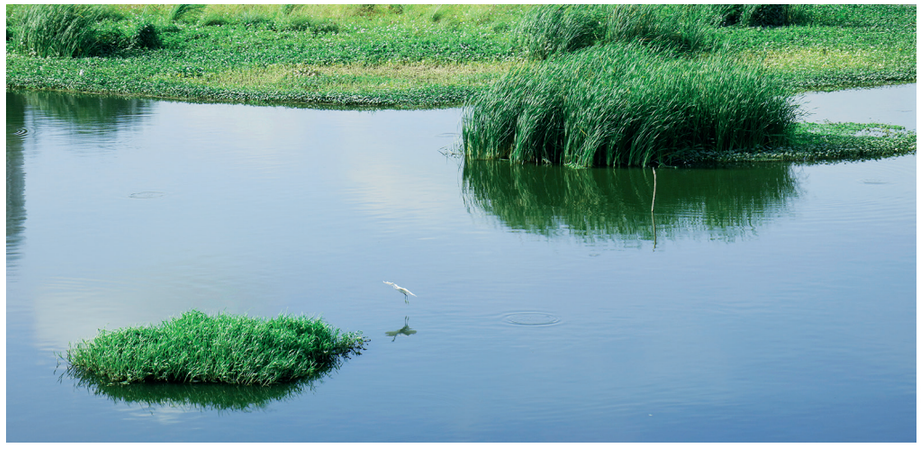
consists of three loops: outmost trail loop is set up around the lake and extends to the Donghe River, serving a part of the pedestrian system of the city; the middle trail loop is integrated with recreational functions in the site, connecting the ponds and the terraced fields, and providing visitors diverse landscape experience and a place to recall collective memory; the inner layer is a boardwalk system that meanders among the Forest-on-Water, providing visitors with unique walking experience. The three trail loops offer citizens opportunities



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16. 湿地经改建后，水质已明显改善。
17. 中央湖区已有鹭鸟回归的身影
18-1. 清晨居民在公园广场锻炼
18-2. 居民在湿地廊架中吹奏乐曲
18-3. 游人带着孩子亲近湿地感受自然
18-4. 居民在公园中休憩

16. The water quality of the wetland is greatly improved.
17. Egrets are found in the Central Lake area
18-1. People taking exercise in the park
18-2. An informal "concert" in the wetland pavilion
18-3. The park becomes a beautiful destination for families to access water.
18-4. Visitors resting in the park

to enjoy the beauty of nature and to experience farming activities in the park. The design also meets the requirements for 50-year storm events, then the middle loop could be inundated while the outmost and inner loops functioning as usual.

4 Performance and Evaluation after the Completion

After several months' construction, the demonstration area of the Dong'an Wetland Park project has finished. The frequency of water logging and flooding has decreased and water quality in the park has been significantly improved — now the water body is clear enough to see tadpoles and fishes in it. *Sagittaria sagittifolia*, *Lythrum salicaria, Nymphaea*, and other aquatic plants have flowered, and *Alocasia macrorrhiza* and *Philodenron selloum* are thriving. Croaks are heard in the ponds and egrets are found in the area of Forest-on-Water. The entrance plaza provides people a place for gathering, exercise, and dancing. Children play and run around the dykes of ponds. The boardwalk on water allows visitors to have access to the wetland and lake and the elevated boardwalk provides a perfect place to exercise and to enjoy the view at night. Now the restored wetland park becomes a resilient urban wetland for rainwater management, a new home for egrets, an outdoor classroom for children's nature education, and a destination for citizens to evoke their memories. **LAF**

REFERENCE

[1] Yu, K. J., Jiang, Q. Z., Wang, Z. F., & Li, M. H. (2015). The Research Progress and Prospect of Bei Tang Landscape. Areal Research and Development, 34(3), 130-136.


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