





1. 改造后的浦阳江三江口湿地
1. The recovered Sanjiangkou Wetland in Puyangjiang River

# “五水共治” 示范工程： 金华市浦阳江生态廊道

## RESTORING THE MOTHER RIVER BACK TO THE CITY: PUYANGJIANG RIVER CORRIDOR IN JINHUA

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### 摘要

作为浙江省“五水共治”（治污水、防洪水、排涝水、保供水、抓节水）的示范工程，浦阳江治理修复项目将原本遭受严重污染的河道转变为了广受市民喜爱的生态廊道。项目从水生态修复入手，引入由小型滞留湿地和大型湿地斑块组成的湿地净化系统，使水质得到显著改善。设计体现了海绵城市建设理念和最小干预策略，在提升场地应对洪水的弹性的同时，将设计对原有自然环境的扰动降至最低。此外，项目对场地原有的农业、水利和文化历史遗迹进行了保护、激活并巧妙改造，赋予了场地艺术与教育价值。

### 关键词

湿地；生态净化；海绵城市建设；最小干预；历史遗迹

### ABSTRACT

As a pilot project of water treatment in Zhejiang Province, the Puyangjiang River Corridor project has remediated the polluted river course into a popular ecological and recreational corridor. The project restored the aquatic ecosystems and improved the water quality by introducing a constructed wetland system which purifies the irrigation water and the tributaries of Puyangjiang River. Under a concept of Sponge City construction and a minimal intervention strategy, the design not only enhances the flood resilience, but also minimizes the disturbance to natural ecosystems of the site. In addition, the existing agricultural, water-conservational, and cultural heritages have been preserved and partly reused as recreational structures and facilities, contributing aesthetic and educational values to the site.

### KEY WORDS

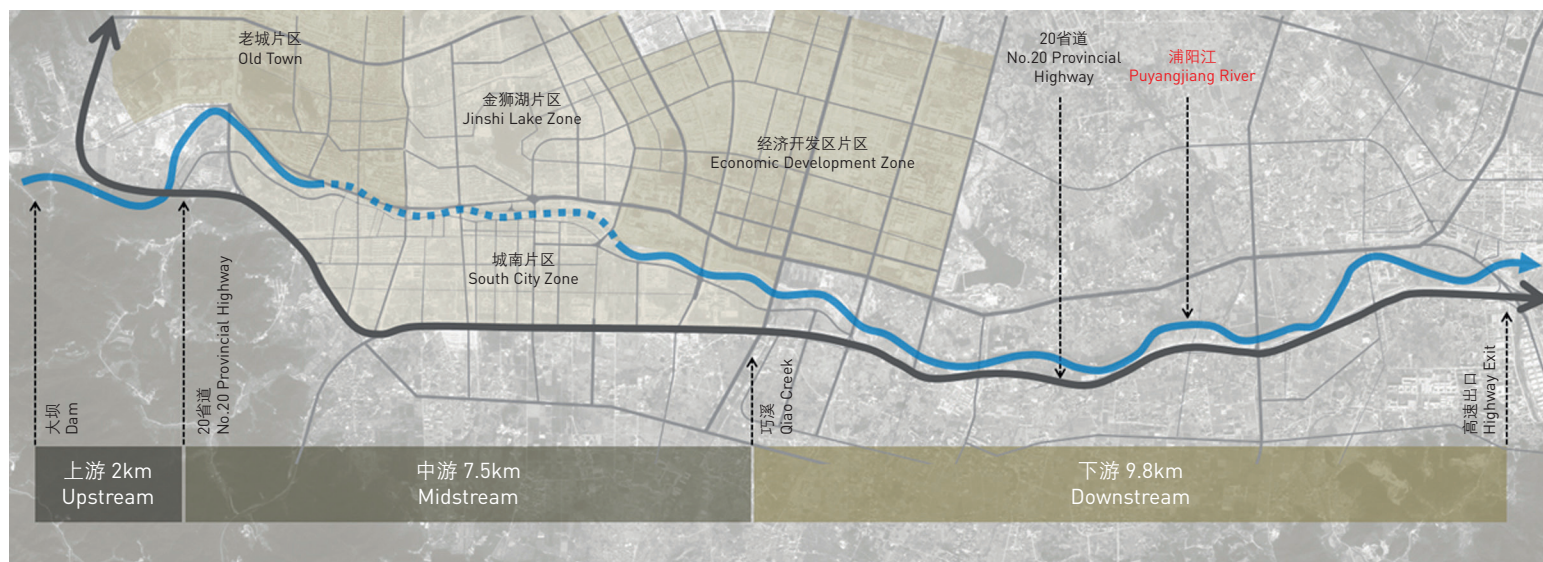
Wetland; Ecological Purification; Sponge City Construction; Minimal Intervention; Historical Heritage

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**项目地址:**

浙江省金华市浦江县

**项目面积:**

196hm<sup>2</sup>

**项目委托:**

浦江县住房和城乡建设局

**首席设计师:**

俞孔坚

**项目团队:**

俞宏前、宋昱、陈昊、周水明、方渊、张冰月、姚斑竹、左俊、张凯元、徐颖、马慧杨、齐文、张璠、王磊、席文静、杨远、张晨曦、张念伟、王丹、刘磊、李圣慧

**设计时间:**

2014年4月~2015年8月

**建成时间:**

2016年12月

**LOCATION:**

Pujiang County, Jinhua City, Zhejiang Province

**AREA (SIZE):**

484 acres

**CLIENT:**

Municipal Bureau of Housing and Urban-Rural Development of Pujiang County

**CHIEF DESIGNER:**

Kongjian Yu

**PROJECT TEAM:**

Hongqian Yu, Yu Song, Hao Chen, Shuiming Zhou, Yuan Fang, Bingyue Zhang, Banzhu Yao, Jun Zuo, Kaiyuan Zhang, Ying Xu, Huiyang Ma, Wen Qi, Fan Zhang, Lei Wang, Wenjing Xi, Yuan Yang, Chenxi Zhang, Nianwei Zhang, Dan Wang, Lei Liu, Shenghui Li

**DESIGN PERIOD:**

April 2014 - August 2015

**COMPLETION TIME:**

December 2016

## 项目背景

在浙江省委十三届四次全会上，“五水共治”（治污水、防洪水、排涝水、保供水、抓节水）理念被提出，以指导浙江省范围内水体治理工作的开展。作为金华市浦江县的母亲河，浦阳江治理修复项目成为了“五水共治”的重点。基于“让河流重新回归城市生活”的设计理念，设计团队运用生态净化、雨洪管理、适应性设计及最小干预策略，重点关注硬质河堤修复、农业水利设施改造、慢行交通网络规划，将过去污染严重的河道彻底转变为广受市民喜爱的生态廊道。

## 现状与挑战

浦阳江全长约150km，是钱塘江的重要支流，也是浦江县的母亲河。项目场地位于浦江县域范围内，规划区域总面积为196hm<sup>2</sup>，长约17km。设计范围被划分为上下游两个区段，上游段从通济湖水坝脚至翠湖，下游段从浦江第四中学至义乌溪。由于河流穿城而过，河段中部沿岸用地性质复

杂，因而未被列入设计范围。

浦江县享有“中国水晶之都”的美誉，水晶产业一度为这座城市创造了巨大的财富，但隐藏在经济繁荣背后的危机却未得到充分警觉：水晶制造业产生的大量污水排入原本清澈的河流，加之农业面源污染和畜禽养殖污染，以及落后的生活污水处理设施，水体污染情况十分严峻。在当地开展水体污染整治前，浦江全县曾同时存在462条“牛奶河”、577条“垃圾河”和25条“黑臭河”<sup>①</sup>。自2006年起，浦阳江水质状况连续8年被列入劣V类，成为浙江全省污染最严重的河流之一。<sup>①</sup>在设计团队介入干预前，河道两侧垃圾遍地、恶气熏天，无人愿意在此停留和活动，河道成为了被城市生活所抛弃的阴暗角落，与此同时，与河道相关的农业、水利和文化历史遗迹也一并被人们所遗忘。如何通过综合有效的生态修复策略恢复浦阳江往日的生机，成为了设计面临的巨大挑战。

## 设计策略

### 湿地净化系统构建及水生态修复策略

项目在场地中构建起了一套湿地净化系

① 2006~2013年浦阳江水质状况数据来源：浙江省浦江县环保局及环境监测站。

2. 项目区位图
3. 总平面图

2. Project location
3. Master plan

统，主要分为小型滞留湿地和大型湿地斑块两部分。小型滞留湿地被设置在农业灌溉水和支流水系与浦阳江交汇处的前端，将原来直接排水入江的方式改为引水入湿地，以使水体得到滞留、净化。针对农业灌溉水和支流水系两种水体，滞留湿地的形式也略有不同。通过在支流与主河道的交汇处设计大型湿地斑块，经过滞留湿地初步净化的水体还将得到进一步净化。其中具有代表性的湿地斑块包括：石马溪翠湖湿地公园斑块、黄龙溪运动公园湿地净化斑块、长春溪湖山桥湿地净化斑块、丽水溪冯村污水处理厂尾水湿地净化公园、五溪彭村湿地净化斑块、和平溪第二医院湿地净化斑块，以及义乌溪三江口湿地净化斑块。

通过构建有效的生态净化系统，结合对水晶制造业的整治和产业转型升级，浦阳江水质目前已得到大幅改善，由劣V类水提升至地表III类水标准，且趋于稳定。

#### 与洪水相适应的海绵弹性系统策略

除具备净化功能外，滞留湿地和湿地斑块同样具备滞蓄雨洪的功能，展现了海绵城

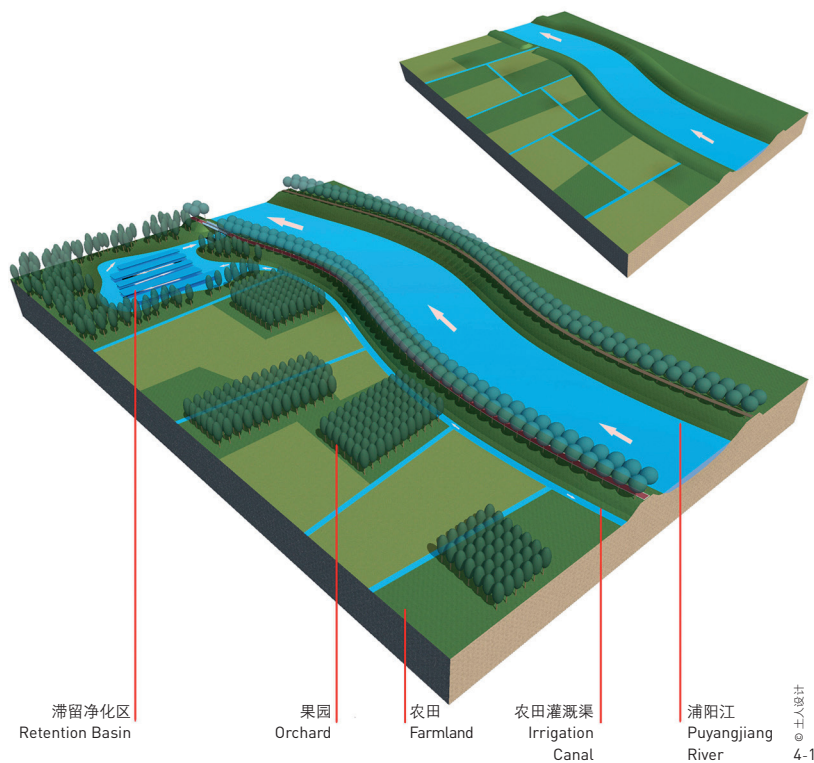
市建设理念。通过在绿地中修建生态水泡和拓展河道水面，设计后的湿地水域面积增加了29.4hm<sup>2</sup>。据统计，项目建设完成后，可淹没的湿地面积约为142hm<sup>2</sup>，占总绿地面积的72.4%；按照平均可淹没100cm洪水水深的设计要求计算，场地蓄洪容量可达142万立方米。这些可淹没湿地一方面极大地缓解了河道及周边场地的洪涝压力，另一方面也有效地蓄存了雨水资源，不仅可以通过下渗补充地下水，还可以作为植被浇灌和景观环境用水。

此外，设计团队还对部分硬质化程度较高的河堤进行了生态改造，改造总长逾3.4km。原有的硬质化堤面被深根性乔木和地被替代，而在河堤生态改造中产生的混泥土块则可被再利用为护坡抛石。亲水平台和栈道均选用耐冲刷和抗腐蚀性的材料，包括彩色透水混凝土和石材。滨水栈道选用架空式构造设计，以尽量减少对河道行洪功能的阻碍和对两栖类生物栖息与迁移的干扰。

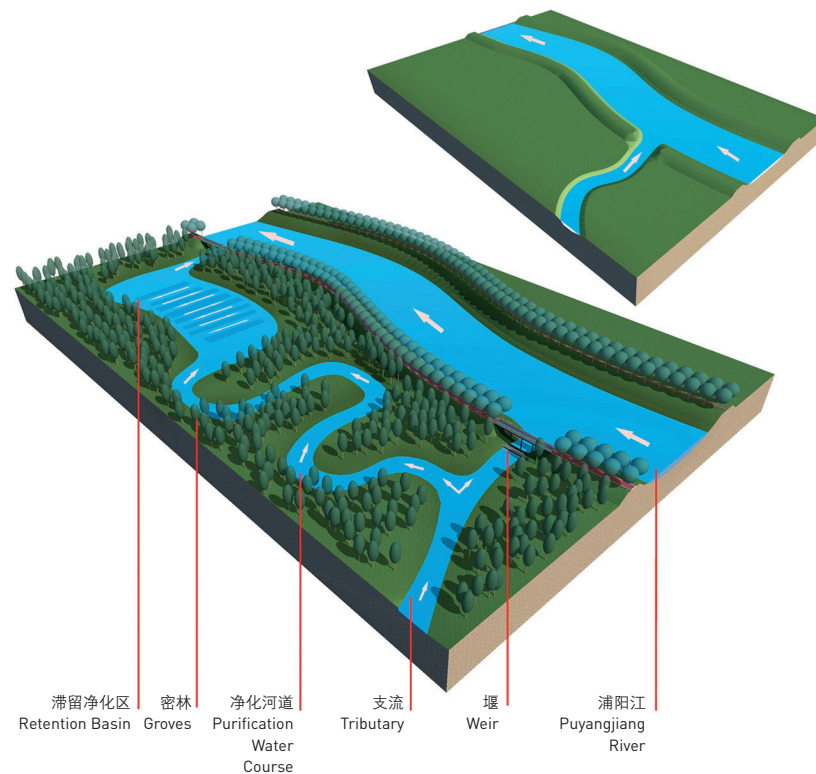
#### 低投入、低维护的最小干预景观设计策略

设计采用针灸式的景观介入手法，将





4-1



4-2

人工景观巧妙地融入自然当中。例如，长约25km的自行车道系统100%利用了原有堤顶道路，以减少对原有植被的破坏并降低工程投入。同时，所有步行栈道的选线均由设计师现场定位，再通过GPS定位反映在图纸上。这种“现场设计”的方法大大提高了设计和建造的综合效率，也确保了场地中所有具有价值的要素都得以保留。此外，对于场地上的历史文化遗迹，设计同样秉持最小干预的设计理念。例如，在原为浦阳江八景之一的湖山桥的桥洞中修建一条游憩栈道，不仅使简洁的设计语言与石桥浑厚的体量形成强烈的对比，也为公众提供了欣赏古桥原始风貌的独特视角。这种节制的、功能至上的设计理念极大地减少了工程投入以及后期的维护成本。

在种植设计中，设计也严格选用能够适应场地地理气候环境的乡土植物，并且尽可能采用小苗密植的种植方式。场地中主要的植物物种包括枫杨 (*Pterocarya stenoptera*)、水杉 (*Metasequoia glyptostroboides*)、

落羽杉 (*Taxodium distichum*)、乌桕 (*Sapium sebiferum*)、无患子 (*Sapindus mukorossi*) 等本土乔木，杨梅 (*Myrica rubra*)、柿树 (*Diospyros kaki*)、樱桃 (*Cerasus pseudocerasus*)、枇杷 (*Eriobotrya japonica*)、果桑 (*Morus alba*) 等当地果树，以及生命力旺盛、能够巩固河堤的细叶芒 (*Miscanthus sinensis*)、芦苇 (*Phragmites communis*)、芦竹 (*Arundo donax*)、狼尾草 (*Pennisetum alopecuroides*)、麦冬 (*Ophiopogon japonicus*) 等地被植物，并间植一些低成本、易维护的撒播野花组合。

#### 水利遗迹保护与再利用

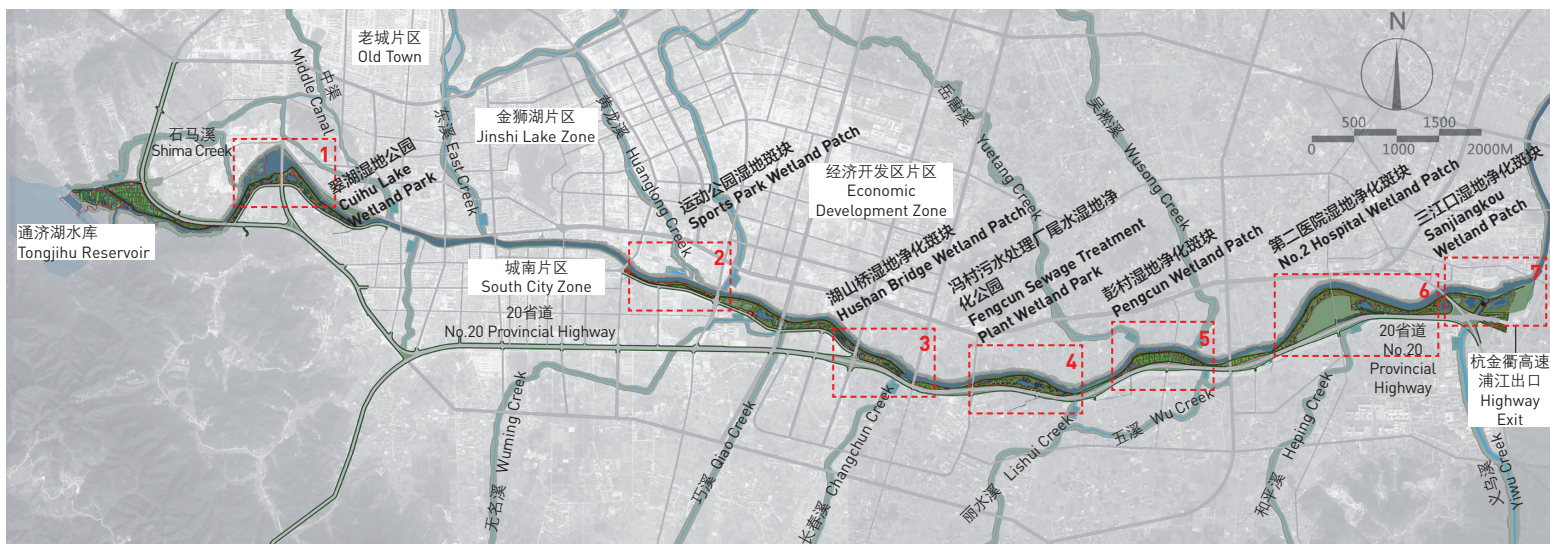
场地内现存大量于20世纪70年代建造的水利灌溉设施，包括7处堰坝、8组灌溉泵房，以及一组跨江渡槽和引水灌溉渠。设计在尊重传统结构的前提下，将部分水利设施改造为了宜人的游憩设施。

设计依附凿山而建的连续引水灌溉渠，

修建出一条长约1.3km的、别具一格的水利遗产体验廊道。在原有引水渠的基础上架设轻巧的钢结构龙骨，铺设防腐木铺装，并巧妙地设置了悬挑观景平台。整条步道穿梭于高耸的水杉林中，使游人与已有自然景观形成互动。此外，在对渡槽和堰坝进行安全评估和结构优化后，设计团队将其改造为步行桥，赋予了传统设施以新的功能，并在步行系统中打造出多处颇具特色的空间节点。由水利设施改造而成的步道和桥梁与新设计的栈道遥相呼应，形成了一种特有的新乡土景观，在保留时代烙印和乡土记忆的同时，倡导对环境的关注、对历史的尊重，结合新建的环境解说系统，为场地赋予了艺术与教育价值。

#### 结语

项目建成后，浦阳江水系得到了净化，人们可以像过去一样在水中游泳、嬉戏。大面积的硬化驳岸被改造为抛石缓



景观大师 © 5-1



© 何敬 5-2

- 4-1. 农田灌溉水滞留湿地
- 4-2. 支流滞留湿地
- 5-1. 7处代表性大型湿地斑块
- 5-2. 湿地斑块兼具净化水体和蓄存雨水资源的功能

- 4-1. Retention wetland for irrigation overflows
- 4-2. Retention wetland for tributaries
- 5-1. Seven typical large-scale wetland patches
- 5-2. The wetland patches can both purify the water and absorb the stormwater

坡，为各种乡土植物提供了自然栖息地，吸引着鸟类和蛙类重回此地安家落户。场地中的步道和自行车道为附近居民提供了平日里漫步或骑行的机会，丰富的游憩设施亦为市民提供了周末举家出游的场所。通过运用当代景观设计手法，浦阳江的风貌焕然一新，每日迎着成千上万的游客到来。

该项目展示了景观设计在解决综合性场地问题中所扮演的统筹者角色。在设计

和建造过程中，景观设计师通过与水利、环保、农业、林业、文化等多个政府部门通力合作，对每一项决策都给予了行之有效的专业建议。项目建成后，浦阳江生态廊道被树立为全国水环境综合整治典范，其成功经验得到了广泛推广。在该项目中，景观设计师以因地制宜的解决策略对生态修复与历史遗迹保护等全球性问题进行了回应，并为世界范围内的类似项目提供了借鉴范例。**LAF**



图  
6-1

6. 设计将原有混凝土驳岸改造为抛石缓坡，并在其上铺设可被洪水淹没的弹性步道。
7. 步道从水杉林中穿行而过，为游客们提供了独特的游赏体验。

6. After the concrete banks of the river were removed, the pedestrian boardwalk was built into the riparian basin that is resilient to flood.
7. The pedestrian path running through the Dawn Redwood grove creates a unique experience for visitors.



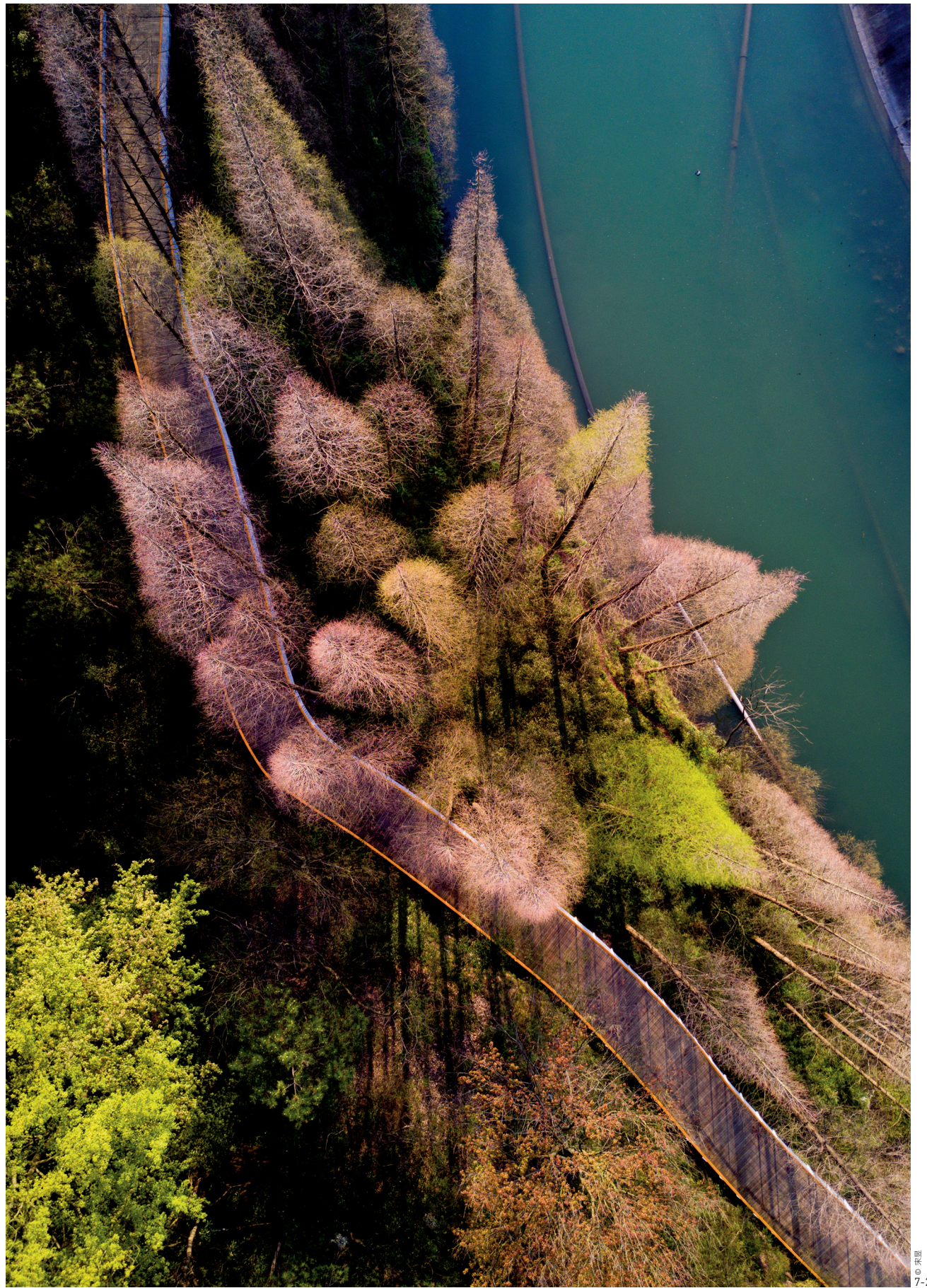
图  
6-2

## Project Introduction

A degraded 10 mile-long river corridor, caused by the local decades of relentless urban development, covering an area of 484 acres, was ecologically recovered and transformed into a vibrant greenway with high ecological performance where humans and nature are reconnected.

## Challenges and Objectives

Pujiang, a small city located in East China and dominated by a monsoon climate, has a resident population of 100,000 with another 400,000 living in its vicinity. It occupies a small and productive basin where the Puyangjiang River runs through. For almost two thousand years, the city and its agricultural vicinity had an Edenic-paradise lifestyle. Their calm and harmony life were broken by the ruthless and rapid industrialization and urbanization in the past four decades: the Puyangjiang River and its tributaries were heavily polluted, water courses were channelled, and the ecosystem





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of the river beds were degraded and damaged by sand mining. The river became a backyard dump and a shunned place with ugliness, annoying smells, and danger. As a matter of fact, Pujiang was ranked as a city of the worst ecosystem in Zhejiang Province. Beginning in early 2014, the local government launched a campaign to improve the overall living environment of the city, and Puyangjiang River was chosen as the site for a pilot water treatment project. Through competition, Turenscape was selected and commissioned to transform the degraded river course into a green corridor with clean water and healthy ecology, providing places

for citizens' daily recreational uses and bringing back the beauty and dignity of their mother river.

### Design Strategies

Three strategies were employed in the restoration of the degraded river.

#### Softening and Remediating

The pollution problem of the Puyangjiang River was largely caused by the over-use of chemical fertilizer in farming lands. The main strategy for this ecological restoration was to establish a constructed wetland

system, consisting of small-scale retention wetlands and large-scale wetland patches. The retention wetlands were designed at the outlets of irrigation overflow and the mouth area of the tributaries to purify and clean the contaminated water before discharging into the Puyangjiang River. The forms of the retention wetlands vary according to specific uses. The wetland patches were designed at the junction of the tributaries with the main water course to further purify the water.

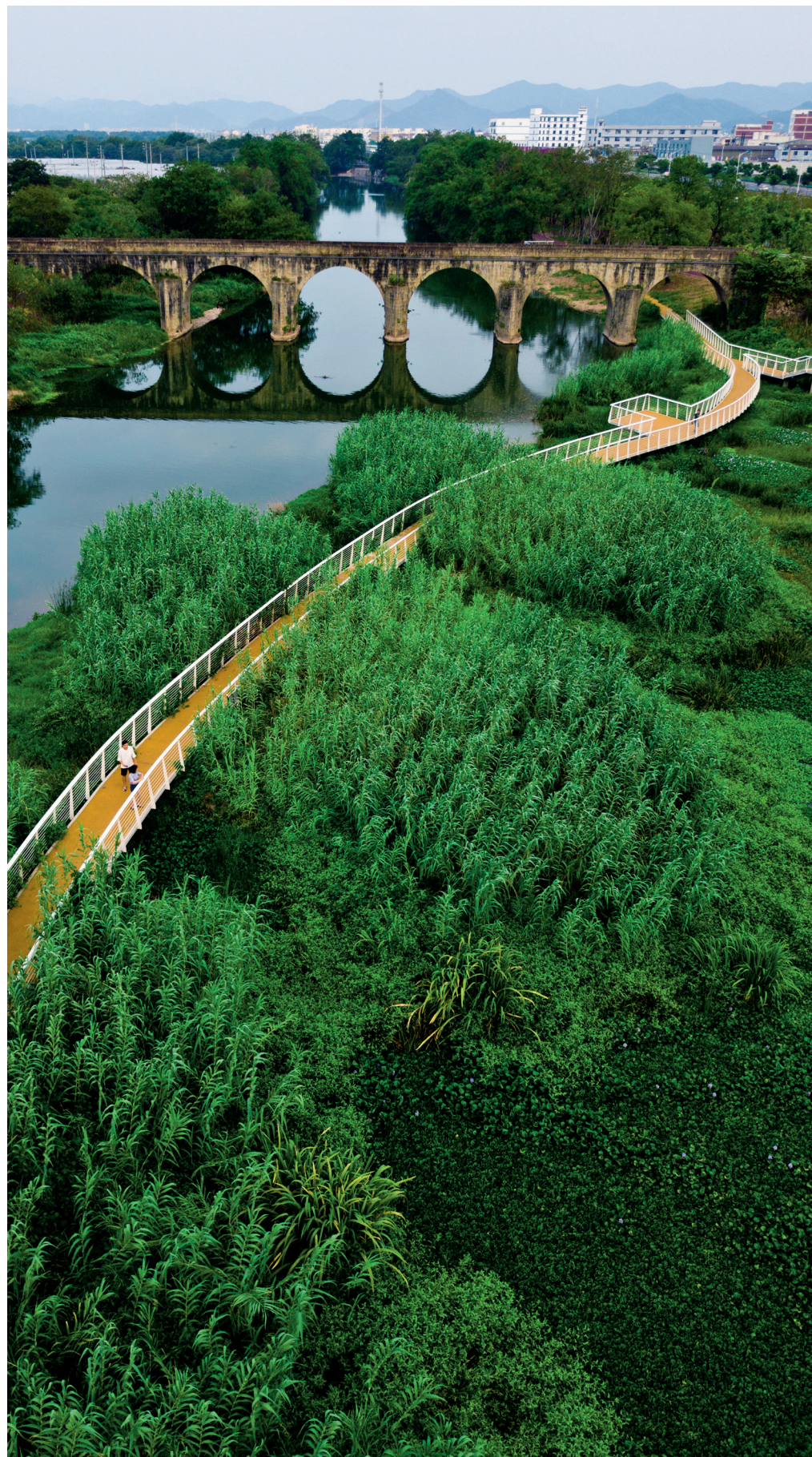
Before design, the river was largely channelled with hard concrete surfaces, declining its resiliency to flood and losing its capacity of self-cleansing. The design

8. 原有凸起的地形转变为一座座由步道、栈道和桥体串联起来的水中岛屿。
9. 建于1906年的湖山桥被保留并整合到绿道系统之中，呈现出旧时与当下的对比关系。
8. The pre-existing pits and piles become islets and lakes that are connected by paths, boardwalks, and bridges.
9. The old bridge built in 1906 was well preserved and integrated into the designed green way to create a dramatic contrast between the past and present.

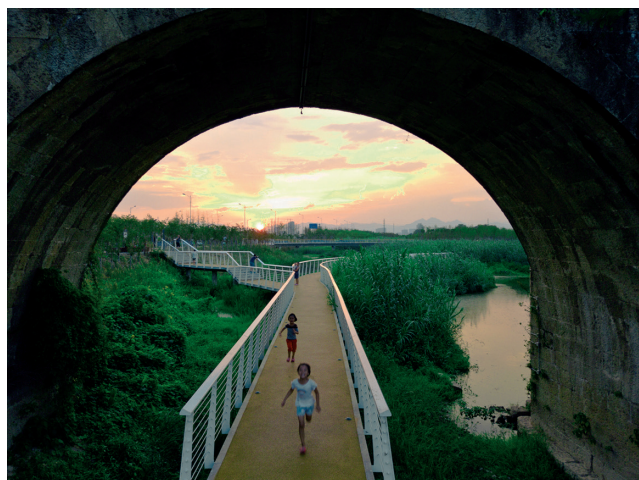
removed the concrete cap of the river bank and recovered the riparian plains, turning them into Green Sponges, which are flood-adaptive and able to catch and remediate the surface overflows from the agricultural fields and runoffs from the surrounding built-up areas. Ecological buffers were designed to divert, slow down, and further clean the river water. By introducing small ecological ponds into the green lands and expanding the width of the water course, the wetland area is increased by 29.4 hm<sup>2</sup>. After the completion of the project, the floodable wetland area reaches 142 hm<sup>2</sup>, accounting for 72.4% of the total site area. Based on the design requirement of an average submergence of 100 cm, the flood storage capacity can reach 1.42 million cubic meters.

### Preserving and Integrating

A 25-km-long bicycling trail system was designed by completely reusing the existing path network on the embankment top to preserve the existing vegetation and save construction costs. All existing vegetation communities along the river, including the Dawn Redwood (*Metasequoia glyptostroboides*) grove at the upper reach of the river, and the Wingnut Trees (*Pterocarya stenoptera*) along the middle and lower reaches, are all well protected



09-2



09-1



10-1

10. 设计在原有引水渠的基础上架设轻巧的钢结构龙骨，铺设防腐木铺装，将其转变为连续的步道。
11. 由堰坝和渡槽改造而成的步行桥成为了步行系统中颇具特色的空间节点。

10. On the basis of the original canals, a lightweight steel keel was erected with anticorrosive wooden pavement, creating a continuous boardwalk.
11. The pedestrian bridges transformed from the aqueducts and dams create unique nodes in the pedestrian system.

and integrated into the new planting design. At the same time, the pedestrian trails were surveyed and mapped on site through GPS. This on-site design method greatly improved the efficiency of design and construction, and ensured the preservation of all valuable elements.

Existing water-conversational heritages and structures, such as aqueducts and water locks, are all well preserved and integrated with the new design in forms of path and platform, recalling the glory past of the river. For example, on the basis of the original canals, a lightweight steel keel was erected with anticorrosive wooden pavement, and a cantilevered viewing platform was built. The whole boardwalk runs through the Dawn Redwood forests, allowing visitors to interact with the beautiful natural landscape. In addition, based on the consideration of safety and structural optimization, the design team transformed part of the aqueducts and dams into pedestrian bridges, giving new function to the heritages and creating unique nodes in the pedestrian system.

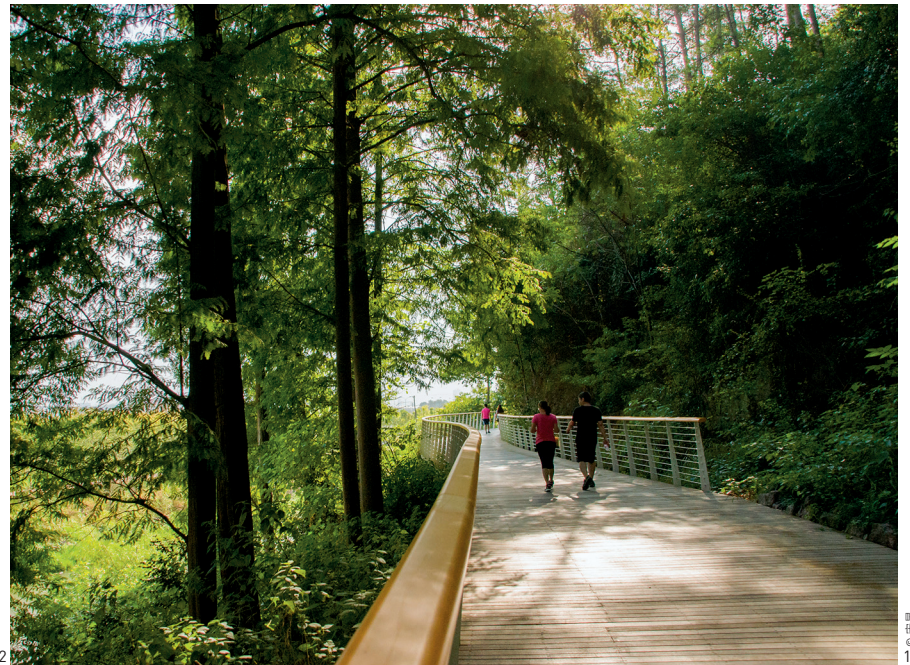
### Connecting and Activating

A network of winding pedestrian and bicycling trails, as well as boardwalks, were built along the river banks, while the bridges being built across the river to connect communities at both sides.

The cultural heritages are activated and connected by the trails in various ways. For example, at an opening of Hushan Bridge, one of the eight scenic spots of Puyangjiang River, is integrated into the trail network, forming a striking contrast and providing the public with a special perspective to view and experience the old bridge. The boardwalks and bridges newly transformed from water conservancy facilities create a unique neo-vernacular landscape. While retaining the imprint of the agricultural age and local collective memories, this transformation encourages the focus on environment and the respect to history, contributing aesthetic and educational values to the site. At the same time, an environmental interpretation system was built along most platforms and gathering places to activate the greenway as a narrator of the natural and cultural stories



10-2



10-3

of the river. Besides, all the hydrophilic platforms and pedestrian trails were made of materials resistant to erosion and corrosion.

### Summary

Three years after the project's completion, the mother river was clean enough for people's recreational activities such as swimming, just as they did when they were kids. The concrete river bank has largely been softened with native vegetation, reintroducing habitats for wild animals including frogs and birds. Continuous pedestrian and bicycling trails allow the nearby residents to jog and ride in the morning and evening or have a leisure weekend for family gathering. The beauty and dignity of the mother river has been restored in a modern and fresh face featured with contemporary landscape design. The corridor now attracts tens of thousands of visitors every day.

The project demonstrates the role that landscape architecture plays in solving



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11-1

complex problems of a site. By working together with various governmental agencies, including water conservancy, environmental protection, agriculture, forestry and culture, Turenscape provided synthesized and effective advice on each decision-making. To deal with the global issue of ecological restoration and historical heritage preservation, the project team

came up with local solutions, offering a new paradigm for similar projects around the world. **LAF**

#### REFERENCE

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11-2