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跨尺度的城市水系生态设计：

昆明滇池水系绿道

Ecologies for an Urban River System across Scales:

Dianchi Greenways in Kunming

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1. 盘龙江南部开发与规划鸟瞰图（滇池附近）
1. Aerial rendering of South Development of Panlong River (near Dianchi Lake)

摘要 ……

本项目对昆明滇池治理问题提出了系统的解决方案，通过建构生态安全格局，将35条流入滇池的河流作为水生生态净化系统和过滤器。整合雨洪利用系统、生物栖息地网络、文化遗产网络，以及自行车和步行绿道，构成一个综合解决城市水环境问题的生态基础设施。项目对绿道系统周边的土地利用进行调整，力求通过解决河流生态恢复、两岸雨污治理、提高土地利用综合效益、增强河流吸引力等问题，实现生态效益、社会效益和经济效益的最大化，还昆明以宁静、美丽、健康和充满活力的母亲河。

关键词 ……

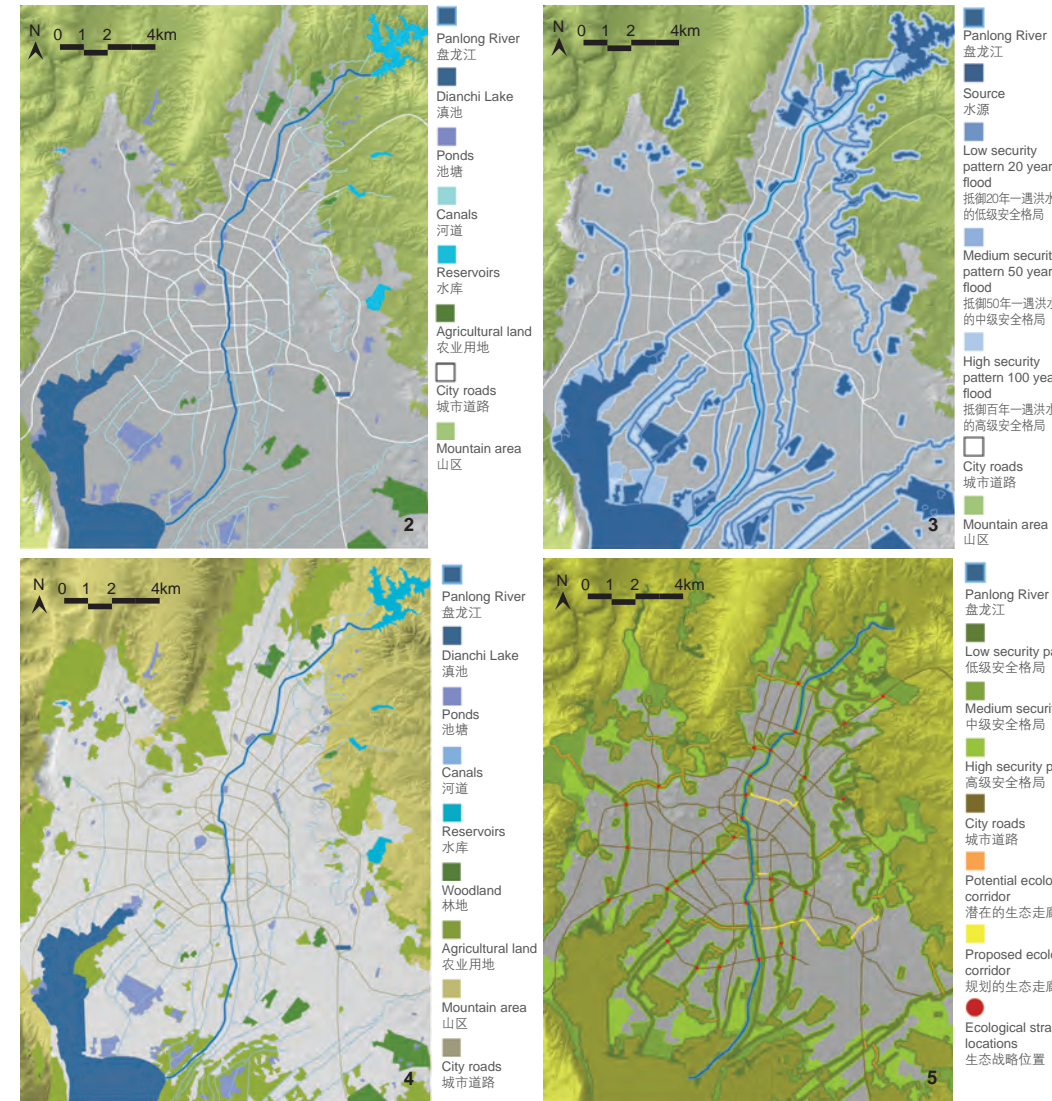
生态安全格局；跨尺度设计；生态恢复；雨洪管理

Abstract ……

The project launches a systematic planning for the Dianchi Lake pollution treatment. An ecological security pattern is set up and 35 rivers flowing into Dianchi Lake are taken as ecological water purification system and filters. The stormwater collection system, bio-habitant network, cultural heritage and greenways for bicycles and pedestrians are integrated as an ecological infrastructure to solve urban water environment problems in a comprehensive way. It adjusts the land use surrounding the greenway system, and attempts to maximize the benefit of ecology, citizens and economics through river ecological restoration, rain sewage management, improvement of land use efficiency. Finally, Panlong River, the mother river of Kunming, would be revitalized to be peaceful, beautiful, healthy and active.

Key words ……

Ecological Security Pattern; Cross-scale Design; Ecological Restoration; Stormwater Management



项目地点：云南省昆明市
项目面积：135hm²
项目委托：昆明市政府
景观设计：北京大学建筑与景观设计学院，北京土人城市规划设计有限公司
首席设计师：俞孔坚
项目团队：孙鹏、贾军、石春、封显俊、肖敬、胡含宇、王云峰、王俊、祁盛、张波、林里、张学年
设计时间：2009年5~12月
建成时间：2010年7月（一期工程）

Location: Kunming, Yunnan
Area: 135 hm²
Client: Kunming Municipal Government
Landscape Architecture: College of Architecture and Landscape Architecture of Peking University, Turenscape Design Institute
Chief Designer: Kongjian YU
Project Team: Peng Sun, Jun Jia, Chun Shi, Xianjun Feng, Min Xiao, Hanyu Hu, Yunfeng Wang, Jun Wang, Sheng Qi, Bo Zhang, Li Lin, Xuenian Zhang
Design Period: May ~ December, 2009
Completion Time: July, 2010 (Phase I)

1 项目背景

中国面临着非常巨大的发展压力，这对环境和社会文化产生了灾难性的影响。河流的渠化现象在整个中国非常普遍，这渐渐使河流失去了它们曾经扮演的文化聚集地和社会中心的作用。在云南的省会昆明，这座城市的“母亲河”盘龙江已经变成了一个硬化（失去自然边界）的景观并俨然成为了城市各区域的下水道。本项目结合新型城市化和城市/农村再认定理念，跨尺度地对景观结构进行了（再）开发。

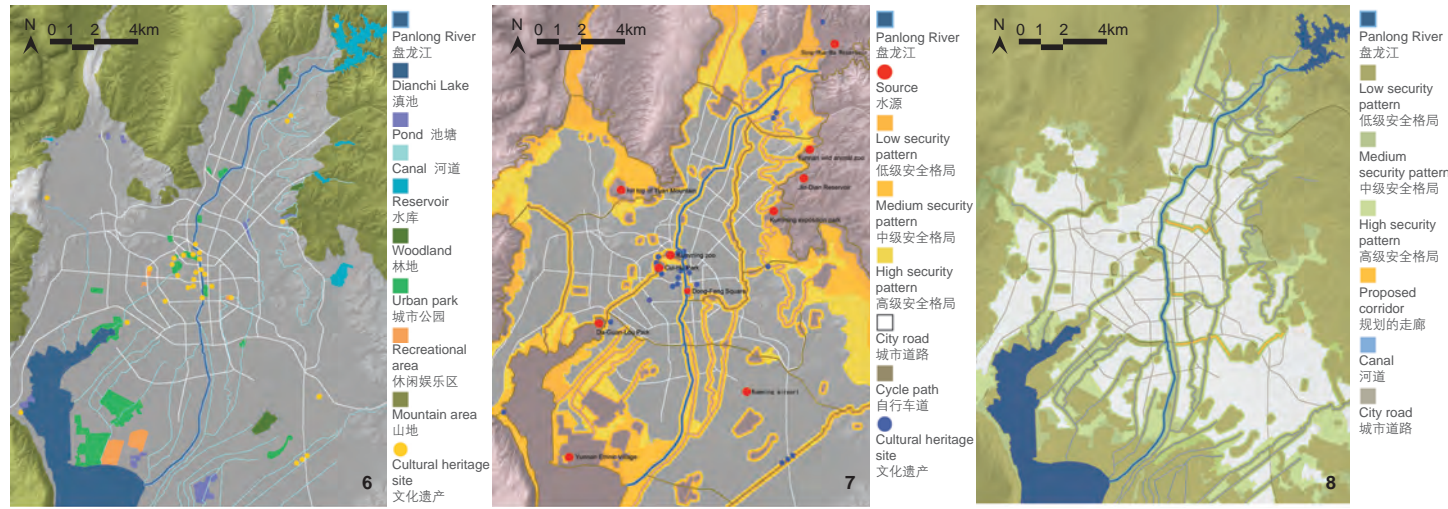
2 项目概况

昆明（拥有570万人口）位于中国西

南部，其地理位置靠近中国与一些东南亚国家的国境线，是云南省第一大城市。它位于海拔1900m的云贵高原上肥沃丰饶的湖泊盆地，周围环绕着湖泊和石灰石山丘。昆明是中国气候条件最温和的城市之一，并以拥有被誉为“高原明珠”的滇池——中国第六大淡水湖而闻名。整座城市及其周边地区是一个巨大的园艺中心，也是亚洲最大的花卉出口基地，并成为了一个不断发展的旅游胜地。优美的景观是这一地区的特质，需要进行良好的保护和土地管理。

盘龙江长23km，贯穿昆明的中心商业区，从北边的松华坝水库直到南边的滇

2. 现有水体和河流系统分析
3. 新的洪水安全格局设计：扩大的水系和新创建的水体形成一个自给自足的供水系统。
4. 现有栖息地分析：生物多样性的适宜性分析被绘制成图，对沿水体和绿色开放空间分布的区域给予特别关注。
5. 新的生物多样性安全格局设计：斑块区域被设计成为一个内部相互连接的绿道网络，对现有水体和开放空间进行严格的保护/保存/净化。
2. Analysis of existing water bodies and stream systems
3. Design of new flood security pattern: The water system is enlarged and new water bodies created to form a self-sustaining water system.
4. Analysis of existing habitats: The suitability for biodiversity was mapped, with particular attention to the areas along water bodies and in the green, open spaces.
5. Design of new biodiversity security pattern: The patchworks are designed to become an inner-connected greenway network, with strict preservation / conservation / purification of existing water bodies and open spaces.



池。在历年的发展和建设过程中，盘龙江狭窄的河道（宽约10~20m）已经被渠化，并且按照百年一遇的防洪标准在河流两岸筑起了具有陡峭斜面的混凝土堤坝——现在只是勉强有些河流的样子罢了。同时，在最近的几十年中，城市以极快的速度发展，城市中的可渗透表面区域不断减少，导致夏季发生洪水的风险持续增加。除此之外，河流的污染程度也在加剧，一方面是因为昆明的下水道网络不健全，许多未经处理的下水道污物被直接排放到这一地区的水道之中；另一方面则是因为河流沿岸存在许多不合理的土地利用方式（包括工业以及仓储用地）。盘龙江曾是昆明的文化和社会中心，尽管仍然保留着许多文化遗产，但几乎都被人们所忽视，需要与“母亲河”重新建立联系。目前，还未建立能够便捷地到达河滨地区的方式，城市景观和水体之间也缺乏自然缓冲带。

3 现存问题和规划目标

盘龙江现存的8大问题包括：内涝、城市整体生态安全、雨污、河流自然功能的丧失、河流文化记忆的丧失、河流与市民生活逐渐疏远、沿江建设用地对河流廊道的侵占、沿江土地利用性质和格局综合

6. 文化遗产分析：通过娱乐系统将历史遗迹与生态走廊，特别是水系统重新连接。
7. 新的文化安全格局设计：新建的生态走廊形成了一个遍布区域的网络。
8. 新建安全格局叠加分析：盘龙江是昆明最大和最重要的集防洪、栖息地和文化遗产格局系统功能于一体的走廊。
9. “昆明之脊”盘龙江的重生：4种空间环境/氛围——北部的农田区、中北部的滨江CBD区、中南部的河滨生活区和南部的农业景观区。
- 10-14. 运用生态技术恢复河道两岸植被。
6. Analysis of cultural heritage: The planning's aim is to re-link historic relics to ecological corridors, particularly water systems, via recreations systems.
7. Design of new cultural security pattern: New ecological corridors are configured to form a network across the territory.
8. Summation of new security patterns: The Panlong River is Kunming's largest and most important corridor integrating flood management, habitat and cultural security pattern systems.
9. Regeneration of the Panlong River as the spine of Kunming: 4 spatial conditions / atmospheres — north as rural farmland; mid-upper as riverfront CBD; mid-lower as living riverfront; south as agricultural landscape.
- 10-14. Using ecological technologies to restore the vegetation on both riversides.





效益低。

针对以上问题，本规划力图将盘龙江改造成为：

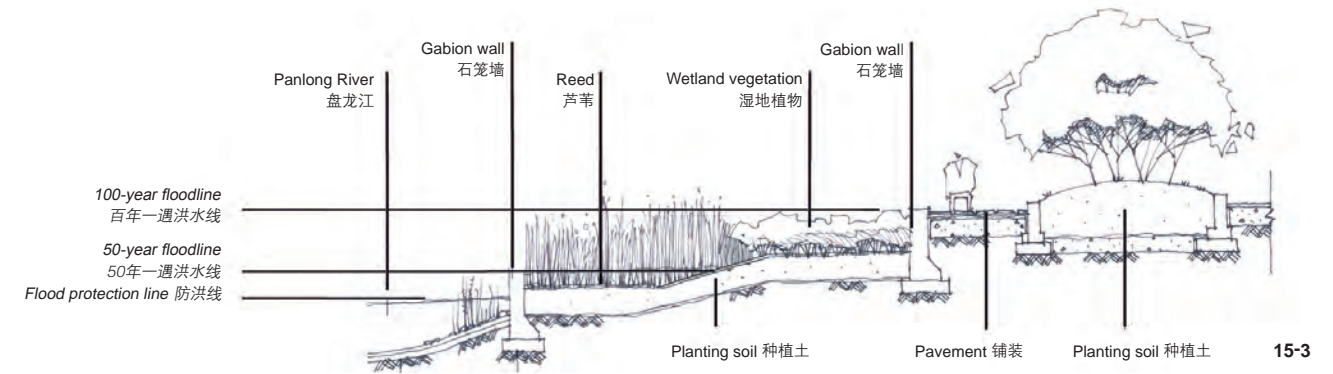
- (1) 一条城市防洪和泄洪的主要流廊道；
- (2) 一条带动城市经济发展、提升城市活力、展示城市文化的重要纽带；
- (3) 一条联系城市与郊野的重要景观廊道；
- (4) 一条维护城市生态安全的主要生态廊道。

4 规划策略和措施

盘龙江复兴项目的总体规划形成于2008~2009年，跨越多个尺度（地区、城



15-1. 北部（临近松华坝水库）发展规划区位图
 15-2. 北部（临近松华坝水库）发展规划鸟瞰图
 15-3. 北部发展规划典型剖面图
 15-1. North development plan (near Songhuaba Reservoir)
 15-2. Aerial rendering of north development plan (near Songhuaba Reservoir)
 15-3. A typical section in north development plan



市和城市区划)以及河滨的实际延伸区域。概括来说，这一项目包括以下4个主要目标：

- (1) 重新改造盘龙江，使其成为缓解城市洪水压力（百年一遇）和净化雨洪的渠道。与此同时，以一种友好且景观/软工程化的方式（需要拆除坚硬的混凝土河堤）使公众到达河滨成为可能。
- (2) 提升盘龙江的环境质量，并以此振兴内城的经济。具体而言，即提升河流沿岸地区房地产自身的土地价值。
- (3) 对盘龙江的上游和下游给予特别关注，这些地区以农田和农业用地为主。显而易见，这一地区正在发生着转变，但是本项目寻求在邻近北部水库和南

部湖区的地区，根据场地内在的景观特质进行建设。

(4) 将盘龙江及邻近地区作为一个能够提高生物多样性的系统，着手进行生态恢复工作（包括在雨季收集水资源，以备旱季所需），以增强自然和文化传统之间的联系，为昆明市乃至整个云南省建造全新的休闲和公共空间。

在地区尺度上，根据先期进行的现状分析进行“生态基础设施”和“安全格局”的开发。生态基础设施意在通过识别和处理基本的自然、生物和文化过程来确保景观的完整性和独特性。生态基础设施包括“防御性措施”（保护受到威胁的生态网络）和“时机性”的干预措施。这些

设施的目的在于恢复、完善和整合遭到破坏的水系网络，使其融入城市肌理。“安全格局”可以划定出自然生态资源，并凸显其不可再生的、基于过程的价值意义。昆明的生态基础设施作为开放空间保护的一种有力途径，着重于三类过程：非生命过程（主要是水资源管理）、生命过程（乡土物种/生物多样性保护）以及文化过程（文化遗产保护和重建）。

自然、文化和社会经济方面的GIS数据为本项目打下了坚实的基础，根据解释性地图所绘制的投影设计制图，被应用于保护景观中三种不同的实践过程。区域尺度上的防洪安全格局通过将自然景观资本化的方式，来寻求替代通常的工程防洪减

灾手段的解决方案，低、中、高级的安全格局分别针对20年一遇、50年一遇和百年一遇的洪水标准进行开发。景观安全格局的建造是为了提供最大程度的保留自然资源的能力。由相互连接的湿地、低地、水道和湖泊所构成的雨洪管理和洪水防护网络，成为了代替混凝土大坝和河堤的有效途径。

生物多样性保护策略建立在土地利用和植被分析地图的基础上，并且结合了基于栖息地和景观生态原理的空间关系进行的栖息地适宜性分析。由此，战略点和重要区域得到确定，并作为互联生态廊道管理和设计的首要考虑对象。在道路和自然廊道的相交点，设计方案采取的干预措施包括供特定野生物种和水流通过的地下通道，以及为动物架设的附加桥梁。文化遗产保护和重建的安全格局也包括在方案之中，这些格局是基于对现存传统场地及其潜在联系的谨慎分析而确定的。

项目在河流本身的尺度上对绵延23km的河道进行了非常细致的分析，并且认识到其具有许多内在特质。鉴于河流的其他部分的致密化趋势和开发的增加，该地区北部和南部的乡村式农业特质需得到尊重和保护。在松华坝水库相邻地区的一项发

展规划中，在除尽可能地保护现有的乡村鱼塘和村庄的同时，建造新的住宅类型与人工湿地和沼泽，以创造出一种新的城市/乡村形态和住宅类型。在滇池的北部地区，现有的村庄也得到了保留，稻田被改造成湿地公园，该公园能够对排放到盘龙江之前已在污水处理厂进行处理的水进行再净化。新的城市开发将完善现有的居住结构，再次创造出传统和现代的结合，以及新的混合用途形态和类型。在河流的中段——特别是穿越昆明市中心商业区的部分——河流被更进一步地打造为一个公园和花园系统，连接文化设施，也为昆明创造出了一个公共走廊和慢行交通系统。盘龙江河道沿岸最大范围的现存形态和类型的改造和调整，将会极大地提升这座城市的生活品质，河堤沿岸的缓坡恢复了市民通往河岸的途径，并令昆明重归盘龙江的怀抱。

5 一项实验项目的实施

项目的一期工程建设是在2009年12月~2010年7月之间进行的，实现了盘龙江下游从官南桥直到滇池湖口长8.3km的河岸恢复。该项目包括运用生态工程技术（活树桩和抛石）进行河堤加固，以增强土壤

结构，并提高其抵御水流侵蚀的能力；运用新的渗透性材料铺设沿河自行车和步行道路；基于水文学的乡土植物种植，以恢复水滨系统；以及在河岸沿线创造新的社交空间而设置木制平台和装置。荒废的河畔被改造成成为具有很高使用率的公共绿色空间，盘龙江再一次作为城市的中脊线回归城市。

最后，对盘龙江，这条昆明的母亲河的恢复工作是重塑这一地区35条河流（滇池的污染源）的一个重要步骤。昆明市长亲自负责监督这一河流项目的进展，并将其他河流分派给每一位副市长负责。LAF

- 16-1. 盘龙江典型河段区位图
 16-2. 位于昆明市中心的盘龙江典型河段开发——改造前原貌
 16-3. 位于昆明市中心的盘龙江典型河段开发——改造愿景
 17. 建成后的位于昆明市中心的盘龙江典型河段
 16-1. Typical riverfront location map of Panlong River
 16-2. Typical riverfront development of Panlong River in the city center of Kunming — before construction
 16-3. Typical riverfront development of Panlong River in the city center of Kunming — vision
 17. Typical riverfront development of Panlong River in the city center of Kunming — after construction



16-1



16-2



16-3



17

1 Background

China faces tremendous development pressure, bringing devastating environmental and socio-cultural consequences. Throughout China, channelized rivers are hardly recognizable as the cultural gathering and social centers they once were. In Kunming, the capital of Yunnan Province, the Panlong River, Kunming's "mother river", has become a hardened landscape with no natural edges and a sewer for parts of the city. This project (re)develops the landscape structure across multiple scales combining with new urbanization and urban / rural requalification.

2 Project Introduction

Kunming, with a population of 5.7 million, bordering several Southeast Asian countries, is the largest city in Yunnan Province of Southwest China. It lies in the fertile lake basin of the Yungui Plateau at 1,900 meters above sea level and is surrounded by lakes

and limestone hills. Kunming is known for having one of the mildest climates in China and for its Dianchi Lake — "the pearl of the plateau" — China's sixth largest fresh water lake. The city and the surrounding region is also an important horticultural center, containing the largest flower export market in Asia, and is a growing tourist destination. Its scenic landscape requires safeguarding and land stewardship.

Kunming's Panlong River stretches 23 km through the city's central business district between the Songhuaba Reservoir in the north and the Dianchi Lake in the south. The river is quite narrow, between 10 ~ 20 meters wide, and over time it has become more and more channelized. It is now embanked with steep concrete slopes to the height of 100-year-flood level. As a whole, it now barely resembles a river. Simultaneously, development has been proceeding at breakneck-speed in Kunming, and as permeable surface areas decrease,

the risk of flooding during the summer months increases. In addition, pollution in the river has increased, due to an incomplete sewer network that causes raw sewage to be discharged directly into the region's waterways and a number of inappropriate industrial land-uses along the riverfront (including industries and warehouses). Panlong River was once the cultural and social center of the city, and while some important relics remain, they are mostly neglected and lack a connection to the "mother river". Currently, there is not convenient access to the riverfront and no vegetative or landscape core between the urban center and the water.

3 Current Conditions and Goals of Planning

The current conditions of the Panlong River can be summarized through eight primary issues of water log, general urban



ecological security, rain sewage, loss of the river's natural function and cultural heritage, separation between the river and citizens' life, encroachment of developed land to the river corridor, and low land use efficiency along the river.

With these issues in mind, this project is expected to:

(1) Transform the Panlong River into a major corridor for urban flood control and discharge;

(2) Create strong local economic development, activate the city, and display the urban culture;

(3) Develop a landscape corridor connecting the city and its suburb;

(4) Establish an ecological corridor to preserve the city's ecological security.

4 Planning Strategy and Approach

The master plan for the Panlong River Rejuvenation Project, which works across multiple scales of the region, city, and district, was developed between 2008 and 2009, and has been implemented for a short stretch of the riverfront. Generally, the project has four major objectives as follows:

(1) To reconfigure the Panlong River into a channel to mitigate 100-year urban floods and purify stormwater, while at the same time, provide public access to the riverfront through landscape based and soft-engineering

practices.

(2) To rejuvenate the economy of the inner city through water based economies and increase land values of the properties immediately adjacent to the riverfront.

(3) To pay particular attention to the upper and lower reaches of the river where farmland and rural land-use is dominant. This territory is in transition, but the project hopes to build upon inherent landscape qualities adjacent to the northern reservoir and the southern lake.

(4) To initiate ecological restoration along the Panlong River and larger region, with the objective to increase habitat biodiversity, including water collection and release in wet and dry seasons. Finally, the project seeks to strengthen linkages between natural and cultural heritage, and to create new spaces for recreational and public use for Kunming and the Yunnan Province.

At a regional scale, "ecological infrastructure" and "security patterns" were developed following analysis of existing conditions. Ecological infrastructure is intended to secure the integrity and identity of the landscape by utilizing natural, biological, and cultural processes. Ecological infrastructure includes both "defensive measures", such as protecting threatened ecological networks, and "opportunistic" interventions to restore, complete, and integrate the damaged water network into the urban fabric. "Security patterns" identify the natural capital of ecology and stresses its non-renewable process-embedded value. The ecological infrastructure for Kunming, as an effective tool for open space conservation, focused on three processes: abiotic (primarily water management), biotic (native species and biodiversity conservation), and cultural (heritage protection and recreation).

The analytical base for the project was developed through natural, cultural, and socio-economic GIS data. Interpretative

maps developed from raw GIS data led to projective design cartographies that were used to safeguard the three different processes in the landscape. Specifically, flood-security patterns at the regional scale sought alternative solutions to standard engineered flood mitigation by capitalizing on assets of the natural landscape and low, medium, and high security patterns were developed for the 20-, 50-, and 100-year floods, respectively. Landscape security patterns were developed to provide maximum water-retention capacity. Stormwater management and flood protection relies on interconnected networks of wetlands, low-lying grounds, waterways, and lakes, providing a sound substitute for concrete dams and riverbanks.

The strategy for biodiversity conservation was built on analytical maps of land use, vegetation patterns, and analysis of habitat suitability based on spatial relationships between habitats and landscape ecology. Strategic points and critical areas were identified as the primary concerns for the management and design of interconnected ecological corridors. At the intersections of roads and natural corridors, interventions included underpasses for wildlife and water and overpasses for animals. Security patterns for cultural heritage and recreation were also included, based on analysis of potential linkages to existing heritage sites.

At the scale of the river, a 23 km transect was analyzed and recognized to have a number of inherent qualities. The north and south ends of this area are presently considered rural, agricultural areas, a quality that needs to be respected as densification and development increase along other parts of the river. In a development plan for the area adjacent to the Songhuaba Reservoir, new housing typologies were developed next to constructed wetlands and swales (while protecting as many existing rural fish

ponds and villages as possible) to create a new urban/rural morphology and housing typologies. In the area just north of Dianchi Lake existing villages were also maintained, with rice fields converted into a wetland park that purifies water from a nearby sewage treatment plant before it is released into the Panlong River. New urban development would complement the existing settlement structure, re-creating a marriage of tradition and modernity, and a host of new mixed-use morphologies and typologies. In the central stretch of the river, particularly through the central business district of Kunming, the river has been upgraded and developed into a system of parks and gardens with links to cultural amenities, public promenades, and low-speed traffic. Modification and adjustment of the existing morphologies and typologies along the greatest length of the river's trajectory would significantly change the quality of life in the city, and shallow slopes along the banks would give citizens access to the river once again, bringing the Kunming back to the Panlong River.

5 Implementation of Pilot Project

Phase I of the project was constructed

between December 2009 and July 2010 along 8.3 km of the river, from the Guannan Bridge to the mouth of the Dianchi Lake. The project included riverbank stabilization using live-staking and riprap to strengthen the structure of the soil and provide added resistance to erosive water flows, new porous bicycle and pedestrian trails, native hydrology-based planting to restore the riparian system, and wooden platforms and furniture to create new social spaces along the riverfront. The dilapidated riverside has been transformed into a usable public green space and the river has once again been returned to the city as the central spine.

Recovery of the Panlong River, as the mother river of Kunming, is an important step for the restoration of the region's 35 rivers, the source of Dianchi Lake's pollution. The mayor of Kunming has undertaken the responsibility of supervising the river projects, and has assigned responsibility to overseeing the recovery of additional waterways to deputy mayors. **LAF**

18-20. 将河流生态恢复与自行车使用和休憩功能相结合, 形成绿道系统。

18-20. Combining the river ecological restoration with cycling use and leisure and recreation functions to form a greenway system.

