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城市湿地建设的战略性途径：
自然保护、工程与景观设计的融合

Strategic Approaches to Urban Wetlands:
Reconciling Nature Conservation, Engineering and Landscape Architecture

摘要 ……

湿地是世界上最具生产力，同时也是最为濒危的生态系统之一。城市化是湿地面临的一项主要威胁。在城市环境中，与湿地相伴而生的是与水相关的疾病、洪水、污染以及恶劣的生活环境，这样的状况已持续了相当长的一段时间。

自20世纪末，人们对待湿地的态度发生了根本性的转变；《拉姆萨尔湿地公约》的提出强调了湿地在自然保护方面的诸多积极的价值，并且推动了湿地管理新概念的产生以消减其健康隐患。同时，工程学大力倡导人工湿地和生物过滤池能够有效地吸收并净化来自雨洪径流、废水，以及受污河流中的污染物这一理念。景观设计将具有审美与娱乐价值的城市湿地公园与生态和技术要素整合在一起，发展出了更为出色的理念，展示出在城市环境中，湿地恢复与建造这一综合性的战略途径所具有的巨大潜力。本文呈现了有关城市湿地的不同观点，并且对相应的案例如何在城市生态系统中发挥重要作用进行了讨论。

关键词 ……

整合设计；景观基础设施；生态系统绩效；生态工程；人工湿地；水资源综合管理

Abstract ...

Wetlands are at the same time among the most productive and the most threatened ecosystems of the world. One of the major threats for wetlands is urbanization. In the urban context there is a long history of associating wetlands with a number of water-related diseases, floods, pollution and poor living conditions.

Since the end of the 20th century, there has been a paradigm shift in the attitude towards wetlands: the *Ramsar Convention on Wetlands* has promoted the importance of new concepts of wetland management in order to reduce health hazards by highlighting the many positive wetland values from the perspective of nature conservation. At the same time, engineering has broadly introduced the concept of constructed wetlands and biofilters as a way of effectively trapping and removing the pollution from stormwater run-off, wastewater and polluted river water. Linking the ecological and technical dimensions and integrating them with the high aesthetic and recreational value of urban wetland parks, landscape architecture has developed fascinating concepts demonstrating the high potential of an integrated strategic approach to the recovery and creation of wetlands in the urban context. This paper brings together these different perspectives on urban wetlands and argues by discussing different case-studies how wetlands can take a prominent role in urban ecosystems.

Key words ...

Integrated Design; Landscape Infrastructure; Ecosystem Performance; Ecological Engineering; Constructed Wetland; Integrated Water Management

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前言

从历史角度而言，在文化与城市景观中，耕作及城市化的格局与当地的流域脉络紧密关联。人类的生存与“临水而居”的思想交织在一起，造就了城市化格局与其水文环境的密不可分。然而，步入20世纪，现代经济增长与日趋精良的技术，使得人类能够突破自然环境带来的制约。水资源管理与控制的技术性基础设施已将城市土地利用从流域脉络的束缚中解放出来。今天，人类的生存依赖于集中布局的基础设施，在这些基础设施的保障之下，城市能够免受洪水侵犯，雨水被尽快排走，与此同时，饮用水的运输距离也在不断增加。人类为了控制自然水资源，已建造出越来越复杂的，高成本、高维护、高能耗的基础设施体系[1]。由于人类对水文环境的人为操纵和对水资源的过度使用，诸如洪水、地下水水位下降，以及饮用水污染这些人为灾害事件猛烈频发。在城市领域中，水资源管理所面临的挑战已迫在眉睫。生活用水、工业用水以及公

Introduction

Historically the cultivation and urbanization patterns of cultural and urban landscapes were inseparably linked to the logics of their watershed. The human survival was closely related to “living with water” in a way which tied urbanization patterns closely to the underlying hydrological conditions. However in modern times economic growth combined with more and more refined technologies in the 20th century, enabled humans to overcome the restrictions of natural environments. Technical infrastructures for water management and water control have disconnected urban land-use from the logics of the watershed. Today human survival depends on the centrally organized infrastructures that protect the city from flood and take out rain water as fast as possible while at the same time transporting drinking water for ever increasing distances. The human efforts to control the natural element of water has led to ever more complex infrastructure systems that are high in cost, maintenance and energy consumption.[1] Due to this human manipulation of hydrologic conditions and an overuse of water resources, humanitarian risks like floods, aquifer drawdown or drinking water contamination have radically increased. In the urban sphere the challenges of water management peak. The domestic, industrial and public use of water generates enormous rates of water consumption and accordingly loads of wastewater and water pollution. At the same time the highest demands for water safety and hygiene are in the cities. Furthermore the biggest rainwater discharges are generated in urban areas due to surface sealing and cutbacks of retention areas. Due to the enormous speed and scale of worldwide urbanization processes many cities face huge challenges concerning the affordability and functioning of centralized water infrastructure as a precondition for human survival. Therefore new approaches to reconciling the logics of the hydrological conditions and sustainable urban development are urgently needed.

Wetlands have always been one of the most challenging environments for humans to deal with. Therefore major attempts were taken to drain and fill the wetlands in order to either create farmland or to develop land for housing and industrial use. Altered water regimes due to human impact cause the still remaining wetlands to be among the most degraded ecosystems, greatly affecting the well-being of people and ecological biodiversity.

The challenges of modern urbanization trends and increasing environmental risks require to link different forms of planning, design and operation of water management infrastructures with the broader concepts of green cities and smart growth.[2] In order to achieve that, various stakeholders and professional disciplines need to combine their knowledge and concepts in order to develop integrated concepts. Relating to the relationship of wetlands and sustainable urban development, different arguments, strategic approaches and projects have been put forward by the three disciplines of nature conservation, water engineering and landscape architecture. Their different frameworks and methods need to be acknowledged in order to find a way of bridging their different views and methods towards an integrated approach to the conservation and new development of urban wetlands.

The Nature Conservation Approach: Wetland Protection and Restoration

The nature conservation movement originates from efforts to protect existing natural monuments, landscapes and habitats from human damage and alteration. Since its origins, the situation changed dramatically and in many parts of the world there is hardly any primary nature left that could be protected. Today nature conservation is active on political, economic and public levels, engaging in policy making, legislation and environmental education. The mechanisms and instruments of nature conservation today are the predominant legal tools for the preservation of nature, landscapes and the functional capacities of ecosystems.

As wetlands within the 20th century became one of the most threatened ecosystems in the world, the *Ramsar Convention on Wetlands* was signed in 1971, being the first modern international treaty aimed at conserving natural resources. Its aims are the “wise use” of wetlands through “the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable

共用水消耗了大量用水，并产生了许多的废水以及水污染问题。与此同时，对于水的安全和卫生要求最高的也是城市。此外，由于城市地面的不透水性与蓄水区的减少，城市成为了雨水排放量最大的地区。随着全球城市化的飞速与大规模发展，许多城市都面临着巨大的挑战，这种挑战来自于与人类生存息息相关的集中式水资源基础设施的负荷与运作能力。因此，人类迫切需要能够调和水文环境脉络与城市可持续发展的新方法。

一直以来，湿地都是人类需要应对的最具挑战性的环境之一。过去，人们主要试图通过排干与填埋湿地来创造农田，或将其开发为居住及工业用地。受人类影响而改变的水文环境使得残存的湿地成为了退化最为严重的生态系统，这对人类福祉与生态多样性产生了巨大影响。

现代城市化的趋势与日益增多的环境灾害所带来的挑战要求水资源管理基础设施的规划、设计与运营以不同形式与更广泛的绿色城市、精明增长的理念相结合。[2]为了实现这一目标，不同的利益相关方与专业学科需要对各自的知识与理念进行整合，从而发展出综合化的理念。就湿地与可持续城市发展之间的关系而言，自然保护、水利工程，以及景观设计这三大学科已经提出了众多与之相关的论点、策略以及实践。我们需要梳理各学科构架与方法的相异之处，以便找到一条可以将这些不同的观点与方法综合起来，并对城市湿地进行保护和开发的途径。

自然保护途径：湿地保护与修复

自然保护运动源于保护现存的自然遗迹、景观和栖息地免遭人类的毁坏与改造。从这一运动发起至今，自然环境已经发生了翻天覆地的变化，世界上可以用来保护的原始自然已所剩无几。今天，自然保护成为了政治、经济与公众各个层面常被谈及的话题，并已渗透到决策、立法，以及环境教育中。自然保护的机制与立法是当今自然、景观与生态系统功能保护的主要法律手段。

20世纪，湿地成为了世界上最为濒危的生态系统之一。1971年签订的《拉姆萨尔湿地公约》成为旨在保护自然资源的第一个现代国际公约。该公约的目标是“在可持续发展的背景下，通过实施生态系统途径来维持湿地的生态特征”，以实现对湿地的“明智利用”。[3]到目前为止，记录在国际性重要湿地名单中的湿地已达2 143处，总面积达205 530 026hm²。

在地方层面，划定保护区域是自然保护方法中的主要实施措施。因此，就城市湿地而言，其目标是保护和修复那些城市地区中“幸免于难”的自然湿地碎片。显然，这些保护区域与人类经济利益之间存在着巨大的潜在冲突。因此，在城市背景下，自然保护的经济—社会范畴被予以了重点关注，整体环境改善、污染防治、教育与市民休闲娱乐等都成为了人们努力去提升的方面。城市栖息地与其自然状态相比通常已经退化。城市湿地的集水区往往遭到了破坏，或是与周边水文环境相割裂。由于这些湿地成为了城市中的孤岛且面积日益缩减，它们的自我净化能力无法应对不断增加的营养流入，从而导致了生物贫瘠化。补救措施与修复工作旨在改变这种不稳定的状态，使得城市生态系统变得足够稳健以应对集约利用带来的影响，从而使湿地栖息地在城市地区中推广开来。重建湿地自我稳定性的关键在于沿岸浅滩的恢复，因为其能够吸收大量沉积物以及营养物，并为因生态多样性的提升而日渐增多的动植物提供食物与栖息地。[4]

案例研究：秘鲁利马市潘塔洛山庄

潘塔洛山庄湿地自然保护区位于秘鲁的超大都市利马的乔里约斯区，它展示了城市自然保护途径所面对的具体挑战。这一保护区被扩张的工业区、旅游度假区以及非正式居住区所蚕食。其南侧为太平洋海域。该地区拥有超过250hm²的受保护的淡水沼泽，是位于亚热带沿海地区中的一个重要的野生动物保护区。这里不但是迁徙鸟类的主要休憩点，也是本地动植物的栖息地。场地的保护与房地产开发商、非正规居住者的利益发生了冲突。这片土地的保护承受了巨大的压力，以至于秘鲁前总统阿尔

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其进行保护。士兵们沿保护地架起了铁丝网，军队充当起了公园护林员的角色。1995年，有超过70hm²的湿地处于法律纠纷中，由公园服务部门和环保组织组成的一方，与已经侵占或意图侵占该地区的居住者、开发商形成了对峙。在湿地的边缘地带，非法的垃圾填埋与倾倒污染了水源。地下水位受到影响，来自附近社区的交通、生活以及工业污水也都汇入了这片湿地之中。

2001年，政府部门Prohvilla成立，主要负责领导保护地的技术与行政工作。Prohvilla与众多公共、私人机构结成联盟，共同合作。学术研究机构

development".[3] So far 2,143 wetland sites have been registered in the list of wetlands of international importance with a total surface area of 205,530,026 hectares.

On the local level, the primary implementing measures of the nature conservation approach is the designation of protected areas. So in terms of urban wetlands this approach aims to protect and restore the remaining fragments of natural wetlands within urban areas. Obviously there is high potential for conflict between conservation objectives and human economic interests. Therefore in the urban context the eco-social scope of nature conservation is emphasized, extending the efforts on general environmental quality, pollution prevention, education and public recreation. Urban habitats are usually degraded compared with their natural state. Urban wetlands often have disrupted watersheds and may be hydrologically isolated. Due to insularity and diminished dimensions, their self-purification capacities cannot keep up with the increased nutrient inflows and results in a biological impoverishment. Remedial action and restoration efforts address destabilizing conditions to make the urban ecosystems robust enough to sustain the impact of intensive use, for wetland habitats are popular in urban areas. Key for the re-establishment of the self-stabilizing qualities of wetlands are the shallow littoral zones that act as a sediment and nutrient traps and simultaneously provide food and habitat for enhanced biodiversity.[4]

Case Study: Pantanos de Villa, Lima, Peru

The wetland nature reserve Pantanos de Villa, located in the Chorillos district of the megacity Lima, Peru, displays the challenges of the urban nature conservation approach in greater detail. The reserve is encroached by the expansion of industrial areas, tourist resorts and informal housing areas. To the south it is hedged by the Pacific Ocean. With more than 250 hectares of protected fresh-water marsh, the area is an important wildlife sanctuary in the subtropical costal desert. It is a prominent resting spot for migratory birds and habitat for indigenous species of flora and fauna. The conservation of the site struggles with the siege of real-estate developers and informal settlements. The pressure on the reserve is so severe that the former President Alberto Fujimori issued a decree in 1991 ordering the army to protect it. Soldiers put a wire fence around the reserve, and troops acted as park rangers. In 1995, more than 70 hectares of the wetland were in litigation, with the park service and environmental groups on one side and residents and business that have encroached or would like to do so on the other. At the edges of the wetland illegal landfill and garbage dumping contaminates the waters. The groundwater level is affected and traffic, domestic and industrial effluents are flowing into the wetlands from its nearby neighborhoods.

In 2001 the municipal authority Prohvilla was created to lead the technical and administrative

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1. 潘塔洛山庄自然保护地位于超大城市利马市。© Antje Stokman
2. 污染与城市发展为湿地带来了巨大的压力。© Antje Stokman
1. The nature reserve Pantanos de Villa is located right in the megacity of Lima. © Antje Stokman
2. Pollution and urban developement put enormous pressure on the wetland. © Antje Stokman

也参与到自然保护地修复与监测措施的调查及理念的探讨中。由于防护举措牵涉到自然保护与公众利益之间的对立，除了基于修复、保护以及限制使用的惯用途径之外，这一行动策略将环境政策的编制、生态旅游开发、积极的公众参与以及环境教育也纳入其中。除此之外，通过新型的生产利用与本地生态多样性的管理，一种自然保护的新方法开始实施。联合国贸易与发展会议发起的“生物贸易倡议”，倡导“在环境、社会与经济可持续发展的准则下”，积极“促进与本土生物多样性的商品和服务的收集、运输以及商品化相关的各种活动”[5]。例如“Ecofibra”（www.ecofibraperu.com）这一合作组织，培训并雇佣当地居民在城市湿地的划定区域中种植并收获本土的湿地植物，用来制作精巧的家具、装饰物以及首饰等产品。由此产生了一种“将利用作为保护”的新形式，有利于在本地社区、消费者与湿地生态系统之间构建起新的联系。

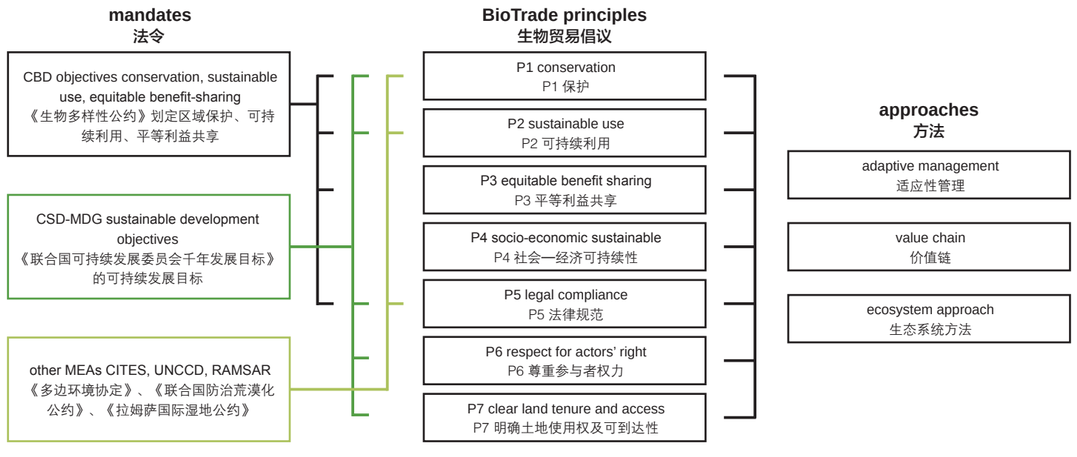
生态工程途径：人工湿地与生物过滤池

千百年来，自然湿地源源不断地为人类提供着洁净的水源。基于对沼泽植物净化水质的能力的研究，第一个为处理废水而设计的人工湿地于20世纪70年代诞生。如今，通过人工湿地系统来净化污水的专业知识与工程技术已经非常成熟。生态工程师已将这一概念传播到全球各地。人工湿地与生物过滤池是一种吸收和净化来自雨水径流、废水以及被污染的河流中的污染物的有效途径，这一点已得到广泛认可。针对各种具体用途的越来越精良的处理系统不断涌现。

人工湿地可以被认为是污水处理的次级步骤，这意味着污水需要在水池或者分离器中先进行预处理，以除去固体悬浮物及较大的颗粒物。人工湿地应用最为普遍的结构作法主要为开挖深度在0.6~1.0m左右的坑池，这些结构作为湿地的衬底以确保未经处理的污水不会渗透到地下水中。洼地中填满的碎石、泥沙、土壤以及复合材料构成植物生长的基质。上部种植芦苇（*Phragmites australis*）与

3. Ecofibra合作组织旨在通过可持续和参与性的价值创造来实现对于湿地的管理。© Cooperativa Ecofibra
3. The project Ecofibra aims on wetland management via sustainable and participatory value creation. © Cooperativa Ecofibra

表1 联合国贸易与发展会议生物贸易倡议的原则与方法（2007）
Table 1 Principles and Approaches of the Biotrade Initiative According to UNCTAD (2007)



conservation efforts. Prohvilla forged alliances with many public and private actors to operate jointly and cooperate. The problem investigation and the concept development for restoration and monitoring measures is accompanied by academic research institutions. As fencing implicates an opposition of nature conservation and the general public, besides classical approaches based on the restoration, protection and restricted use, the action strategy implies the support of environmental policy making, eco-tourism, active public participation and environmental education. Beyond that a new approach of nature conservation through new forms of productive use and management of local biodiversity has been implemented. The *BioTrade* initiative, launched under the umbrella of the United Nations Conference on Trade and Development (UNCTAD), actively promotes “different activities relating to the collection, transformation and commercialization of goods and services derived from native biodiversity under the criteria of environmental, social and economic sustainability”[5]. Cooperatives like the “Cooperativa EcoFibra” (www.ecofibraperu.com) train and employ local citizens to grow and harvest local wetland species in designated parts of the urban wetlands for the skillful production of furniture, decoration objects and jewelry. This enables a new form of “Conservation through Use” that helps to establish new links between local communities, consumers and wetland ecosystems.

The Ecological Engineering Approach: Constructed Wetlands and Biofilters

Natural wetlands have served humans for centuries to provide clean water. Research on the capacity of marsh plants to purify water led to the first deliberately engineered wetlands for wastewater treatment in the 1970s. By now the knowledge and engineering expertise for purifying polluted waters by artificially created wetland systems has become quite sophisticated. Ecological engineers have broadly introduced the concept all around the globe. It is now recognized, that constructed wetlands and biofilters are an effective way of trapping and removing pollution from stormwater run-off, wastewater and polluted river water. More and more refined treatment systems are emerging for all kinds of specific applications.

Constructed wetlands can be considered secondary treatment steps, meaning that the effluent needs to be pre-treated in ponds or separators to remove suspended solids and larger particles. The most commonly applied constructions consist essentially of excavations of about 0.6 ~ 1.0 m in depth, which are lined to ensure untreated effluent cannot percolate into the groundwater. The basins get filled with gravel, sand, soil or composit media as substrate for plant growth. Marsh plants like *Phragmites australis*, *Typha latifolia* and others are planted on top with their extensive root and rhizome systems penetrating the constructed beds. The polluted water to be treated gets distributed via pipes either surface or sub-surface on the bed and filtrates through the substrate either vertically or horizontally. Besides filtration and sedimentation, the major cleaning effect is actually performed by micro-organisms living in the medium and root zone of the wetland system. The bacteria draw responsible for the decomposition of organic compounds and are particularly important for the removal of carbonaceous, nitrogenous and phosphatic contaminants. The aquatic plants in the system with their rhizomes are essential to generate an oxygen enrichment to allow for an alternation of aerobic and anaerobic microbial populations.[6] This principle works with consistent performance even in temperate climates in winter, when there is no metabolism of the plants involved.

On the far side the clean water is being collected and discharged off the bed. If built in sloping terrain, gravity flow and natural processes do all the work. No power is required and the use of mechanical equipment is almost eliminated. Operational and maintenance requirements include water level and flow control, weed control just as periodic monitoring of water quality by certain parameters. Compared to conventional treatment plants, however, constructed wetlands are robust technology with low operational costs. Higher investment costs for more space needed compared to highly technical treatment technologies will be repaid by lower maintenance and running costs in a relatively short period of time (up to 10% ~ 50% cheaper than conventional systems).[7]

宽叶香蒲（*Typha latifolia*），以及其他一些湿地植物，其发达的根茎系统可扎根于人工床体中。需要处理的污水通过管道输送到人工床的表层或者潜层，通过垂直或水平方向上的基质进行过滤。除了过滤与沉淀过程，主要的净化工作实际上是由生活在湿地系统中的基质与根系中的微生物来完成。这些细菌负责分解有机化合物，并在去除含碳、氮以及磷的污染物方面发挥着重要的作用。系统中的那些具有根状茎的水生植物是形成富氧环境的必不可少的要素，这样的环境有利于喜氧与厌氧微生物种群的相互转换[6]。即便是在冬天的气温条件下，当植物的新陈代谢停止时，这一系统依旧能够保持一贯的绩效。

最终，经过处理的水汇集到一起被排出人工床。如果这一系统建立在具有坡度的地形上，那么可以利用重力和自然过程来完成这些步骤。这既不需要利用能源，也无需依靠任何设备。操作与维护的要求包括通过特定参数定期检测水质，从而做到调节水位与流量，以及控制杂草。相比传统的污水处理设施，人工湿地拥有强大的技术支持，且运营成本低廉。与技术性难度较高的处理技术相比，人工湿地建设所需的更大的空间会产生较高的投入成本，但更低廉的维护与运营费用能在相对较短的时间内对此进行弥补（与传统的系统相比，新系统能够使总费用降低10%~15%）[7]。

案例研究：中国上海华新人工湿地

华新镇位于上海周边地区，这里地处长江河口地带且人口稠密。无数的水道沟渠在建成区域中纵横交错，成为了这片居住土地的显著特色。这些水体几乎都拥有水泥河床与硬质堤岸，水生植被根本无法在此生长。大部分的城市污水在未得到处理的情况下被直接排放到这些水体中。因此，这些沟渠与汇流的河流受到严重的污染，同时也对附近居民的健康造成了威胁。市政府已经计划在邻近的公园内建立一个技术性的污水处理厂，并且打算掩埋道路两旁所有的小水渠，将它们转化成一个将水流输送至污水处理厂的地下排水系统。这意味着人们将会失去大量的绿色开放空间。工程师们就此提出了另外一个方案：通过重新利用现有的水渠，将之转化为线性的、易于操作与维护的污水净化湿地，从而替代之前提及的污水处理厂。工程师们设法说服了政府批准实施他们的计划。因此，在2003年，德国Janisch & Schulz工程公司与上海典辰工程管理有限公司在短短4个月的时间内就建立起一个污水日处理量达80m^{3}的湿地处理系统。垂直流系统的应用能够很容易地将排放的废水水质维持在法律规定的标准之内。这一得到重新利用的基础设施成为了城市开放空间体系的重要组成部分。同时，处理后的水流通过一个采用该净水系统的喷泉作为“成果展示”，该系统中的各种相互关系也被可视化地表现出来——以帮助市民理解污水处理的过程，使他们意识到富有成效且具有实际意义的湿地是其生活环境中的组成部分。

景观设计途径：湿地公园与环境教育

由于项目委托方与公众认识上的不足，景观设计往往被视作一个仅从美学角度出发，塑造优美的绿色空间的行业。许多景观设计师也习以为常，主要扮演着户外设施设计者的角色。他们大都受过观赏植被应用方面的训练，却对乡土植物群落以及复杂的生态系统知之甚少。诸如雨洪管理、城市生态

Case Study: Constructed Wetland Huaxin, Shanghai, China

Huaxin is located in the densely populated Yangtze estuary of the greater Shanghai area. The settlements are characterized by countless ditches and canals permeating the built environment. The water bodies have mostly concrete beds and fortified embankments, that do not allow aquatic vegetation to grow. The major part of the effluents of the city does not get treated and is discharged directly to the receiving waters. Therefore the water of the canals and receiving rivers is severely polluted which also causes a health threat to the adjacent population. The municipality had been planning to construct a technical wastewater treatment plant within a nearby park and to cover up all the small canals next to the roads, converting them to an underground drainage system leading the water to the plant. This would have meant a significant loss of open and green space. The engineers suggested another plan: to reuse the existing water canals by converting them into linear treatment wetlands that can replace the water treatment plant and are easy to operate and maintain. They managed to convince the municipality which gave permission to implement their plan. So in 2003 the engineering company Janisch & Schulz mbH Gambach, Germany together with Shanghai Decent Engineering Management Co., Ltd. constructed a wetland treatment system with a capacity of 80 cubic meters a day within only four months. The applied vertical flow system could easily stay below the legal limits for wastewater standards. This way the territory of infrastructure was reclaimed as a significant part of the city's open space system. At the same time, the interrelations of the system were kept visible by highlighting the purified water outflow through the installation of a fountain with clean water — for the citizens to understand the processes within this not only effective but also meaningful wetland as part of their living environment.

The Landscape Architecture Approach: Wetland Parks and Environmental Education

The profession of landscape architecture is often reduced by clients and the general public to its artistic approach in shaping beautiful green spaces. Many landscape architects are customarily working to fulfill this role and primarily operate as designers of outdoor facilities. They have mostly been trained in the use of ornamental plants and only very limited understanding of native plant communities and complex ecological systems. Environmental issues such as stormwater management, urban ecology and resource efficiency are often neglected and landscape architect often enter projects at a late stage in order to beautify an already defined project. However, there is a growing awareness within the profession, that landscape architects need to move beyond their role as mere “decorators” and need to get involved in the early, conceptual stages of urban development projects on different scales. By targeting an ecological urbanism perspective that links ecological sustainability with social justice and the pursuit of sustainable livelihoods, landscape architects are beginning to be perceived as important contributors to urban development on equal ground with other professions.

Concerning the design of urban wetlands, landscape architects needs to have a broad educational background bridging knowledge of natural sciences, engineering and architecture design. As the understanding of the ecology of a wetland, their role in storm water management and

4. 人工湿地建设之前未经处理的污水 © Jörg Janisch
5. 湿地的建设仅花费了4个月 © Jörg Janisch
6. 人工湿地将水处理系统转化为了城市绿色空间。© Jörg Janisch

4. Existing situation with untreated effluents before construction. © Jörg Janisch
5. The construction works for the wetland took only four months. © Jörg Janisch
6. The constructed wetland transforms the water treatment system to a part of the city's green space. © Jörg Janisch

环境以及资源有效利用这样的环境问题往往会被人们忽视，景观设计师常常是在项目最后的美化阶段才参与进来。然而，在这个行业领域中，有一种意识正在觉醒，这就是景观设计师需要超越他们作为“装饰者”的角色，应该介入到不同尺度的城市发展项目中的最初概念阶段。通过以生态都市主义的视角将生态可持续性与社会公平，以及对可持续生活方式的追求连接在一起，景观设计开始与其他专业一样，被视为城市发展的重要贡献力量。

论及对城市湿地的设计，景观设计师需要具备能够贯通自然科学、工程和建筑设计等学科的广泛的教育背景。出于对湿地生态方面的理解，景观设计师在雨洪管理、水体净化，以及对于城市景观的审美贡献中所扮演的角色已超越其他专业，成为前沿领域的探索者。景观设计师开始在湿地设计与规划中发挥愈发举足轻重的作用[8]。城市湿地的设计目标是为了使之具有更高的生态稳定性，并利用这些湿地的自然生态系统绩效来实现城市的基础设施功能，这就要求城市湿地受到较少的干预和技术控制，同时提供富有吸引力的景观体验。在这种情况下，对于一个成功的项目而言，社会效益如何在政治家与普通大众中进行传达与理解变得越来越重要——这是一个需要在项目的设计、汇报以及视觉交流中解决的问题。

在这个意义上，景观设计所采用的方式是将分析和逻辑思考与直观和创造性思考结合起来，并且在不同的尺度上（包括结构、组织与财政框架、自然与社会经济的动态过程、要素与功能）展示对于景观的综合解读。设计过程同时也是一个对适合当地的可持续景观格局的理解过程。这种理解改变了城市景观的范式：从一种在社会能够承受的美化、工程或生态的代价范围内实现的景观，转变为一种结合了不同功能效益的城市绿色基础设施中不可或缺的组成部分的景观[9]。

案例研究：中国哈尔滨群力雨洪公园

位于中国北方城市哈尔滨东部郊区的群力新区规划始于2006年。在规划的最后阶段，预计将会有超过30万人居住在这片2 733hm²的土地上。总体规划中，16%的发展用地被设计为（透水）绿地。2009年，土人设计受到委托为新区中心设计一个公园。场地原为一片占地面积34hm²的受保护的区域湿地，其四周被道路与高密度的城市开发所环绕，湿地面临着水源枯竭的威胁。设计师俞孔坚与他的团队超越了原本只是保护湿地的目标而提出了更加综合的设计方案：将场地转化为一个能够提供多样化的协同效益的城市雨洪公园。

公园被设计为一块“绿色的海绵”，从周边新建的城市环境中收集雨水径流，将城市水网与被切断的水文地形重新连接在一起。雨水在沿着公园的边缘地带而设的人工池塘与湿地中得到吸纳、储存、过滤与净化，并最终被排放到中央湿地中。这一过程降低了洪水与内涝的灾害风险，同时回补了地下水。场地中心现有的湿地被单独保留下来，从而使自然栖息地得以持续演化。外围的山丘与池

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7. 群力雨洪公园的设计形成了调和城市与自然的缓冲带 © Kongjian Yu
8. 高架平台提供了可以远眺的视角。雨水径流在公园中得到收集和净化，并滋养了中央的湿地。© Kongjian Yu
7. The design of Qunli Stormwater Park provides a buffer zone, conciliating between urban and natural. © Kongjian Yu
8. The skywalk provides a gaze into the distance. Rainwater runoff gets collected and cleansed in the park and nourishes the central wetlands. © Kongjian Yu

water purification as well as their aesthetic contributions to the urban landscape come to the forefront within the different professions, landscape architects start to play an increasingly greater and more important role in wetland design and planning. The aim for designing urban wetlands is to enable a higher degree of ecological stability and making use of their natural ecosystem performance for urban infrastructure functions which require less intervention and technical control while still offering attractive landscape experiences. In that context it becomes increasingly important for the success of a project how the societal benefits are communicated and understood by politicians and the general public — an issue to be addressed in the design, presentation and visual communication of a project.

Landscape architecture in this sense applies methods combining both analytical and logical thinking with intuitive and creative thinking, expressing a comprehensive understanding of the landscape on different scales: its structure, organizational and financial frameworks, natural and socio-economic dynamic processes, elements and functions. The process of designing becomes at the same time a process of understanding towards a recognition of locally appropriate, sustainable landscape patterns. This understanding shifts the urban landscape paradigm: from a landscape that the society can bear the cost for beautification or engineering or ecology towards an understanding where landscape becomes an inevitable and constituent part of the city´s green infrastructure combining the benefits of the different functions.

Case Study: Qunli Storm Water Park, Harbin, China

A new urban district named Qunli New Town was planned from 2006 at the eastern outskirts of Harbin in northern China. At the final stage, more than one third of a million people are expected to live in the 2,733 hectares district. In the masterplan, 16 percent of the developable land was designated as permeable green. In 2009, the landscape architecture office Turenscape, Beijing was commissioned to design a park right in the center of the district. The existing situation was a 34 hectares area, listed as a protected regional wetland. Surrounded on four sides by roads and dense urban development, the wetland was under threat, cut off from its water sources. Going beyond the original task of preserving the wetland, the designer Kongjian Yu and his team developed an integrated design proposal, turning the site into an urban storm water park that provides multiple, synergetic benefits.

The park is designed as a “green sponge”, collecting rainwater runoff from the newly built urban surroundings, reconnecting the hydrologically cut-off terrain with the water networks of the city. Along the park’s edges constructed ponds and artificial wetlands absorb the storm water, storing, filtrating and cleansing it to be ultimately released evenly into the wetland. This procedure reduces the degree of floods and waterlogging risks, while the sinking ground water table gets recharged simultaneously. The existing wetland in the heart of the site is left alone to allow the natural habitats to continue to evolve. The outer ring of mounds and ponds performs as a buffer zone and a transition between nature and city. A cut-and-fill strategy enabled to reduce earthwork to a minimum and transforms the ring with a network of paths linking the ponds and mounds. Instead of fencing off the inhabitants to protect the wetland they are invited to the craftily designed transitional zone. Newly planted groves allow visitors a walking-through-wilderness experience. Platforms and seats close to the ponds enable people to get in touch with nature. In turn a skywalk makes for an in-the-canopy experience. Viewing towers offer views into the distance and observation of nature in the untouched center of the park. Potentially storm water flooding contributes to a new aesthetic experience of natural processes in the city, feeding the wetland that has become a popular public space for recreational use.

Conclusions

In the past, ecologists, engineers and designers have created isolated ecological, technical and aesthetic solutions. As elaborated by the case studies presenting different types of urban wetlands above, it is well possible to boost the performance of the urban landscape. To generate ecological urban development the existing models of urban design, infrastructure and

塘在自然与城市之间起到缓冲与过渡作用。填挖方平衡的策略将土方量减少到最小，并用环状道路网将池塘与山丘连接在一起。不同于将居民阻挡在外的湿地保护方法，通过巧妙的设计将人们引导至过渡地带。新种植的树丛使游人有一种漫步郊外的感受。邻近池塘的平台与座椅可以让人们更加亲近自然。同时，一座步行天桥为人们创造了漫步林冠的体验。观景塔让人们欣赏到公园中心无法领略的自然风景。潜在的雨洪为城市提供了一种崭新的对自然过程的审美体验，在雨洪灌溉下的湿地已经成为一处受欢迎的、可供人们休闲娱乐的公共空间。[10]

结论

过去，生态学家、工程师、设计师已经创造出了各自独立的生态、技术与审美途径。上述展示的不同类型的城市湿地的案例，都极有可能促进城市景观绩效的提升。为了促进生态城市的发展，当前的城市设计、基础设施与生态模型必须通过一个跨学科的知识成果来进行重新评估与整合。生态工程、景观设计与生态学的结合对于提高它们各自多元化的子目标有着巨大的潜能。为了让城市景观全面运作起来，人类与自然之间的矛盾应该通过一种包容性的综合途径来解决。

城市湿地凭借其特殊的适用性，能够为城市景观的社会、生态与经济健康方面带来多重效益。城市湿地的水资源管理综合概念同样适用于城市中的其他水环境。这样的生态工程体系更具灵活性，并且成本更加低廉，因此非常适于应对城市所面临的各种挑战。绿色基础设施可以很容易地与生态、社会以及文化功能结合在一起，从而支持城市的可持续与弹性发展。

我们难以找到一种可以满足所有要求的万全之策。但是，一个项目所依据的知识背景越广泛，其获得成功的可能性也就越大。如此，不但可以尽可能地规避错误，而且能够最大程度地从中获益。目前的挑战是，与单一目标的方法相比，一个综合的方法将牵扯到日益复杂的规划与实施过程。为了寻求到一种可靠的途径，人工湿地的建设考虑到了水文、生物、化学、地质、构造、经济以及社会各个方面。如果要在城市发展概念框架的范围内将人工湿地纳入到湿地修复的途径中，那么对项目管理与团队合作的要求将大幅度提高。

对一种跨学科方法论的成果进行广泛的应用与协调，要求这支组合而成的团队能够在工作目标、优先任务、知识分享、接受失败以及利用冲突等方面体现出灵活多变的特性。同时，要成为跨学科团队中的一员，还需要培养与训练沟通、理解以及创造力等技巧。

城市湿地的跨学科特征在于它能够兼顾生态、工程以及设计，并且能够积极地将它们统一起来，将城市创造成一个宜居的、弹性的、为生活提供配套服务的人居环境。对于城市湿地的多线宣传与推广有助于提高城市湿地的可实施性，并将最大程度地提高成功的胜算。LAF

9. 道路以及平台的设计使得人们能够亲近自然。© Kongjian Yu
9. Paths and platforms allow for close-up experience of nature. © Kongjian Yu

ecology have to be reassessed and integrated, using a transdisciplinary type of knowledge production. A joint venture of ecologic engineering, landscape design and ecology has a huge potential for the enhancement of all their diversified sub-ordinate targets. To make the urban landscapes work holistically, the contradiction between human and natural as to be resolved to be replaced by an all-inclusive integrated approach.

Urban wetlands have a special suitability to contribute to the social, ecologic and economic health of the urban landscapes in many-sided ways. Integrated concepts of water management by urban wetlands can be applied in all water related urban contexts. The ecologically engineered systems are more flexible and less expensive and therefore apt to cope with urban challenges. The green infrastructures can easily be combined with ecologic, social and cultural functions in support of urban sustainability and resilience.

To meet the claim of an holistic approach is hard to achieve. As a matter of fact, the broader the knowledge on which a project is based, the more probable is its success. The more mistakes can be avoided and broader is the amplitude of benefits. The challenge is, that a holistic approach implicates an increasing complexity of planning and implementation processes in comparison to a single-purpose approach. To create a reliably working constructed wetland already involves the consideration of hydrological, biological, chemical, geological, constructional, economical and social aspects. If the constructed wetland then shall be included as a tool for wetland restoration within the framework of an urban development concept for example, the requirements for project management and team coordination rise substantially.

The productive application and orchestration of a transdisciplinary methodology, demands altered abilities to structure the variegated team. This includes to work out goals, prioritize tasks, share knowledge, accept failures and drag use from conflicts. To be a productive part of an interdisciplinary team at the same time requires training and development of communicative, empathetic and creative skills.

The transdisciplinary quality of urban wetlands is capable to reconcile ecology, engineering and design, unified in their ambition to contribute to the cities as livable, resilient and life-supporting human environment. Communicating and marketing urban wetlands on multiple lines of argumentation can help to enhance the implementation of urban wetlands and maximize the prospects of success. LAF

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