

悉尼公园水资源再利用项目 SYDNEY PARK WATER RE-USE PROJECT

Turf设计与环境事务所 / Turf Design Studio & Environmental Partnership

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摘要

该项目作为“悉尼2030可持续发展战略规划”的重要组成部分，是悉尼市迄今为止最大的环境保护工程。项目旨在通过在本地蓄水并将之再利用的方式来满足用水需求。城市从而抓住了一次千载难逢的机会，以基础设施工程为载体，赋予公园以新的生机。

关键词

景观设计；水资源管理；绿色基础设施；可持续性；协作

ABSTRACT

This project forms City of Sydney's largest environmental project to date and an integral component of Sustainable Sydney 2030. It targets water demand to be met through local water capture and re-use. The City seized a once in a lifetime opportunity to use what was essentially an infrastructure project as a vehicle to breathe new life into the park.

KEY WORDS

Landscape Architecture; Water Management; Green Infrastructure; Sustainability; Collaboration

整理 王颖

译 杨思佳 王颖

EDITED BY Ying WANG

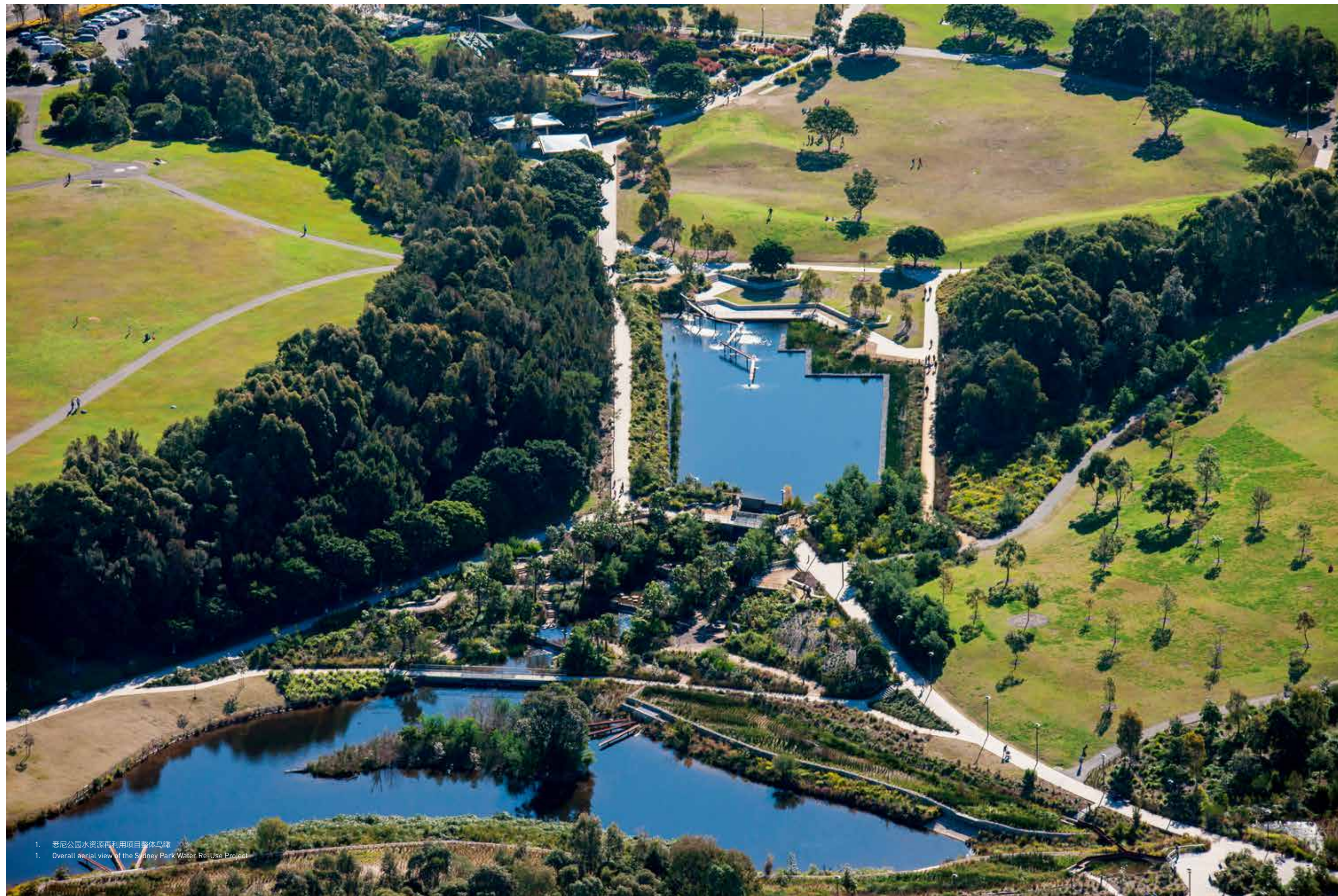
TRANSLATED BY Sheila YANG Ying WANG

项目背景

上世纪90年代末至21世纪初的千年大旱，是澳大利亚历史上最严重的一次干旱。在2012年正式宣告早期结束之前，悉尼市都不得不从其他偏远的河流流域引流以维持其供水。

自此次事件以来，悉尼市政府开始未雨绸缪，批准并实施了《水资源分散管理总体规划（2012~2030年）》，并将之作为“悉尼2030可持续发展战略规划”的一部分。该规划力图通过一系列策略减少自来水的消耗和需求，包括建立雨水花园、植被系统、雨水循环系统和热电冷联产工厂等。

悉尼公园水资源再利用项目是这一系列水资源综合管理策略的一部分。在“全国城市用水和海水淡化计划”之下，设计与澳大利亚政府合作建设，使其成为悉尼市迄今为止最大的环境保护工程。作为“悉尼2030可持续发展战略规划”的重要组成部分，该项目期望通过在公园内蓄集本地水资源并将之再利用的方式来满足悉尼市10%的用水需求。由于全球气候变化，澳大利亚东南部的降水会愈加无规律，因而该项目展示了一个能应对城市未来几十年发展变化的综合性预



1. 悉尼公园水资源再利用项目整体鸟瞰
1. Overall aerial view of the Sydney Park Water Re-Use Project



改造前
2013年4月
Before Construction
April 2013

改造中
2014年6月
During Construction
June 2014

改造后
2016年5月
After Construction
May 2016

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案，即在当地水体的流域范围内为该城市提供急需的水资源供应。城市从而抓住了一次千载难逢的机会，以基础设施工程为载体，赋予公园以新的生机，为悉尼提供一个充满活力的休闲与环境资源。

设计愿景

该项目预期实现三个关键目标：

- 1) 水资源管理：有效收集城市废水，改善水质，并减少饮用水消耗。
- 2) 打造景观和栖息地：加强公园现有水体之间的视觉和功能上的联系。改善景观环境，升级休闲设施，增强环境舒适度，提升栖息地价值。
- 3) 诠释场地：通过对场地的设计与艺术性表现来揭示和讲述公园中水的故事，包括提供交互式游戏和教育的体验机会。

设计策略

悉尼市政府和设计团队认识到，要想充分把握该项目以及场所提供的机会，必须建立一个全面协作的设计环境。他们因此总结了一系列的关键策略，以确定和指导项目的设计、开发和交付。

水的再利用与排放

该项目贯彻悉尼政府所推行的大型蓄水倡议，其每年可蓄集并净化的水量相当于340个奥林匹克运动会标准游泳池的容量。而当这一用于水资源回收的街道网络系统扩展到东部工业区域时，相应的饮用水的消耗量将有效减少。

在过渡时期，大量蓄集的水将用于灌溉公园中的景观。为维持水循环的平衡，少量蓄集的水将通过亚历山大河道中的排放系统排出，净化过后的水体可减少原有城市排水过程中对城市集水区的水道和水环境的影响。

生态环境

Dragonfly环境公司是设计团队的重要成员，其为项目提供了生态方面的专业技术咨

询。项目在生态方面的主要问题包括如何为可能生存的本土动物提供栖息地、如何提高物种多样性，以及如何在施工过程中保护现有的动植物。

悉尼公园为人们创造了接近自然的机会，让人们能够再次聆听青蛙的鸣叫、等待春天里候鸟的到来。

生物多样性

生态学是一种基于居住空间的研究。在悉尼公园项目中，这些“居住空间”包括湿地、边缘植被、林地、开敞草地，以及其间水的流动、营养循环、传粉、动植物与菌类之间的共生关系等中的物理、化学和生物过程。

每一个表面都可能成为居住空间，这是

该项目生态策略及设计方案的主旨。这些表面可包括开敞水面、连接水生植物和旱生植物的边缘植被、生态滞留区域（模拟天然的季节性湿地）、种植的灌木丛及砂岩溪谷等主要的栖息地类型。

在大范围的景观中营造微型栖息地是一种对自然环境的模拟，可有效提高本土动植物的存活率。微型栖息地即窄小的空间，包括岩石间的空隙、茂密的水生植物之间平静的水面、厚厚的落叶堆等。项目也打造了一些特别的微型栖息地，以满足更多动物物种的需求，包括青蛙、小型鸟类、蜥蜴、哺乳动物（如蝙蝠）及诸如蜻蜓和微小水生生物一类的昆虫。

项目采用了湿地植物物种，不仅可以提

2. 悉尼公园改造前后的变化
3. 悉尼公园水资源再利用项目夜间鸟瞰
2. The transformation of Sydney Park
3. Night aerial of the Sydney Park Water Re-Use Project



© © Ernan Ren/Art

项目位置：
澳大利亚新南威尔士州悉尼市

项目面积：
16 000m²

项目委托：
悉尼市政府

景观设计：
Turf设计与环境事务所

项目负责人：
Mike Horne, Adam Hunter

项目团队：
Turf设计与环境事务所、Alluvium公司、Turpin + Crawford工作室、Dragonfly环境公司、Design Landscapes景观工程公司、Partridge公司

设计时间：
2012年2月

建成时间：
2015年5月

所获奖项：
2016年澳大利亚景观设计师协会国家奖（基础设施类）
2016年美国建筑奖年度景观设计奖

LOCATION:
City of Sydney, New South Wales, Australia

AREA (SIZE):
16,000 m²

CLIENT:
City of Sydney

LANDSCAPE ARCHITECTURE:
Turf Design Studio & Environmental Partnership

PROJECT LEADERS:
Mike Horne, Adam Hunter

PROJECT TEAM:
Turf Design Studio & Environmental Partnership, Alluvium, Turpin + Crawford Studio, Dragonfly Environmental, Design Landscapes, Partridge

DESIGN PERIOD:
February 2012

COMPLETION TIME:
May 2015

AWARDS:
2016 Winner of AILA National Award for Infrastructure
2016 Landscape Architecture of the Year Prize of the American Architecture Prize



4. 总平面图
5. 雨水蓄集策略图

4. Master plan
5. Water harvesting plan

高水质，也可为本地及外来动物提供各类栖息地，同时营造出四季皆美的低维护景观。

公共艺术

该项目的另一个主要目标是为游客提供不同的“时刻”体验，包括视觉上的愉悦、适时的探索与研究，以及随时节变化的游赏氛围等。为了实现这些并非独立存在的目标，项目将其融合设计于系统主要的环境功能中，而在公园开放的过程中，它们又将分化为更多样的功能。

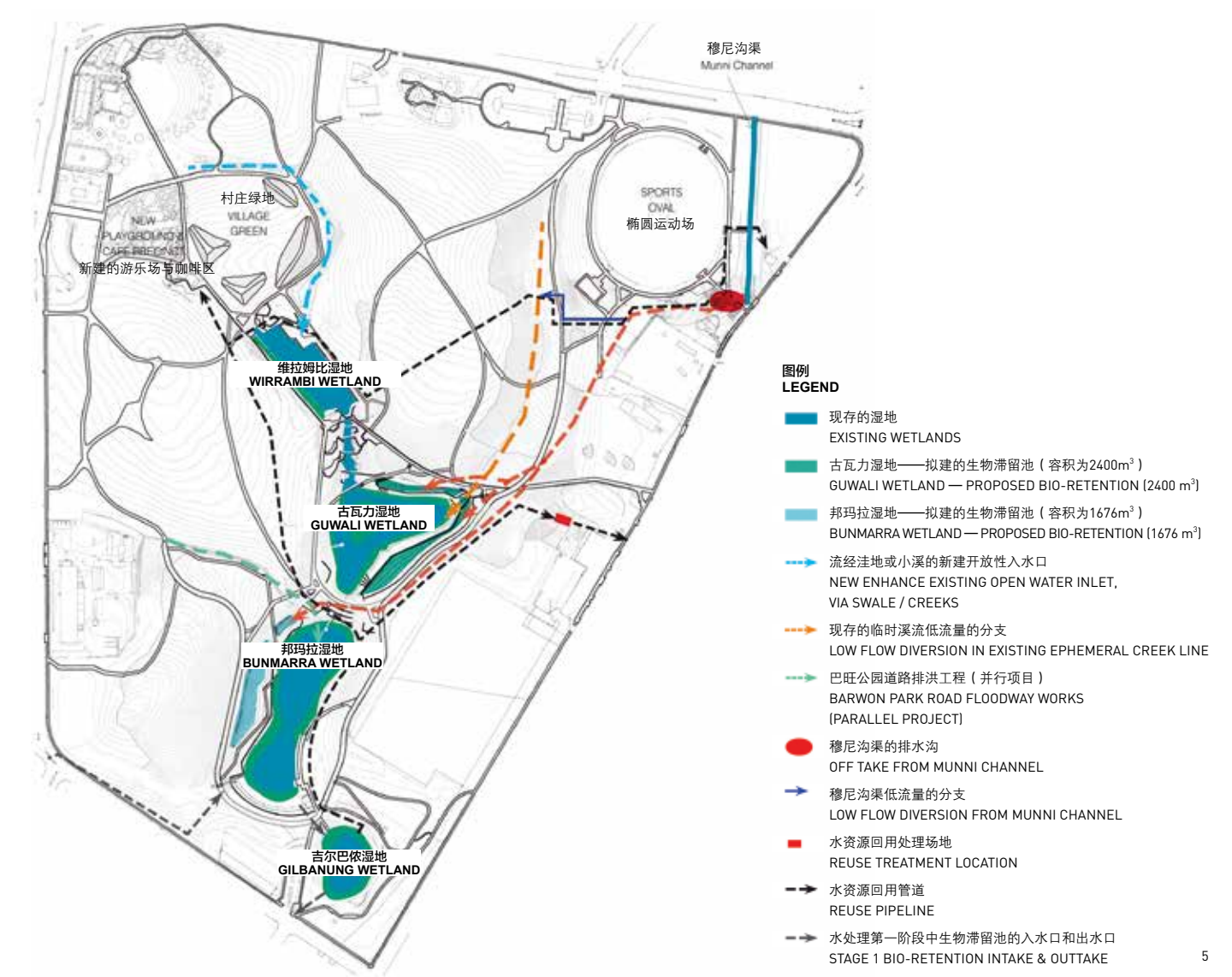
各方协作

受悉尼市政府委托，Turf设计与环境事务所（TDEP）集结并领导了一个由设计、艺术、科学和生态等多学科共同协作的设计团队。由此促成的“圆桌会议”也增进了来自Alluvium公司的水利专家、Turpin + Crawford工作室的艺术家、Dragonfly环境公司的生态学家、Partridge公司的工程师和来自市政府的景观设计师之间的相互交流。而Design Landscapes景观工程公司则凭借其丰富的技术经验，承担了该复杂工程的实施落成。多方的合作最终成就了这个将水资源再利用、休闲设施和栖息地交织的混合系统，使水体得以重生，并赋予这一广受喜爱的公园以新的维度。

结果与效益

悉尼公园所在场地曾经是工业用地和垃圾填埋场。在过去的20年间，通过人们的不懈努力，这里变成了一个面积达44hm²的公园，并对悉尼东南部的社区发展有着重要的价值和作用。在此之前，来自上游200hm²集水区的所有雨水未经处理就直接流入慕尼沟渠，汇入亚历山大河道和波特尼海湾，悉尼公园内的池塘水质因而变差。且由于降雨量少，水体在暖季滞留，导致蓝藻、绿萍和浮萍等爆发。

悉尼公园水资源再利用项目促进了池塘、湿地系统中的水循环，从而改善了水质，提高了视觉效果并优化了滞洪蓄水的能力。



- 图例 LEGEND**
- 现存的湿地 EXISTING WETLANDS
 - 古瓦力湿地——拟建的生物滞留池（容积为2400m³） GUWALI WETLAND — PROPOSED BIO-RETENTION [2400 m³]
 - 邦玛拉湿地——拟建的生物滞留池（容积为1676m³） BUNMARRA WETLAND — PROPOSED BIO-RETENTION [1676 m³]
 - 流经洼地或小溪的新建开放性入水口 NEW ENHANCE EXISTING OPEN WATER INLET, VIA SWALE / CREEKS
 - 现存的临时溪流低流量的分支 LOW FLOW DIVERSION IN EXISTING EPHEMERAL CREEK LINE
 - 巴旺公园道路排洪工程（并行项目） BARWON PARK ROAD FLOODWAY WORKS [PARALLEL PROJECT]
 - 慕尼沟渠的排水沟 OFF TAKE FROM MUNNI CHANNEL
 - 慕尼沟渠低流量的分支 LOW FLOW DIVERSION FROM MUNNI CHANNEL
 - 水资源回用处理场地 REUSE TREATMENT LOCATION
 - 水资源回用管道 REUSE PIPELINE
 - 水处理第一阶段中生物滞留池的入水口和出水口 STAGE 1 BIO-RETENTION INTAKE & OUTTAKE



6 © Scott Robertson



7 © Simon Ward

作室还与TDEP及Alluvium公司合作设计了水力“排气扇”，展示了水从进行生物降解的“田”转移到泻湖的过程。这些节点不仅展现了水的精神，更与地形、结构、地表、植物和动物群落相互作用。而“排气扇”只在强降雨后的两到三个小时内发挥作用，因为彼时的水量已超过生物降解床的荷载。

经过一段时间的试运营之后，该水资源再利用项目现已完全开始运作，并与其所在的公园环境融为一体。公园的动植物蓬勃生长，新的栖息地和受到保护及强化的原有栖息地遍布整个公园。该项目在当地水资源的蓄集与再利用方面发挥了重要作用，是向实

现“悉尼2030可持续发展规划”迈出的关键一步，并预示着将再生水网络化模式应用于当地工业中的可能。

未来展望

悉尼市政府正在寻找基于当前和过去的工程，且有望在将来实施一系列举措。这其中包括为犬类提供的戏水设施或者一系列“水洼”，以及在公园内建立永久性“城市农场”等。最近，TDEP还协助市政府重建了符合C.A.R.E.S.^①要求的儿童自行车道，其设计既保证了骑行安全，又让骑行充满了

游乐的体验。

这些举措既是对雨水收集工程的补充与平衡，也大大促进了悉尼公园的发展。悉尼公园自此从后工业的砖厂遗址转变为对当地社区起到重要影响的绿色基础设施。该项目不仅为公园带来了休闲体验、视觉享受和生物多样性等多方面价值，更对相邻地区未来的可持续用水起到了至关重要的作用。

公园内的湿地将继续演化，并促进场地中景致的美化和环境的优化。人造栖息地将变得更具多样性和弹性，其中的原生植物群落也将不断稳固和繁衍，将公园多层次与多维度的价值融入当地社区。LAF

① C.A.R.E.S.指“社区和道路教育计划”，是为儿童而设立的有关道路与自行车骑行教育的计划。

Project Background

The Millennium Drought of the late nineties and early 2000s brought to Australia its worst period of drought on record. Unwillingly, Sydney had to draw upon remote river catchments to maintain its water supply until the drought was declared officially over in 2012.

Looking to the future, City of Sydney endorsed and is implementing the Decentralized Water Master Plan (2012–2030) as part of Sustainable Sydney 2030. The plan is focused on reducing mains water consumption and demand through a number of approaches including rain gardens, vegetated systems, stormwater recycling and tri-generation plants.

The Sydney Park Water Re-Use Project is part of this comprehensive water strategy and forms the City of Sydney’s largest environmental project to date, built in partnership with the Australian Government through the National Urban Water and Desalination Plan. It is an integral component of Sustainable Sydney 2030; targeting 10% of water demand to be met through local water capture and re-use in the park. With climate change predictions of more irregular rainfall patterns in south-eastern Australia, the project demonstrates an integrated approach to prepare the city for the decades ahead and looks within its catchment to provide the much needed water supplies for the city. At the same time, the City also seized a once in a lifetime opportunity to use what was essentially an infrastructure project as a vehicle to breathe new life into the park — as a vibrant recreation and environmental asset for Sydney.

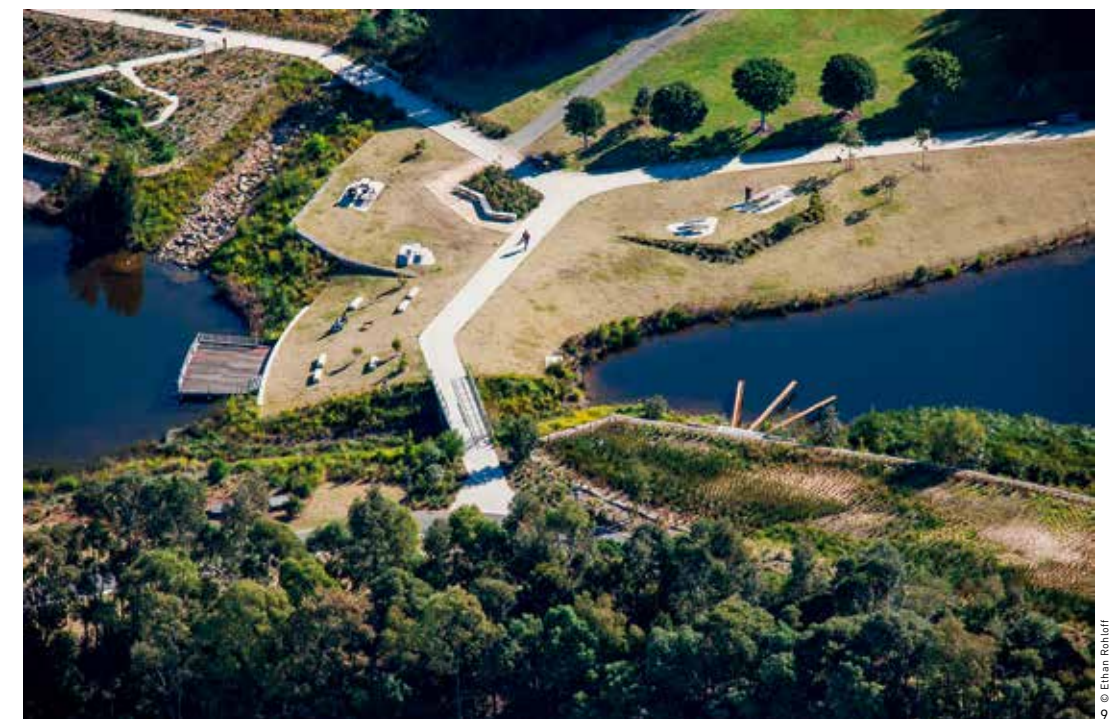
Design Objectives

There are three key objectives of the project:

- 1) Water Management: Effectively harvesting urban waste water, improving water quality and reducing potable water consumption.



8 © Ethan Rehoff



9 © Ethan Rehoff

- 6, 7. 成叉状的考顿钢高架水道将水流引至生物滞留池中，使其在净化后排入古瓦力湿地中。
8. 维拉姆比湿地与瀑布鸟瞰
9. 连接古瓦力湿地和邦玛拉湿地的通道

- 6, 7. A bifurcated Corten steel viaduct delivers water into bioretention ponds to be cleaned and released into Guwali Wetland.
8. Overlooking Wirrambi Wetland and The Cascades
9. Pathway intersecting Guwali Wetland and Bunmarra Wetland



© Ethan Rehuff
10-1

2) Landscape and Habitat: Strengthening the visual and functional connections between the park's existing water bodies and improving the landscape setting, recreational opportunities, environmental amenity and habitat value.

3) Interpretation: Uncover and express the park's water story through design and artful influences within the landscape, including immersive opportunities for interactive play and education.

Design Strategies

City of Sydney and the design team recognized that a fully integrated collaborative design environment was required to fully realize the opportunities presented by the project and the site. A set



© Ethan Rehuff
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of key strategies was adopted to shape and guide the design, development and delivery of the project.

Water Reuse and Discharge

The project encompasses the largest water harvesting initiative undertaken by the City of Sydney and has the capacity to capture and clean the equivalent of 340 Olympic-sized swimming pools of water per annum. When street reticulation for recycled water is extended to the industrial areas to the east, there is potential that an equivalent reduction of potable water use can be achieved.

In the interim, a volume of the harvested water will be used for irrigating landscapes throughout the park. For the balance, as a minimum this will re-enter the drainage system at Alexandra Canal in significantly higher quality, reducing the impact of the urban catchment on the city waterways and aquatic environments.

Ecological Environment

Dragonfly Environmental was a key part of the Turf Design Studio & Environmental Partnership (TDEP) team providing specialist technical advice on the ecological opportunities of the project. Specific targets included how to provide habitats for viable populations of native fauna; how to increase fauna diversity; and protecting existing plants and animals during works.

Sydney Park provides a window for people to get closer to nature and once again appreciate the call of the striped marsh frog and the arrival of the migratory birds in spring.

Bio-diversity

As such ecology is the study of the house. In the case of Sydney Park the "house" is the wetlands, fringing vegetation, forested zones, and open grass areas along with the physical, chemical and biological processes of water-flow, nutrient cycling,

pollination and associations between plants, animals and fungi.

Every surface is a possible home and this is a key driver of the ecological strategies and proposed works. This includes the major habitat types of open water, fringing vegetation that links the wet and dry, bio-retention areas (which mimic natural ephemeral wetlands), the planted bushland pockets, and the sandstone gully.

Creating microhabitats within the larger landscape mimics nature and greatly increases the opportunities for native plants and animals to survive. Microhabitats are the small places — spaces between rocks, the quiet water among dense water plants, deep leaf litter and more. Specific microhabitat has been created and enhanced for a diverse range of animals including frogs, small birds, lizards, mammals (including micro-bats) and insects such as dragonflies and microscopic aquatic species.

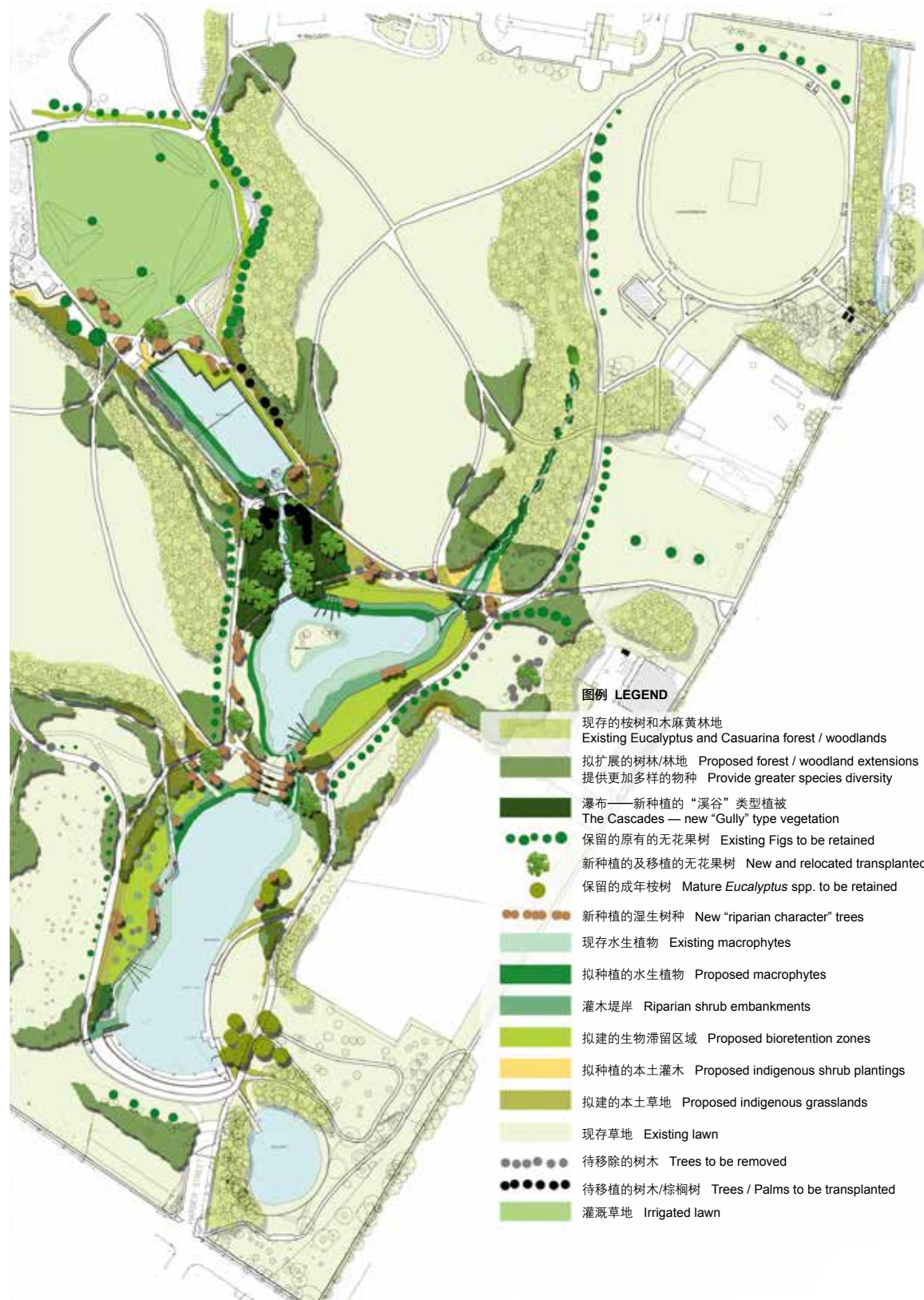
Wetland plant species were chosen to improve water quality, provide a range of habitats for resident and visiting fauna as



© Adam Hunter
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10. “瀑布”不仅深受人们的喜爱，也是遛狗的好去处。
11. 人们在瀑布旁的汀步上嬉戏，在起伏流淌的流水中倾听悉尼公园中水的故事。

10. “The Cascades” welcomes all walks of life and is a favorite amongst the daily dog walkers.
11. Park users frolic across stepping stones at The Cascades; celebrating Sydney Park's water story through its visible ebbs and flows.



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well as being great to look at throughout the seasons and easy to maintain.

Public Art

Creating “moments” that offer visual delight, prompt enquiry and investigation, and that change moods with the cycles of the day and seasons has been a concerted project goal. In achieving this — no one element has a single purpose — all are embedded in the primary environmental function of the system, but have been orchestrated to serve dual or multiple functions across the life and use of the park.

Collaboration

The City engaged a design team led by landscape architects TDEP who orchestrated a multi-disciplinary collaboration inter-weaving design, art, science and ecology. The resulting “roundtable” facilitated a shared design dialogue between water experts Alluvium, artists Turpin + Crawford Studio, ecologists Dragonfly Environmental, engineers Partridge and the City’s own Landscape Architects. Design Landscapes were then the skilled landscape contractors responsible for implementing this complex project on the ground. The result is an interwoven system of water re-use, recreation and habitat that gives life to its water story, and an exciting new dimension to this well-loved parkland.

Results and Benefits

Much has been achieved over the past two decades in transforming the Sydney Park site from its industrial and landfill legacy, into 44 hectares of parkland and a vital asset for the growing communities of Sydney’s south east. Previously, all stormwater flowed through to Munn Channel, and into Alexandra Canal and Botany Bay untreated. The ponds at Sydney Park suffered poor water quality and outbreaks of blue-green

12. 种植策略图
13. 栖息地修复策略图

12. Vegetation strategy plan
13. Habitat strategy plan



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algae, Azolla and Duckweed largely due to periods of low rainfall and the stagnation of water during the warmer months.

The Sydney Park Water Re-Use Project now provides enhanced circulation of water through the chain of ponds and wetlands; improving water quality, visual amenity and detention storage effectiveness.

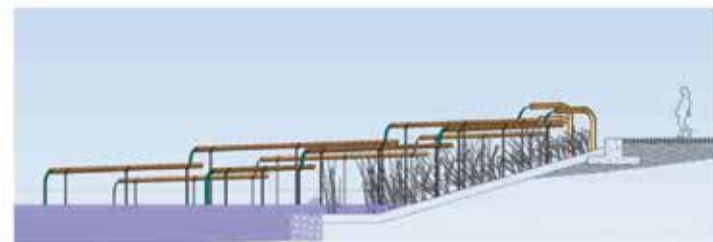
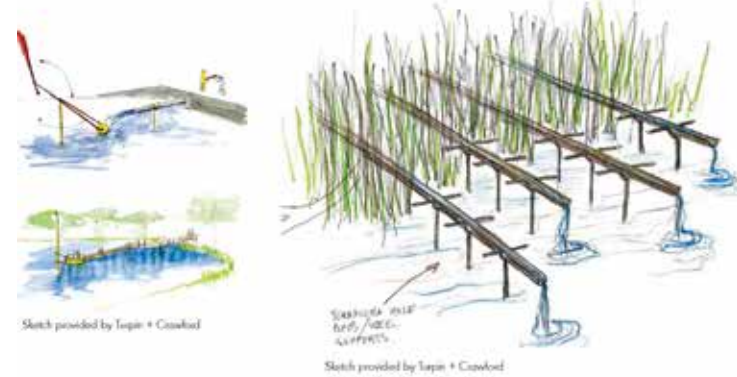
The water scheme diverts an average of 840 mega litres per annum of stormwater for treatment and re-use. The treatment train includes a gross pollutant trap, 5,000 m² of bio-retention system, wetlands and the existing ponds. Water recycled for

irrigation is further treated by filtration and UV disinfection. 30 million litres a year of harvested water is now recycled for improved circulation of the ponds, irrigation of Alan Davidson oval and the Village Green, and non-potable water supply for the nursery and truck washing at the City of Sydney Depot.

The scheme is also intended to ultimately service additional uses beyond Sydney Park. These include nearby industrial sites such as concrete batching plants, metal recyclers, industrial laundry facilities, and textile manufacturers, as well as future urban

redevelopment projects such as Ashmore Precinct and Alexandra Canal. The project is reducing potable water use, improving water quality in the ponds, improving the quality of stormwater run-off discharged to Alexandra Canal and Botany Bay, and ameliorating flooding issues currently occurring in some areas of the park.

More broadly, the new landscapes and habitats provide the community benefit of creating new and engaging recreational and environmental experiences for park users, drawing on both a local and regional catchment.



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In conveying the water story through its visible processes; the project is educating the community about the importance of urban water management, and the interdependent nature of our urban and natural environments. The function and processes of water harvesting and cleansing is made legible through its visible ebbs and flows in the landscape.

Highlighting these processes was an important part of the project. Turpin + Crawford's "Water Falls" celebrates the passage of water from the end of the water treatment "train" back into the system at Wirrambi Wetland, while supplementing "The Cascades" in providing critical aeration of the stored waters. Turpin + Crawford Studio also worked with TDEP and Alluvium to conceive the water "Exhaust Fans" celebrating

the transfer of water from bioremediation "paddies" to the lagoons. These play on the spirit of water and its interactions with topography, form, surfaces, plant life and fauna. The fans only function for two to three hours after heavy rainfall, reflecting that the bioremediation beds are full.

After an intensive period of "easing in," the water re-use project is now fully operational and intrinsically merged with its park setting. The park's fauna and flora is thriving, with new habitats created and existing ones protected and enhanced throughout the park. This project has made a significant contribution to the realization of the Sustainable Sydney 2030 targets for local water capture and reuse, and promises the opportunity to significantly expand re-use through the reticulation of recycled water to local industry.

① C.A.R.E.S. stands for "Community and Road Education Scheme," a road and bicycle education program for children.

14. 艺术装置策略图
15. 公共艺术的应用可以让公众了解城市水循环的过程，为其展示难得一见的雨水净化过程。
16. 由Turpin + Crawford工作室打造的开放式赤陶管道，可将水从生物滞留池中引入湿地。
14. Art strategy plan
15. Integration of Public Art aims to connect the community to urban water cycles, highlighting the hidden or invisible process of storm water remediation.
16. Turpin + Crawford's open terracotta pipes from the bioretention ponds into the wetlands.

Future Prospects

City of Sydney is investigating several initiatives that may be implemented in the future, building on current and past projects. This includes the roll out of dog water play facilities or "puddles", along with the potential for the "City Farm" facility to be permanently located at Sydney Park. More recently, TDEP assisted the City with the redevelopment of the C.A.R.E.S.^① Children's Bike Track, which integrates bike safety with experiential play.

These initiatives both complement and leverage off the stormwater harvesting project, and significantly contributes to the evolution of Sydney

Park; from its post-industrial and Brickworks legacy into a significant piece of green infrastructure for the community. While tangibly adding to the recreational, visual, and biodiversity value of the park, the project also plays a key role in future-proofing the adjoining areas for sustainable water use.

The wetlands will continue to evolve and enhance the landscape setting and environmental amenity of the park. The created habitats will become more diverse and resilient, and indigenous vegetation communities will stabilize and strengthen, consolidating the park's multi-layered and multi-dimensional value to the community. **LAF**



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