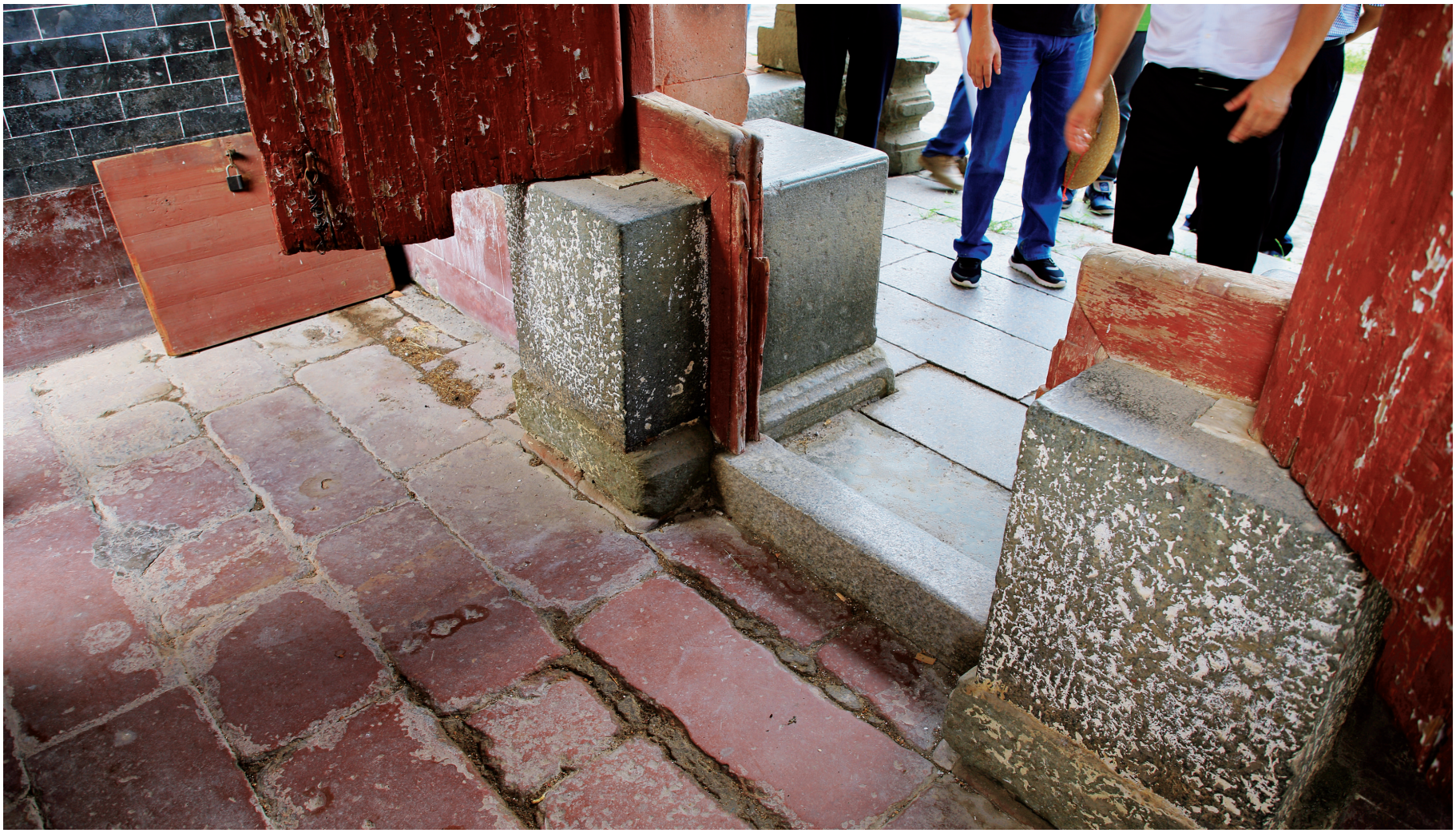

EDITORIAL
主编寄语

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东莞谢岗镇黎村的罗公祠，这样的宗族祠堂在珠江三角洲一带数以千计，遍布每个村庄。它们是中国数千年宗族社会稳定的结构基础，亦是构建韧性社区的关键性基础设施。而尤其值得我们关注的是，这些宗族祠堂从房屋选址、布局到结构设计，都体现了抗震、抗风、防火、防洪等生态韧性智慧。图片中的门槛被设计成水闸，是应对珠江三角洲一带季风性气候和极端气候的一种弹性机关。相较于当代工业文明下耗费巨大人力、物力、财力建造的防洪堤，这种简单而投入甚微的传统设计具有更好的韧性。

Date August 5, 2018 **Location** Dongguan City, Guangdong Province **Photographer** Yu Kongjian

The Luogong Ancestral Hall of Li Village, Xiegang Town, Dongguan. Ancestral halls, like this one in Li Village, are found throughout the Pearl River Delta area. Having survived earthquakes, wind, fire, and floods, the siting and design of these halls serve as structural units for traditional Chinese society and key nodes of resilience in ancient communities. The threshold to the ancestral hall, pictured here, was designed as a sluice gate to prevent or drain floods in monsoon seasons. Compared with modern large-scaled flood-controls that rely on huge amounts of manpower and resources, this kind of simple, low-cost, and smart-designed facility has a higher resilient performance.

三大创新策略综合解决雄安新区的水问题

主编　俞孔坚
译　萨拉·雅各布斯　张健

建设雄安新区是中国的一项重大决策部署，其建设目标应体现“蓝绿交织、清新明亮、水城共融的生态城市”理念，成为生态文明与美丽中国梦的典范。雄安新区目前面临严重的生态问题，尤其是水问题，对实现美好城市的目标提出严峻挑战，同时也是中国向世界展示其生态文明建设成就及卓越智慧的极好机遇。中国自然科学基金针对建设安全韧性的雄安新区，启动了2017年第四期应急项目，其中包含了《雄安新区生态安全格局构建及保护策略研究》[①]。

1 挑战与机遇：雄安新区建设目标及其面临的世界性难题

雄安新区面临诸多以水为核心的严峻生态环境问题，包括：

水资源问题：连年干旱缺水，白洋淀每年依赖“输液式”水资源补给；

水安全问题：季节性降雨，旱涝不测；九河下梢，洪涝风险非常严峻；

水环境问题：为华北平原污染汇聚之地，污染严重，富营养程度高；

水生态问题：近 50 年来，白洋淀生态恶化，生物多样性大大下降；

水文化问题：与淀共生的乡土文化遗产保护不当，文化景观特色丧失。

这些问题的存在向实现雄安新区的建设目标提出了严峻挑战。同时，我们也必须认识到，水资源短缺、洪涝灾害、水质污染、水生态破坏等一系列以水为核心的生态问题，也是世界性难题。

2 反思工业文明的问题解决之道：雄安新区的“现代化”陷阱

西方工业文明关于城市建设的理念和技术为人类发展做出了巨大贡献，为我们规划设计好雄安新区提供了丰富的经验积累；同时，工业文明的城市建设理念和人地关系处理方法也留下了许多教训，其中关于水问题的解决之道往往依赖诸如灰色基础设施等封闭式、集中式、单一功能导向的工程化模式，然而其结果往往是给自然系统带来副作用，导致其自我调节能力和抗风险能力下降，系统韧性的降低使人与自然关系进入恶性循环。

雄安新区的建设，应该对这些教训和反思给予足够的重视，并避免重蹈覆辙。课题组认为，在解决以水为核心的生态环境问题时，雄安新区的规划（以下简称《规划》）应在以下几个方面规避工业化和“现代化”陷阱：

（1）水资源：《规划》计划从黄河调水两亿立方米，从南水北调中线调水一亿立方米，注入白洋淀。尽管此举可以解决水资源短缺问题，但反而加剧了其他区域的水资源短缺问题，这会使雄安新区成为广大华北平原上的一个水资源“黑洞”。

（2）水安全：《规划》采取城区集中排涝、环城高筑200年一遇暴雨事件防洪堤的方式来进行封闭式集中防洪，此举成本高、韧性差、潜在风险高。这些水安全防控模式未能体现生态文明理念下的人水和谐、蓝绿交织、水城相融的理念。

（3）水环境：《规划》提出通过大面积清淤的方式来解决白洋淀的污染问题，加上开挖湖区，预计需投资1 000多亿人民币。这种简单粗暴的水环境治理工程，不但可能破坏原有的白洋淀生态系统，而且可持续性差，极有可能投入巨大而无经济回报。

（4）水生态：《规划》将白洋淀定位为“自然保护区”乃至保护级别更高的“国家公园”，为了修复白洋淀的生态环境，淀区核心地带计划迁出8个村庄，总迁移人口约20 000人。这种为保护而保护的做法，没有充分尊重白洋淀作为文化景观的历史和事实——文化景观是人与自然长期和谐共生而形成的景观类型。白洋淀作为历史上的蓄滞洪区，其居民的生产生活是白洋淀生态过程中不可或缺的组成部分，也是白洋淀文化遗产产生和存在的基础，也必将成为未来雄安新区市民生态游憩活动的主要区域。一味追求生态保护和修复而排斥人的活动，

① 本文由国家自然科学基金应急项目《安全韧性雄安新区构建的理论方法与策略研究》的初步成果整理而成。总课题为《安全韧性雄安新区构建的理论方法与策略研究》，课题总负责人：中国城市科学研究会理事长仇保兴；子课题《雄安新区生态安全格局构建及保护策略研究》，课题负责人：北京大学建筑与景观设计学院教授俞孔坚；参与研究人员：贺敏，任佰强、刘伟、王秦乔丹、安凌翰。

是没有意义的，也是代价高昂且不可持续的。

（5）水文化：《规划》的集中封闭式防洪大堤，以及白洋淀作为“自然保护区”和“国家公园”的定位，将人的活动与淀和水隔离，也将城与水隔离，未能体现“清新明亮、水城共融的生态城市”理念，也湮没了具有独特历史文化价值的白洋淀文化景观。

3 基于生态文明理念的三大创新策略

基于上述认识，课题组通过对区域水生态系统的格局、过程和历史发展进行详细调研，并深入研究和汲取了中国五千年的传统生态智慧，特别是洪泛区水适应性城市和景观策略，结合当代国际先进的生态治水理念与方法，提出综合解决雄安新区水问题的三大创新策略：

3.1 格局策略：“海绵国土、城水相依”的开放式生态防洪与水资源管理

基于国土生态安全格局的分析，构建“一心、九廊、四大堤内湿地”的海绵系统，实现区域开放式的生态防洪和水资源管理格局；避免城－水隔离、田－水隔离的对抗式防洪模式，从区域上缓解雄安新区的防洪压力，并实现雨洪的资源化利用，有效补充地下水；节省投资，并以水为主导生态要素，充分尊重自然过程，全面改善水生态环境，营造优美的区域大地景观。

（1）“一心”为白洋淀：维持白洋淀现有的低标准防洪堤，恢复白洋淀作为蓄滞洪区和生产性湿地的功能。

（2）“九廊”为府河等“八条入淀、一条出淀”的河流生态廊道：两岸河堤恢复其自然形态，退田还湿（保留其生产性湿地的功能，可以通过生态补偿的方式解决低概率洪涝灾害带来的粮食生产损失），构建由大量荷田湿地及河滩林地构成的漫滩生态廊道。根据居民点具体高程状况，进行差别化防洪，围绕村镇小范围建堤（防洪堤2~3m高足矣）。通过在河漫滩构建分散式的湿地和林地，形成沿季节性河流分布的“海绵”系统，滞蓄雨洪资源，补充地下水，削减洪峰。

（3）“一环”为环白洋淀堤内宽度不低于1.2km的生态公园带（包含众多生物栖息地与乡土文化遗产）：此淀区部分在历史上曾是滞洪区，后因开垦耕地而被侵占。修复后的生态公园带既可以作为城市内涝的排泄区和滞洪区，也可以为当地居民营造环淀休闲空间。

（4）“四大堤内湿地”为生态公园带内的4个经过人工修复的湿地：这些区域在历史上频繁受淹，后被围垦在堤内。4个湿地都在原有低洼地形的基础上进行修复，它们与城市相依而生的同时，也形成具有活力的休闲区。修复后的湿地调蓄容量预计将达一亿立方米。这样既解决防洪安全，又形成服务于人民的亲水界面，从而修正目前《规划》的城水隔离的对抗姿态。

研究发现，在开放式生态防洪模式下，白洋淀及入淀河流廊道周边的低洼地带皆可作为潜在的蓄滞洪区，最大滞蓄容量将达25亿立方米，白洋淀下游的潜在蓄滞洪区最大滞蓄容量可达20亿立方米，两者合计45亿立方米，足以应对约43亿立方米的百年一遇暴雨事件入淀洪水量。对于更大规模的区域洪水，亦可通过淀–库–滞洪区联防调控以及重点地区的差别化堤防建设进行应对。

3.2 形态策略：“多塘串联，水城交融”的分散式洪涝适应性街区

策略的核心是分散式雨洪管理模式，通过就地填挖方平衡，形成多塘湿地，构建街区排涝单元和具有韧性的内涝适应性海绵城市形态；同时，结合宜居性考虑，使外来的净水穿城，构建城水交融的生态宜居城市形态。

（1）构建以街区为单位的洪涝适应性城市：汲取中国洪泛区建城的水中有城、城中有水的传统智慧，建立分散式的防洪排涝系统。通过就地填挖方平衡，使城市组团高地与低洼水塘

湿地交替分布，抬高道路交通与建设用地，让道路成为分区防洪排涝的界堤，让水塘成为内部消化雨涝的滞蓄区，从而实现街区化的外防（洪）内蓄（涝）的单元格局。同时，汲取白洋淀当地平屋顶的防洪智慧，将建筑底层架空至12.5m标高（架空4m左右），将二楼裙房连为一体，成为城市的第二街道层，在满足社区活动空间需求的同时，达到200年一遇防洪要求。

（2）净水穿城，水城交融：在严重缺水的现实下，调水济城是必要的，但水是可以被多次使用的。依照《规划》，“南水北调中线工程”与“引黄入冀补淀工程”每天将为新城输送水资源100万立方米，输送来的清水先引入城区的方塘和街区绿道，使净水常年穿城，再依次进入堤内湿地和堤外的白洋淀。这样，一方面可以大大提升新城的亲水性，另一方面也可以克服新城面临的季节性旱涝矛盾，最终实现“清新明亮，水城交融”的宜居城市形态。据初步计算，在此模式下，每个街区内部的“海绵”空间至少可消纳1 000m^3的城市径流，即可应对20年一遇的24小时暴雨事件；而配合堤内湿地系统的2 500万立方米调蓄容积，亦可从容应对50年一遇的24小时暴雨事件，使新区具有高度洪涝自适应性。

3.3 过程策略：“化污为肥，营养循环”，形成将水质净化与绿色能源生产相结合的闭合式营养链

将白洋淀的功能定位从“自然保护区”回归为当地已延续千年的生产性湿地文化景观，以白洋淀盛产的芦苇为媒介，在自然净化白洋淀水质的同时进行生物质燃料的资源化利用，既减少了燃煤消耗，缓解了空气污染，也有助于形成水生态修复、环境保护与绿色能源生产相结合的产业链，再现独特的淀区乡土文化景观。

据计算，每千吨芦苇可移除14.7吨的氮和0.72吨的磷，用作生物质燃料可代替燃煤883吨，减少SO_2排放量2.67吨。目前淀区每年可生产芦苇10万吨，如果充分利用，年均可吸收氮1 470吨、磷72吨，用作生物质燃料可代替燃煤8.83万吨，减少SO_2排放量267吨。以白洋淀目前的水质为基础，在严控污染排放的前提下，经过约三年时间，即可通过芦苇的自然净化将目前淀内的劣Ⅴ类水质提升到地表水标准的Ⅲ类水。此外，通过将污水处理厂与人工湿地相结合的方式来净化雄安新区的城市生活污水，可以大大节约能源消耗。

THREE COMPREHENSIVE AND INNOVATIVE STRATEGIES TO SOLVE THE WATER PROBLEMS IN XIONG'AN NEW DISTRICT

CHIEF EDITOR YU Kongjian
TRANSLATED BY Sara JACOBS Angus ZHANG

The construction of the Xiong'an New District is a major moment for China's urban development. Its construction targets reflect a vision that "blue-green intertwined, fresh and bright, eco-city blending water with the city," as a model of Ecological Civilization and the Beautiful China dream. Xiong'an New District is currently facing serious ecological challenges, especially with water. It is also an excellent opportunity for China to show its extraordinary knowledge in ecological construction to the world. In 2017, the National Natural Foundation of China launched the fourth emergency project for security and resilience in the Xiong'an New District. This initiative included the Research on Xiong'an New District's Ecological Security Pattern Construction and Protection Strategy①.

1 Challenges and Opportunities: Construction Targets and Challenges for the Xiong'an New District

The Xiong'an New District faces many serious water environmental problems including years of drought and water shortage. The Baiyangdian Lake relies on an "infusion" water supply every year, while seasonal rainfall bringing unpredictable droughts and floods in the Haihe basin. The region is also where pollution is concentrated in the North China Plain, which causes serious pollution and eutrophication problems. In the past 50 years, the ecological system of the Baiyangdian Lake area has deteriorated as biodiversity has declined. The ecological degradation has also affected the local cultural landscape of the lake. Together, these issues have posed challenges to the construction targets of the Xiong'an New District. Similarly, water shortages, flood risks, water pollution, and hydrological damage are also global problems.

2 Rethinking Industrial Problem Solving: The "Modernization" Trap

The urban construction technologies adopted from the industrialization in western countries have made great contributions to human and societal development and provided rich planning knowledge for the design of the Xiong'an New District. At the same time, urban industrial construction has relied on closed, centralized, and single-function-oriented engineering models such as gray infrastructure. This decency has caused changes in the ability of natural systems to self-adjust.

The Xiong'an New District construction should avoid repeating these mistakes, and solutions to water-based ecological problems should avoid the trap of modern industrialization through the following:

1) Water resources: The plan diverts 200 million cubic meters of water from the Yellow River and 100 million cubic meters from the South-to-North Water Transfer Project to the Baiyangdian Lake. This will aggravate water shortage in neighboring regions, causing the Xiong'an New District to become a "black hole" in the vast North China Plain.

2) Water safety: The plan includes centralized drainage in the urban area and a 200-year flood event control levee. This will increase the cost of the project and the potential risk of flooding. Rather, water controls should reflect a harmony between humans and water, blue and green, and the integration of water and cities.

3) Water environment: The plan proposes addressing the Baiyangdian Lake pollution through large-scale dredging. An estimated 100 billion RMB will be invested in the dredging and

① This article is developed under a primary research subject, Theoretical Methods and Strategies for the Construction of Security and Resilience in the Xiong'an New District. The General Director of the project: Qiu Baoxing, Chairman of Chinese Society of Urban Studies. The article is an excerpt of one of the sub-subjects, Research on the Ecological Security Pattern Construction and Protection Strategy of the Xiong'an New District; Project Director: Yu Kongjian, Professor at the College of Architecture and Landscape of Peking University; Research team: He Min, Ren Baiqiang, Liu Wei, Wang-Qin Qiaodan, and An Linghan.

excavation of the lake. This crude treatment may damage the original ecosystem of the lake area, and is problematic as it may not result in an economic return.

4) Water ecology: The plan designates the Baiyangdian Lake as a “nature reserve”and a “national park”with a high level of protection. To remediate the ecology of the Baiyangdian Lake area, eight villages with a migrant population of 20,000 people will be relocated. This method of “protection for protection” does not respect the history of the Baiyangdian Lake as a cultural landscape formed through the long-term coexistence of man and nature. The production and living of the residents in the Baiyangdian Lake area is an indispensable part of the lake’s ecological processes because it is the source of the Baiyangdian Lake’s cultural heritage. The site is supposed to accommodate future ecological and recreational activities of the Xiong’an New District’s citizens. The pursuit of ecological protection and restoration that excludes human activities is meaningless, costly, and unsustainable.

5) Water culture: Creating a centralized closed flood control embankment and positioning the Baiyangdian Lake as a“nature reserve” and “national park” will isolate the lake area from people and the city. Failing to reflect the concept of an “eco-city integrated with bright and clean water,” it will also annihilate the cultural landscape of the Baiyangdian Lake.

3 Three Innovation Strategies Based on the Concept of Ecological Civilization

Based on the understanding above, the research team conducted detailed research on China’s 5,000-year traditional ecological wisdom, especially water-adaptive urban and landscape strategies for flooded areas. Along with contemporary ecological water management, three innovative strategies could comprehensively solve the water problems of the Xiong’an New District:

3.1 Patterning Strategy: Open Ecological Flood Control and Water Resources Management Integrating the City with a Sponge System

Based on ecological security patterns, a sponge system of “One Heart, Nine Corridors, One Ring, and Four Wetlands in the Levees” is built for regional ecological flood control and water resources management. Anti-flooding urban-water and field-water isolation infrastructures need to be replaced with eco-solutions, to alleviate regional flood control pressure on the Xiong’an New District. This will better utilize rainwater and help replenish groundwater. With water as a driving ecological factor, a series of water quality improving measures are developed to create a beautiful regional landscape.

1) Baiyangdian Lake as the “One Heart” maintain the existing low flood-control embankment in the lake area and restore it as a retention area and a productive wetland.

2) The “Nine Corridors” refer to the eight rivers that flow into Baiyangdian Lake and one river out. The river system includes levees on the river banks that will be deconstructed to allow the river to return to its natural form as a productive wetland. With this restoration, the loss in food production will result in newly productive wetlands and riverain forests. According to the specific elevation of the residential areas, flood control embankments will be built at two to three meters in height to proctect the surrounding villages. Scattered wetlands and woodlands will

help form a sponge system of seasonal rivers that replenish groundwater and reduce flooding.

3) “One Ring” is a 1.2 kilometer wide ecological habitat belt around the Baiyangdian Lake Dike. This part of the lake was a flood retention area that was later converted to cultivated lands. The restored ecological park belt will serve as a drainage and flood retention area for the city, and a recreational destination for the local residents.

4) The “Four Wetlands in the Levees” are four artificially restored wetlands within the ecological belt: these are areas that have been frequently flooded and confined within levees. The storage capacity of the restored wetlands is expected to reach 100 million cubic meters and supply spaces for leisure and recreational activities within the community. This ensures flood prevention by alleviating urban-water isolation.

With ecological flood controls, the Baiyangdian Lake and other low-lying areas can be used as 2.5 billion cubic meters of potential flood storage areas. The largest flood storage area of the downstream of the Baiyangdian Lake could reach two billion cubic meters. Together, the 4.5 billion cubic meters of total storage capacity is enough to cope with a 100-year flood event. Large-scale regional floods also benefit from joint prevention and control of the lake-reservoir-retention area.

3.2 Morphological Strategy: A Pond System and Water-City Blending in the Decentralized Floodplains and Stormwater Adaptive Neighborhoods

The core strategy is to decentralize stormwater management through cut-and-fill to form multi-pond wetlands, drainage blocks, and resilient sponge city. The plan also considers livability with externally clean water passing through the city to create ecologically livable urban forms that blends the city with water.

1) Construct flood-adaptable city blocks: Establish a decentralized flood control system based on traditional knowledge through in-situ cut and fill, alternate urban highland groups, and distributed low-lying ponds. Design roads to be elevated boundary levees for divisional flood control and drainage that can also absorb on-site rainfall to create a unit storage pattern at a neighborhood scale; Raise the bottom of the building overhead to an elevation of 12.5 meters and make the second-floor level connected into a sort of city street while meeting the needs of a 200-year flood prevention.

2) Blend water and city: During periods of severe water shortages, it is necessary to transfer water to the city where it can be used multiple times. The “South-to-North Water Transfer Middle Line Project” and the “Yellow River Diversion to Replenish Baiyangdian Lake Project” will together transport one million cubic meters of water per day to the new city. The clean water will be introduced into the pond network and green urban streets to ensure perennial clean water throughout the city. The water will then move through the Baiyangdian Lake outside the embankment. This diversion will greatly improve water quality and mitigate seasonal drought and flooding to form a livable city. According to preliminary calculations, the sponge on each block will absorb at least 1,000 cubic meters of urban runoff, enough to withstand a 20-year rainstorm event for 24 hours. With an additional 25 million cubic meters of capacity, the wetland system within the embankment could easily cope with a 50-year rainstorm event for 24 hours.

3.3 Processing Strategy: Contamination to Fertilizer through a Closed Nutrition Chain that Combines Water Purification and Green Energy Production

The function of the Baiyangdian Lake will transform from a nature reserve to a productive wetland and a cultural landscape that has been developing for over a thousand years. The native reeds will purify the water of the lake while generating biomass fuel. This will not only reduce coal consumption and alleviate air pollution, but also help form an industrial chain that combines water, ecological restoration, environmental protection, and green energy production to reintroduce the unique local cultural landscape of the Xiong'an New District.

Based on initial calculations, 14.7 tons of nitrogen and 0.72 tons of phosphorus can be removed from the water by every 1,000 tons of reeds, and the biomass created can replace 883 tons of coal and reduce SO_2 emissions 2.67 tons. The lake area currently produces 100,000 tons of reeds per year. If fully utilized, it can absorb 1,470 tons of nitrogen and 72 tons of phosphorus per year. The biomass fuel created can replace 88,300 tons of coal and reduce SO_2 emissions by 267 tons. The current water quality of the Baiyangdian Lake can be upgraded to a Class III Surface Water Standard through the natural purification of the reeds in about three years. In addition, municipal sewage in the Xiong'an New District can be purified by combining sewage treatment plants with constructed wetlands to save energy consumption.

1. 格局策略：“一心九廊四湿地，海绵国土、城水相依”的开放式防洪与水资源安全格局。
2. 形态策略：多塘串联，构建街区防洪排涝单元；净水穿城，构建水城交融的生态宜居城市形态。
3. 形态策略：将建筑底层架空至12.5m高，作为社区活动空间；二层楼板达到200年一遇洪水高度，并将二楼裙房连成第二街道。
4. 过程策略：“化污为肥，营养循环”的“绿色能源生产示范基地”，经过约三年时间，即可通过芦苇自然净化将目前淀内的V类水质提升至地表水标准的III类水。

1. Ecological security pattern strategy: An open flood management system and water environmental security pattern of the Xiong'an New District are established with a sponge city strategy to "integrate the new town with the Baiyangdian Lake area by introducing one heart, nine corridors, and four wetlands."
2. Morphological strategy: A pond network acts as a flood retention, water filtration, and drainage system of the Xiong'an New District.
3. Morphological strategy: In the proposal, the ground floor of buildings would be elevated to 12.5 meters high and provide space for community activities, while the elevation of the second floor being supposed to above the water level of a 200-year flood event. Besides, the connected second floor corridor of buildings can be connected to form a sort of street.
4. Processing strategy: The Xiong'an New District will become a demonstration site of green energy utilization and resource recycling, where the water quality of the lakes can be improved from Class V into Class III Surface Water Standard by planting contaminant-adsorption vegetation like reeds.