

A Comparative Study of Landscape Design for Urban Waterfront Parks in Beijing and Minsk from an Ecological Perspective

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Abstract: Urban waterfront parks are situated at the intersection of water bodies, land, and urban built environments, offering multifaceted value in improving the urban ecological environment, organizing public activities, and shaping the local landscape. Waterfront spaces formed under different natural conditions and urban development contexts exhibit distinct differences in ecological design concepts and their modes of expression. Taking ecological principles as the starting point, this paper selects the Winter Olympics Park along the Yongding River in Beijing and Victory Park along the Svisloch River as well as the Komsomolskoye Lake waterfront space in Minsk as subjects for comparison. The analysis examines aspects such as spatial structure, shoreline treatment, plant arrangement, stormwater management, pedestrian and bicycle systems, and expressions of local culture. The study found that the Beijing case places greater emphasis on ecological restoration, the integration of blue and green spaces, and the multifunctional use of infrastructure, demonstrating a strong sense of systemic coherence; the Minsk case, meanwhile, continues the urban water-green framework jointly formed by rivers and large-scale green spaces, exhibiting distinctive characteristics in terms of natural landscape continuity, the creation of open spaces, and seasonal landscapes. Although both cases emerged from different urban environments, they both exhibit a trend shifting from simple landscape beautification toward the synergistic development of ecological processes and public life. Based on the comparative results, the article proposes design approaches such as strengthening the ecological transition between land and water, enhancing the resilience of waterfront spaces, preserving regional landscape characteristics, and establishing continuous public spaces, thereby providing a reference for the renewal of waterfront parks in cold-temperate and temperate cities.

Keywords: Ecological concepts; waterfront parks; landscape design; Beijing; Minsk; comparative study.

1. Introduction

Waterfront spaces are among the areas where the urban natural system and the built environment are most closely interconnected [1]. Rivers, lakes, and their surrounding green spaces not only serve ecological functions such as water storage, drainage, and habitat maintenance but also serve as important venues for residents' daily recreation and urban public life. As urban development practices have evolved, the design objectives of waterfront parks are no longer limited to greening and aesthetic appeal but have begun to focus on aquatic ecosystem restoration, stormwater adaptation, biodiversity, and the reestablishment of the relationship between humans and nature.

Beijing and Minsk exhibit distinct differences in urban scale, historical background, and landscape culture; however, both cities have developed significant green open spaces based on their river systems. Beijing is located in a warm-temperate, semi-humid, and semi-arid monsoon climate zone, where water resources and seasonal precipitation variations significantly influence the design of waterfront spaces; Minsk is situated on the East European Plain, with abundant urban green spaces [2]. The Svisloch River runs through the city center and, together with the parks along its banks, forms a continuous urban landscape structure. Therefore, a comparison of the two cities allows us to observe how different natural conditions and urban development traditions influence the design of waterfront parks.

This paper selects the Yongding River section of the Beijing Winter Olympics Park and the waterfront space of

Minsk's Victory Park—Komsomol Lake—for a comparative case study. The research does not simply judge which of the two models is superior or inferior; rather, by analyzing their ecological design approaches, it discusses how waterfront parks can harmonize ecological functions, recreational needs, and regional identity, and further summarizes landscape design experiences that offer valuable insights.

2. Ecological Concepts and Landscape Design of Urban Waterfront Parks

2.1. The Shift from Landscape Construction to Ecological Processes

Traditional waterfront landscape design placed greater emphasis on visual composition, creating aesthetically pleasing waterfront spaces through paths, plazas, greenery, and landscape amenities. With the introduction of ecological principles, the scope of design has gradually expanded from individual landscape nodes to ecosystems composed of water bodies, shorelines, vegetation, soil, and biological communities [3]. Under this approach, riverbanks are no longer merely a boundary between water and land but are viewed as transitional zones that facilitate material exchange, connect habitats, and regulate stormwater runoff. Designs must account for shoreline changes under varying water levels and create a more complete aquatic-terrestrial ecological gradient through the use of wetland plants, gentle slopes, and water retention areas. Ecological principles have also transformed the evaluation criteria for plant landscapes. In addition to color, seasonal changes, and spatial

composition, plant selection must also prioritize the proportion of native species, community stability, and the ability to provide habitats for birds and insects. As a result, waterfront parks are gradually evolving from artificially landscaped urban green spaces into green infrastructure capable of participating in urban ecological cycles.

2.2. Balancing Ecology and Public Access

Waterfront parks are characterized by high openness and a diverse user base. Overemphasizing ecological conservation may reduce spatial accessibility, while development focused solely on recreational activities may disrupt riparian habitats. Therefore, ecological design does not exclude human use but rather determines appropriate activity intensities in different spaces [4]. More natural riverbank and wetland areas can minimize human disturbance and prioritize ecological conservation; in areas with high population density, continuous walking trails, waterfront platforms, and rest areas can be provided. Through spatial zoning, maintaining an appropriate distance between ecologically sensitive areas and high-intensity public activities while still allowing residents to access and experience the water is a key feature of modern waterfront park design.

3. Characteristics of the Beijing and Minsk Case Studies

3.1. Yongding River Waterfront Space at the Beijing Winter Olympics Park

The Beijing Winter Olympics Park is located along the Yongding River in western Beijing and was formed by integrating multiple existing parks and riverside spaces. Its defining feature is its use of the river's ecological space as a foundation to connect green spaces, wetlands, public activities, and industrial heritage sites. The open spaces created along the river have transformed the previously relatively isolated relationship between certain urban areas and the river, gradually transforming the waterfront from the urban periphery into an accessible and usable public landscape. In terms of ecological design, the park largely preserves the original vegetation and topography, utilizing wetlands, gently sloping shorelines, and continuous green spaces to create transitions between land and water.

Components such as the Yongding River Recreational Forest Park feature high vegetation coverage, while facilities like constructed subsurface flow wetlands further enhance the ecological functions of the waterfront green spaces. In terms of spatial use, a continuous pedestrian and bicycle network connects various landscape nodes, allowing activities such as running, cycling, walking, and water-based recreation to take place within the same waterfront space. At the same time, the integration of Shougang's industrial heritage, railway relics, and Winter Olympics landscape elements into the park system ensures that ecological restoration does not completely erase the city's original memory, but rather creates a spatial character where natural landscapes coexist with industrial culture.

3.2. Minsk Victory Park and the Svisloch River Waterfront

The Svisloch River flows through downtown Minsk, forming an important urban water and green space together with Komsomol Lake and numerous parks along its banks. Victory Park occupies a key position within this continuous system, where extensive bodies of water, wooded areas, lawns, and open activity spaces collectively create an urban landscape with a strong sense of nature. Compared to the Beijing case, Minsk's waterfront landscape exhibits a more pronounced tradition of European urban parks. Vast lawns, tall trees, and open water surfaces form the primary landscape foundation. The park space is not fragmented by a large number of landscape structures but is organized primarily through vegetation, topography, and water bodies. The dense greenery in spring and summer, coupled with distinct seasonal changes in fall and winter, makes vegetation a key factor in shaping the character of the place. However, certain sections of the Svisloch River in the city center exhibit strong signs of engineering intervention [5]. Some sections of the shoreline feature hard revetments, which to some extent restrict the ecological transition between land and water; although there are relatively abundant public green spaces along the river, there are still issues of insufficient connectivity between different spaces in some areas. This also indicates that there is still room for further optimization of the traditional urban water-green structure within the context of new ecological design.

Table 1. Comparison of Basic Characteristics Between the Beijing and Minsk Cases

Comparison Criteria	Beijing Winter Olympics Park—Yongding River	Minsk Victory Park—Svisloch River
Water Body Type	Large urban river and riparian wetlands	Urban rivers and artificial lakes
Landscape Context	Rivers, wetlands, woodlands, industrial heritage sites	Rivers, lakes, woodlands, and large grassy areas
Spatial Form	Ribbon-like riverside spaces, a continuous sequence of multiple parks	A water-and-greenery axis linking multiple urban parks
Shoreline Characteristics	Coexistence of natural and engineered shorelines	Coexistence of natural shorelines and hard revetments
Main Activities	Running, cycling, leisure, and cultural experiences	Walking, cycling, leisure, and waterfront activities
Cultural Expression	Yongding River culture, industrial heritage, Winter Olympics elements	Urban History, Commemorative Landmarks, Eastern European Park Traditions
Ecological Priorities	Ecological restoration, wetland development, integration of blue and green spaces	Continuity of Water and Greenery, Vegetation Landscapes, Protection of Open Spaces

4. Comparison of Waterfront Park Landscape Designs in the Two Locations Based on Ecological Principles

4.1. Spatial Structure: Networked Integration and Continuity of Water-Green Axis

A prominent feature of the Beijing case is “integration”. Along the banks of the Yongding River, there were originally parks, roads, industrial sites, and urban spaces developed during different periods. The Winter Olympics Park reorganizes these relatively dispersed spaces through riverside green belts and pedestrian and bicycle routes. Its design logic is not to rebuild an isolated park, but to form a larger scale riverside network through linear ecological spaces. Minsk, on the other hand, is characterized by the strong continuity inherent in its urban water-green structure. The Svisloch River, serving as the urban spatial framework, forms a continuous relationship with Komsomol Lake, Victory Park, and other green spaces in the city center. [6] The river not only serves as a water body but also plays a role in organizing urban public spaces. Its advantage lies in the fact that green spaces and water bodies maintain a relatively large spatial scale in the city center, allowing natural landscapes to penetrate deep into the urban fabric. Therefore, Beijing’s approach is more about reconnecting fragmented urban spaces, while Minsk’s is about extending and maintaining the existing water-and-green framework.

4.2. Waterfront Design: Different Emphases on Ecological Restoration and Landscape Accessibility

The shoreline is the aspect where differences in the ecological design of waterfront parks are most evident. In recent years, Beijing’s waterfront landscape development has placed greater emphasis on ecological shorelines, creating a rich interface between land and water through gentle slopes, wetland vegetation, and varying water depths. Similar concepts are also common in other large ecological parks in Beijing, where wetland plants are arranged according to

different habitats—such as marshes, shallow waters, and submerged zones—to combine water purification with landscape design. The area surrounding Minsk Victory Park features relatively open waterfront landscapes with strong visual connections between people and the water; however, traditional engineered revetments remain in some sections [7]. Hardened shorelines help maintain a neat urban interface and are well-suited for high-intensity public use, but their capacity for ecological exchange between land and water is relatively limited. From an ecological design perspective, both areas could be further enhanced in the future by adding submersible gentle slopes, shoals, and zones of wetland vegetation. While ensuring flood control and public safety, this would transform the riverbanks from clearly defined artificial boundaries into ecological transition zones of a certain width.

4.3. Planting Design: Multi-layered Communities and Seasonal Landscapes

Plant design in Beijing’s waterfront parks is influenced by climate, water resources, and ecological restoration needs; in recent years, greater emphasis has been placed on combinations of trees, shrubs, grasses, and wetland plants. Multi-layered plant communities reduce exposed ground and provide habitats for diverse organisms. For Beijing, which is relatively sensitive to water resources, drought-tolerant, cold-hardy, and low-maintenance plants hold greater practical value. In contrast, Minsk’s plant landscapes exhibit distinct characteristics of a temperate continental climate [8]. Large-scale lawns and mature trees form the core of the parks, with relatively open spaces beneath the canopy. In summer, they form a dense green backdrop; in autumn, they offer a rich variety of foliage colors; and in winter, the branches and trunks of deciduous trees, combined with the snow and ice, create a distinctive seasonal landscape. Beijing’s strengths lie primarily in its rich diversity of plant communities and complex ecological functions, while Minsk is characterized by its mature trees, large-scale green spaces, and natural seasonal variations. These two models demonstrate that there is no single, uniform approach to ecological landscape design; the key lies in establishing plant communities adapted to local climate, soil, and moisture conditions.

Table 2. Comparison of Ecological Design Elements in Waterfront Parks of the Two Cities

Evaluation Dimensions	Beijing Case	Minsk Case	Comparative Insights
Connection of Blue-Green Spaces	Strong, with an emphasis on the integration of riverside spaces	Strong, relying on existing water-green axes	Both emphasize continuity
Naturalization of the shoreline	Ecological restoration is a prominent feature	Some areas still feature distinctly engineered shorelines	Beijing’s ecological transformation is more proactive
Wetland Utilization	Relatively prominent	Relatively limited	Beijing places greater emphasis on water purification and stormwater management functions
Plant Seasonal Variation	Rich in spring, summer, and fall scenery	Seasonal changes are more pronounced	Minsk exhibits distinct cold-climate characteristics
Habitat Creation	Emphasis on multi-layered vegetation and land-water transitions	Leveraging large-scale forested areas and water bodies	Different Implementation Approaches
Pedestrian and Bicycle Network	Long-distance, continuous routes that highlight	Tightly integrated with the urban park system	All possess a strong public character
Cultural Landscapes	A blend of industrial, Winter Olympics, and river culture	Prominent commemorative and urban historical elements	All exhibit distinct regional characteristics

4.4. Stormwater Adaptation: Proactive Storage and Utilization of Natural Substrates

Precipitation in Beijing is distinctly seasonal, and waterfront green spaces must address both runoff during the rainy season and daily water shortages. Therefore, wetlands, sunken green spaces, permeable surfaces, and ecological shorelines not only provide landscape value but also serve to regulate stormwater runoff. This design clearly embodies the concept of landscaping infrastructure. Minsk boasts relatively abundant natural green spaces and water systems; its extensive lawns, woodlands, and water bodies inherently possess a certain capacity for rainwater infiltration and retention. Its strengths stem more from the large-scale green infrastructure preserved within the urban fabric than from a large number of visible engineering facilities. This difference reflects how ecological design must respond to specific environmental pressures [9]. In regions with water scarcity, concentrated rainfall, and high urban development density, stormwater facilities must be integrated more proactively; in cities with a solid foundation of green spaces, priority should be given to protecting the existing natural base to prevent excessive development from diminishing the original ecological regulation capacity.

4.5. Public Activities and Expressions of Local Culture

An ecological park does not imply a reduction in human activity. The Beijing Winter Olympics Park connects multiple functional spaces through long-distance pedestrian and bicycle routes, making sports an integral part of public life along the waterfront. At the same time, the preservation of industrial heritage allows visitors to experience the city's industrial transformation process, creating a sense of place distinct from that of typical natural parks. The public spaces in Minsk's Victory Park place greater emphasis on everyday life. Spacious lawns, tree-lined paths, and waterfront walkways offer relatively unrestricted ways to engage with the space; people can stroll, linger, cycle, or admire the

waterfront views. The interconnection between commemorative landscapes and public green spaces also allows the city's history to naturally integrate into daily life. Together, these examples demonstrate that an ecological approach does not imply the complete "renaturalization" of waterfront spaces [10]. A truly vibrant waterfront park should strike a balance between ecological conservation and public use, allowing natural processes to continue while encouraging residents to use the space over the long term.

5. Comparison Results and Implications for Waterfront Park Design

The comparison reveals that although Beijing and Minsk differ in their natural environments and urban development contexts, their waterfront parks have both taken on functions that go beyond those of traditional recreational green spaces. Rivers serve not only as ecological corridors but also as public spaces and carriers of urban culture.

The value of Beijing's experience lies primarily in ecological restoration and the integration of multiple systems. Faced with a high-density urban environment and a complex land-use context, connecting wetlands, forests, pedestrian and bicycle networks, industrial heritage sites, and sports facilities via the river can enhance the comprehensive benefits of limited urban land. However, the design must still avoid allowing excessive artificial structures to encroach on natural spaces, ensuring that areas of genuine ecological value retain a certain degree of tranquility. The insights from Minsk stem more from the preservation of large-scale green spaces. Mature woodlands, lawns, water bodies, and a network of contiguous parks collectively form a relatively stable urban ecological foundation. Such spaces do not require the continuous addition of landscape structures; instead, greater emphasis should be placed on protecting existing natural resources. For localized areas of hardened shorelines, a gradual approach to ecological restoration can be adopted rather than completely altering the original landscape structure.

Table 3. Areas for Mutual Learning in the Design of Waterfront Parks in Beijing and Minsk

Design Issues	Beijing Can Learn from Minsk	What Minsk Can Learn from Beijing
Creation of Natural Spaces	Reduce excessive design and preserve open, natural spaces	Strengthen the systematic organization of different ecological spaces
Shore Management	Maintain some simple, open urban waterfronts	Add ecological gentle slopes, wetlands, and shallow areas
Planting Design	Enhance the presence of mature trees and natural seasonal expressions	Add multi-layered vegetation and wetland communities
Stormwater Design	Enhance the self-regulating capacity of natural substrates	Introduction of Decentralized Stormwater Management Facilities
Public Spaces	Increase Unplanned, Freely Accessible Spaces	Enhancing the Continuity of the Waterfront Pedestrian and Bicycle Network
Cultural Expression	Strengthen the integration of local cultural heritage into the natural landscape	Integrating historical and cultural considerations with ecological restoration

Based on the above comparison, future urban waterfront park design can focus on three key areas.

First, shift from "shoreline design" to "land-water system design." The scope of design should not be limited to the riverbank's edge but should treat rivers, wetlands, green

spaces, and surrounding urban areas as an integrated system, creating different spatial gradients based on water levels and usage intensity.

Second, avoid formalizing ecological landscapes. Ecological design is not merely about adding wetlands,

wooden boardwalks, or planting large quantities of vegetation; rather, it involves allowing natural processes to genuinely participate in the functioning of the space. Whether plants can adapt to the environment, whether rainwater can naturally infiltrate the soil, and whether organisms can establish stable habitats are far more important than superficial “ecological aesthetics.”

Third, the unique landscape characteristics of each city should be preserved. Beijing’s river culture, industrial heritage, and history of modern urban development, as well as Minsk’s large-scale green spaces, cold-climate seasonal changes, and urban water-green structure, should not be replaced by a uniform design language. Ecological design must ultimately respond to the specific context of each site, rather than replicating a fixed model.

6. Conclusion

The waterfront parks in Beijing and Minsk emerged from different natural conditions and urban development contexts, but their evolution reflects a trend in urban landscape design shifting from a mere pursuit of visual effects toward the coordinated development of ecological functions, public life, and local culture. The Beijing case exemplifies ecological restoration, blue-green networks, and the integration of multiple functions, while the Minsk case highlights the value of continuous water-green spaces, large-scale natural foundations, and distinct seasonal landscapes. There is no simple hierarchy of superiority or inferiority between these two models. For waterfront parks, the key to effectively implementing ecological principles lies in respecting the river’s natural processes, selecting appropriate design methods based on climate and site conditions, and establishing a reasonable balance between ecological conservation and public use. Through the coordinated organization of natural shorelines, continuous green spaces, site-appropriate vegetation, and pedestrian and bicycle networks, waterfront parks can transform from mere recreational spaces into vital components of the urban ecosystem, thereby forming public landscapes with distinct regional identity and long-term adaptability.

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