land

Article

Urban Waterfront Regeneration on Ecological and Historical Dimensions: Insight from a Unique Case in Beijing, China

Lulu Chen [1,2], Hong Leng [1,2], Jian Dai [1,2,*], Yi Liu [3,*] and Ziqing Yuan [4]

1 School of Architecture and Design, Harbin Institute of Technology, Harbin 150001, China; chenlulu@hit.edu.cn (L.C.); hitlaura@hit.edu.cn (H.L.)
2 Key Laboratory of National Territory Spatial Planning and Ecological Restoration in Cold Regions, Ministry of Natural Resources, Harbin 150001, China
3 School of Art and Archaeology, Hangzhou City University, Hangzhou 310015, China
4 Department of Geography, Faculty of Social & Historical Sciences, University College London, London WC1E 6BT, UK; ziqing.yuan.22@ucl.ac.uk
* Correspondence: daijianhit@hit.edu.cn (J.D.); liuyi@hzcu.edu.cn (Y.L.); Tel.: +86-182-0460-4598 (J.D.); +86-139-4518-7753 (Y.L.)

Abstract: To address current ecological issues and a lack of historical preservation in Beijing's waterfront, it has become necessary to establish an urban design project that optimizes these aspects. This study focuses on "Beijing's Waterfront Overall Urban Design," a project that integrates government requirements with Beijing's waterfront urban design characteristics and problems to establish an urban layer system from two dimensions: historical and ecological. It explores how the urban layer system can be applied to Beijing's overall waterfront urban design, from investigation to evaluation, analysis, visualization, and strategy development. First, an urban layer system for Beijing's waterfront was established from a historical perspective, based on urban setting and construction stages and space utilization, referring to the literature and field surveys. The evolution of urban layers of waterbodies, the water–city relationship, and water functions was systematically analyzed. Second, an urban layer system was established for the ecological dimension of Beijing's waterfront based on a literature review, expert interviews, and analytic hierarchy process methods. It included four urban layers: waterbody, greening, shoreline, and ecological function. The quality of the ecological urban design of 54 waterfront reaches in Beijing was evaluated using questionnaires and field surveys. Third, a series of urban layer maps was generated using the mapping method. Finally, urban design strategies were developed based on the combined historical and ecological characteristics and problems of Beijing's waterfront. The results of this study and the concept of an urban layer system for waterfront urban design can benefit waterfront urban design projects and future studies.

Keywords: urban layer system; Beijing's waterfront; overall urban design; historical dimension; ecological dimension

Citation: Chen, L.; Leng, H.; Dai, J.; Liu, Y.; Yuan, Z. Urban Waterfront Regeneration on Ecological and Historical Dimensions: Insight from a Unique Case in Beijing, China. *Land* **2024**, *13*, 674. https://doi.org/10.3390/land13050674

Academic Editor: Teodoro Semeraro

Received: 25 March 2024
Revised: 30 April 2024
Accepted: 11 May 2024
Published: 13 May 2024

1. Introduction

The urban waterfront serves as a bridge between artificial and water environments [1,2] with several salient ecological and sociocultural features. The waterfront includes the riverfront, lakefront, lake regions, coastal zones, and other spaces besides the waterbody [3]. Waterfronts of inland cities include riverfronts, lakefronts, and lake regions, such as those in Beijing, with 2616.75 km of riverfront and 41 lakes.

Since the 1970s, the United States and European countries have focused on regenerating urban waterfronts [4]. By the 1980s, urban design and placemaking on urban waterfronts played a major role in their regeneration [4]. Urban design can improve the functional [5,6], ecological [7–11], and historical quality [4,12] of waterfronts by optimizing their spatial features. At present, urban design projects on waterfronts are a worldwide trend, enhancing the waterfront and attracting visitors [13,14]. Some waterfronts in China have been redesigned and regenerated since 2010 and have now entered a new stage transfer from engineered channel reconstruction to ecological landscape space regeneration [8,15,16].

The focus of urban design projects for waterfront regeneration has included preserving river corridors [3,5,8], landscape planning and aesthetic design [11,17], optimizing waterfront accessibility [13], space vitality [18], revitalizing culture [4,16], and managing governance [19,20]. Most of these studies have focused on unique features of and significant issues in specific urban design waterfronts.

Beijing is a famous historical city, and its water system has a history of over 2500 years [20]. Beijing's water system acts as its spine, influencing the city's development and the establishment and location of streets, parks, and other public areas [12]. The current urban design of Beijing's waterfront has two outstanding issues, poor ecological quality and the historical patterns that have been erased over time [21].

Notably, cities' historical development has had a significant, dynamic impact on the transformation of the waterfront and water–city relationships [22], particularly urban waterfronts with a long history, such as Suzhou's waterfront [23], Nanjing's waterfront [24], and Beijing's waterfront. The water–city relationship can be strengthened by enhancing the cultural character of the waterfront [25]; the majority of historically oriented waterfront urban design projects thus concentrate on regenerating culture, preserving history, renewing waterfront functionality, and reshaping historical water systems [4]. Furthermore, the ecological and topographical contexts of waterways are crucial for waterfront urban design [11,26]. The urban waterfront establishes a balance between nature and city life for a sustainable urban eco-aesthetic and ecological function [27]. Most ecological urban design studies on the waterfront focus on biodiversity, water and shoreline restoration, greening, and landscape planning [3,8].

However, most of the existing studies on Beijing's waterfront regeneration focus on a single dimension of regeneration, such as landscape design [28–30], ecological regeneration [31], and cultural heritage [32]. There is a lack of studies that combine historical and ecological dimensions on urban waterfront regeneration design [21]. The combination of ecological restoration and historical preservation does not significantly increase the potential value of Beijing's waterfront.

Therefore, this study comprehensively investigates Beijing's waterfront regeneration from historical and ecological dimensions. The historical development and characteristics, ecological needs, and problems of Beijing's waterfront are systematically analyzed to define the main characteristics and problems of the waterfront [3,12,33].

This paper draws conclusions from a case study of an urban design project at "Beijing Waterfront Overall Urban Design." The project has resulted in "Urban Design Guidelines for Beijing Waterfront," which have been used to guide the subsequent implementation of the project.

When developing urban design strategies for waterfront regeneration projects, it is crucial to directly implement their investigation, evaluation, and analysis results. In addition, issues concerning and characteristics of the reaches of different waterfronts in the same waterway can vary greatly, from natural to human-made environments and from historic to modern blocks [34]. Different urban design projects have been established for different waterfront reaches—some relate to waterbody and shoreline ecological restoration; some are based on landscape aesthetics; and the rest are related to entertainment, commercial spaces, and residential development [35]. Simultaneously, a few are neglected [15]. Nevertheless, a few of the current studies on the implementation of urban waterfront regeneration have methodically investigated, analyzed, and assessed the issues and characteristics of each waterfront reach and applied it to the entire urban design process [11,13]. The urban layer system established by the authors' pre-research can work as a form of whole-process research on Beijing's waterfront regeneration [21,36].

Consequently, this study works as whole-process research on Beijing's waterfront regeneration from the two most critical dimensions: history and ecology. This study used the multi-dimensional urban layer system on ecological and historical dimensions for urban design surveys, evaluation, analysis, visualization, and strategy-making in Beijing's waterfront regeneration [21,36].

Two topics were explored: (1) What are the urban layers and elements affecting the historical and ecological dimensions of Beijing's waterfront urban design? (2) How do we emphasize the historical pattern of erasure over time, as well as the potential value of recovery, in conjunction with ecological patterns? The urban layer system, in conjunction with the mapping method, illustrates the examination of different waterfront reaches and distills the results into a series of maps for comparative analysis of Beijing's waterfront in general, and in reaches, specifically [36].

2. Methodology

2.1. Study Framework and Methods

This study investigated, analyzed, and strategized on the overall urban design of Beijing's waterfront from both historical and ecological perspectives. The study process was divided into four parts: (1) field survey; (2) construction of an urban layer system for Beijing's waterfront urban design based on separate historical and ecological dimensions; (3) analysis of the characteristics and issues of each urban layer and the elements of Beijing's waterfront urban design from historical and ecological perspectives using the mapping method; and (4) the proposal of strategies for ecological restoration and historical preservation in the overall urban design of Beijing's waterfront.

Regarding the historical dimension, this study extracted the urban layers of Beijing's waterfront urban design from the literature review to construct the historical dimension of the urban layer system of Beijing's waterfront. Subsequently, the mapping method was used to present the urban layers of the historical dimension on the maps.

Regarding the ecological dimension, this study collected urban elements using literature and expert interviews for the ecological dimension and then used the analytic hierarchy process (AHP) method to yield an urban layer system of Beijing's waterfront. This study evaluated the ecological quality of urban design in 54 waterfront reaches in Beijing using data collected through field surveys, questionnaires, literature, and open maps from 2020 to 2022. Finally, a series of maps obtained from the above study was used to analyze the issues and characteristics of historical and ecological dimensions of Beijing waterfront urban design and propose some urban design strategies (Figure 1).

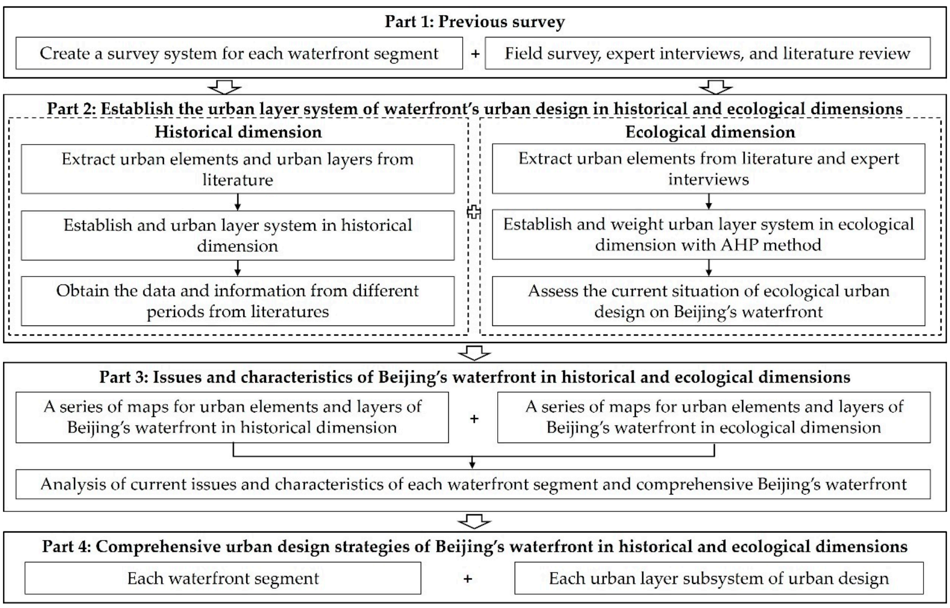


Figure 1. Study framework.

2.1.1. Field Survey

Firstly, a waterfront survey program was created for the Beijing Waterfront Regeneration Study. Secondly, based on existing research and the urban layer system for the waterfront proposed in this study, the survey group created a survey form that included waterbodies, shorelines, riparian areas, uplands, and ecological functions [3,11] (Table 1). A survey form was used to record the urban element characteristics of each waterfront reach in the field survey. Thirdly, owing to the large seasonal differences in Beijing's waterfront, this study conducted field surveys in different seasons from July 2020 to March 2022 to collect ecological urban design data from 54 waterfront reaches in four seasons.

Table 1. Survey form of each waterfront reach.

Waterfront Reach Number and Name	**Waterbody**	
	Water Quantity	**Waterbody's Width**
	☐ Abundant ☐ Suitable ☐ Less ☐ Dries up seasonally ☐ Dry all year round	☐ >20 m ☐ 15–20 m ☐ 10–15 m ☐ 5–10 m ☐ <5 m
Shoreline		
Channel form	**Riparian area form**	
☐ Concrete canal ☐ Concrete U-shape canal ☐ Natural waterline ☐ Landscaped covered concrete U-shape canal ☐ Terrain-formed canal	☐ Green buffer ☐ Sloped green flood protection buffer ☐ Sloped green flood protection buffer with linear path ☐ Natural flood protection buffer ☐ Landscaped flood protection buffer ☐ Stepped flood protection buffer ☐ Terraced park flood protection buffer	
Shoreline buffer	**Water access** (along the stretch)	
☐ Adequate buffer zone ☐ Wider buffer zone ☐ Some buffers ☐ Few buffers ☐ No buffer	☐ (Almost) total ☐ Partial ☐ Occasional ☐ Few ☐ None	
Riparian area and upland		
Riparian area vegetation	**Upland vegetation**	
☐ High vegetation coverage ☐ Medium vegetation coverage ☐ Low vegetation coverage ☐ Unvegetated	☐ High upland vegetation coverage, connected to channel ☐ Medium upland vegetation coverage ☐ Low upland vegetation coverage ☐ Unvegetated; no connection	
Ecological functions		
Ecological functions of waterbody		**Ecological functions of the waterfront**
☐ Water sources ☐ Scenic rivers ☐ Drainage channels		☐ Waterfront for city ☐ Waterfront for community ☐ Poor waterfront
Remarks		

Bold in the table means indicates the content and indicators of the field survey.

2.1.2. Construction of an Urban Layer System for Beijing's Waterfront Urban Design Based on Historical and Ecological Dimensions

(1) Construction urban layer system with historical dimensions by the literature review method.

Firstly, extensive scientific literature has been used to understand and analyze the historical evolution of Beijing's water system and create a diachronic urban layer system for Beijing's waterfront. The literature includes historical documents, research reports, and various local chronicles, such as the "Annals of Beijing" and other information from Beijing's Local Chronicle Museum. This theoretical framework for the urban waterfront layer system and the observational study results provides a research basis for analysis of waterfront urban design [36]. Secondly, an urban layer system with a historical dimension was developed using time periods that correspond to the development stages of Beijing's water system.

(2) Construction of an urban layer system with an ecological dimension by field survey and the expert interview method.

Firstly, the literature review and expert interview method was used to extract elements and layers of Beijing's waterfront ecological dimension within the urban layer system to increase the academic and localized validity of this study, as described in detail below. Secondly, this study used the AHP method to yield an urban layer system of Beijing's waterfront. Thirdly, this study evaluated the ecological quality of urban design in 54 waterfront reaches in Beijing using data collected through field surveys, questionnaires, literature, and open maps [36,37].

2.1.3. Visualization and Analysis Issues of Beijing's Waterfront in Historical and Ecological Dimensions by the Mapping Method

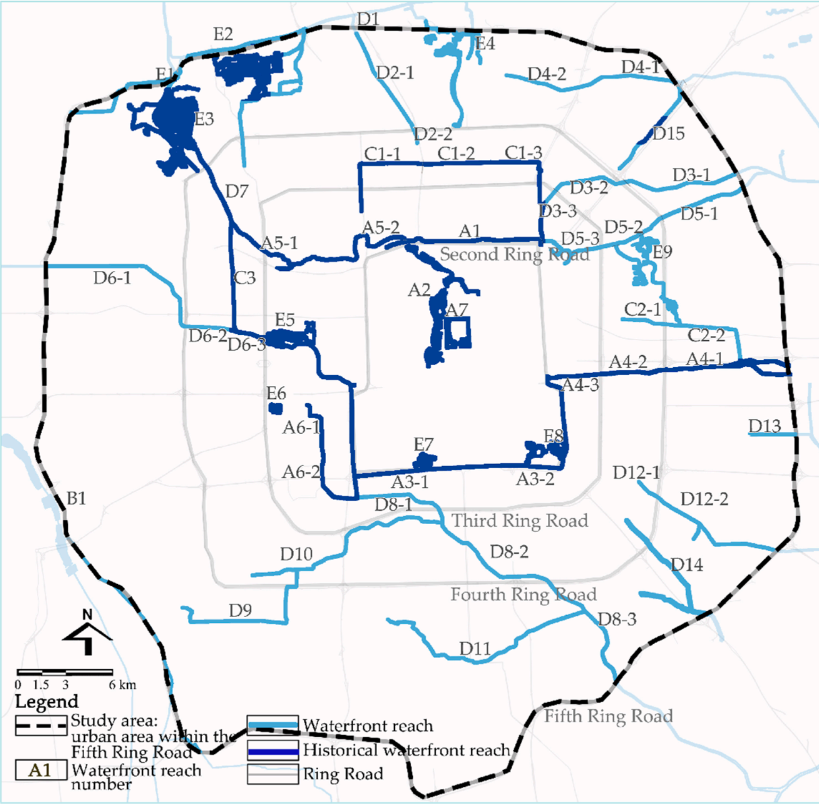
Firstly, a visualization of a series of maps for the urban elements and layers of Beijing's waterfront in historical and ecological dimensions was generated by mapping methods. The mapping method allowed us to visualize the geographic relationships among various issues faced by Beijing's waterfront. Using the method, we can independently present the analysis results for each urban layer and element of waterfront urban design on the same map, creating an overall urban layer system map using the overlay [36,37]. The mapping method also made it easier to apply the study results directly to the overall urban design of Beijing's waterfront. The "mapping for" method was used to study and display the historical dimensions of the urban layers and urban elements of Beijing's waterfront urban design on the base map. The ecological-dimensional urban layers and elements of Beijing's waterfront used the "mapping of" method to present directly on the base map.

Secondly, analysis issues and characteristics of each waterfront reach and a comprehensive view of Beijing's waterfront were defined. Isolating the urban layers and urban elements on the map appears to be a useful way to clarify the different dimensions of Beijing's waterfront and then graphically explain their relationship to the other urban layers through the urban layer map [21,36]. This initial layer relationship observation method was intended to support the creation of an urban layer system and obtain a well-informed proposal for Beijing's waterfront [21].

2.2. Study Area

This study focused on two areas. First, there is no uniformity in the study area in the historical dimension: it is composed of the urban scope of Beijing in different historical periods since the establishment of the city and is extracted from the literature on Beijing's waterfront in different historical periods.

Second, the study area in the ecological dimension focused on the waterfront on the Fifth Ring Road of Beijing. This study area was composed of 9 lakes and 26 rivers, with most being artificial, and some waterfronts in the east and the third ring road have been transformed. The drainage area covers over 1200 km^2 and has a total length of over 500 km. Issues on the waterfront could differ significantly from one position in the same river to another [3,10]. To maximize the relevance of this study, each waterfront was separated into a series of waterfront reaches by the main urban roads; there were 54 waterfront reaches in total (Figure 2). A waterfront reach, as defined in this study, was the area between the first set of municipal roads on both sides of the waterbody; it contains waterbodies, channels, riparian areas, and uplands. The waterbody, channels, and riparian areas comprise the shoreline (Figure 3). Channels refer to U-shaped embankments, excluding water bodies.



Waterfront Number	River Name
A1*	North Moat
A2*	Liuhai
A3*	South Moat
A4*	Tonghui River
A5*	Nanchang River
A6*	Lianhua River
A7*	Tongzi River
B1	Yongding River
C1*	Tucheng River
C2	Erdao River
C3*	Kunyu River
D1	Qing River
D2	Xiaoyue River
D3	Ba River
D4	Beixiao River
D5	Liangma River
D6*	Yongding River Diversion Canal
D7*	Jingmi River
D8	Liangshui River
D9	Macao River
D10	Fengcao River
D11	Xiaolong River
D12	Xiaotaihou River
D13	Tonghuibei River
D14	Dayangfang River
D15	Wangjing River
E1	Cuihu Wetland Park
E2*	Old Summer Palace
E3*	Summer Palace
E4*	Olympic Forest Park
E5*	Yuyuantan Park
E6*	Lianhuachi Park
E7*	Taoranting Park
E8*	Longtanhu Park
E9*	Chaoyang Park
* for historical waterfront reach	

Figure 2. The study area.

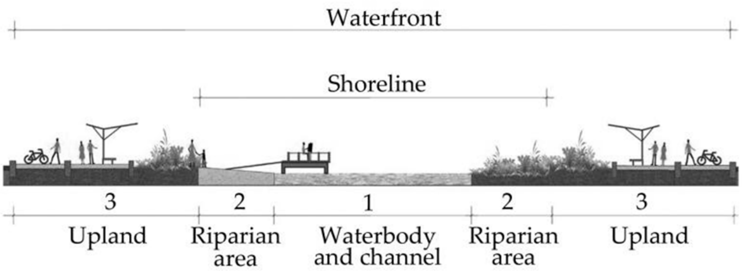


Figure 3. Profile of a waterfront reach.

2.3. Construction for Historical and Ecological Dimensions of the Urban Layer System

2.3.1. Urban Layer System of Urban Design

Urban elements and the connections between them in urban design are referred to as urban layers [36]. Each urban element's visualized, explicit information and non-visualized, hidden information are included in the urban layer; thus, a dynamic information operator is formed by elements with common properties [37]. Through superposition, related urban layers form an urban layer system [36]. This consists of several relatively independent layers, each of which may be connected to other layers. The effects of urban layers on urban design can be separate or interactive [36,37].

2.3.2. Construction for the Historical Dimension of the Urban Layer System

The content of the historical dimension of the urban layer system needs to be obtained from historical literature and documents. The analysis of historical data showed that the information on the waterbody, water–city relationship, and water function is more comprehensive and can support this study. Therefore, three layers—the waterbody layer, the water–city relationship layer, and the water function layer—were used to describe the historical dimension of the urban layer system in this study. The waterbody layer describes where waterways are, while the water function layer describes what waterways and waterfronts do. Water has always had an impact on the location, construction, and development of cities. As a result, this study examined the three layers mentioned above in three stages: urban siting, construction, and regeneration. Each stage is divided by dynasties.

2.3.3. Construction for the Ecological Dimension of the Urban Layer System

(1) Extraction of the ecological urban elements of Beijing's waterfront.

There are four criteria for extracting urban elements [10,38]: they should be (a) easy to evaluate; (b) easy in terms of obtaining information and data; (c) independent of other elements; and (d) crucial for ecological urban design quality, in this case that of Beijing's waterfront. Four urban layers were selected based on the literature: waterbody, greening, shoreline, and ecological function layers, containing a total of 13 elements. The literature that each indicator's selection was based on is listed in Table 2.

Table 2. The ecological dimension of the urban layer system of Beijing's waterfront.

Urban Layer	Urban Element (*i*)	Literature	Average Value (*Q*)	Standard Deviation (*SD*)	Coefficient of Variation (*CV*)
Waterbody	Water quality	Gao et al., 2019 [38]	3.47	0.499	0.144
	Water quantity	Gao et al., 2019 [38]	3.24	0.644	0.199
	Waterbody's width	Gao et al., 2019; Shi et al., 2018 [15,38]	3.18	0.617	0.194
Greening	Water access	Vian et al., 2021; Wang et al., 2019; Hermida et al., 2019; Shah and Roy, 2017 [3,10,11,39]	3.47	0.606	0.175
	Vegetation	Vian et al., 2021 [3]	3.53	0.606	0.172
	The connection between waterfront and urban green space	Hamidi and Moazzeni, 2019; Hermida et al., 2019; Shi et al., 2018 [10,15,40]	3.24	0.644	0.199
	Landscape quality	Chou, 2016 [8]	1.94	0.802	0.413
	Species	Hermida et al., 2019 [10]	2.06	0.802	0.390
Shoreline	Shoreline form	Vian et al., 2021 [3]	3.35	0.588	0.175
	Shoreline buffer	Chou, 2016; Vian et al., 2021 [3,8]	3.12	0.582	0.187
	Shoreline material	Vian et al., 2021; Hermida et al., 2019 [3,10]	2.29	0.749	0.326
Ecological functions	Ecological functions of waterbody	Vian et al., 2021; Wang et al., 2019 [3,11]	3.24	0.546	0.169
	Ecological functions of waterfront	Che et al., 2012; Chou, 2016; Wang et al., 2019 [8,11,13]	3.29	0.570	0.173

In this study, secondary extraction of urban elements was conducted using questionnaires. To evaluate the effects of urban elements, this study distributed ten expert questionnaires (ten valid ones returned) and ten local resident questionnaires (seven valid ones returned). The important of each urban element was assessed across four levels: unimportant, generally important, important, and extremely important. The ten experts were all planners and teachers from the Department of Urban Planning in China Architecture Design and Research Group and Harbin Institute of Technology. All ten local residents lived by or worked near the waterfront in Beijing, which ensured the localization and professionalism of identified urban elements. Excel software was used to analyze the questionnaires and obtain the average value, standard deviation, and coefficient of variation for each urban element (Table 2).

$$CV_{\mathrm{i}} = \frac{SD_i}{Q_i}, \tag{1}$$

where CV_i is the coefficient of variation of i, SD_i is the standard deviation of i, and Q_i is the average value of i. According to the selection principle [37,38], this study selected urban elements with $Q_i > 2.50$, and $CV_i < 0.200$. A ten-element, four-layer urban layer system was thus established for Beijing's waterfront urban design.

(2) Weighting for the ecological dimension of the urban layer system with the AHP method.

In this study, the waterbody, greening, shoreline, and ecological function layers were used to evaluate the ecological urban design quality of Beijing's 54 waterfront reaches. Urban layers and elements were analyzed using the AHP method. The weights of the elements were revealed by pairwise comparisons using a table matrix of relevant values. Nine-level scales were used for pairwise comparisons. The values and corresponding important levels in the nine-level scale were 1 = equally important; 3 = slightly more important; 5 = clearly more important; 7 = strongly more important; 9 = extremely more important; and 2, 4, 6, 8 = middle values [41].

There were ten expert questionnaires (all returned valid) for the weights that passed the consistency test.

$$CI = \frac{\lambda_{\max} - n}{n - 1}, \tag{2}$$

$$CR = \frac{CI}{RI} \tag{3}$$

where CI is the consistency index, CR is the random consistency ratio, RI is the average random consistency index, and n is the element count. The obtained weighting coefficients were suitable for $CR < 0.1$; in contrast, if $CR \geq 0.1$, it is necessary to re-evaluate the judgment matrix [37,39]. During the calculation, some expert questionnaires with a CR higher than 0.1 were corrected, and the weights were calculated (Table 3).

Table 3. The weights of the urban layer system in the ecological dimension.

Urban Layer	Weight	Urban Element	Weight	Data Source
1 Waterbody	0.2697	11 Water quality	0. 1598	"Water Quality Report of Beijing (2020)" from the Beijing Municipal Water Bureau
		12 Water quantity	0.0598	Field survey
		13 Waterbody's width	0.0501	Field survey and Baidu open map
2 Greening	0.4181	21 Water access	0.1779	Field survey
		22 Vegetation	0.1590	Field survey
		23 The connection between waterfront and urban green space	0.0812	Baidu open map
3 Shoreline	0.1833	31 Shoreline form	0.1386	Field survey
		32 Shoreline buffer	0.0447	Field survey
4 Ecological functions	0.1289	41 Ecological functions of waterbody	0.0788	"Function plan of Beijing surface water system" from the Beijing Municipal Water Bureau
		42 Ecological functions of waterfront	0.0501	Field survey

(3) Evaluation standards for the ecological dimension of the urban layer system.

Evaluation standards for each urban ecological element were established from the literature and field surveys (Table 4).

Table 4. Classes and rating of urban ecological elements.

Urban Layer	Urban Element and Literature Basis	Classes
1 Waterbody layer	11 Water quality [38]	I II III IV V

Table 4. *Cont.*

Urban Layer	Urban Element and Literature Basis	Classes
1 Waterbody layer	12 Water quantity [38]	Abundant Suitable Less Dry up seasonally Dry all year round
	13 Waterbody's width [15,38]	>20 m 15–20 m 10–15 m 5–10 m <5 m
2 Greening layer	21 Water access [3,11]	(Almost) Total Partial Occasional Few None
	22 Vegetation [3,11]	High upland vegetation coverage, connected to the riparian area High riparian area vegetation coverage, medium upland vegetation coverage; medium riparian area vegetation coverage, high upland vegetation coverage Medium riparian area vegetation coverage and upland vegetation coverage Low riparian area vegetation coverage and upland vegetation coverage Unvegetated; no connection
	23 The connection between waterfront and urban green space [3,11]	Waterfront adjacent to urban green space There are urban green areas within 100 m surrounding the waterfront There are urban green areas within 200 m surrounding the waterfront No connection
3 Shoreline layer	31 Shoreline form [3,8]	Natural Semi-natural Combination of natural and artificial Semi-artificial All artificial
	32 Shoreline buffer [3,11]	Adequate buffer zone Wider buffer zone Some buffers Few buffers No buffer
4 Ecological functions	41 Ecological functions of waterbody [3]	Water sources Scenic rivers Drainage channels
	42 Ecological functions of waterfront [8]	Waterfront for city Waterfront for community Poor waterfront

3. Results

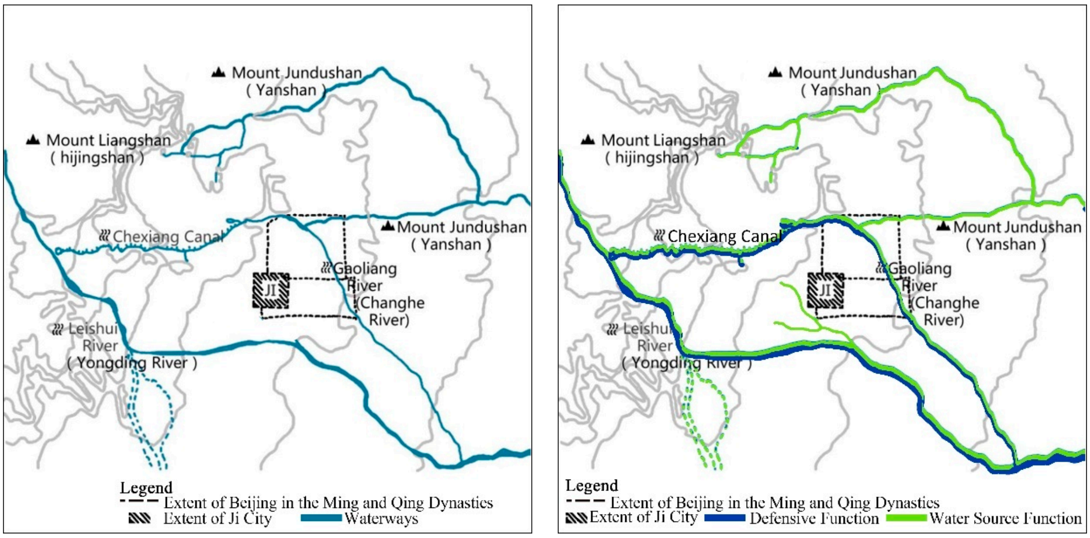
3.1. Historical Dimension of the Urban Layer System

This study summarizes the diachronic or historical evolution of Beijing's waterfront urban layer system based on the literature [42–44] and historical records [20]. The water environment layer system was divided into three layers: the waterbody layer, the water–city relationship layer, and the water function layer. The "mapping for" method was used to represent the water function layer, the water–city relationship layer, and the waterbody layer during the urban siting stage (B.C. 475–221), urban construction stage (B.C. 202–A.D. 1949), and urban regeneration stage (since A.D. 1949) on maps.

3.1.1. The Urban Layer System of Beijing's Waterfront during the Urban Siting Stage

The city of Beijing can be traced back to the Warring States period (B.C. 475–221). When the city was first sited, it was known as Ji, the capital of the State of Yan. Beijing's original site was on a small plain close to where water was available in the northwest corner of the North China Plain. To the north, west, and east of the city are mountains, while to the north and south are rivers [20].

For the waterbody and water–city relationship layers, Beijing originally had three waterways: the Chexiang Canal in the north, the Leishui River (now named Yongding River) in the south, and the Gaoliang River (now named Changhe River) in the center [42,44] (Figure 4). Meanwhile, Beijing's site layout, which is surrounded by mountains and faces waterways, is consistent with the traditional Chinese feng shui concept of "one water and three mountains" [43].



(**a**) (**b**)

Figure 4. The urban layer system of Beijing's water environment during the urban siting stage (B.C. 475–221): (**a**) the waterbody layer and the water–city relationship layer; (**b**) the water function layer.

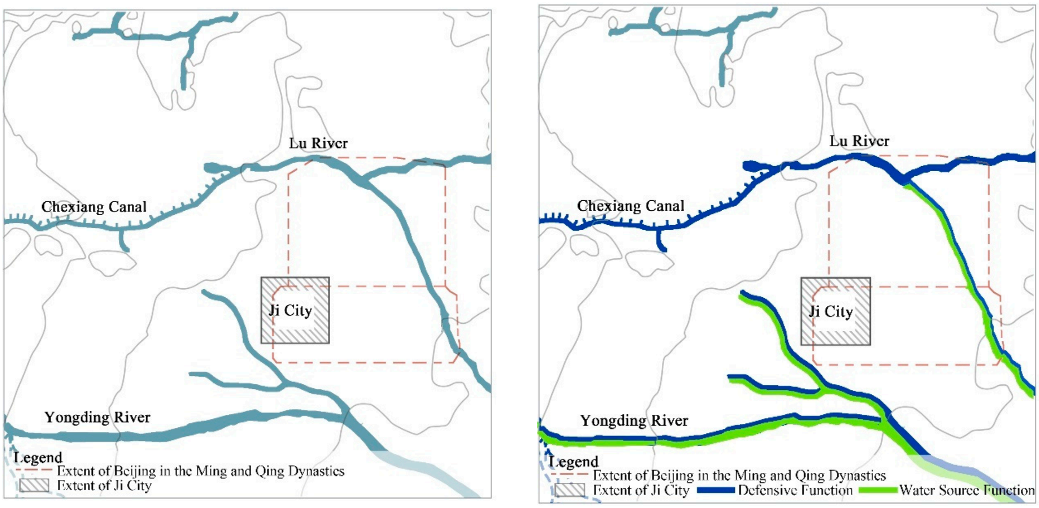
For the water function layer, the Leishui and Gaoliang Rivers provided water sources for the city, while the Chexiang Canal and Leishui River had defensive functions (Figure 4). In addition to the advantages of topography and water sources, Beijing's waterbodies provide a comfortable climate, such as moderate humidity and temperature.

3.1.2. The Urban Layer System of Beijing's Waterfront during the Urban Construction stage

During the urban construction stage, Beijing's waterways and waterfronts went through a series of constructions and transformations. This study examines the urban layer system during a period of critical change in the water system.

First, Beijing was known as Ji and Youzhou during the Han Dynasty (B.C. 202–A.D. 220) and the Three Kingdoms period (A.D. 220–280). The city carried out the first large-scale canal construction project, which changed the water–city relationship and water function. The city used the Wenyu River as a transport function; opened canals from the Yongding River to divert water into the city to provide water sources and irrigation; built the Liling Weir as a defensive function; and dug the Chexiang Canal, connected to the Gaoliang

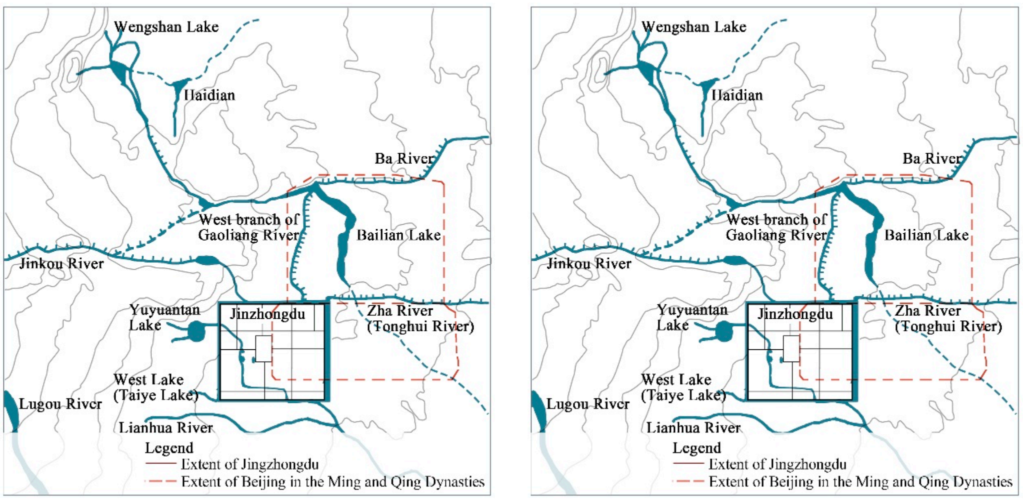
River [42,43] (Figure 5). The water–city relationship became closer during this period, and water functions began to increase.



(**a**) (**b**)

Figure 5. The urban layer system of Beijing's water environment during the Han Dynasty (B.C. 202–A.D. 220) and the Three Kingdoms period (A.D. 220–28): (**a**) the waterbody layer and the water–city relationship layer; (**b**) the water function layer.

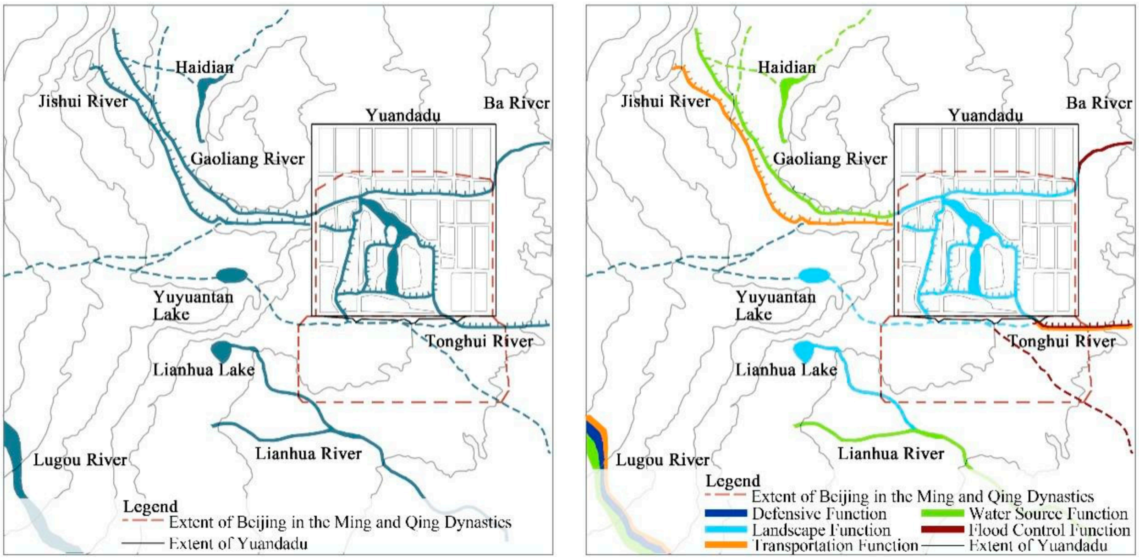
Second, during the Sui and Tang Dynasties (A.D. 581–907), the city of Beijing built the Yongji Canal connected to the Wei River, a model for the later Grand Canal, establishing a water transport system. During the Jin Dynasty (A.D. 1115–1234), the city was the capital of Jin, called Jinzhongdu, and was developed as an imperial city. The Tonghui River and a moat were built around the city. The Tonghui River provided water source and drainage functions, while the moat provided water source, defense, and landscape functions. Jinzhongdu established a complete drainage and flood control water system [20]. Based on these transformations, a water system pattern dominated by the Yongding and Gaoliang rivers, which are still present today, was created in Beijing [44] (Figure 6).



(**a**) (**b**)

Figure 6. The urban layer system of Beijing's water environment during the Jin Dynasty (A.D. 1115–1234): (**a**) the waterbody layer and the water–city relationship layer; (**b**) the water function layer.

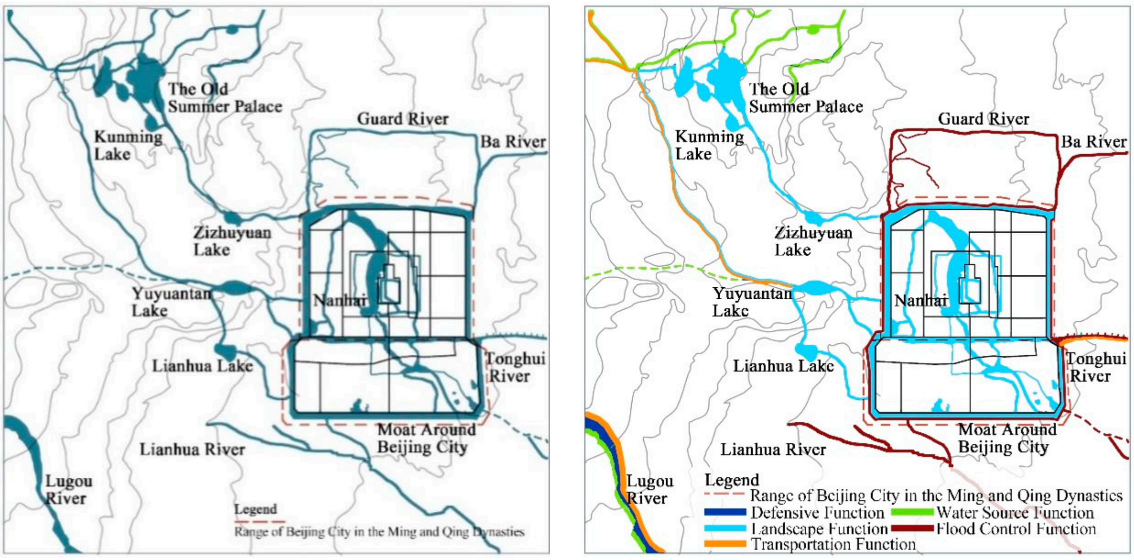
Third, during the Yuan Dynasty (A.D. 1271–1368), as the city expanded, it was the capital of Yuan, called Yuandadu, and underwent extensive water system construction to establish water sources both inside and outside the Forbidden City, particularly the Goryang River system in the north [20,44] (Figure 7).



(**a**) (**b**)

Figure 7. The urban layer system of Beijing's water environment during the Yuan Dynasty (A.D. 1271–1368): (**a**) the waterbody layer and the water–city relationship layer; (**b**) the water function layer.

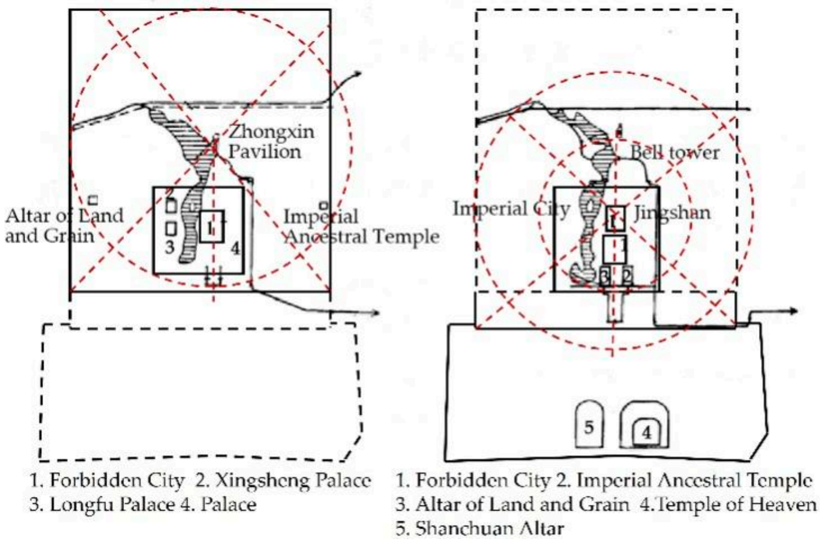
During the Ming and Qing dynasties (A.D. 1368–A.D. 1911), the water system pattern of Beijing city became stable and similar to its present form (Figure 8). The water system in this period was mainly for landscape functions, particularly the newly built Imperial Palace facilities, such as the Summer Palace [42,43].



(**a**) (**b**)

Figure 8. The urban layer system of Beijing's water environment during the Ming and Qing dynasties (A.D. 1368–1911): (**a**) the waterbody layer and the water–city relationship layer; (**b**) the water function layer.

The water–city relationship layer of Beijing's water environment experienced significant change during the urban construction stage. On a macroscopic scale, Beijing's urban form was established based on waterways from ancient times to the present, and the central axis of the urban space was the waterbody; the spatial planning structure of the Forbidden City was also centered around the water [43] (Figure 9). On a mesoscopic scale, the spatial layout of Beijing's blocks was also planned with consideration to water and topography, such as blocks adjacent to water, which formed many inclined streets [44].



(**a**) (**b**)

Figure 9. The water–city relationship layer of Beijing: (**a**) during the Yuan Dynasty; (**b**) during the Ming and Qing dynasties.

3.1.3. The Urban Layer System of Beijing's Waterfront during the Urban Regeneration Stage

In the urban regeneration stage, the waterbody layer and the water–city relationship layer is stable, while the water functional layer becomes critical and complex. In the Ming and Qing dynasties, the urban waterfront began to see more human activities, which were included in the landscape function. In the Republican period, activities on the waterfront began to exhibit seasonal characteristics: the waterfront offered leisure activities such as ice skating during the winter, and shipping, running, fitness, fishing, singing, and other activities during other seasons [44]. In the urban regeneration stage, the water functions in Beijing mainly contribute to landscape and drainage (in the city) and water sources (in the countryside). All Beijing's waterfronts in the urban regeneration have landscape functions. Only the Kunyu River still serves as a means of water transportation, but it is more for sightseeing than for transport (Figure 10). Beijing's waterfront urban design should consider attracting more people by enhancing historical features as waterfronts become the site of increasingly more activities.

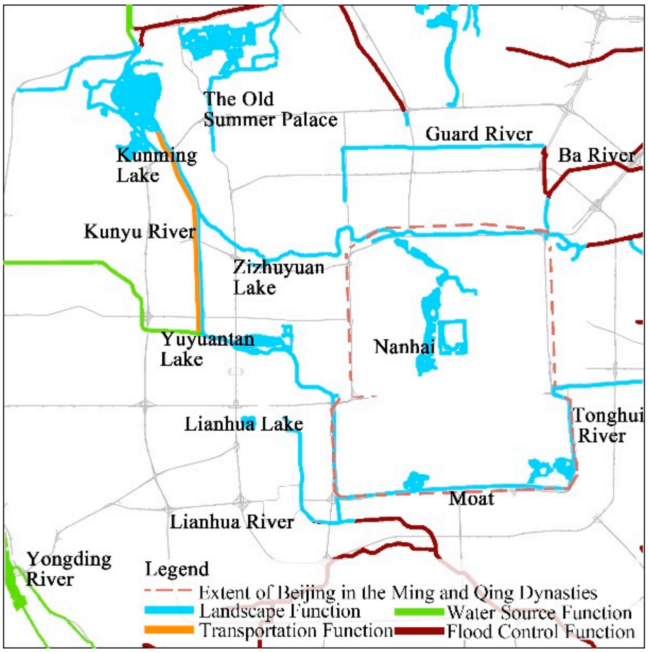


Figure 10. The water function layer during the urban regeneration stage.

3.1.4. Evolution for the Historical Dimension of the Urban Layer System for Beijing's Waterfront

Based on the above representation of the waterbody layer and the water–city layer and observing their changes in different periods, we first noticed the evolution of the historical dimension of Beijing's water environment layer system and represented it with the "mapping for" and diagrams method (Figure 11). Figure 11 shows that, as the city grew, the water system developed further, and the connection between the waterbody layer and the water–city layer became stronger as more water systems were established in the city's interior and exterior.

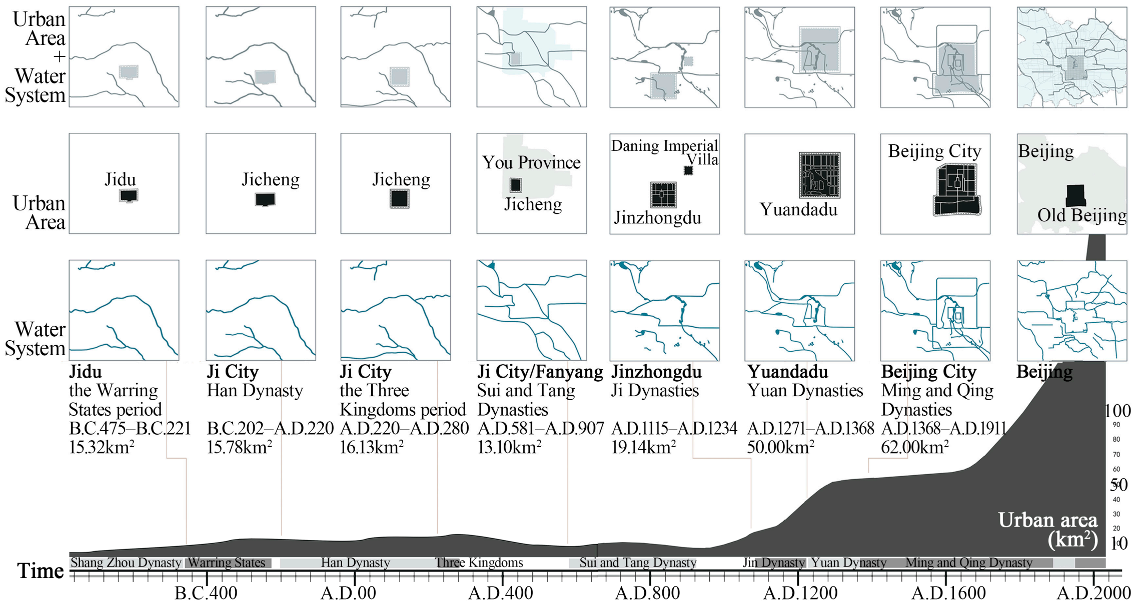


Figure 11. Evolution of the waterbody layer and the water–city layer of Beijing's waterfront.

The "mapping for" method can be used to organize the evolution of Beijing's water function layer in various periods (Figure 12). Figure 12 illustrates that during the urban siting stage, the water function was only a water source function and a defense function; as the city was constructed, water functions became more diverse, and they included flood control, landscape, and transportation. With the stabilization of the urban structure after the Qing and Ming dynasties, the transportation and defense functions decreased. The water system, now with only one water source function, gradually moved outside the city because of the ecological damage caused by urban development. The water system in the urban area gradually developed to have a landscape function and flood control function. Therefore, waterfront and water systems in Beijing should emphasize support for landscape functions in urban design.

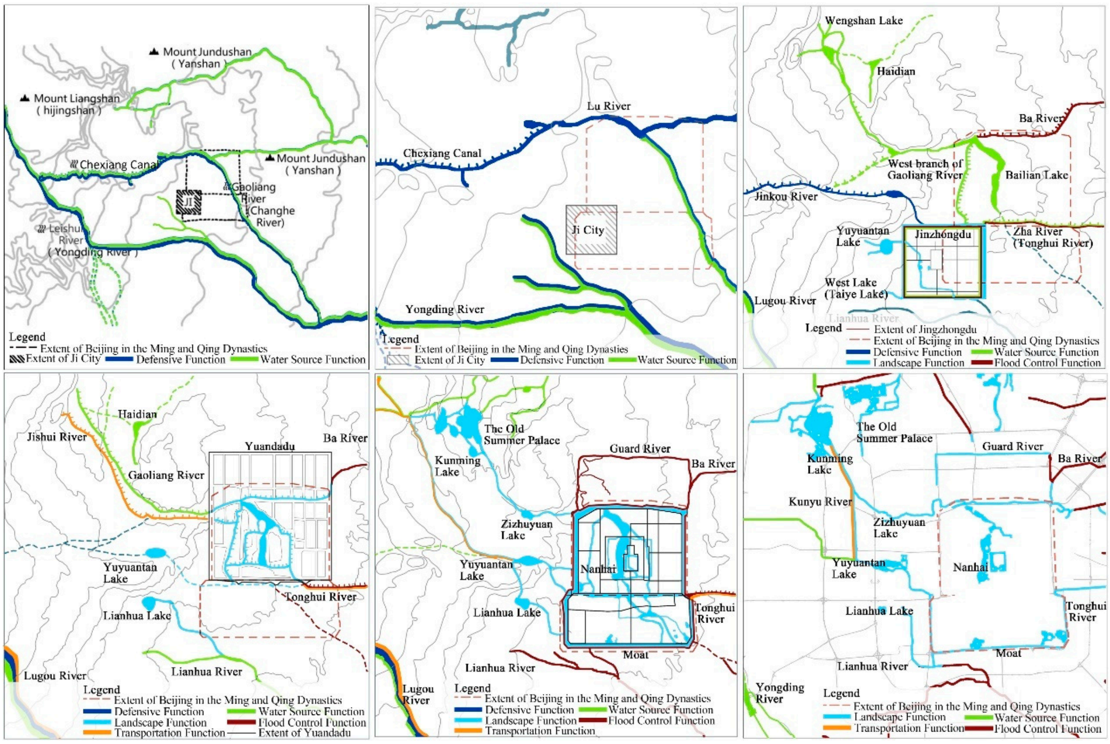


Figure 12. Evolution of the water function layer of Beijing's waterfront in various periods.

3.2. Ecological Dimension of the Urban Layer System

3.2.1. Overall Evaluation of Beijing's Waterfront

Based on the ecological dimension of the urban layer system of Beijing's waterfront as constructed in Section 2.3.2, this study evaluated all the urban elements and the overall ecological urban design quality of Beijing's 54 waterfront reaches. A series of maps, including the overall ecological evaluation maps (Figure 13) of Beijing's waterfront urban design and maps of ten urban elements, are represented using the mapping method.

The average value score for the Beijing's waterfront reaches was 5.14, which is low. A total of 38 waterfront reaches had poor ecological design quality (less than six points), which made up 70.37% of the total number of waterfront reaches. Thus, those 38 waterfront reaches should have a focus on ameliorating this in the overall urban design (A4-1, E8, D7-1, C1-1, A4-3, A7, A3-1, A3-2, D4-2, D2-1, D6-4, D9, D8-2, D13-2, D13-1, D8-1, A6-2, D8-3, A6-1, D2-2, D3-3, D6-3, D4-1, D3-2, D6-2, D5-2, D12-1, D6-1, D3-1, D5-1, D11, C2-2, D10, C2-1, D12-2, A2, E6, D14). These results indicate that the current ecological situation of Beijing's waterfront is unsatisfactory.

The quality in the north was higher than that in the southern area and was higher in the outer areas than in the city center. The ecological urban design quality of lakefronts was found to be higher than that of riverfronts.

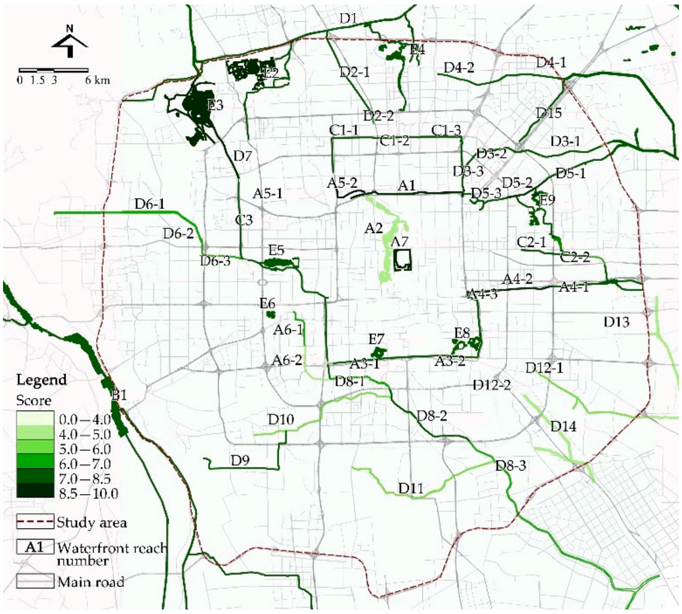


Figure 13. Overall evaluation map of the ecological quality of Beijing's waterfront.

3.2.2. Waterbody Layer

Water quantity, water quality, and waterbody width are the three urban elements included in the waterbody layer. Beijing's water system was constructed during many historical periods to accommodate shifting waterbody layers (Figure 14). Currently, the waterway in Beijing extends both vertically and horizontally. Figure 14a shows Beijing's waterway layout layer using the "mapping of" method. We can observe that there are more waterways in the north and that the distribution of water systems is uniform. Beijing's water system runs from the northwest to the southeast.

Based on the water quality measurements provided by Beijing's Municipal Water Bureau for multiple indicators, the *water quality* in Beijing can be roughly divided into five types. Figure 14b shows that less than 40% waterfront reaches had a water quality of category 1–2, which indicates the poor water quality in Beijing. It is notable that the water quality of A7, D5-2, D12-1, D12-2, and E9 was Category 5 and was in urgent need of improvement. The water quality in the northwestern region of Beijing was better than that in the southeastern region. This phenomenon can be attributed to two reasons. First, it is related to the direction of flow and topography of the water system, which is higher in the northwest than in the southeast, and the water system's direction of flow is also from northwest to southeast. Second, the water quality in the urban area is related to whether water quality improvement projects have been carried out for the respective waterbodies.

Figure 14c shows the *water quantity* of Beijing's water system. The quantity of water in Beijing is affected by (artificial) regulations and seasonal influences. The water quantity of each waterbody varies from period to period. Almost 40% of waterfront reaches are dry all year round or seasonal. There were three waterfront reaches that have water bodies that were found to be dry all year round (D9, D11, D14), and 17 waterfront reaches were found to be dry seasonally (A6, A3, D3, D8, D12, D13, D4, D5, E7). Affected by water quality and quantity, the water environment in Beijing forms three patterns: surrounding mountains with abundant water, some rivers cut off in the suburbs of Beijing, and some rivers with poor water quality in urban areas.

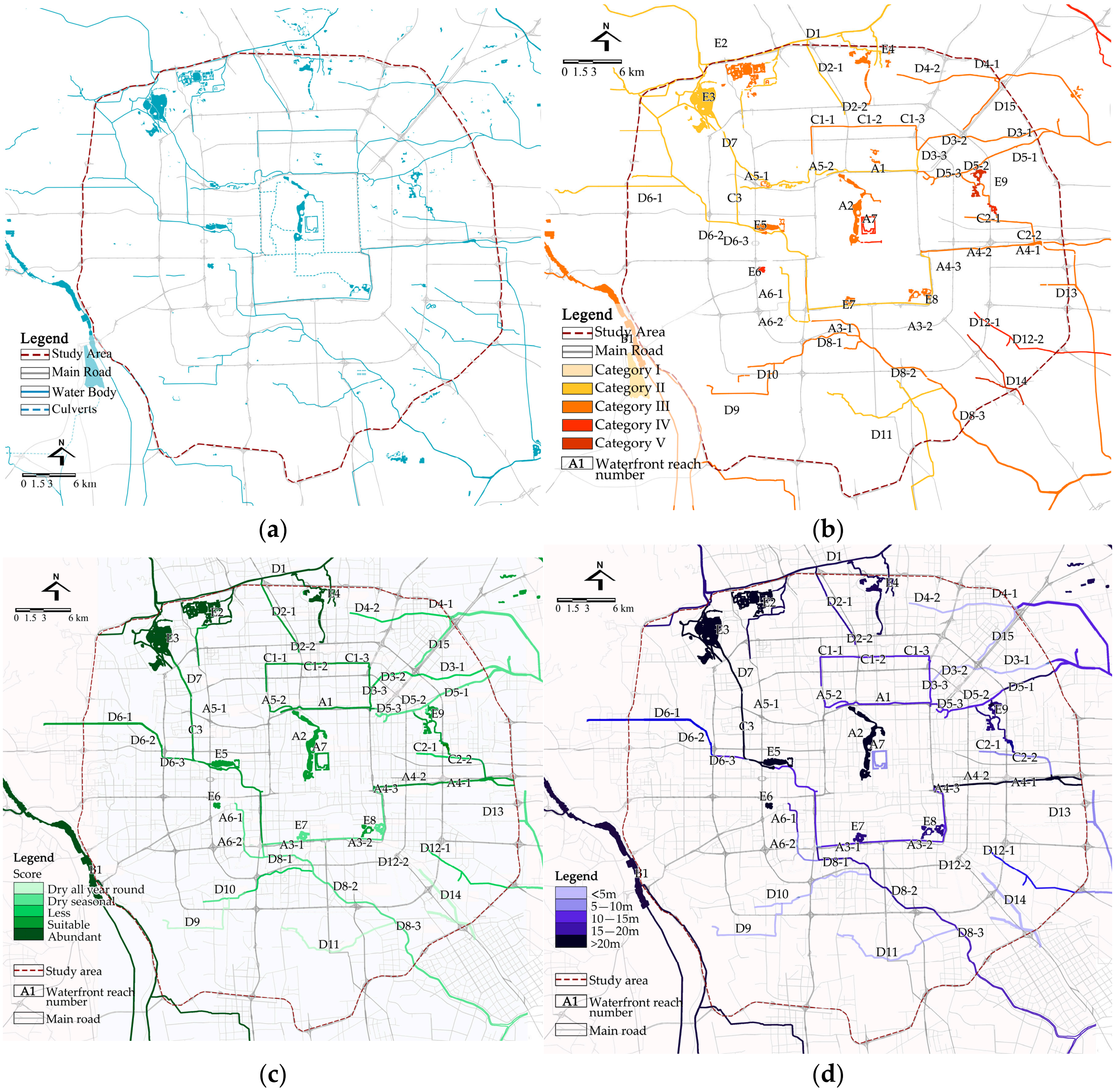
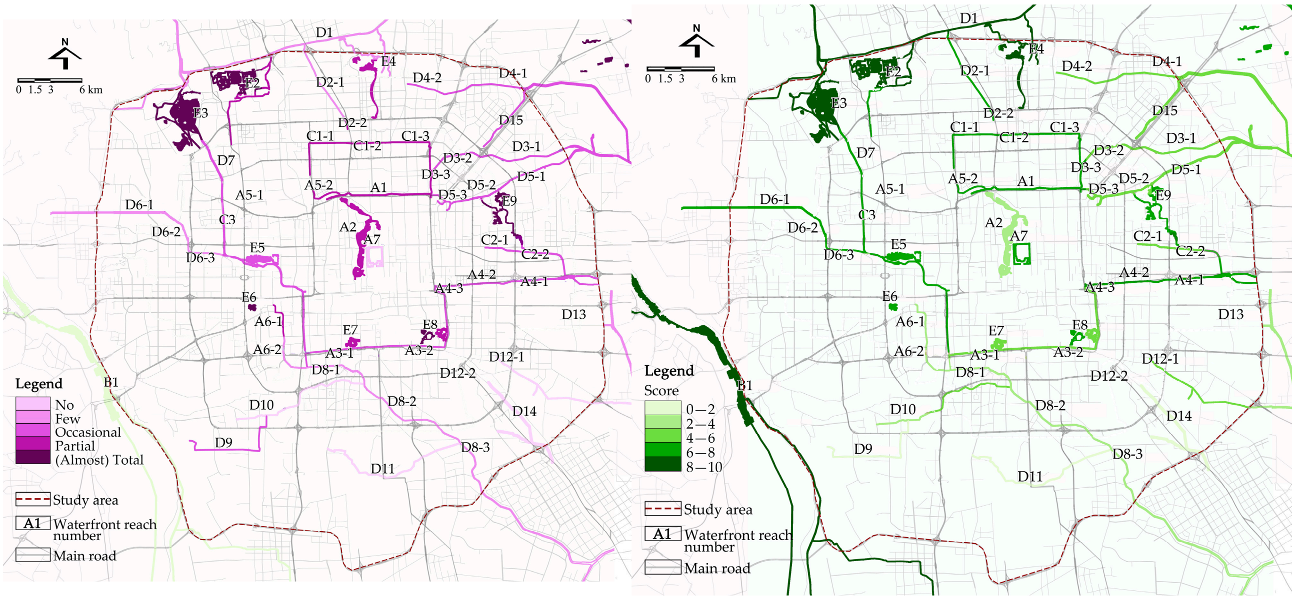


Figure 14. The waterbody layer in Beijing: (**a**) waterway layout; (**b**) water quality; (**c**) water quantity; (**d**) waterbody width.

Figure 14d shows the *waterbodies' width* in Beijing. It is obvious that the width of the waterbody is larger outside the city and generally smaller in the south. The width of the waterbody is related to the water quantity, shoreline form, and water function: the water quantity directly affects the width of the waterbody. In particular are D9, D11, D12, D13, and D14, which have waterbody widths of 2-3 m and have an almost vertical berm. In addition, rivers with ecological shorelines have wider water surfaces, and water source rivers have a wider water surface width, while drainage rivers have the smallest water widths.

3.2.3. Greening Layer

The greening layer includes three urban elements: water access, vegetation, and the connection between the waterfront and urban green space (Figure 15).



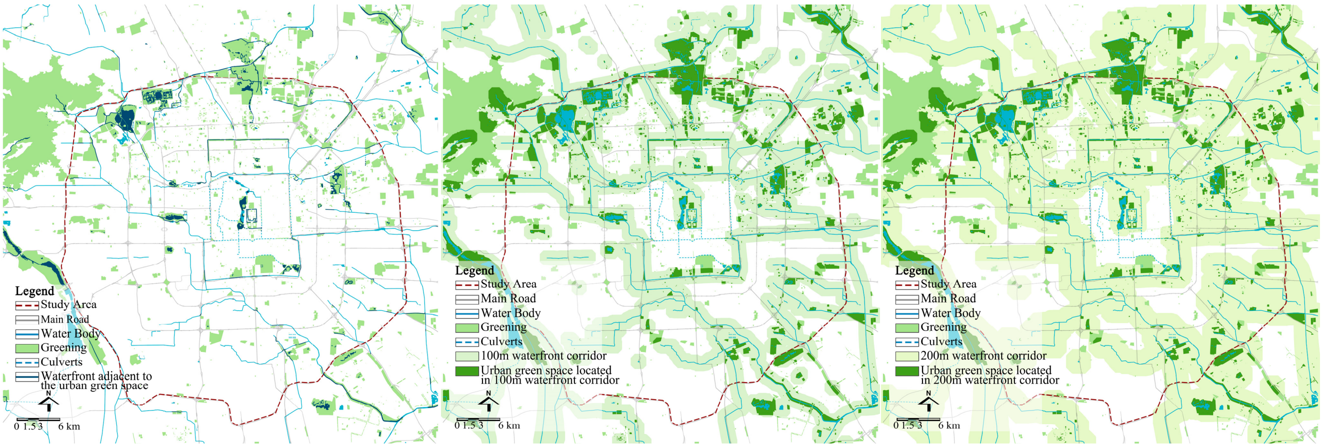
(**a**) (**b**)

Figure 15. The greening layer in Beijing: (**a**) water access; (**b**) vegetation.

Figure 15a shows that the *water access* of Beijing's waterfront was found to be extremely poor, which is mainly related to the shoreline form and ecological functions of the waterbody. Only 12 waterfront reaches were found to have partial water access; most are lakefront in parks. Almost 80% waterfront reaches lacked hydrophilicity. Multi-level and ecological shorelines are more hydrophilic. The waterfronts of ecologically renovated landscape-type rivers, lakes, and parks were found to have the highest hydrophilicity. However, the water source rivers are less hydrophilic because the government has taken measures to protect them by forbidding people's entry.

Figure 15b shows that there were 33 waterfront reaches (61.11%) with low quality vegetation (less than six points). These waterfront reaches are in need of landscaping and updating (D2-1, D4-1, D4-2, D15, D14, D13, D12-1, D12-2, D3-1. D3-2. C1-1, C1-2, C1-3, A5-2, A1, D5-3, D5-3, D5-1, C2-1, C2-2, A2, E7, A3-1, A3-2, A6-1, A6-2, D10, D9, D8-1, D8-2, D8-3). The *vegetation* quality of the waterfront in the northwestern region was significantly higher than that in the southeastern region (Figure 15b). The vegetation of Beijing's waterfront was related to whether the waterfront had undergone ecological renovation. This vegetation was mostly planted as protective greenery. The quality was generally rough, mostly in the form of several lawns combined with a few trees and shrubs, in a single color and with a lack of ornamental plants. Meanwhile, the combination of channel and upland vegetation was found to be poor and lacking continuity.

The connection between the waterfront and urban green space can be visualized on Beijing's map using the "mapping of" method (Figure 16). Figure 16a shows that there is a certain spatial coupling relationship between the greenspace network and the water network in Beijing, particularly in lakes and parks. The waterways and greening in the northern region were closely related, whereas those in the southern region were unrelated in Beijing. Figures 16 and 17 show 100 m and 200 m on both sides of the waterbody as boundaries of the water ecological corridor(s) and map Beijing's water corridor with a greening layer overlaid. It can be seen that the green space in the 100 m water ecological corridor was insufficient, less than 10%, while the green space in the 200 m water ecological corridor was less than 35%. Most water ecological corridors are urban construction blocks.



(**a**) (**b**) (**c**)

Figure 16. Connection between the waterfront and urban green space in Beijing: (**a**) waterfront adjacent to the green space; (**b**) green space in 100 m of water ecological corridor; (**c**) green space in 200 m of water ecological corridor.

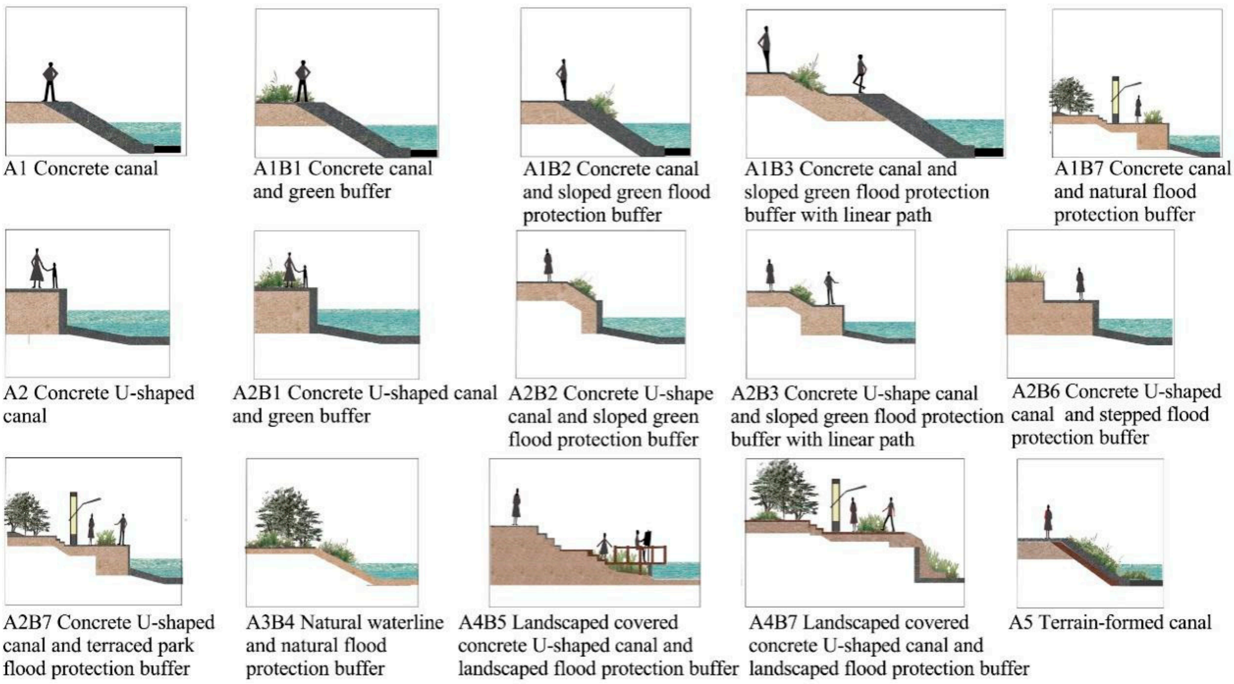


Figure 17. Fifteen types of shorelines in Beijing's waterfront.

3.2.4. Shoreline Layer

The shoreline layer includes the shoreline form and buffer elements. A river's shoreline reflects its physical space and landform. In this study, the *shoreline form* consisted of a channel and a riparian area. Field surveys revealed that there are five different types of waterfront channels in Beijing: concrete canals, concrete U-shaped canals, natural waterlines, landscape-covered concrete U-shaped canals, and terrain-formed canals. The riparian area of Beijing's waterfront, also referred to as the "shoreline buffer", can be classified into seven types of buffers: green, sloped green flood protection, sloped green flood protection with linear paths, natural flood protection, landscape flood protection, stepped flood protection, and terraced park flood protection (Table 5).

Table 5. The classification of shorelines in Beijing's waterfront.

Area	Code	Classification
Channel	A1	Concrete canal
	A2	Concrete U-shaped canal
	A3	Natural waterline
	A4	Landscaped covered concrete U-shaped canal
	A5	Terrain-formed canal
Riparian area	B1	Green buffer
	B2	Sloped green flood protection buffer
	B3	Sloped green flood protection buffer with linear path
	B4	Natural flood protection buffer
	B5	Landscaped flood protection buffer
	B6	Stepped flood protection buffer
	B7	Terraced park flood protection buffer

Through a field survey, we found 15 types of shoreline combinations on Beijing's waterfront (Figure 17). The distributions of the different types of shorelines are shown in Figure 18. It is evident that to ensure good flow efficiency, over 90% of the current waterfront shoreline has been artificially reformed into a straight, concrete artificial shoreline. A shoreline buffer, which weakens the water–greenery connection, is rare. The high proportion of hardened waterfront areas leads to direct pollution of the river by stormwater runoff, which cannot be filtered and permeated, causing safety hazards.

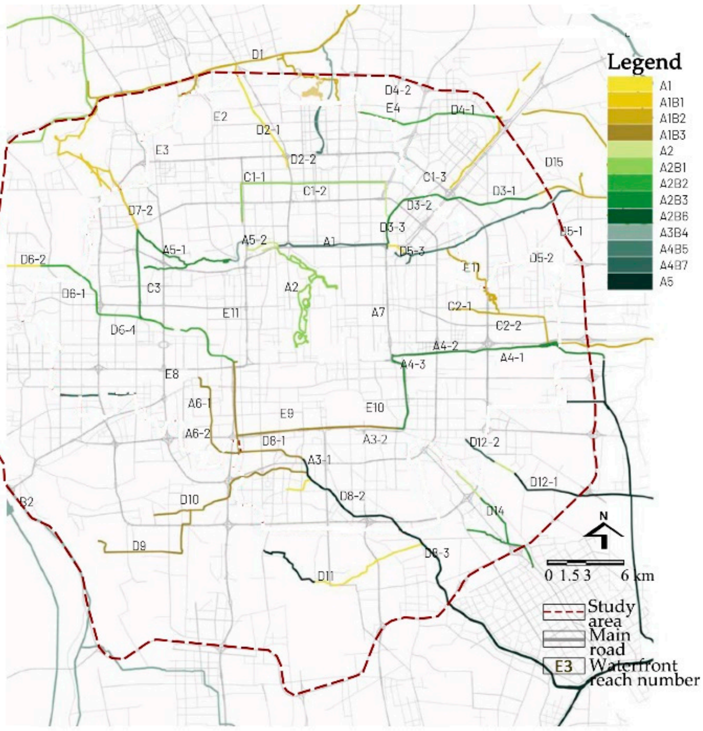


Figure 18. Distribution of 15 types of shorelines in Beijing's waterfront.

3.2.5. Ecological Function Layer

The ecological function layer includes the ecological functions of the waterbody and waterfront. According to the regulations of the Beijing municipal government, the ecological function of the waterbody in Beijing is divided into water source, drainage channel, and scenic river. Water source rivers were found to have relatively independent waterfront spaces and to lack effective management. The urban design of the drainage channel has low ecological quality. Water quality was found to generally be better in landscape areas, particularly in broad rivers, lakes, and moats in the urban center.

The ecological function of the waterfront in Beijing can be divided into three levels: waterfront for the city, waterfront for the community, and poor waterfront. It is shown that the functional classification of the waterfront is mainly guided by policies: "Beijing's Master Urban Plan (2015–2035)" and the "Functional Plan of Beijing's Water System". In addition, the function of the waterfront is affected by ecological quality. A waterfront reach with a higher ecological quality will attract more citizens and visitors and naturally serve a larger and wider urban region.

4. Discussion

4.1. Historical Strategy of Beijing's Waterfront

Urban history, as represented in the cultural and built environment, can serve as an important asset for and sustainable stewardship [45]. There is an accumulation of historical and cultural dimensions on Beijing's waterfront. However, the historical aspect of Beijing's waterfront has gradually disappeared. On the macroscale, to accommodate urban development, some historic rivers have been eliminated or changed into underground culverts, which compromises the historicity of the waterfront [46]. Most culverts have a drainage function and thus are not suitable for restoration to the surface [47]. Due to engineering functions and Beijing's urban planning, it is impossible to restore underground culverts in Beijing to the surface. This does not mean reverting entirely to the scales, channels, and other features of a historic water system. Instead, it refers to discussing the way in which to restore the historical water system's structure and reopen underground culverts as de-culverting or daylighting in conjunction with engineering functionality [46–48] (Figure 19). It is sustainable to focus on both ecological and historical patterns in the Beijing waterfront regeneration [47]. Integration of blue-green networks into historic preservation planning can be used to ecologically design culverts and other disappearing historical water systems [47,48].

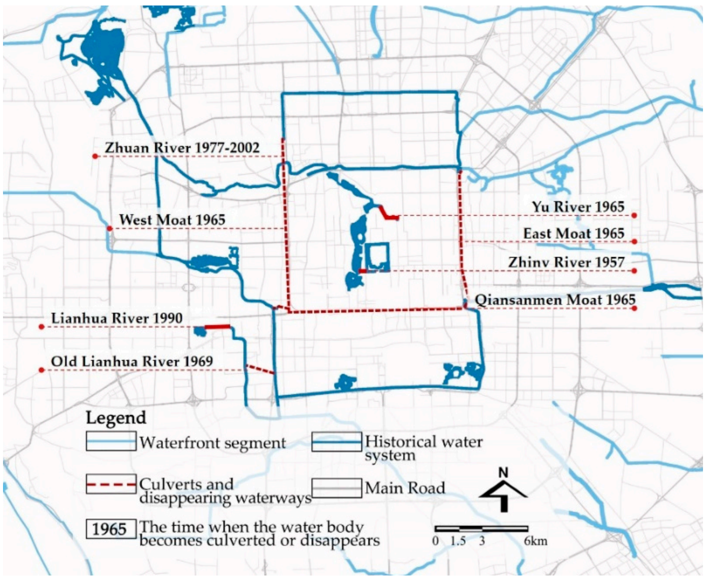


Figure 19. Map of Beijing's culvert.

At the mesoscale, the historical sites of Beijing's water system are distributed in fragments closely related to the surrounding historical blocks. Scholars have found positive correlations between historic districts and rising property values, increased local investment, and related economic benefits [49–51]. Therefore, the preservation of historic neighborhoods is particularly critical to Beijing's waterfront regeneration. We can strengthen the connections between each waterfront reach and adjacent historic districts through urban design approaches, such as pedestrian transportation connections and waterfront route planning [52]. Depending on the specific circumstances of a particular waterfront reach, historical protection strategies can be achieved through different urban design approaches [45].

As a result, we took a step-by-step approach to the waterfront's historic preservation (Figure 20). The first step in this urban design is to classify Beijing's waterfront based on whether it is a historical water system or if it is adjacent to a historical block. A special kind of urban design should be implemented for the waterfront of the historical water system and be fully protected. In addition, other waterfronts should be protected through block-by-block urban design. In the second step, Beijing's waterfront is divided into one of historical blocks, one of residential areas, and one including other areas in block urban design. Corresponding historical protection strategies were formulated for the different types of waterfronts (Figure 21).

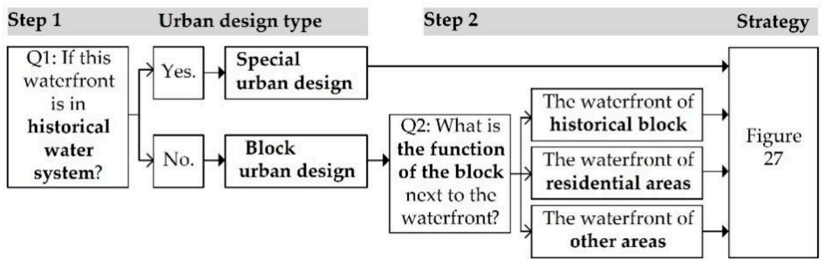


Figure 20. The step of historical protection strategies.

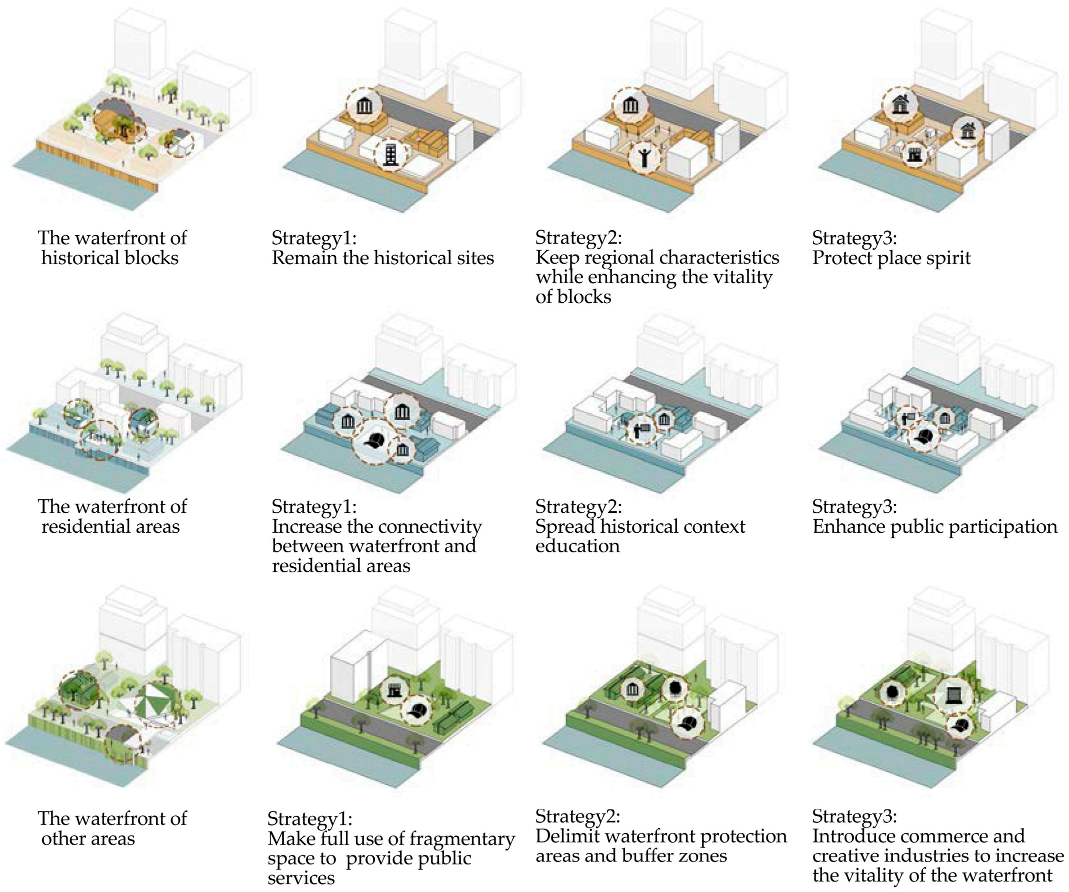


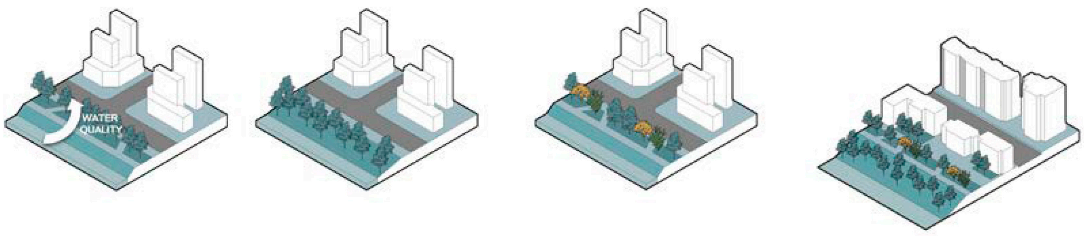
Figure 21. Historical protection strategies for Beijing's waterfront's overall urban design.

At the microscale, placemaking and creative placemaking are historical preservation strategies that are usually used for cultural and social patterns of use [45,53]. The goals include improving or building a sense of place identity in historical blocks [54]. Beijing's waterfront should fully abstract the historical elements of different periods in its urban design to restore the city's historical context and reshape the waterfront's place spirit and historical sense. It can be grounded in the development of local culture, enhancing quality of life, and attracting residents and visitors [54]. Placemaking engages and makes use of the historical culture in several ways [55]. To emphasize the historical context of the waterfront, urban design should extract the historical symbols of the site and apply them to urban and landscape design strategies.

4.2. Ecological Strategy of Beijing's Waterfront

Most of Beijing's waterfronts are artificially constructed, destroying the natural characteristics of the original water environment. It is necessary to use ecological design methods to restore the ecology of Beijing's waterfronts, such as wetland protection, ecological shoreline transformation, and gray-green infrastructure construction [56,57].

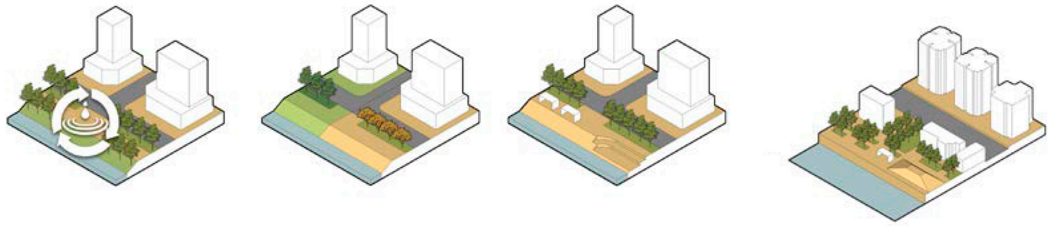
At the macroscale, Beijing's waterfront urban design is supposed to implement ecological shorelines with flexible forms to replace existing artificial canals [29]. Through the expansion and renovation of the waterfront corridor, the greenspace pattern of Beijing will be integrated, the relationship between water and greenspace will be strengthened, and a net-like urban greening system will be formed. Generally, shoreline structure design considers primarily engineering functionality, and these designs consequently have poor ecological functionality [52]. To increase the city's ecological carrying capacity, Beijing's waterfront's overall urban design should build ecological wetlands on the main rivers for flood drainage and increase the connection between the waterfront and other green spaces. Multifunctionality improved with the horizontal extent of the structure, the occurrence of coastal plants in a buffer zone, and increased public access and use [52]. Therefore, in the overall urban design, a large amount of native vegetation should be used, and diverse vegetation communities should be built along the full corridor to create diverse wildlife habitats and clean up the channel (Figure 22).



(**a**) (**b**) (**c**) (**d**)

Figure 22. The macro-level ecological strategies of Beijing's waterfront overall urban design: (**a**) clean up the pollutants in channel and rainwater runoffs; (**b**) use gentle shoreline for planting to replace the vertical impermeable shoreline; (**c**) construct a diverse range of native vegetation communities; (**d**) make an overall ecological design form of the waterfront.

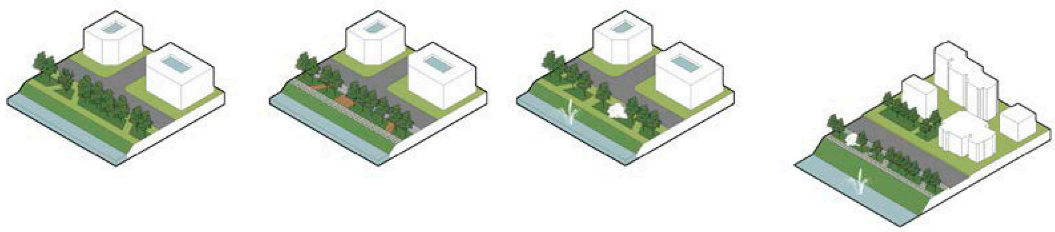
At the mesoscale, to control waterlogging, a special urban design for stormwater management of Beijing's waterfront should be proposed, and stormwater management should be carried out in the waterfront and surrounding blocks, such as the use of rainwater collection systems and permeable pavements. The urban design should also consider seasonal landscape changes and plant arrangements [58]. Some scholars' studies have shown that the water access of the waterfront is more attractive to the public than the vegetation [59]. Thus, seasonal water activities are extremely important. At the same time, micro-topography and plants can be used to build shadow spaces to accommodate seasonal changes (Figure 23).



(**a**) (**b**) (**c**) (**d**)

Figure 23. The meso-level ecological strategies of Beijing's waterfront overall urban design: (**a**) installing a rainwater collection system and using permeable surfaces; (**b**) enhancing the viewing experience by varying the effects of plants and space in different seasons; (**c**) adapting to seasonal changes by micro-topography and building shaded space; (**d**) making an overall ecological design form of the waterfront.

At the micro-scale, urban design should use a low-intervention landscape strategy with minimal input to maximize the preservation of native vegetation. Second, considering the surrounding land, the micro-landscape intervention approach should be used to subtly integrate the artificial landscape into nature [30]. Third, shoreline forms could be made ecologically diverse by adding habitat baskets, habitat stairs, and mesh cages [52]. Fourth, more ecological materials should be used in shoreline design, such as permeable sand, gravel, natural stone, and vegetation. Shoreline bottoms should be replaced with soft and natural materials rather than current artificial materials to improve the permeability of the shoreline bottoms [15,47,48] (Figure 24).



(**a**) (**b**) (**c**) (**d**)

Figure 24. The micro-level ecological strategies of Beijing's waterfront overall urban design: (**a**) adopting multi-level ecological plant configuration based on the native plants with low-maintenance demands; (**b**) the paving material being mainly composed of concrete and brick, as well as the partial use of plain soil; (**c**) taking advantage of local waterbodies and whole stones to simulate the state of nature; (**d**) making an overall ecological design form of the waterfront.

5. Conclusions

A waterfront is an ecological, social, and historical urban public space. Waterfronts can enhance a city's ecological carrying capacity, reduce soil and water pollution, and prevent flooding. Additionally, a waterfront can express a city's history and culture at different periods and help create a local identity. Based on a real practice project, "Beijing's Waterfront Overall Urban Design," this study focused on historical and ecological dimensions as its two key points. It explores how to use an integrated approach to analyze the current state of Beijing's waterfront's overall urban design, visually represent it, and develop urban design strategies to improve the implementation of urban design.

The main contribution of this study is the proposal of an urban layer system, which is a multidimensional urban design research method. This study establishes an urban layer system for Beijing's waterfront urban design along ecological and historical dimensions and analyzes the urban elements and layers within the system individually and by superimposing them. Fifty-four waterfront reaches were investigated. The field survey, literature review, and mapping methods were used to obtain the historical and ecological dimensions of Beijing's waterfront urban design. The mapping method was used to visualize the current characteristics and problems that are more direct.

Compared to previous studies, the urban layer system established in this study is more intuitive and systematic in guiding urban design. The "mapping for" method is used to represent the waterbody layer, water–city relationship layer, and water function layer of Beijing's waterfront over several historical periods. This allows for a more systematic and visual analysis of the historical development and features of Beijing's waterfront. In addition, the ecological dimension of the urban layer system contains the waterbody, greening, shoreline, and ecological function layers. Using the AHP method, each layer and element is weighted to provide a flexible and systematic analysis of the current ecological quality of Beijing's waterfront urban design.

First, the results of this study show that Beijing's waterfront has unique and continuous historical characteristics that should be emphasized and protected in the overall urban design. Second, the results of this study indicate that the ecological quality of Beijing's waterfront urban design is not very high, and urban design should be transformed for the waterbody, greening, shoreline, and ecological function layers. Third, this study suggests multiple strategies for Beijing waterfront's overall urban design, from historical to ecological and macro to micro perspectives.

In this study, the urban layer system study was carried out for the entirety of Beijing's waterfront overall urban design process, from investigation to evaluation and analysis to strategy development. However, there are some limitations. First, future studies should increase the study of other urban layers and apply the approach to other urban design projects, with a flexible selection of different urban elements and layers. Second, to demonstrate its viability, an urban layer system should also be used in other types of urban design research and programs.

Author Contributions: Conceptualization, L.C. and H.L.; methodology, software, and formal analysis, L.C.; investigation, L.C., Y.L. and Z.Y.; data curation, L.C.; writing and visualization, L.C., J.D. and Z.Y.; supervision, H.L.; funding acquisition, L.C. and J.D. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by National Natural Science Foundation of China, grant number 52308059; Heilongjiang Provincial Natural Science Foundation of China, grant number LH2023E050; Heilongjiang Province Social Science Research Planning Foundation, grant number 22GLC275; China Postdoctoral Science Foundation, grant number 2023M730861; Heilongjiang Postdoctoral Found, grant number LBH–Z22158; and Heilongjiang Province Double Innovation Think Tank Project, grant number ZKKF2022187.

Data Availability Statement: Data are contained within the article.

Acknowledgments: This research acknowledges the support of the China Architecture Design and Research Group for the field survey.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Hall, P. *Cities in Civilization: Culture, Innovation and Urban Order*; Weidenfeld and Nicolson: London, UK, 1998.
2. Silva-Sánchez, S.; Jacobi, P. Implementation of riverside parks in the city of São Paulo—Progress and constraints. *Local Environ.* **2014**, *21*, 65–84. [CrossRef]
3. Vian, F.; Izquierdo, J.; Martínez, M. River-city recreational interaction: A classification of urban riverfront parks. *Urban For. Urban Green.* **2021**, *59*, 127042. [CrossRef]
4. Gunay, Z.; Dokmeci, V. Culture-led regeneration of Istanbul waterfront: Golden Horn Cultural Valley Project. *Cities* **2012**, *29*, 213–222. [CrossRef]
5. Evans, G. Measure for measure: Evaluating the evidence of culture's contribution to regeneration. *Urban Stud.* **2005**, *42*, 959–983. [CrossRef]

6. Sairinen, R.; Kumpulainen, S. Assessing social impacts in urban waterfront regeneration. *Environ. Impact Assess. Rev.* **2006**, *26*, 120–135. [CrossRef]
7. Hillman, M.; Brierley, G. A critical review of catchment-scale stream rehabilitation programs. *Prog. Phys. Geogr.* **2005**, *29*, 50–76. [CrossRef]
8. Chou, R.J. Achieving successful river restoration in dense urban areas: Lessons from Taiwan. *Sustainability* **2016**, *8*, 1159. [CrossRef]
9. Talen, E.; Hermida, S. Neighborhood evaluation using GIS: An exploratory study. *Environ. Behav.* **2007**, *39*, 583–615. [CrossRef]
10. Hermida, A.; Cabrera-Jarab, N.; Osoriob, P.; Cabrera, S. Methodology for the evaluation of connectivity and comfort of urban rivers. *Cities* **2019**, *95*, 102376. [CrossRef]
11. Wang, M.; Hou, X.; Wang, F.; Wang, J. Influencing mechanism of ecological aesthetic preference on urban river ecological restoration: A case study of Kunshan, Jiangsu Province. *Landsc. Archit. Front.* **2019**, *10*, 40–63. [CrossRef]
12. Timur, U.P. Urban Waterfront Regenerations. In *Advances in Landscape Architecture*; Tech Open Acess: London, UK, 2013; Volume 13, pp. 169–206.
13. Che, Y.; Yang, K.; Chen, T.; Xu, Q. Assessing a riverfront rehabilitation project using the comprehensive index of public accessibility. *Ecol. Eng.* **2012**, *40*, 80–87. [CrossRef]
14. Attia, S.; Ibrahim, A.A.A.M. Accessible and inclusive public space: The regeneration of waterfront in informal areas. *Urban Res. Pract.* **2018**, *11*, 314–337. [CrossRef]
15. Shi, S.; Kondolf, G.M.; Li, D. Urban river transformation and the Landscape Garden City Movement in China. *Sustainability* **2018**, *10*, 4103. [CrossRef]
16. Liu, S.; Lai, S.Q.; Liu, C.; Jiang, L. What influenced the vitality of the waterfront open space? a case study of Huangpu River in Shanghai, China. *Cities* **2021**, *114*, 103197. [CrossRef]
17. Hagerman, C. Shaping neighborhoods and nature: Urban political ecologies of urban waterfront transformations in Portland, Oregon. *Cities* **2007**, *24*, 285–297. [CrossRef]
18. Fan, Y.; Kuang, D.; Tu, W.; Ye, Y. Which Spatial Elements Influence Waterfront Space Vitality the Most?—A Comparative Tracking Study of the Maozhou River Renewal Project in Shenzhen, China. *Land* **2023**, *12*, 1260. [CrossRef]
19. White, J. Pursuing design excellence: Urban design governance on Toronto's waterfront. *Prog. Plan.* **2016**, *110*, 1–41. [CrossRef]
20. Annals of Beijing Compilation Committee. *Annals of Beijing, Water Conservation Annals*; Beijing Publishing House: Beijing, China, 2000.
21. Chen, L.L.; Liu, Y.; Leng, H.; Xu, S.N.; Wang, Y.C. Current and expected value evaluation of the waterfront urban design: A case study of the overall urban design of Beijing waterfront. *Land* **2023**, *12*, 85. [CrossRef]
22. Oakley, S. Waterfront regeneration in Australia: Local responses to global trends in reimagining disused city docklands. *Geogr. Res.* **2021**, *59*, 394–406. [CrossRef]
23. Yassin, A.B.; Eves, C.; McDonagh, J. An evolution of waterfront development in Malaysia. In Proceedings of the 16th Pacific Rim Real Estate Society Conference, Wellington, New Zealand, 24–27 January 2010; pp. 1–17.
24. Zhang, J.; Yue, W.; Fan, P.; Gao, J. Measuring the Accessibility of Public Green Spaces in Urban Areas Using Web Map Services. *Appl. Geogr.* **2021**, *126*, 102381. [CrossRef]
25. Fan, Z.; Duan, J.; Luo, M.; Zhan, H.; Liu, M.; Peng, W. How Did Built Environment Affect Urban Vitality in Urban Waterfronts? A Case Study in Nanjing Reach of Yangtze River. *ISPRS Int. J. Geo-Inf.* **2021**, *10*, 611. [CrossRef]
26. Kondolf, G.M.; Pinto, P.J. The social connectivity of urban rivers. *Geomorphology* **2017**, *277*, 182–196. [CrossRef]
27. Díaz, E.; Ollero, A. Metodología para la clasificacion "geomorfologica" de los cursos fluviales de la cuenca del Ebro. *Geographicalia* **2005**, *47*, 23–46. [CrossRef]
28. Cheng, S.; Zhai, Z.; Sun, W.; Wang, Y.; Yu, R.; Ge, X. Research on the Satisfaction of Beijing Waterfront Green Space Landscape Based on Social Media Data. *Land* **2022**, *11*, 1849. [CrossRef]
29. Li, M.; Liu, R.; Li, X.; Zhang, S.; Wu, D. The Effect of Perceived Real-Scene Environment of a River in a High-Density Urban Area on Emotions. *Land* **2024**, *13*, 35. [CrossRef]
30. Zhou, X.; Cen, Q.; Qiu, H. Effects of urban waterfront park landscape elements on visual behavior and public preference: Evidence from eye-tracking experiments. *Urban For. Urban Green.* **2023**, *82*, 127889. [CrossRef]
31. Zheng, S.; Zhang, X.; He, X.; Zhang, J.; Hui, X. Green Ecology-Oriented Revitalization Strategies and Planning Responses for Waterfront Areas in Urban Centers–The Case of Tonghui River Waterfront Area in Nanmufang, Beijing. *Beijing Plan. Rev.* **2021**, *05*, 142–148.
32. Liao, H. Urban Design Strategy Research on Historical City Waterfront from the Perspective of Lineal or Serial Cultural Heritages. Master's Thesis, Southeast University, Nanjing, China, 2019.
33. Ge, Z.; Xin, Z. The Spatial Ecological Environment Design of the Waterfront Public Areas of Rural Rivers. *Ecol. Chem. Eng. S.* **2023**, *8*, 235–241. [CrossRef]
34. Hofmann, M.; Westermann, J.R.; Kowarik, I.; Van der Meer, E. Perceptions of parks and urban derelict land by landscape planners and residents. *Urban For. Urban Green.* **2012**, *11*, 303–312. [CrossRef]
35. Lehrer, U.; Laidley, J. Old mega-projects newly packaged? Waterfront redevelopment in Toronto. *Int. J. Urban Reg. Res.* **2008**, *32*, 786–803. [CrossRef]

36. Xu, S.N.; Chen, L.L. Construction of technical method and path for urban layer system research in urban design. *Planners* **2020**, *20*, 20–26.
37. Chen, L.; Xu, S.; Hou, X.; Xue, B. Study on the Framework of Water Environment Layer in Urban Layer System. In Proceedings of the 54th ISOCARP, Bode, Noway, 1–5 October 2018.
38. Gao, W.F.; Zhu, J.W.; Hao, X.W. Landscape spatial accessibility analysis of urban water system planning: A case study of Xixian New Area. In *Proceedings of the IOP Conference Series: Earth and Environmental Science, Macao, China, 16–19 July 2019*; Volume 344, p. 012155. [CrossRef]
39. Shah, S.; Roy, A.K. Social sustainability of urban waterfront-the case of carter road waterfront in Mumbai, India. *Procedia Environ. Sci.* **2017**, *37*, 195–204. [CrossRef]
40. Hamidi, S.; Moazzeni, S. Examining the relationship between urban design qualities and walking behavior: Empirical evidence from Dallas, TX. *Sustainability* **2019**, *11*, 2720. [CrossRef]
41. Saaty, T.L. Decision making—The analytic hierarchy and network processes (AHP/ANP). *J. Syst. Sci. Syst. Eng.* **2004**, *13*, 1–35. [CrossRef]
42. Liu, Y.; Chen, L.L.; Jiang, H.Z. Influencing factor extraction of healing environment identifiability based on environmental psychoanalysis. *Psychiatr. Danub.* **2022**, *34*, 620–627.
43. Xu, L. Natural Adaptability Chinese Ancient Capital. Master's Thesis, Chongqing University, Chongqing, China, 2014.
44. Yan, S.; Pei, W. Ecological wisdom in the construction of ancient China capital city and its modern enlightenments: The empirical research on Chang'an of Sui and Tang Dynasties, Lin'an of Song Dynasty, and Beijing of Ming and Qing Dynasties. *Urban Plan. Int.* **2017**, *32*, 40–47. [CrossRef]
45. Ryberg-Webster, S.; Loh, C.; Ashley, A.; Crisman, J.J.A.; Ruberto, D.; Durham, L.; Louya, K. The Arts and Historic Preservation: Intersections in the Urban Context. *J. Plan. Lit.* **2024**, 1–14. [CrossRef]
46. Jones, P.; Macdonald, N. Making space for unruly water: Sustainable drainage systems and the disciplining of surface runoff. *Geoforum* **2007**, *38*, 534–544. [CrossRef]
47. Üzümcüoğlu, D.; Polay, M. Urban Waterfront Development, through the Lens of the Kyrenia Waterfront Case Study. *Sustainability* **2022**, *14*, 9469. [CrossRef]
48. Sealey, K.S.; Andiroglu, E.; Lamere, J.; Sobczak, J.; Suraneni, P. Multifunctional performance of coastal structures based on South Florida coastal environs. *J. Coast. Res.* **2021**, *37*, 656–669. [CrossRef]
49. Annika, A.; Peter, V.H.; Pamela, S. Asserting historical "distinctiveness" in industrial waterfront transformation. *Cities* **2015**, *44*, 86–93. [CrossRef]
50. Leichenko, R.M.; Edward, C.; Listokin, D. Historic Preservation and Residential Property Values: An Analysis of Texas Cities. *Urban Stud.* **2001**, *38*, 1973–1987. [CrossRef]
51. Thompson, E.; David, R.; Benjamin, S. Property Values on the Plains: The Impact of Historic Preservation. *Ann. Reg. Sci.* **2011**, *47*, 477–491. [CrossRef]
52. Üzümcüoğlu, D.; Polay, M. Enhancing urban waterfront development: A groundbreaking framework for fostering creativity. *GeoJournal* **2023**, *88*, 6091–6104. [CrossRef]
53. Project for Public Spaces. "What is Placemaking"? 2021. Available online: https://www.pps.org/category/placemaking (accessed on 7 February 2024).
54. Janet, K.; Ruther, M.; Ehresman, S.; Nickerson, B. Placemaking as an Economic Development Strategy for Small and Midsized Cities. *Urban Aff. Rev.* **2017**, *53*, 435–462. [CrossRef]
55. Loh, C.G.; Amanda, J.; Ashley, L.D.; Karen, B. Our Diversity is Our Strength: Explaining Variation in Diversity, Equity, and Inclusion Emphasis in Municipal Arts and Cultural Plans. *J. Am. Plan. Assoc.* **2022**, *88*, 192–205. [CrossRef]
56. Yu, K.J.; Wang, S.S. Ecological Baseline for Beijing's Urban Sprawl: Basic Ecosystem Services and Their Security Patterns. *City Plan. Rev.* **2010**, *34*, 19–24.
57. Li, F.; Ma, X. Study on Plan of rural waterfront greenway in Beijing based on valley economy. *Earth Environ. Sci.* **2018**, *108*, 042121.
58. Donati, G.F.A.; Bolliger, J.; Psomas, A.; Maurer, M.; Bach, P.M. Reconciling cities with nature: Identifying local Blue-Green Infrastructure interventions for regional biodiversity enhancement. *J. Environ. Manag.* **2022**, *316*, 115254. [CrossRef]
59. Ma, F. Seasonal effects on blue-green space preferences: Examining spatial configuration and residents' perspectives. *Environ. Res. Commun.* **2023**, *5*, 065009. [CrossRef]