Kyiv School of Economics

Faculty of Social Sciences

Urban Studies and Postwar Reconstruction

Master's Thesis

Between Development and Resilience: Applying the Ecosystem Approach to Riparian Land Use on the Dnipro in Kyiv

Author:

Veronika Deineha

Supervisor:

Maria Smirnova

June 2026

CONTENT

Abstract.

The Dnipro is one of Kyiv's most significant natural elements. It shapes the city's administrative divisions, landscape, climate, and public spaces. At the same time, almost all of its riparian territories have either been developed in the past or are actively being developed today. This intensive residential development, ongoing since 2005, has been made possible by weak regulatory oversight and the absence of any assessment of its ecosystem consequences. This study examines whether the current land-use practices along the Dnipro riverbanks in Kyiv conform to the principles of the ecosystem approach and climate resilience. The analytical framework used is the Five Steps to Implementing the Ecosystem Approach (Shepherd, 2004) a tool developed by IUCN on the basis of the 12 principles of the Convention on Biological Diversity. The five steps are applied as an analytical checklist: each step defines conditions whose observance indicates environmentally responsible decision-making. The spatial scope of the study covers the riparian territories of the Dnipro within Kyiv; the temporal scope is 2005–2025. Five first-line residential complexes and the relevant urban planning documentation are analysed.

The analysis found that active development of the Dnipro's riparian territories generates long-term costs for the city in the form of increased climate vulnerability. A pattern of market distortion was also identified: developers capitalise on the ecosystem value of riparian territories through the waterfront premium, while bearing no responsibility for the degradation of the functions that generate this value. Costs are externalised and transferred to the municipal budget and the wider community. In addition, mechanisms for monitoring and adaptively reviewing decisions regarding riparian territories at the level of urban planning documentation remain underdeveloped. The findings confirm that the existing management system for the Dnipro's riparian territories is currently incompatible with the principles of the ecosystem approach and with the requirements of climate resilience: the ongoing loss of natural riparian cover measurably increases the city's exposure to flood risk, heat extremes, and ecological fragmentation, but holds significant potential for development, drawing on systems already functioning in Western Europe that can be adapted to the Ukrainian context.

Keywords: riparian territories, ecosystem approach, climate resilience, Dnipro River, urban development, ecosystem services, waterfront premium, nature-based solutions

Word count: 14 201

INTRODUCTION

In the past, rivers often formed the foundation of urban settlements — serving simultaneously as a water source, a transport artery, and a natural line of defence. Today, rivers take on a particular significance as natural refuges that offer proximity to nature within the densely built urban fabric. And precisely because of this value, riparian territories have become the focus of intensive residential development.

The Dnipro River occupies a singular position in Kyiv's urban geography. Stretching for approximately 20 kilometres within city limits, it divides Kyiv into its Right Bank and Left Bank parts, each with distinct urban histories and characters. Historically, the riverbanks served as floodplains, green corridors, and publicly accessible recreational spaces as an ecological and social resource shared by the entire city. This character began to change fundamentally from the mid-2000s, when large-scale residential construction reached the first shoreline. The scale of transformation has been significant: between 2005 and 2025, a succession of high-rise residential complexes was built directly on the riverbank, replacing natural riparian vegetation with concrete embankments, parking infrastructure, and enclosed private territories. The ecological consequences of this shift have largely gone unmeasured and unaccounted for in planning practice. Meanwhile, the urgency of the issue is growing. Climate projections for Kyiv indicate increases in the intensity of precipitation events and the frequency of heatwaves, precisely the conditions under which riparian ecosystems perform their protective functions. Understanding whether current land-use practice along the Dnipro is compatible with climate resilience is a practical planning challenge with long-term consequences for the city's vulnerability..

The central question of this study is whether the current land-use practices along the Dnipro's riparian territories are compatible with the principles of climate resilience and ecosystem management — and if not, where exactly the gap lies between what responsible natural resource management requires and what is actually happening on the ground. To answer this, the study uses the methodology of the ecosystem approach (Shepherd, 2004), an analytical framework developed by IUCN on the basis of the 12 principles of the Convention on Biological Diversity, which allows an assessment of the extent to which decisions made regarding riparian land use conform to the principles of ecosystem preservation.

The structure of the study follows the five steps of the methodology: from the identification of stakeholders and ecosystem boundaries (Step A) to adaptive management over time (Step E). Each step is applied to specific residential complexes on the Dnipro riverbanks in Kyiv. The study also raises the question of what makes it difficult for already well-developed Western concepts to take hold in Ukraine — namely the characteristics of a post-socialist institutional environment in which development outpaced regulation. At the same time, Ukraine is in the process of European integration and has assumed obligations to harmonise its legislation with EU directives, which makes the question of conformity between our practices and Western standards particularly urgent.

LITERATURE REVIEW

Climate Change and Urban Vulnerability

Climate change is one of the greatest challenges of this century: average temperatures have already risen by 1.42°C compared to pre-industrial levels, trends in the intensity and uneven distribution of precipitation continue to shift, and the frequency of extreme weather events keeps growing. Extreme weather and climate-related events are already affecting people's lives and well-being. Moreover, there are currently no signs that temperature rise will slow, or that the intensity of extreme weather events will decrease: "In a series of UN reports, thousands of scientists and government reviewers agreed that limiting global temperature rise to no more than 1.5°C would help us avoid the worst climate impacts and maintain a liveable climate. Yet policies currently in place point to up to 2.8°C of warming by the end of the century" (United Nations, n.d.).

Today, 55% of the world's population lives in urban areas, and this figure is projected to rise to 68% by 2050 (United Nations Department of Economic and Social Affairs, 2018). Cities are particularly vulnerable to climate change: high concentrations of people, complex interdependent infrastructure, and the urban heat island effect all amplify exposure to climate risks.

The Paris Agreement (2015) established binding commitments for states to keep the rise in global temperature within 1.5–2°C and identified two complementary lines of action: mitigation — the reduction of greenhouse gas emissions, and adaptation — the adjustment of systems to the already irreversible consequences of climate change. For cities, adaptation is of particular importance: even if mitigation targets are met, the consequences of already accumulated emissions will demand active responses at the level of urban planning and infrastructure.

Ukraine, too, is facing the consequences of climate change, most notably through shifts in temperature patterns and precipitation levels. Since the beginning of the full-scale invasion, the main efforts of the government and local communities have been directed at overcoming the immediate consequences of the war, particularly in the areas of security, humanitarian needs, and the provision of basic services to the population. The urgency of these challenges can undeniably push other external threats into the background, especially those associated with natural hazards or climate change. At the same time, climate change does not pause and the infrastructure decisions being made today will determine the vulnerability of cities for decades to come. Countries experiencing armed conflict fall behind in disaster risk reduction, as risk management systems are disrupted, which in turn sets back hard-won economic progress and sustainable development (Peters, 2019).

Riverbanks in cities: from the industrial to the ecosystemic perspective

The siting of human settlements along rivers has been a defining feature throughout history: rivers simultaneously provided access to fresh water, enabled food production, served as natural defensive barriers, and facilitated the transport of goods and trade. Many of the world's major cities formed precisely alongside water — lakes, rivers, or seas.

With the onset of the Industrial Revolution (second half of the 18th century), riparian territories in the cities of Western Europe and North America were transformed into centres of production and trade, and riverbanks were increasingly given over to the construction of large ports, industry, warehousing, and transport infrastructure. River water was actively used as a receptor for industrial waste, leading to the rapid degradation of water quality and the destruction of riparian ecosystems.

This trend towards industrialisation continued until the mid-20th century, with transport and industry remaining the dominant uses of the waterfront. In the post-war period, the spread of the automobile and the car-centric orientation of cities meant that riparian territories frequently became urban motorways, which definitively severed residents from access to water. Since industrial and warehousing zones and motorways blocked public access, the connection between city-dwellers and water was progressively lost across all of these periods. From the 1980s onwards, driven by pressure for urban renewal and growing environmental awareness, waterfronts were rediscovered by the city. Revitalisation projects in Barcelona, Hamburg, and Baltimore demonstrated that returning the river to urban space could become one of the tools of urban development.

It was not only the spatial understanding of the river within the city that was changing, but also the approaches to managing it. The concept of the river as primarily a threat or a resource gave way to a gradual recognition of it as natural infrastructure — one that provides cities with indispensable protective, climatic, and social functions. It was during this same period that researchers began to systematically document the consequences of the previous approach: biodiversity degradation and growing flood risks. It became clear that waterfront revitalisation was not merely a social, aesthetic, or economic project. The high level of economic development, social cohesion, and commitment to sustainable development within the EU created the institutional conditions for embedding this new discourse and approach at the level of legislation.

This shift found expression in interrelated conceptual directions: nature-based solutions and the ecosystem approach to water resource management. All three are part of a broader discourse that dominates academic circles today and is reflected in the key regulatory documents of the European Union.

The European Regulatory Framework: WFD, Biodiversity Strategy, and Nature-based Solutions

EU Water Framework Directive

EU environmental policy traces its origins to 1972, when, following the first UN Conference on the Human Environment, the European Council declared the need to develop an environmental policy. This marked the beginning of the European Commission's practice of periodically issuing Community Environmental Action Programmes (EAP).

Between 1975 and 1988, EU water policy focused primarily on the protection of public health through the establishment of Water Quality Standards (WQS) and the protection of designated water resources. "Although this approach was effective, it reduced environmental systems into parameters without adequate assessment of the actual environmental state and did not describe the health of aquatic ecosystems in an integrative way" (Giakoumis & Voulvoulis, 2018). The management instruments of the time included: regulations on drinking water, standards for fishery waters, and standards for shellfish-growing waters. With regard to pollution caused by the discharge of hazardous chemical substances into the aquatic environment, a range of substance-specific directives existed, listing harmful substances and setting permissible discharge levels. An engineering view of nature prevailed: the standard approach to rivers involved their straightening, lining with concrete, and the construction of dams, while control was exercised through established maximum permissible pollutant concentrations. Overall, this represented a more localised view of individual river stretches — one that inevitably lost sight of the river's ecosystem as a whole. Moreover, the emphasis on point-source pollution monitoring meant that the problem of diffuse pollution caused by agriculture — the runoff of nitrogen and phosphorus residues from fertilisers — went unaddressed by regulators for years.

The adoption of the Water Framework Directive in 2000, after three decades of EU water legislation development, marked a new era in water policy — both in terms of objectives and instruments. The WFD has been regarded as "the most ambitious and complex piece of legislation on environment ever enacted in the EU" (Prieto, 2009). The Directive introduced a system of integrated river basin management; it emerged from an already established understanding that managing water resources within administrative boundaries is ineffective — management should follow natural hydrological boundaries (river basins). The subject of assessment also changed: the focus shifted to the structure and functioning of the entire ecosystem. The Directive also provided for decentralisation, the transfer of powers to basin level, public participation, and the incorporation of socio-economic considerations through the integration of economic analyses of water use. The objective was defined as good ecological status of waters, meaning only minor deviation from the condition in which a water body would exist without human intervention. It was this Directive that formally embedded the logic by which the condition of the riparian environment is part of water quality.

Although the target of good status for all waters was set for 2015, by 2024 only around 37% of surface water bodies had achieved this status. This demonstrates that even under conditions of well-developed institutions, the transition from declared principles to real systemic change is extraordinarily difficult.

EU Biodiversity Strategy

The EU Biodiversity Strategy for 2030 is a comprehensive, ambitious, and long-term plan to protect nature and reverse the degradation of ecosystems, and constitutes one of the key components of the broader European Green Deal — the EU's overarching programme for the transition to climate neutrality and sustainable development. To achieve its objective of restoring Europe's biodiversity by 2030, the Strategy introduced a system of commitments and actions to address the main drivers of biodiversity loss: changes in land and sea use, the overexploitation of biological resources, climate change, pollution, and invasive alien species (European Commission, 2020).

With regard to river ecosystems, the EU Biodiversity Strategy introduced a specific and measurable target: to restore at least 25,000 km of free-flowing rivers. It is important that, according to the European Commission (2021), a free-flowing river is one that maintains connectivity across four dimensions: "longitudinal (connectivity between up- and downstream); lateral (connectivity to floodplain and riparian areas); vertical (connectivity to groundwater and atmosphere); and temporal (connectivity based on seasonality of fluxes)."

Thus, the necessary conditions for the restoration of free-flowing rivers include "the removal of artificial structures affecting the free-flowing character of water" and "the rehabilitation of hydrological, morphological and biological connectivity between wetlands, floodplains and their river channels." A sole focus on longitudinal connectivity would significantly narrow the scope of the Strategy, which explicitly calls for the restoration of floodplains and wetlands. The Strategy therefore places emphasis also on lateral connectivity — between the river, its riparian zone, and its floodplain — recognising these as important hydromorphological supporting quality elements. The new model thus entails the removal of obsolete artificial barriers and the restoration of the natural functions of riparian ecosystems and floodplains, while the reference condition describes the near-natural state of the floodplain without significant human intervention.

Although the reference condition serves as a benchmark, planning constraints — such as the need to protect cities from flooding — must often be taken into account. In such cases, restoration goals are adjusted according to the constraints specific to a given area: "Restoration goals are only defined for areas with agricultural or natural land use at a safe distance from infrastructure or residential areas" (European Commission, 2021). Accordingly, restoration potential is reduced in proportion to the constraints of urban planning. Furthermore, the Nature Restoration Law — which gives legislative form to the Biodiversity Strategy — contains no direct reference to urban rivers, leaving them in an in-between legislative space: between the target on urban green spaces and the river restoration target focused on removing barriers and improving aquatic biodiversity (Zingraff-Hamed et al., 2024). Despite being subject to significant anthropogenic pressure, urban rivers remain without direct regulatory coverage.

Nature-based Solutions

One of the instruments for implementing the provisions of the Water Framework Directive and the Biodiversity Strategy is the transition from traditional engineering-based protective methods to the deployment of Nature-based Solutions. According to the International Union for Conservation of Nature (IUCN), NbS are defined as: "Actions to protect, manage and restore natural or modified ecosystems, which address societal challenges, effectively and adaptively, providing human well-being and biodiversity benefits" (IUCN, 2020). NbS harness the natural properties of ecosystems to address contemporary societal challenges. The concept was introduced by IUCN in the 2000s and was subsequently adopted by the European Commission and the United Nations. Unlike the WFD and Biodiversity Strategy, which are normative documents with specific targets, NbS constitutes a conceptual framework for achieving those targets.

In 2020, IUCN adopted the Global Standard for NbS — a standardised document establishing eight criteria for assessing the quality of nature-based interventions: addressing societal challenges, designing for the appropriate scale, generating a net gain in biodiversity, economic viability, inclusive and transparent governance, equitable balancing of trade-offs, adaptive management, and sustainability and systemic integration (IUCN, 2020). Prior to its adoption, no universally recognised framework existed for assessing the effectiveness, efficiency, and sustainability of nature-based solutions. While the IUCN Standard represents a step towards filling this gap, it remains a voluntary instrument and has not resolved the absence of mandatory assessment and monitoring mechanisms.

The EU Water Framework Directive, the EU Biodiversity Strategy 2030, and Nature-based Solutions — despite their differences in legal force and instruments — all represent the same shift in the understanding of rivers and riparian territories that has been taking place in international academic and policy thinking over the past three decades.

Implementation challenges

At the same time, all three concepts emerged and are being implemented primarily in countries with well-developed institutions, where land relations are clearly regulated and the state's regulatory capacity is sufficient to ensure compliance. Yet even within the European Union itself, the implementation of these concepts runs into systemic obstacles and institutional layering. This creates a specific context for their application beyond Western Europe.

The Post-Socialist Institutional Contex

Ukraine represents a fundamentally different context — not only quantitatively (fewer resources, lower capacity) but also structurally. Like most countries of Central and Eastern Europe, Ukraine faces governance challenges associated with the transition from centralised, vertical to decentralised and often inconsistent models of urban development. This transition has contributed to such trends as a reduction in green space per capita and diminished resident access to green areas (Rîșnoveanu & Bărbulescu, 2025). This contrasts with processes occurring simultaneously in Western European countries, where movement proceeded in the opposite direction: increased interconnectedness of urban green spaces and their accessibility to citizens, and an overall expansion of urban green areas (Kabisch & Haase, 2013; Halbac-Cotoara-Zamfir et al., 2021). Furthermore, these countries face difficulties transitioning to strategic urban spatial planning, owing to unresolved questions about the distribution of powers between centralised systems and local autonomy.

In this context, the phenomena of "green grabbing" and "ecological gentrification" deserve particular attention — whereby ecological rhetoric is used to capture valuable land under the guise of "urban development." Researchers document that nature-oriented projects can raise property values and stimulate gentrification, effectively excluding from access to nature precisely those groups that need it most (Anguelovski et al., 2022; Dooling, 2009).

Institutional vacuum

During the Soviet era, riverbanks performed either industrial functions or served as "public" parks with minimal management and no clearly defined legal status. After 1991, mass privatisation and land re-registration took place, in which riparian plots were particularly attractive due to their high market value. Under conditions of weak regulatory capacity, this created ideal conditions for rapid land grabbing. In practice, development outpaced regulation — not because norms were entirely absent, as some did exist, but because there was no capacity to enforce them.

Moreover, the legal status of riparian lands long remained undefined in practical terms. Under the Land and Water Codes of Ukraine, lands of the water fund are in state or communal ownership and are not subject to privatisation, as they form the basis for the protection of water bodies. The only exception is enclosed natural water bodies of up to 3 hectares, which may be transferred into private ownership by decision of the relevant authorities. However, in most cases the boundaries of coastal protection zones were not properly documented in the cadastre, which opened the door to challenges of their status in the courts.

Ukraine's European Integration Commitments

Ukraine has assumed specific international obligations regarding water resources and ecosystems. In 2014, it signed the Association Agreement with the EU, under which it is obliged to harmonise its water legislation with six EU directives, among them the Water Framework Directive, the Floods Directive, and the Urban Waste Water Directive (EU-Ukraine Association Agreement, 2014).

Despite the full-scale invasion, Ukraine adopted River Basin Management Plans for all nine river basin districts (Cabinet of Ministers of Ukraine, Orders No. 1077-r, 1078-r, 1079-r of 01.11.2024 and No. 1347-r of 31.12.2024); the first implementation cycle covers 2025–2030. The adoption of the RBMPs means that water resource management at the river basin level is now a legally binding planning instrument. The question of riparian development and the protection of riparian ecosystems within cities is not directly addressed in the RBMPs — which confirms the existence of a regulatory gap precisely in the area where development pressure is greatest.

Ukraine has not yet ratified the Water Framework Directive itself. The Association Agreement establishes an obligation to harmonise legislation, but formal ratification of the WFD as a binding instrument of domestic law has not taken place. This means that even the foundational requirement of achieving good ecological status for water bodies, including their riparian zones, has not acquired full legal force within the Ukrainian system.

The dominant academic discourse holds that rivers, together with their riparian territories, perform systemic functions at the basin scale — functions that are subject to protection and restoration, and that land use must treat these functions as a binding condition rather than an optional consideration. Yet these concepts were born in societies with already well-developed institutions, clearly regulated land relations, and sufficient regulatory capacity — and even there their implementation encounters systemic challenges.

In Ukraine, the institutional vacuum that emerged following the collapse of the Soviet Union created conditions in which development outpaced any form of regulation, and where ecologically valuable lands — riparian zones — became the primary target of capture.

ANALYTICAL FRAMEWORK

Climate Resilience

Climate change poses numerous challenges to urban systems and threatens urban infrastructure and human health. Since the pace of climate change mitigation has been slower than expected and progress remains limited, cities will have to adapt to the consequences of climate change regardless. In contemporary understanding, adaptation is increasingly framed as climate risk management, linking it to the broader concept of urban resilience (Leichenko, 2011). From an urban perspective, any impact on the urban system — regardless of whether it has a climatic origin — can either be overcome if the system has a high level of resilience, or lead to its weakening, contraction or decline in the opposite case (Lindley et al., 2006).

According to Carter et al. (2015), climate risk in cities consists of three components: hazard (the extreme weather events themselves), vulnerability (the extent to which the urban environment and its residents are exposed to that impact), and adaptive capacity (the availability of resources to recover). Thus, climate resilience is the ability of a system — a city, a community, a landscape — to withstand climate shocks and recover quickly. This definition is important here because it shifts the focus from the question of "whether a disaster will occur" to "how capable the city is of absorbing it and recovering." In this context, natural infrastructure becomes particularly significant.

The traditional "engineering approach" — dams, drainage canals, concrete bank reinforcements — is becoming increasingly less effective for achieving these goals, since grey infrastructure is by its nature designed to control or even resist nature rather than to adapt to it, and was largely developed under different climatic conditions. Instead, scientific discourse is increasingly affirming the concept of "green" infrastructure (e.g. parks, trees, and green spaces) and "blue" infrastructure (e.g. lakes and coastlines, wetlands, restored floodplains) as a cost-effective and self-sustaining alternative for achieving climate resilience (Skidmore & Wheaton, 2022). A further advantage of these solutions is their multifunctionality: unlike monofunctional engineering solutions, green-blue infrastructure simultaneously performs multiple functions.

Thus, natural elements of the urban environment — and riparian zones in particular — are no longer regarded as an optional addition to the urban fabric that provides certain benefits such as aesthetic appeal, but are instead recognised as functional infrastructure performing an indispensable protective role. For this reason, the preservation of natural river landscapes is considered an instrument of adaptation for building resilience to climate change.

In the context of projected intensification of climate risks in cities, and given the heightened vulnerability of urban environments to climate change, the development of riparian zones is no longer merely a local ecological or aesthetic question, but rather a strategic decision regarding the climate vulnerability of the entire city: every lost metre of the riparian ecosystem will affect the capacity of the whole system — one that the city will have to compensate for either through costly engineered infrastructure, or by accepting greater exposure to the consequences of climate change. This is why, in this study, the riparian zone of the Dnipro River in Kyiv is considered primarily as an element of urban climate infrastructure rather than a standalone natural object.

The Ecosystem Approach

The ecosystem approach originated within the Convention on Biological Diversity (1992), a summit at which world leaders agreed to uphold the concept of "sustainable development" — meeting the needs of the present generation while preserving a healthy and habitable world for future ones: "this pact among the vast majority of the world's governments sets out commitments for maintaining the world's ecological underpinnings as we go about the business of economic development" (Secretariat of the Convention on Biological Diversity, n.d.).

It was from the three core objectives of the Convention — the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising from the utilisation of genetic resources — that a new approach to natural resource management began to take shape, since the diversity of ecosystems is regarded as an integral aspect of biodiversity.

The ecosystem approach emerged at the intersection of ecology, management, and policy, and was officially adopted as the primary framework for natural resource management within the Convention on Biological Diversity. In this study, the ecosystem approach is used as an analytical framework that allows an assessment of the extent to which land-use decisions align with the principles of climate resilience and the preservation of the ecosystem functions of riparian territories, evaluated from a governance perspective.

The ecosystem approach places at its centre the interconnectedness of all system elements: unity exists not only among individual components, but also between them and the environment with which they interact, together forming a coherent whole (Veklych, 2010). This approach therefore aims to ensure the long-term viability of biodiversity, and the conservation and integrity of ecosystems through the application of sustainable natural resource management principles. At the same time, natural resource management is understood as a process of interaction not only between humans and nature, but also among people within society. It encompasses the use of resources and the restoration of environmental quality through a system of interrelated economic, ecological, and social linkages. The assessment instrument consists of the 12 CBD principles, grouped by IUCN into 5 steps: from the identification of stakeholders and ecosystem boundaries (Step A) to adaptive management over time (Step E).

Ecosystem Services

The ecosystem approach is inextricably linked to the concept of ecosystem services — the benefits that humanity continuously derives from ecosystems. This concept serves as an instrument that translates the "invisible" functions of ecosystems into a language accessible to governance and economic analysis. Several classifications of ecosystem services currently exist, with the key distinction lying in their intended purpose: economic accounting (CICES, TEEB) or an emphasis on social values and nature's contributions to human life (IPBES). This study uses the Millennium Ecosystem Assessment classification as its foundational framework, since it underpins the 12 principles of the ecosystem approach (Millennium Ecosystem Assessment, 2003). According to MEA, ecosystem services are divided into four categories reflecting different dimensions of our dependence on nature: Provisioning services —

material products that people obtain directly from ecosystems (food, materials, freshwater); Regulating services — derived from the natural regulation of ecosystem processes, responsible for maintaining the environment within safe parameters for human life (climate regulation, water purification, erosion control); Cultural services — non-material benefits obtained through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experience (the value of recognisable places with which people identify, aesthetics, recreation); and Supporting services — processes necessary for the existence and functioning of all other service categories (soil formation, production of atmospheric oxygen, nutrient cycling) (Millennium Ecosystem Assessment, 2003).

Critique of the Ecosystem Approach

Over this period, the concept of the ecosystem approach has evolved from a conceptual idea into the dominant model of governance in scientific discourse. However, scholarly debate also exists regarding the limitations of this model.

The ecosystem approach has been applied primarily in developed countries, where resources are generally available for all stages of project implementation, and may be difficult to implement in countries with more limited institutional capacity: "EA proponents in less developed countries (LDCs) will need to be realistic about limited resources and should set goals which enable the EA to simplify rather than complicate the goals of sustainable management" (Shepherd, 2004). The complexity of implementation means that, depending on the scenario or problem being addressed, one or more principles may be omitted while the activity is still described as EA: "In fact, few if any case studies applied all Principles but the consensus was that most cases were nonetheless effective at illustrating the EA" (Smith & Maltby, 2003).

Furthermore, increasing attention to ecosystem services has not promoted decentralised governance or the use of diverse forms of knowledge, and effectively marginalises the social and ethical dimensions of the ecosystem approach (Waylen et al., 2014). Smith and Maltby (2003) also concur that the focus of the ecosystem approach should not be reduced solely to ecosystem services.

According to Norgaard (2010), the contemporary focus on market mechanisms and project-level analysis ignores the true complexity of nature and the need for large-scale institutional change. The economic valuation of ecosystem services is an excessive simplification and cannot be the sole instrument of governance; moreover, the attempt to evaluate nature through ecosystem services leads global environmental policy down the wrong path (Schröter et al., 2014). Redford and Adams (2009) also critique the concept of ecosystem services for its anthropocentrism — for selecting only those services that meet human needs — and argue that the economic metaphor of "services" encourages an exclusively exploitative attitude.

These caveats have been taken into account in this study: the ecosystem approach is used here not as a comprehensive management programme, but as an analytical checklist. The emphasis on ecosystem services is a deliberate methodological choice, rather than a claim to exhaustive coverage of all ecological dimensions.

Characteristics of Riparian Territories

The riparian zone of the Dnipro River examined in this study constitutes a riparian ecosystem — an ecosystem associated with the riparian zone of water bodies (rivers, streams, lakes), shaped by the influence of water and periodic flooding, and forming a transitional zone between aquatic and terrestrial environments. Biodiversity here is always higher than in purely forested or purely aquatic environments, as species from both realms intersect. Riparian corridors regulate nutrient, organic matter, and sediment transport, which determines water quality in rivers and connected water bodies downstream. When riparian corridors remain in a natural, largely undisturbed state, they retain the capacity to deliver ecosystem services of the highest quality.

However, in areas where urbanisation proceeds rapidly, these riparian ecosystems are adversely affected by intensive human activity and development. The degradation of riparian territories can disrupt the natural cycles of biological and physical activity that normally occur within these systems. The cumulative effects of channel modification, bank erosion, and chemical pollution substantially alter river corridors, reducing their biodiversity and their ecological and recreational value. This in turn increases socio-economic risks, including threats to human health and growing costs associated with remedying the consequences of system degradation.

For this reason, the preservation of functional riparian corridors or the restoration of already degraded sections are considered key strategies for water quality management at the scale of entire catchment basins, and should be regarded as complementary strategies (Atkinson & Lake, 2020).

For the purposes of this study, the most relevant ecosystem services are: flood regulation, bank stabilisation, biological corridor function, microclimatic regulation, and recreation.

Flood Regulation

When a riparian ecosystem is in its primary state, vegetation and natural permeable surfaces in floodplain zones absorb excess water during peak flood events, slow surface runoff, and reduce the velocity and force of floodwaters.

Development within the riparian zone disrupts this mechanism through two interrelated processes. On natural, undeveloped land, precipitation and snowmelt accumulate and are retained in vegetation, the soil layer, or surface depressions. Once their storage capacity is reached, runoff slowly percolates through the soil. Urbanisation, by contrast, involves the construction of roads and new buildings. A significant proportion of the surface becomes covered with impervious materials — concrete, asphalt, and roofing — which have a much lower water-retention capacity. Permeable soil is replaced by these impervious surfaces, which reduce infiltration and accelerate runoff into drainage ditches and watercourses (U.S. Geological Survey, 2003). Urbanisation overall increases the area of impervious surfaces and thereby raises flood risk: surface runoff increases, the urban area fills with water more rapidly, and peak flood discharge is reached sooner. Second, the physical elimination of floodplain space deprives floodwaters of a buffer zone for the temporary storage of excess water.

Development within the Dnipro floodplain narrows the channel, thereby reducing its conveyance capacity and potentially increasing the water surface elevation (also known as stage). Water levels rise as a result, and areas upstream experience more frequent inundation (U.S. Geological Survey, 2003).

Bank Stabilisation

The root systems of riparian vegetation — primarily trees and shrubs — mechanically hold the soil of riverbanks in place, preventing erosion and collapse. Vegetation slows the movement of water by dissipating the energy of the current. Sediment is trapped, settling and forming bank slopes. Bank stabilisation is closely linked to flood regulation, since frequent floods in urban areas further intensify the erosion of channels and banks. Where vegetation has been removed from banks, current velocity increases, enabling the watercourse to transport greater quantities of sediment. As noted by the U.S. Geological Survey (2003): "In many urban areas, stream-bank erosion represents an ongoing threat to roads, bridges, and other structures that is difficult to control even by hardening stream banks."

When residential complexes are constructed, natural riparian vegetation is removed and replaced with concrete bank reinforcements, which in the urban context are presented as embankments. Such structures provide mechanical protection against erosion. However, they are "rigid" engineering solutions serving a single function, and perform none of the other functions delivered by natural vegetated riparian cover: they do not cool, do not filter, and do not serve as habitat.

Biological Corridor

Riparian territories are ecological corridors that connect different natural habitats and facilitate the movement of species. Riparian corridors along riverbanks and waterways are vital for biodiversity maintenance, supporting a range of aquatic and terrestrial species while filtering pollutants from urban runoff (Wang et al., 2024).

The Dnipro, as a major river corridor, functions as a migration route for birds and a connective element between natural zones within the city. The development of riverbanks with residential complexes (or other types of construction) interrupts this corridor: fenced or fragmented sections of the riverbank, the absence of vegetation, and the constant presence of people destroy the conditions necessary for this function to operate.

Green spaces within the city should be connected through wildlife corridors and ecological networks in order to facilitate species movement, maintain genetic diversity, and strengthen ecosystem resilience.

Microclimatic Regulation

Riparian vegetation cools the surrounding air through two mechanisms: evapotranspiration (the evaporation of moisture through leaves) and the shading of surfaces by tree canopies (Peroni et al., 2023). The replacement of natural vegetation with concrete surfaces and buildings intensifies the urban heat island effect, as these surfaces absorb heat during the day and release it slowly at night. In the context of climate change, which is characterised by an increasing frequency and duration of heatwaves, this function is becoming increasingly important.

Recreation

Recreational services encompass a wide range of non-material benefits that people derive from interaction with the natural environment: physical activity in the open air, aesthetic enjoyment of landscapes, psychological restoration, social interaction, and a sense of belonging to a place. Unlike other services, whose degradation may go unnoticed until a critical threshold is reached, the loss of recreational access is felt immediately by primary stakeholders. The recreational function of urban ecosystems can either provide access to nature in the city for all residents, or conversely, be restricted to a limited group of people. The condition in which riparian zones are transformed into closed spaces reserved for certain residents is described in the literature through the concepts of "ecological gentrification" or "green grabbing" — the appropriation of the ecological value of a place by a narrow group while excluding the broader community. Furthermore, public access to the riverbank can be understood as having both an individual dimension (health, leisure) and a collective one (quality of the urban environment, social justice).

Why the Existing Model is Incompatible with the Ecosystem Approach

Every square metre of riparian land covered with concrete, asphalt, or built structures loses the capacity to deliver ecosystem services, and the system loses its functions. Natural land absorbed water during sudden increases in flow and attenuated peak discharge; an impervious surface performs none of these functions, and water that previously infiltrated or was retained in the soil now flows immediately into the urban drainage system. In the process, sewer networks designed for a particular runoff volume find themselves under increased pressure. Development also means the destruction of natural cooling infrastructure, since the same surfaces amplify the urban heat island effect. The development of riparian territories cannot be treated as a localised event, since the consequences unfold gradually and unevenly over time, ultimately affecting the entire city.

Once riverbanks are built upon, restoring their functions requires substantial investment: either full-scale reconstruction, or the construction of costly compensatory engineered infrastructure. In this sense, the decision to develop riparian land is irreversible or very difficult to reverse. A city that permits intensive riverbank development, whether consciously or not, thereby increases its own vulnerability.

The preservation or restoration of riparian zones is the most cost-effective means of ensuring sustainability and protection from natural hazards. Rather than creating complex engineered solutions, it is often more effective — and significantly less costly — to preserve the natural ecosystem that will perform the same functions without capital expenditure.

Incompatibility of the Contemporary Model with the Ecosystem Approach

Riparian development is a manifestation of the conflict between the fundamental logic of the market — which prioritises short-term profit — and the logic of ecosystem management, which operates over the long term. A development project is typically realised over a period of 5–15 years (from the acquisition of a site to the sale of apartments), while ecosystems operate on entirely different cycles measured in decades. The 8th principle of the Ecosystem Approach also emphasises: "Recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term."

Contemporary development on riparian land therefore represents a model of land use in which the spatial and ecological value of a site is capitalised upon without any direct compensation for the costs incurred.

Proximity to water is a stable factor that increases residential property values. Nicholls and Crompton (2017), in a systematic review of studies, demonstrated that properties located in close proximity to rivers, streams, and canals (linear water features) command a price premium compared to comparable properties without water access: "In urban settings, the premium associated with river views was typically in the range of 10–30%." A developer who constructs a residential complex on the bank of the Dnipro captures this premium through the per-square-metre sale price of apartments, while the functions that generate this value are destroyed or curtailed in the process of construction. The costs of this destruction are borne by the city and its residents in the form of growing infrastructure expenditure, flood damage, and the deterioration of urban environmental quality. In economic theory, this process is described as the externalisation of costs.

Principle 4 of the Ecosystem Approach recognises the need to understand and manage ecosystems in an economic context, and emphasises the necessity to "reduce those market distortions that adversely affect biological diversity" (CBD, 2000). This formulation directly describes the structural problem currently observable in Kyiv.

Thus, the prevailing model of land use in riparian territories and their active development is fundamentally market-oriented in nature, manifesting in the privatisation of benefits and the externalisation of costs. For this reason, in order to address the question of whether land use is consistent with the principles of climate resilience, this study employs the ecosystem approach as a framework oriented towards broad and systemic thinking.

Research Question

While the ecosystem approach has been applied as an analytical framework in various riparian and urban water management contexts, no study has systematically applied it to assess land-use decision-making along the Dnipro riverbanks in Kyiv — a post-socialist context where institutional vacuum, weak regulatory enforcement, and active waterfront development have converged in ways that existing Western-oriented frameworks do not adequately capture.

Research question: Does the current land use of the Dnipro riverbanks within Kyiv conform to the principles of the ecosystem approach and climate resilience?

Hypothesis 1: Developers capitalise on the ecosystem value of riparian zones while externalising the costs of their degradation onto the city and the community. The absence of cost internalisation mechanisms is one of the key market distortions that makes riparian development financially attractive despite its systemic ecological consequences.

Hypothesis 2: The cumulative effect of first-line riparian development along the Dnipro leads to a measurable increase in the city's climate vulnerability — through amplification of peak flood discharge, intensification of the urban heat island effect, and fragmentation of the riverbank ecological corridor, as well as a ***reduction in public access to the riverbank for recreation.***

METHODOLOGY

The Ecosystem Approach: Five Steps to Implementation, developed by IUCN (Shepherd, 2004), is used here as an analytical framework for assessing the extent to which existing development practice conforms to the principles of climate resilience. The methodology serves as the primary framework for action under the Convention on Biological Diversity (CBD) and consists of 12 principles. This document serves as a bridge between theoretical concept and practical field application.

This study adopts a confirmatory research design: it tests two explicitly formulated hypotheses against empirical material drawn from specific sites and planning documents. The Five Steps to Implementing the Ecosystem Approach (Shepherd, 2004) serves as a normative standard against which observed decision-making practices are evaluated. At the same time, the study retains an exploratory dimension, since the application of this framework to the post-socialist urban context of Kyiv, where institutional vacuum and development pressure have converged in historically specific ways, has not previously been attempted. The confirmatory approach is appropriate because it allows the gap between declared principles and actual practice to be measured systematically; its key limitation is that the framework was developed primarily for contexts with stronger institutional capacity, which this study explicitly acknowledges.

In this study, it is used as an analytical checklist: each step defines a set of conditions that should have been met under ecologically responsible land-use decision-making. By examining whether these conditions were observed in real cases, the study attempts to answer the research question. The question of "how far development conforms to the principles of climate resilience" is evaluative in nature and requires interpretive rather than statistical tools.

If the ecosystem approach represents the normative standard for "what responsible management of riparian ecosystems should look like" from the perspective of sustainable and climate-resilient governance, then the gap between that standard and the documented decision-making practice is a measure of non-conformity. This study also attempts to move beyond the question of "whether contemporary riparian development along the Dnipro is relevant to climate change" towards identifying which specific steps in the current model were skipped or insufficiently observed.

The spatial boundaries of the study are the riparian zone of the Dnipro River within Kyiv, and the temporal boundaries are 2005–2025. This period was chosen because the most intensive wave of residential construction on the Dnipro riverbanks is observed precisely after 2015, generating a sufficient number of cases for comparative analysis, while remaining recent enough for data to be both available and relevant.

The five steps of the ecosystem approach are applied as follows:

Step A (identification of stakeholders and ecosystem boundaries): this step examines whether all interested parties were identified, whether primary stakeholders — the users of the riverbanks — had a voice in the decision-making process, and whether the ecological boundaries of the riparian zone were taken into account when designating sites for development.

Step B (characterisation of ecosystem structure and functions): this step examines whether an assessment of the riparian zone's ecosystem services was conducted prior to development, and whether the ecosystem's functions were taken into account in the decision-making process.

Step C (economic drivers): this step examines which economic incentives and distortions shaped the decisions of developers and regulators.

Step D (adaptive management in space): this step examines whether the impact of riparian development on adjacent ecosystems was considered, and whether any mechanism for spatial coordination existed.

Step E (adaptive management in time): this step examines whether long-term objectives and temporal monitoring mechanisms for ecosystem management were considered, and whether any mechanism existed for reviewing decisions in light of changing internal and external conditions.

Data sources: data sources used in this study fall into four categories. First, urban planning documentation: Detailed Development Plans (DDPs) for four of the five studied residential complexes, publicly available through the Kyiv City State Administration's open data portal. Second, strategic planning documents: the Kyiv City Development Strategy to 2027 and the Dnipro River Basin Management Plan (2025–2030). Third, remote sensing data: Sentinel-2 satellite imagery accessed via Copernicus Browser, used to calculate NDVI (Normalized Difference Vegetation Index) and NDBI (Normalized Difference Built-up Index) for August 2016 and August 2025 for RC Zarichnyi and RC RiverStone. Fourth, academic literature and policy documents: peer-reviewed articles, IUCN methodological guidance (Shepherd, 2004), EU directives and strategies, and relevant Ukrainian legislation.

The following sections apply the five steps of the ecosystem approach sequentially to specific sites and documents. Each step opens with an explanation of its logic, followed by analysis of the relevant material.

Step A — Stakeholders and Ecosystem Boundaries

In the early 2000s, Kyiv was undergoing a transformation in land relations: following the large-scale privatisation of the 1990s, riparian plots along the Dnipro were gradually shifting from industrial and recreational to residential use. Despite the fact that the concept of the ecosystem approach had been formally embedded in international law as early as 1992 with the signing of the Convention on Biological Diversity, this approach remained largely unknown in Ukrainian urban planning practice.

The analysis of Step A involves the classification of stakeholders into primary, secondary, and tertiary categories, and an examination of whether their interests were taken into account in development decision-making. According to the methodology, in the context of the Dnipro riparian zones, primary stakeholders are the general public, residents of adjacent neighbourhoods who had traditional recreational access to the riverbank, and other active users of the riparian zone. Secondary stakeholders include: residents of the new residential complexes (whose relationship with the ecosystem is indirect), developers (with an economic interest not directly contingent on ecosystem services), and the Kyiv City State Administration (KSCA) and district administrations. Tertiary stakeholders are national authorities and environmental organisations.

This study focuses on residential complexes that meet the following criteria: location on the Dnipro riverbank, no separation from the water by motorways or other major structures, and under construction or commissioned no earlier than five years ago. Currently in Kyiv, the following complexes fall within this scope: Novyi Podil, Rusanivska Havan, the complex at 101 Yevhena Malaniuka Street, Rusaniv Residence, RiverStone, and Zarichnyi.

The overwhelming majority of the complexes currently occupying riparian plots along the Dnipro, with the exception of Novyi Podil, were approved as projects at the Detailed Development Plan (DPT) stage before 2011, which is a critical factor in this analysis.

A Detailed Plan of the Territory (DPT) is the primary spatial planning instrument at the level of an individual site. It defines the organisation, layout, and future development of a specific territory:

"The detailed development plan elaborates the provisions of the general plan of a settlement or the comprehensive plan, and defines the planning organisation and development of part of the territory of a settlement or territory beyond its boundaries, without changing the functional designation of that territory" (Article 19, Law of Ukraine "On the Regulation of Urban Development Activity"). The preparation of a DPT may be financed not only from state or local budgets, but also from other sources not prohibited by law, provided that the relevant local self-governance body acts as the client. However, when a developer finances the preparation of a detailed plan for the territory on which it intends to build, there is a risk that architects will work in the interests of the developer rather than those of the community or the ecosystem.

Importantly, following the adoption of the Law of Ukraine "On the Regulation of Urban Development Activity," the transfer of state or communal land plots into private ownership or use for urban development purposes was prohibited in the absence of a Detailed Development Plan for the relevant territory.

The evolution of public participation procedures

Prior to 2011, community participation in the review of urban planning documentation was nominal. The procedure required the publication of a notice in mass media (the newspaper *Khreshchatyk*). If no proposals were received from the public within 30 days, the procedure was considered complete. Any process of transparent communication between local self-governance bodies and the community was absent.

The situation partially changed with the adoption of Cabinet of Ministers Resolution No. 555 of 25 May 2011. From that point, the client (the local self-governance body) became obliged to inform the community about the commencement of DPT development, both in print publications and on its official website. The project's objectives, its main technical and economic indicators, and the procedure for submitting proposals were required to be made publicly available. All proposals submitted were subject to review and could either be incorporated or rejected with reasoned justification, with the outcomes published in the form of a report or minutes.

However, no documented public consultations or public hearing reports for any of the analysed sites were found in open registries.

The introduction of Strategic Environmental Assessment (SEA)

Prior to 2018, the assessment of environmental risks was reflected in DPT sections such as: "environmental protection measures," "environmental protection," or "scheme of ecological and urban planning assessment of the territory and planning restrictions." These sections were descriptive rather than evaluative in character: they recorded existing conditions but did not provide for systematic analysis of the planned development's impact on the ecosystem, alternative development scenarios, or monitoring mechanisms. It was within this window — 2005 to 2018 — that the DPTs for the majority of the analysed sites were approved. As a consequence, all development based on these earlier plans remains outside the scope of environmental oversight even today.

Following the entry into force of the Law of Ukraine "On Strategic Environmental Assessment" (12 October 2018), SEA became a mandatory procedure for all urban planning documentation: it is a public report in which the state of the ecosystem must be addressed comprehensively. In practice, however, SEA is often treated by developers as yet another bureaucratic obstacle rather than an instrument for preserving ecosystem structure and functions.

Who carried the greatest weight in decision-making

Principles 1 and 12 of the CBD emphasise that the objectives of the management of land, water, and living resources are a matter of societal choice, and that all relevant sectors of society should be involved in this process. The analysis of the six sites on the Dnipro riverbanks in Kyiv demonstrates that neither of these principles was systematically observed.

In all of the cases examined, the key actors in the permitting process were exclusively the KSCA (Department of Urban Planning and Architecture) and DABI (the State Architectural and Construction Inspectorate, now DIAM) — as the bodies responsible for issuing urban planning conditions and restrictions and construction permits. The genuine primary stakeholders under the logic of the ecosystem approach — residents of adjacent neighbourhoods, users of the riverbanks — had no documented mechanism for participation in these decisions, or such documentation is not available in the public domain.

The table below sets out the key parameters for each of the analysed sites — including the existence of a DPT, its year of adoption, and whether an SEA and public consultations were conducted.

	RC RiverStone	RC Rusanivska Havan	RC Novyi Podil	Rusaniv Residence	RC Zarichnyi
Address	14 Dniprovska Embankment	101Sh Y. Malanyuka St.	14 NaberezhnoKhreshchatytska St.	54 Sverstyuka St.	Zarichna St. / Bazhana Ave.
District	Darnytskyi	Dniprovskyi	Podilskyi	Dniprovskyi	Darnytskyi
Developer	UDP / Miskzhytlobud	Kovalska	SAGA Development (Vavrysh)	Perfect Group/CI TEC	bUd development/IB Alliance
Status (2026)	Completed	Partially commissioned	Preparatory works/Under construction	Partially commissioned	Partially commissioned
Construction Years	2010–2022	2009–2022	2017–	2019–	2007–
DPT Year	2006	2016	—	2003	2006
Was SEA required (by law)	No (permit before 2018)	No (permit before 2018)	Formally yes, but not found	No (permit before 2018)	No (permit before 2018)
Public consultation protocols online	Not required	Not found	—	Not required	Not required

Legal cases	Yes (embankment, 2025)	Yes (SACI 2019–2021)	Yes (Prosecutor's Office 2022–2025)	Yes (criminal proceedings)	Yes (criminal proceedings)

Table 3.1 — Characteristics of the Residential Complexes within the Study Area

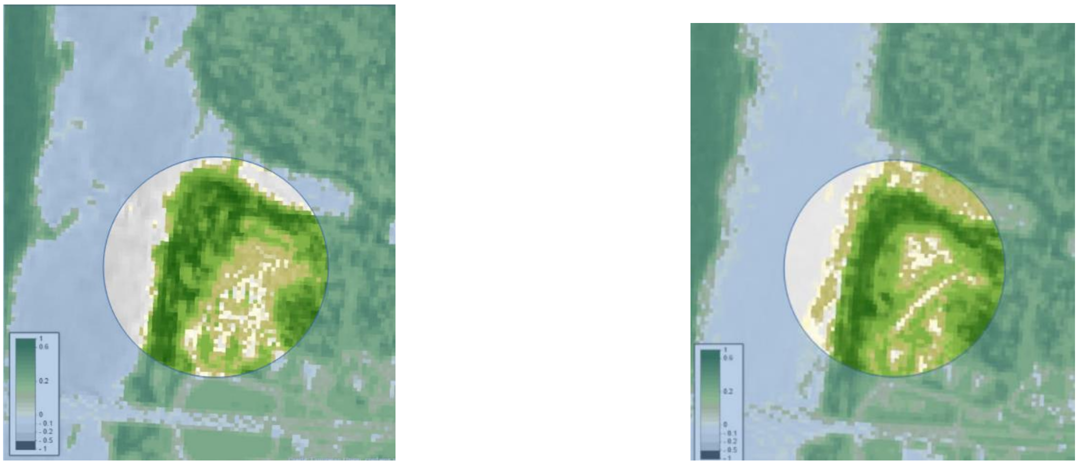
Source: Compiled by the author based on urban planning documentation (Detailed Development Plans for RC RiverStone, RC Rusanivska Havan, RC Zarichnyi, and Rusaniv Residence), court records and administrative proceedings, and publicly available construction registry data (2026).

Step B — Characterisation of Ecosystem Structure and Functions

Step B examines whether an assessment of the riparian ecosystem was conducted prior to development decisions, and whether the ecosystem's functions were taken into account in the planning process. Principles 5 and 6 of the Ecosystem Approach emphasise that management must be grounded in an understanding of what services an ecosystem provides, and must respect the limits of its resilience. Step B therefore asks: was the condition of the ecosystem recorded before development began, and was there any attempt to document what would be lost as a result of construction?

To address this step, changes in the structure of riparian vegetation cover were recorded using NDVI (Normalized Difference Vegetation Index) imagery based on Sentinel-2 data (Copernicus Browser). NDVI is a standard spectral index reflecting the density and condition of vegetation: higher index values (dark green) correspond to denser vegetation cover, while lower values (yellow, white) indicate bare soil or impervious surfaces.

A full analysis across all five studied complexes was not possible, however, due to a straightforward data limitation: Sentinel-2 imagery of sufficient quality and spatial resolution is only available from 2015 onwards, while most of the studied complexes began construction considerably earlier. As a result, the earliest available images already show the sites mid-construction rather than in their original near-natural state. The baseline condition of vegetation prior to development is not recorded — neither in planning documentation nor in remote sensing data. For the vegetation cover analysis, RC Zarichnyi and RC RiverStone in Darnytskyi District were selected. These two complexes were chosen for a specific reason: by 2015, only the first phase of each had been completed, with the second phase still at the excavation stage — which allowed the pre-construction vegetation to be partially captured, even if less completely than would be ideal. Comparable images were obtained for August 2016 and August 2025; using the same month ensures a valid seasonal comparison, free from distortions related to the vegetation cycle. The analysis would have been cleaner had the sites not already been mid-transition.



a) b)

Figure 3.1 — Comparative analysis of the NDBI index for RC Zarichnyi:
a) August 2016; b) August 2025

Source: Author’s own calculations based on Copernicus Sentinel-2 data (2025–2026)

In the centre of the identified zones, the excavation pit and already-constructed buildings are visible as white and yellow pixels with minimal NDVI values. At the same time, fragments of natural riparian vegetation were still present around the perimeter of the site — visible as dark green areas with higher index values. This vegetation represents the remnant of the natural cover of the riparian territory that existed before development began.

The August 2025 image shows a noticeably different cover structure. Part of the site has taken on a deeper green tone compared to 2016, reflecting the established artificial landscaping between the buildings of the complex. At the same time, new lines and patches of low NDVI are visible within the zone — roads, parking areas, and other impervious surfaces. The natural riparian vegetation that was still present around the perimeter in 2016 has significantly diminished by 2025. The artificial landscaping of the residential complex — lawns and tree-lined paths — differs fundamentally from the natural vegetation cover of the floodplain zone in terms of its ecosystem characteristics: it does not perform bank stabilisation functions and does not constitute an ecological corridor. It is reasonable to conclude that no assessment of the ecosystem functions of the developed areas was carried out prior to construction

Step C — Economic Issues

This step identifies the key economic factors that influenced decisions regarding riparian ecosystems and their inhabitants. The central question here is whether the economic logic behind these decisions accounted for the full range of consequences — including environmental ones — or only those that produced immediate private gain.

Specifically: was there a market distortion in which the direct economic benefits of construction were counted, while externalities — the degradation of natural regulatory functions, biodiversity loss, increased urban heat island effect, or future costs of flood damage — were ignored?

To examine this, the draft detailed plans (DDPs) for four of the five studied residential complexes were analysed (data for the fifth were unavailable).

Analysis of the DDP for Livoberezhny District

The draft detailed plan for the territory along Vozziednannia Avenue, Zaliznytsya Street, Brovarskyy Avenue, R. Okipna Street and the Rusanivska Channel in Dniprovskyi District — which includes the Rusaniv Residence residential complex — shows that all key calculations revolve around future residential floor space, and the primary criterion for evaluating the plan's success is its increase.

The indicator "engineering preparation and landscaping" is assessed by criteria such as "area of development requiring engineering preparation measures" and "length of closed drainage systems." The section "Environmental Protection" contains only two criteria: sanitary protection zones (ha), including greened areas. These are the only indicators in the entire technical-economic section that were left blank, with no target values.

The economic section contains no calculation of the value of lost ecosystem services. Nature is mentioned — but more as a feature to sell. The document states that "great attention in the project is paid to the formation of a recreational zone along the embankment of the Rusanivska Channel, with a yacht club to be built in the northern part," that landscaping is aimed at "creating convenient pedestrian connections between residential developments," and that "new religious buildings will add compositional expressiveness." The riverbank is treated primarily as a marketing advantage, not as an ecosystem to be preserved. Meanwhile, despite a planned significant increase in population, the area of public green space does not grow over the next 3–7 years, with only a symbolic increase projected in the 15–20 year horizon — from 7.81 to 9.32 sq.m per person.

Analysis of the DDP for Microdistrict 11, Poznyaky-Zakhidni

The draft DDP for Microdistrict 11, Poznyaky-Zakhidni — within which the Zarichnyi and RiverStone residential complexes are located — is perhaps the most striking example of how the economic logic of development not only ignores the ecosystem, but literally builds on its place.

The entire plan is oriented toward maximising residential and commercial floor space along the riverbank. The projected land use includes relatively large residential complexes (from 2,800 to 8,300 residents each), as well as a water park, office and retail centres, a business centre, and hotels.

The planning constraints map had previously identified zones labelled "boundary of 1% flood inundation" and "waterlogging zone." But these zones were not treated as areas requiring caution or possessing natural value — they were treated as an engineering problem to be solved. Instead of preserving the natural meadows and water bodies shown on the existing land-use base plan, the territory was to be transformed into a densely urbanised space with a "public embankment," stadiums, and parking lots.

The plan contains no calculation of the value of lost ecosystem services. Moreover, interventions such as yacht clubs, observation towers with restaurants, and a water park represent not the preservation of an ecosystem, but its conversion into marketable real estate attractiveness.

Analysis of the DDP for Mykilska Slobidka

This document covers the large-scale redevelopment of the Livoberezhny residential district and Rusanivski Sady (RC Rusanivska Havan), and is an example of how environmental rhetoric is used to justify hyper-dense construction.

The primary criterion for the plan's success is an increase in housing stock and population. The number of residents was projected to grow from 19,400 to 126,200 — more than six times. The multistorey residential housing stock was planned to increase from 46.4 ha to 205.9 ha, a 4.4-fold increase. What distinguished this plan from earlier ones was a particular emphasis on constructing "high-comfort housing" in the riparian zone — up to 30 storeys in height.

Against this backdrop, the treatment of green space is especially telling. At the time of the survey, green areas covered 118.7 ha (21% of the territory). According to the project, recreational and park areas were to constitute 99.0 ha (17.2%). So, with a population increase of more than six times, the total area of green space was actually decreasing.

Environmental protection in the document is reduced entirely to engineering and sanitary measures: municipal waste removal, stormwater discharge into collectors, and emissions calculations from underground parking. The environmental section acknowledges that "the territory is partially waterlogged by groundwater and subject to 1% flood inundation" — the response to which is not a question about the appropriateness of development, but artificial terrain modification: land reclamation and fill, and partial straightening of the shoreline. No economic assessment of lost ecosystem services was carried out.

Conclusion for Step C

Three analysed and approved DDPs — for Vozziednannia Avenue and Rusanivska Channel, for Microdistrict 11 Poznyaky-Zakhidni, and for Sahaydaka Street 101 — were adopted in different years and cover different sites, but they reflect the same pattern of decision-making.

In all three cases, a market distortion was identified: the private benefit from construction is short-term and easily quantified — square metres, sale price, project return on investment. The losses — degradation of natural functions, destruction of the capacity of riverbanks to absorb water, fragmentation of ecological corridors, urban heat island mitigation — are social and long-term costs. But they are not counted, not because they cannot be measured, but because the city did not require developers to account for them.

Profit is privatised and realised immediately. Costs are externalised and deferred — into future municipal budget expenditures for flood protection, additional engineering infrastructure, and riverbank stabilisation.

Under the logic of the Ecosystem Approach (Principle 4), management should not allow situations where benefit is derived at the expense of ecosystem degradation, while the costs of restoration are transferred to society. In the context of Kyiv's riparian zones, this is embedded in the very structure of the planning documents, where nature and environmental condition are present only nominally.

The Waterfront Premium — and Who Actually Pays

There is a well-documented market phenomenon known as the "waterfront premium" — the price markup on real estate for proximity to water. Studies have found that apartments with water views or in the first shoreline row sell for 10–30% more than comparable housing without this feature (Nicholls & Crompton, 2018). In Kyiv's riparian residential complexes this is also present, where "a view of the Dnipro" can be the primary marketing argument, embedded directly into the price per square metre.

Yet this premium monetises the value of the ecosystem without returning anything to it. The developer capitalises on the aesthetic and recreational value of the riverbank zone: clean water, open horizon, access to nature. The buyer pays for "nature" as a property attribute. Meanwhile, the ecosystem functions that generate this value — the floodplain's capacity to regulate the water regime, stabilise the banks, support biodiversity, and cool the urban environment — gradually degrade or are entirely destroyed in the course of the same development. The consequence is a reduced capacity of the city to cope with climate change, or the need for additional measures to mitigate its effects. And the developer is not required to compensate for any of this.

It is worth noting that this work is not a protest against development as such. The absence of ecosystem service losses from almost any planning documentation reflects the fact that the current system simply does not provide any mechanism that would require a developer to count and compensate for these losses.

Approaches: Mechanisms Already in Practice

This problem is not unique to Kyiv. In Western Europe, concrete instruments have already been developed and implemented that integrate ecosystem value into economic decisions about development.

In the United Kingdom, the Biodiversity Net Gain (BNG) system has been mandatory for most new developments since 2024, requiring developers to achieve at least a 10% net gain in biodiversity, or to compensate through biodiversity credits (DEFRA, 2023). In the Netherlands, the approach focuses on integrating ecosystem services into strategic planning and environmental assessment, where natural capital valuation is a tool for justifying projects within municipal environmental standards and climate adaptation frameworks.

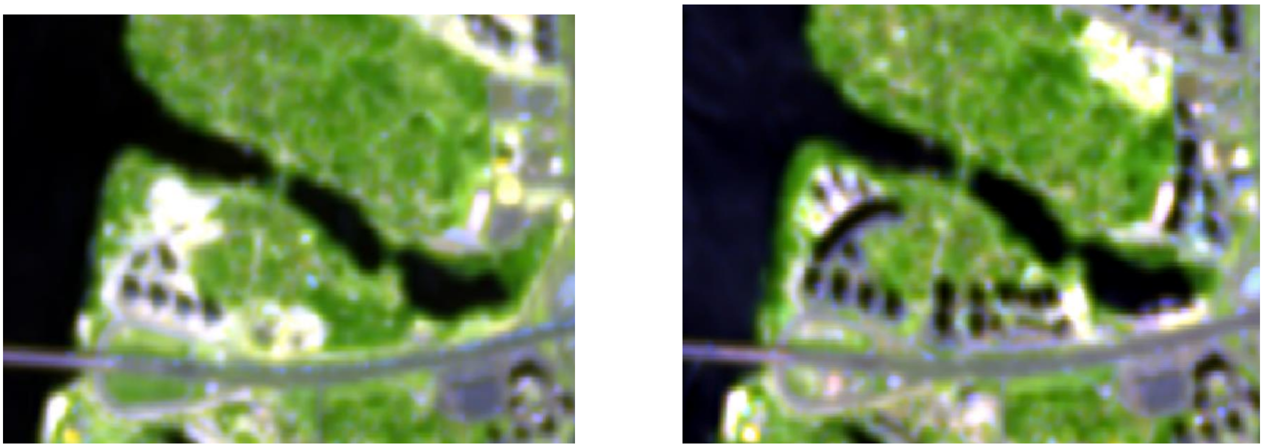
Instruments can vary. In the Netherlands, under the *ruimtelijke kwaliteitsbijdrage* (spatial quality contribution) system, developers in designated zones are required to contribute to a municipal fund directed toward the restoration and maintenance of public space and natural areas near the development site — a mechanism that can partially redirect the waterfront premium back into supporting the very ecosystems that generated that value. Another instrument is negotiable developer obligations, where cities sell or lease sites on the condition that developers deliver specific ecological programmes (Candel, 2022).

What all these existing mechanisms share is not a prohibition on development, but the creation of a system in which the developer pays to maintain the ecosystem on which they profit.

Step D — Adaptive Management in Space

Step D examines whether the impact of development on adjacent ecosystems beyond the immediate site boundary was taken into account, and whether any mechanism for spatial coordination of management decisions existed. Principles 7 and 10 of the Ecosystem Approach emphasise that management boundaries should follow the natural boundaries of the ecosystem rather than the administrative boundaries of a development plot. This means that impact assessment cannot be limited to the perimeter of a specific project — it must capture changes in the surrounding natural systems as well.

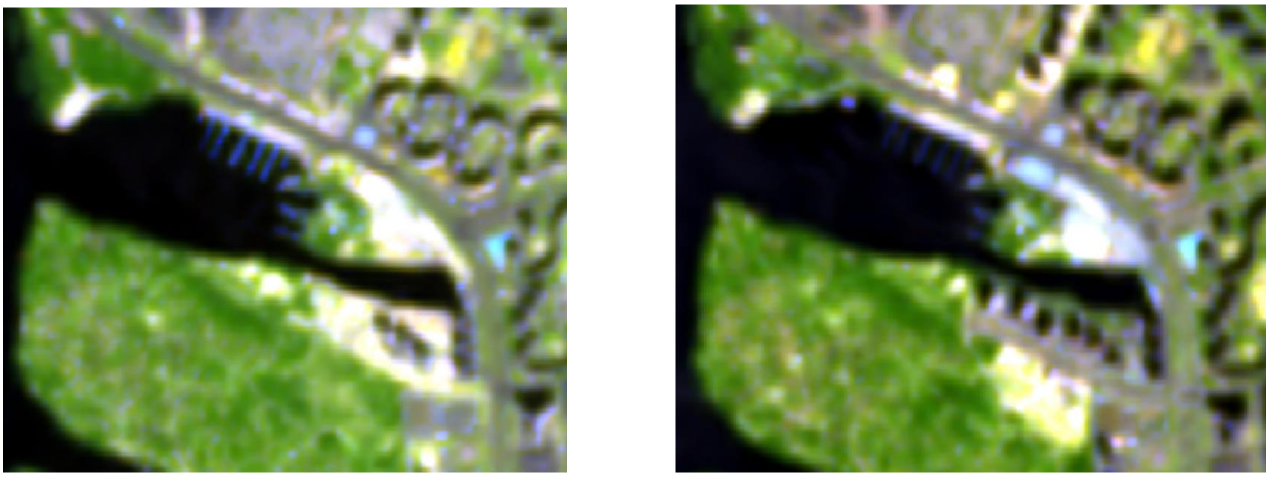
To assess spatial changes in land cover at the RC Zarichnyi and RC RiverStone in Darnytskyi District, False Color (Urban) composite imagery was applied using Sentinel-2 bands B12, B11, and B4 for 2016 and 2025. This band combination is specifically designed to distinguish built-up surfaces from natural cover. In this rendering, urbanised zones — buildings, concrete, asphalt, and active construction sites — appear in bright tones ranging from white and light grey to neon blue or yellowish, as artificial materials strongly reflect shortwave infrared radiation. Vegetation — forests, parks, and grassland — is rendered in various shades of green. Water bodies, including the Dnipro and its channels, appear near-black or very dark blue, as water absorbs infrared wavelengths almost entirely.



a) *b)*

Figure 3.2 — Comparative analysis of False Color (Urban) composite imagery for RC Zarichnyi: *a) June 2016; b) June 2025*

Source: Author's own calculations based on Copernicus Sentinel-2 data, bands B12, B11, B4 (2025–2026)



a) *b)*

Figure 3.3 — Comparative analysis of False Color (Urban) composite imagery for RC RiverStone: *a) June 2016; b) June 2025*

Source: Author's own calculations based on Copernicus Sentinel-2 data, bands B12, B11, B4 (2025–2026)

The 2016 image shows a large, diffuse bright patch of light yellow and white across the site — characteristic of an active construction phase: exposed soil, sand, and concrete foundations. The surrounding riparian areas retain green tones, indicating that natural vegetation cover was still largely intact at that time.

The 2025 image reveals different spatial structure. The previously undifferentiated bright patch has been replaced by a clearly articulated built environment: darker contours and shadows mark the completed high-rise residential buildings, while the organised spaces between them reflect the established infrastructure of the complex. The transformation is not confined to the plot boundary — bright tones indicative of impervious surfaces extend into adjacent sections of the riparian zone, pointing to a gradual densification of development along the shoreline as a broader, ongoing process.

The impact of development extends beyond the boundaries of the developed plot and affects adjacent riparian areas that still retained natural cover in 2015. The construction of a single site is accompanied by increasingly intensive development of the surrounding area, raising the overall share of impervious surfaces across the wider riparian zone. This confirms that the planning system governing these territories remains project-oriented rather than ecosystem-oriented — evaluating each site in isolation while remaining blind to cumulative spatial effects.

Step E — Adaptive Management Over Time

Step E examines adaptive management over time. It asks whether long-term ecological goals and time lags in ecosystem processes were taken into account, and whether mechanisms exist for monitoring and revising decisions in response to change. Step E calls for planning with long-term goals and flexible means of achieving them. Principles 7, 8, and 9 together assert that ecosystem processes involve time lags and unpredictable effects, and therefore management objectives must be long-term while the instruments themselves must be regularly reviewed.

Time Lags

The consequences of today's floodplain development will not manifest immediately — they will emerge over 15 to 30 years, in the form of increased flood damage, a growing urban heat island effect, and irreversible degradation of the shoreline and the riparian zone more broadly. This creates conditions in which, at the time development permits are issued, there is a tendency toward systematic underestimation of risk, because the consequences of decisions do not appear immediately — or even within the first several years. Management must also acknowledge that change is inevitable and adapt accordingly.

Effective management over time therefore requires functioning monitoring methods for early detection of the consequences of decisions and emerging problems, as well as transparent stakeholder relationships that create an environment in which these problems can be discussed.

Step E thus asks three questions: were long-term ecological goals established; do monitoring mechanisms exist to track changes in ecosystem condition over time; and are there instruments for reviewing management decisions in response to changing conditions?

Analysis of the Dnipro River Basin Management Plan (2025–2030)

The Dnipro River Basin Management Plan (RBMP), approved by the Cabinet of Ministers of Ukraine in 2024, is currently the most relevant planning document through which these questions can be examined.

The RBMP establishes a clear strategic environmental objective for all water bodies across the Dnipro basin: achieving and maintaining good ecological and chemical status of surface waters, and good quantitative and chemical status of groundwater. The planning cycle covers 2025–2030, with implementation of key measures to begin no later than 2028 — the third year of the cycle. The Programme of Measures includes a total of 523 measures across the entire Dnipro basin. The first implementation cycle is explicitly framed as the beginning of a multi-cycle process: for water bodies at risk of not meeting ecological objectives, good status is projected only within the second or third cycle — with a time horizon extending to 2040 and beyond.

The plan's structure — multiple cycles with built-in revision of objectives — is an acknowledgement that not all goals can be achieved within the first planning period. Both the structure and the mandatory regular review formally correspond to the logic of adaptive management over time required by Principles 7, 8, and 9 of the Ecosystem Approach. It is therefore worth noting that the adoption of the RBMP represents an institutional step forward: Ukraine now has a legally binding basin-scale planning document with defined ecological objectives, a monitoring framework, and an embedded revision mechanism.

In December 2025, the Government adopted a further strategic document — the Operational Plan for the Implementation of the Water Strategy of Ukraine for 2025–2027. This represents a continued commitment to the water governance reform agenda. Yet the approval and construction of new riparian development projects proceeds considerably faster than the implementation of the planning and legislative instruments designed to prevent the degradation of the shoreline. Institutional progress is consistently outpaced by development pressure.

Limitations of the RBMP in the Context of Urban Riparian Management

Nevertheless, the structure of the RBMP's Programme of Measures reveals a certain imbalance. The document itself acknowledges that the large majority of measures — between 61% and 88% depending on the sub-basin — are directed at reducing pollution by organic, nutrient, and hazardous substances through the construction, reconstruction, and modernisation of wastewater treatment facilities and sewer networks. Measures aimed at improving hydrological regime and morphological conditions — such as restoring lateral connectivity between river channels and their floodplains — represent a small share of the total by both number and cost, and are assessed in the plan's cost-effectiveness analysis as measures with low or very low effectiveness.

It is also significant that the RBMP contains no measures directly addressing the management of urban riparian development. While the document does acknowledge the problem of degradation of riparian buffer strips — raised by participants in public consultations — it frames this exclusively as a problem of diffuse agricultural pollution, not as a planning or ecosystem management issue. As a result, the delineation of water protection zones and riparian buffer strips is included in the Programme of Measures for all sub-basins, but this measure is formulated as a regulatory instrument for agricultural land, not as a constraint on urban development.

The RBMP, as the planning document that now serves as the primary instrument of adaptive management at the basin scale, therefore does not address the mechanism of ecosystem service loss documented in this study. The challenges identified in this work — sealing of riparian areas with impermeable surfaces, destruction of riparian vegetation, fragmentation of the coastal ecological corridor — are not identified in the RBMP as problems to be resolved.

Monitoring

The RBMP establishes a monitoring system for surface and groundwater bodies, including hydromorphological assessment. However, the document itself acknowledges that the existing surface water monitoring network has insufficient spatial coverage for applying the developed methodologies, and that groundwater monitoring is effectively not being carried out. The document explicitly states that ecological objectives for individual groundwater bodies have been defined only in the most general terms and will require refinement as monitoring data accumulates.

For urban riparian zones in particular, no systematic monitoring of vegetation cover or shoreline condition is provided for. The hydromorphological assessment included in the RBMP evaluates water bodies at the scale of entire river reaches — a spatial resolution at which the impact of individual development sites remains invisible.

The consequences of riparian development described in this study will not manifest within a six-year planning cycle, but over fifteen to thirty years. This time lag means that the consequences of decisions made during the 2005–2025 development wave will become fully visible only in the second or third RBMP cycle — by which point the presence of this development will already be irreversible.

Conclusion

The adoption of the Dnipro RBMP in 2024 is a significant step toward implementing the Water Framework Directive and meeting Ukraine's European integration commitments. The document establishes a legally binding adaptive management framework with defined ecological objectives, a monitoring system, and a multi-cycle revision mechanism.

However, from the perspective of Step E of the Ecosystem Approach as applied to urban riparian territories, the RBMP has a clearly defined scope that does not cover the problem examined in this study. Active development of urban riparian areas — as a driver of ecosystem service loss — is not identified in the RBMP as a problem, does not appear in the Programme of Measures, and is not subject to monitoring or revision mechanisms in the current planning cycle. The gap that results allows urban riparian development along the Dnipro to continue, and is not addressed by the planning instrument that now governs water resource management in Ukraine.

It should be noted that this conclusion is specific to this study. The existing RBMP satisfies the requirements of adaptive management under the WFD; it simply does not correspond to the framework this work applies.

Addressing this gap requires either the inclusion of urban riparian development as a distinct category in future RBMP cycles, or a separate instrument at the level of the city's urban planning documentation — one that establishes long-term ecological objectives for the riparian zone and a mandatory mechanism for monitoring and reviewing decisions concerning it.

Analysis of the Kyiv City Development Strategy to 2027

The Strategy includes a dedicated section, Direction 1.5 "Ecological Policy and Environmental Protection," with operational objectives and indicators. These include targets for green space (23–25 sq.m per resident by 2027), the share of protected natural areas within the city (up to 26.0%), and coverage of water bodies by water quality monitoring. However, the document contains no objectives specifically tied to the Dnipro riparian zones as an ecosystem object — no references to the restoration of riparian areas or shorelines, to floodplain vegetation, or to public access to the riverbank as a measurable indicator. The Dnipro is mentioned in the general geographic description of the city, but it is not treated as a managed object with measurable ecological objectives.

Monitoring mechanism

The Strategy provides for annual monitoring of the implementation of the Action Plan. There is an indicator for water quality monitoring coverage of water bodies (from 69.2% in 2023 to 90% in 2027) and for the development of the environmental monitoring system (from 59% to 71% of the territory). However, these indicators describe the percentage of territory covered by a monitoring system — they are not measures of ecosystem condition. No specific methods are provided for, such as satellite imaging of the shoreline or field surveys of floodplain condition. Monitoring of the Dnipro riparian zone as an object requiring dedicated attention is not distinguished within the Strategy.

Mechanism for reviewing decisions in response to changing conditions

The Strategy contains no mechanism for reviewing management decisions in response to changes in hydrological regime, exceedance of ecological threshold values, or the onset of climate change. The document provides for annual monitoring of indicator implementation, but this is monitoring of administrative performance — not ecosystem feedback. There is no mechanism or condition under which a planned review of development permits or a change in the land-use regime for riparian territories would be possible.

The analysis of the Kyiv City Development Strategy to 2027 shows that the document partially meets the formal requirements of adaptive management, but does not meet them with respect to the management of riparian territories along the Dnipro. The document contains neither long-term ecological objectives for the riparian zone with specific indicators, nor a specialised mechanism for monitoring the condition of riparian ecosystems, nor instruments for reviewing management decisions in response to changing ecological or hydrological conditions. For the purposes of this study, this means that the system is more administratively oriented — and therefore structurally incapable of adaptive management over time for the Dnipro's riparian ecosystems.

Alternative Approaches: Mechanisms Already in Practice

Rotterdam Climate Adaptation Strategy and Rotterdam Climate Proof

Rotterdam is the first major European city with an approved climate adaptation strategy that, in the area of water and riparian zone management, demonstrates all three criteria of Step E. Rotterdam Climate Proof is built around four interconnected instruments: the Climate Atlas (a spatial database of climate risks), the Adaptation Toolkit (a set of measures), the Adaptation Barometer (a progress measurement system), and Adaptation Pathways (scenario-based trajectories). The strategy combines a long-term vision with a short-term action plan and set of instruments.

With regard to waterfront zone management specifically, Rotterdam's spatial development strategy identifies the river as the city's most important ecological system, designates specific sections along the shoreline with flood protection potential, and establishes requirements that development of these sites must make use of existing slopes, meadows, and trees as flood barriers.

Also relevant is the example of *viadonau*, the Austrian programme providing for bank stabilisation, maintenance, and floodplain restoration. In terms of adaptive management, the floodplain restoration work along the stretch of the Danube near Vienna is carried out through an adaptive management process and is aimed at achieving good ecological status of the river in accordance with the Water Framework Directive.

RECOMMENDATIONS

1. To foster a culture of community engagement on issues relating to nature conservation, environmental protection, and ecosystems. Understanding of the ecosystem approach remains virtually absent from the public discourse surrounding urban planning decisions in Ukraine. This is a question that calls for educational initiatives — such as the inclusion of ecosystem considerations in

public consultations on Detailed Development Plans, and support for NGOs engaged in ecological monitoring of urban territories. Alongside this, public participation in the review of DDPs for riparian zones should be strengthened.
2. To include the Dnipro riparian zone in the Kyiv City Development Strategy as a distinct managed object with measurable ecological objectives. At present, the Dnipro is mentioned in the strategy only in the general geographic description of the city. A minimum set of indicators of riparian zone condition should be defined — the share of natural surface cover (km^2), the length of shoreline with public access (km), the area of restored floodplain vegetation (ha) — and included as mandatory monitoring indicators.
3. To develop a systematic monitoring framework for the Dnipro's riparian territories. Regular satellite imaging of the shoreline — for example, using Sentinel-2 data — and field surveys of floodplain vegetation should be introduced as standard tools of urban planning practice.
4. To introduce mechanisms for the internalisation of ecosystem losses for developers. The analysis has shown that the current system does not require developers to account for or compensate the degradation of ecosystem functions. The experience of Western countries suggests that such mechanisms are feasible to implement.

CONCLUSION

This thesis set out to answer whether the current land-use practices along the Dnipro's riparian territories are consistent with climate resilience and the principles of the ecosystem approach. After analysis across the five steps, the answer is closer to no than yes. But beyond the answer itself, what mattered more was understanding why. The Dnipro's riparian territories were not developed illegally, and not in defiance of the existing system — the system itself was simply built this way. Detailed development plans prior to 2018 did not include strategic environmental assessment, and even since its introduction, it still does not provide a robust methodology for calculating ecosystem losses. Public consultations before 2011 were largely nominal, and even after that, their records remain difficult to access. Risks such as hydrological hazards, though acknowledged, were typically resolved through engineering solutions rather than through any reconsideration of whether development was appropriate in the first place. Within such a system, the benefits of riparian development are private and realised immediately, while the costs — in the form of managing the consequences — are social, long-term, and go uncounted.

The analysis of strategic documents — the Kyiv City Development Strategy to 2027 and the Dnipro River Basin Management Plan (2025–2030) — showed that this gap persists today. The RBMP is a significant institutional step forward and meets the requirements of the Water Framework Directive, but does not treat urban riparian development as a problem to be addressed.

Hypothesis 1 is confirmed. In all three analysed Detailed Development Plans, private benefits from construction were quantified and maximised, while ecosystem service losses — degradation of flood regulation, bank stabilisation, microclimatic cooling, and biological corridor functions — were neither calculated nor required to be compensated. Costs were externalised onto the municipal budget and the broader community. This pattern is not incidental: it is structurally embedded in the planning documentation itself, where nature appears primarily as a marketing asset rather than a managed object.

Hypothesis 2 is confirmed. The NDVI and NDBI analysis of RC Zarichnyi and RC RiverStone demonstrates a measurable replacement of natural riparian vegetation with impervious surfaces between 2016 and 2025, reducing the capacity of the riparian zone to absorb stormwater, stabilise banks, and moderate urban temperatures. The spatial analysis under Step D shows that this densification extends beyond individual plot boundaries into adjacent riparian areas, indicating a cumulative process of corridor fragmentation rather than a series of isolated development events. Taken together, these findings confirm that the ongoing development of the Dnipro's first shoreline is increasing the city's exposure to climate risks — through mechanisms that are well-documented, measurable, and in principle preventable.

Several limitations of this study should be acknowledged. First, the documentary record for Step A is substantially incomplete. The majority of the analysed residential complexes were approved at the DDP stage between 2003 and 2006, and the relevant planning documentation from that period is either unavailable in open registries or exists only in physical archives. No protocols of public consultations were found for any of the studied sites — whether because they were not conducted, or because records were not published or have since been lost. This limits the analysis of stakeholder participation to what can be inferred from the legislative framework rather than from direct documentary evidence.

Second, the remote sensing analysis in Steps B and D was possible for only two of the five studied complexes — RC Zarichnyi and RC RiverStone. Sentinel-2 imagery of sufficient spatial resolution is only available from 2015 onwards, while most of the complexes began construction considerably earlier. As a result, even the earliest available images already show the sites mid-construction, meaning the pre-development baseline condition of riparian vegetation could not be captured. The findings from the satellite analysis are therefore illustrative rather than comprehensive, and should be interpreted as indicative of broader patterns rather than as a full quantitative assessment across all studied sites.

Finally, the study relies exclusively on documentary and remote sensing sources; the absence of expert interviews or stakeholder consultations means that the motivations and constraints of decision-makers could only be inferred from planning documents rather than examined directly.

This thesis is not an argument against development as such. Development must account for the full cost of its consequences — and mechanisms for doing so already exist. They do not prohibit construction; they create transparent conditions under which those who profit from development are required to account for the damage to the ecosystem. Ukraine is on the path to European integration and has already committed to harmonising with the Water Framework Directive. The next cycles of the RBMP, updates to urban planning legislation, and new strategic documents for Kyiv are all windows of opportunity for change. No new system needs to be invented. What is needed is to make visible the costs that, so far, no one has been counting.

REFERENCES

Atkinson, S. F., & Lake, M. C. (2020). Prioritizing riparian corridors for ecosystem restoration in urbanizing watersheds. *Heliyon*, *6*(2), e03351. https://doi.org/10.1016/j.heliyon.2020.e03351

Carter, J. G., Cavan, G., Connelly, A., Guy, S., Handley, J., & Kazmierczak, A. (2015). Climate change and the city: Building capacity for urban adaptation. *Progress in Planning*, *95*, 1–66. https://doi.org/10.1016/j.progress.2013.08.001

European Commission. (2020). *EU Biodiversity Strategy for 2030: Bringing nature back into our lives*. https://eur-lex.europa.eu/EN/legal-content/summary/eu-biodiversity-strategy-for-2030.html

European Commission. (2021). *Biodiversity strategy 2030: Barrier removal for river restoration [Guidance document].* https://environment.ec.europa.eu/system/files/2021-12/Barrier%20removal%20for%20river%20restoration.pdf

Fuller, R. A., & Gaston, K. J. (2009). Green spaces of European cities revisited for 1990–2006. *Biology Letters*, *5*(3), 352–355. https://doi.org/10.1098/rsbl.2008.0610

Giakoumis, T., & Voulvoulis, N. (2018). The transition of EU water policy towards the Water Framework Directive's integrated river basin management paradigm. *Environmental Management*, *62*(5), 819–831. https://doi.org/10.1007/s00267-018-1080-z

Halbac-Cotoara-Zamfir, R., Ferreira, C. S. S., & Salvati, L. (2021). Long-term urbanization dynamics and the evolution of green/blue areas in Eastern Europe:

Insights from Romania. *Sustainability*, *13*(24), 14068. https://doi.org/10.3390/su132414068

IUCN. (2020). *IUCN global standard for Nature-based Solutions: A first edition of the self-assessment tool for users*. IUCN. https://doi.org/10.2305/IUCN.CH.2020.08.en

Kabisch, N., & Haase, D. (2013). Green spaces of European cities revisited for 1990–2006. *Landscape and Urban Planning*, *110*, 113–122. https://doi.org/10.1016/j.landurbplan.2012.10.017

Leichenko, R. (2011). Climate change and urban resilience. *Current Opinion in Environmental Sustainability*, *3*(3), 164–168. https://doi.org/10.1016/j.cosust.2010.12.015

Lindley, S. J., Handley, J. F., Theuray, N., Peet, E., & McEvoy, D. (2006). Adaptation strategies for climate change in the urban environment: Assessing climate related risk in UK urban areas. *Journal of Risk Research*, *9*(5), 543–568. https://doi.org/10.1080/13669870600798020

Millennium Ecosystem Assessment. (2003). *Ecosystems and human well-being: A framework for assessment*. Island Press.

Nicholls, S., & Crompton, J. L. (2017). The effect of rivers, streams, and canals on property values. *River Research and Applications*, *33*(9), 1377–1386. https://doi.org/10.1002/rra.3197

Norgaard, R. B. (2010). Ecosystem services: From eye-opening metaphor to complexity blinder. *Ecological Economics*, *69*(6), 1219–1227. https://doi.org/10.1016/j.ecolecon.2009.11.009

Peroni, F., Codato, D., Buscemi, L., Cibrario, M., Pappalardo, S. E., & De Marchi, M. (2023). Rethinking urban riparian ecosystems as a frontline strategy to counter climate change: Mapping 60 years of carbon sequestration evolution in Padua, Italy. *Frontiers in Climate*, *5*, 1235886. https://doi.org/10.3389/fclim.2023.1235886

Peters, K. (2019). *When disasters and conflict collide: Uncovering the evidence*. ODI. https://odi.org/en/publications/when-disasters-and-conflict-collide-uncovering-the-evidence/

Redford, K. H., & Adams, W. M. (2009). Payment for ecosystem services and the challenge of saving nature. *Conservation Biology*, *23*(4), 785–787. https://doi.org/10.1111/j.1523-1739.2009.01271.x

Rîșnoveanu, G., & Bărbulescu, D. (2025). Knowledge of urban ecosystem services in Central and Eastern Europe and their implications for urban planning: A review. *Environments*, *12*(12), 469. https://doi.org/10.3390/environments12120469

Schröter, M., van der Zanden, E. H., van Oudenhoven, A. P. E., Remme, R. P., Serna-Chavez, H. M., de Groot, R. S., & Opdam, P. (2014). Ecosystem services as a contested concept: A synthesis of critique and counter-arguments. *Conservation Letters*, *7*(6), 514–523. https://doi.org/10.1111/conl.12091

Secretariat of the Convention on Biological Diversity. (n.d.). *Guide to the Convention on Biological Diversity*. https://www.cbd.int/convention/guide/default.shtml

Shepherd, G. (Ed.). (2004). *The ecosystem approach: Learning from experience*. IUCN. https://portals.iucn.org/library/node/8430

Skidmore, P., & Wheaton, J. (2022). Riverscapes as natural infrastructure: Meeting challenges of climate adaptation and ecosystem restoration. *Anthropocene*, *38*, 100334. https://doi.org/10.1016/j.ancene.2022.100334

Smith, R. D., & Maltby, E. (2003). *Using the Ecosystem Approach to implement the CBD: A global synthesis report drawing lessons from three regional pathfinder workshops*. IUCN.

United Nations. (n.d.). *What is climate change?* https://www.un.org/en/climatechange/what-is-climate-change

United Nations Department of Economic and Social Affairs. (2018, May 16). *68% of the world population projected to live in urban areas by 2050, says UN*. https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html

U.S. Geological Survey. (2003). *Ecosystems: The work of the USGS* (Fact Sheet 076-03). https://pubs.usgs.gov/fs/fs07603/

Veklych, O. O. (2010). *Sutnist poniattia "ekosystemnyi pidkhid"* [The essence of the concept of an "ecosystem approach"]. *Ekonomika Ukrainy* [Economy of Ukraine], *(9)*, 65–74.

Wang, D., Xu, P.-Y., An, B.-W., & Guo, Q.-P. (2024). Urban green infrastructure: Bridging biodiversity conservation and sustainable urban development through adaptive management approach. *Frontiers in Ecology and Evolution*, *12*, 1440477. https://doi.org/10.3389/fevo.2024.1440477

Waylen, K. A., Hastings, E. J., Banks, E. A., Holstead, K. L., Irvine, R. J., & Blackstock, K. L. (2014). The need to disentangle key concepts from ecosystem-approach jargon. *Conservation Biology*, *28*(5), 1215–1224. https://doi.org/10.1111/cobi.12331

World Meteorological Organization. (2025). *2025 set to be second or third warmest year on record, continuing exceptionally high warming trend*. https://wmo.int/news/media-centre/2025-set-be-second-or-third-warmest-year-record-continuing-exceptionally-high-warming-trend

Zingraff-Hamed, A., Egger, G., Wantzen, K. M., et al. (2024). The missing piece in restoring Europe's ecosystems: Urban riverscapes. *BioScience*, *74*(12), biae116. https://doi.org/10.1093/biosci/biae116