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URBAN-PLANNING CRITERIA FOR PLANNING AND DESIGNING PUBLIC CITY PARKS IN THE REGENERATION OF WATERFRONT BROWNFIELDS

DOCTORAL DISSERTATION

Book I

Supervisor:

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URBANISTIČKI KRITERIJI ZA PLANIRANJE I PROJEKTIRANJE JAVNIH GRADSKIH PARKOVA U REGENERACIJI OBALNIH BROWNFIELDA

DOKTORSKI RAD

Knjiga I

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Structure of the Doctoral Dissertation

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Disclaimer

Microsoft Office (Excel, Word, Powerpoint) and Graphisoft Archicad software was used in writing texts and creating graphics for the doctoral dissertation. Foxit PDF Reader, Adobe Reader, PDF to PNG (https://pdf2png.com/), Microsoft (2026) *Snipping Tool* (Version 11.2504.38.0) were used to process graphics for insertion into the doctoral dissertation text. Google Maps, Google Earth Pro, Google Streetview, QGIS, OpenStreetMaps were used for data collection, data processing, to assist in study design, data analysis and interpretation.

Generative AI tools (including text-structuring and paraphrasing assistants) were used in the drafting phase to organize and clarify the author's own notes and literature synthesis (Perplexity, SciSpace). The final text, including all arguments, critical analysis, and structure, is the author's own intellectual work. Generative AI tool (InstaText.io) was used to polish and enhance the final text for clarity, readability, flow, grammar, spelling, and word choice.

The author remains responsible for the work in its entirety, regardless of the tools used.

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Abstract

This doctoral thesis investigates Waterfront Brownfield Urban Public Parks (WBUPPs): parks developed on former industrial, infrastructural, or other purpose-related waterfront land. It addresses a research gap: brownfield regeneration, waterfront transformation, public parks, and sustainability have mostly been studied separately, without a holistic framework integrating these domains.

The central research question asks which urban-planning criteria govern WBUPP planning and design, and how they can be identified, classified, and systematized. It tests whether WBUPPs constitute a distinct typology, whether their criteria can form a scientifically grounded classification system, and whether the system can be validated through empirical analysis.

The methodology combines systematic literature review, document analysis, and comparative example case studies. An inventory of 151 global examples was screened to 99 cases. More than 400 literature-derived criteria were refined to 375 and operationalized as 13 screening and 50 analysis criteria. Five cases—Abandoibarra, Jubileumsparken, Brooklyn Bridge Park, Jurong Lake Gardens, and Biidaasige Park—were examined using content analysis and GIS-based spatial analysis.

The findings confirm all hypotheses. WBUPPs are a distinct typology. The three-pillar sustainability model was limited by cross-dimensional criteria. WBUPP representative example cases analysis identified 16 additional WBUPP-specific criteria absent from the literature, producing a final framework of 66 environmental, social, and economic criteria. The thesis contributes a synthesized knowledge base, a structured criteria system, the global WBUPP inventory and screening dataset, and a replicable GIS-based methodology. The framework offers an adaptable tool for transforming disused waterfronts into resilient, inclusive public spaces.

Keywords: Waterfront brownfield urban public park (WBUPP); brownfield regeneration; waterfront transformation; urban public parks; urban-planning criteria; sustainable urban development; GIS-based spatial analysis.

Sažetak

Doktorska disertacija istražuje javne gradske parkove na obalnim brownfield lokacijama (Waterfront Brownfield Urban Public Park - WBUPP) - javne parkove realizirane na nekadašnjim industrijskim, infrastrukturnim, ili namjenski bliskim područjima uz rijeke, jezera ili obale mora. Istraživanje obuhvaća jaz u postojećoj znanstvenoj literaturi: iako se regeneracija brownfield lokacija, transformacija obala, javni gradski parkovi i održivost proučavaju zasebno, ne postoji cjelovit okvir koji integrira navedena područja.

Središnje istraživačko pitanje propituje koji se urbanistički kriteriji primjenjuju za planiranje i projektiranje javnih gradskih parkova u regeneraciji obalnih brownfielda te kako se ti kriteriji mogu identificirati, klasificirati i sistematizirati. Ispituje se predstavljaju li WBUPP-ovi zasebnu tipologiju, mogu li se njihovi kriteriji organizirati u znanstveno utemeljen klasifikacijski sustav te može li se taj sustav validirati empirijskom analizom.

Metodologija kombinira sustavni pregled literature, analizu dokumenata i komparativnu analizu primjera. Početni inventar od 151 globalnih primjera WBUPP-ova sužen je na 99 klasificiranih slučajeva. Iz literature je identificirano preko 400 kriterija, koji su pročišćeni na 375 te dalje razvijeni u dva operativna skupa: 13 kriterija za selekciju i 50 kriterija za analizu. Pet reprezentativnih slučajeva - Abandoibarra, Jubileumsparken, Brooklyn Bridge Park, Jurong Lake Gardens i Biidaasige Park - analizirano je korištenjem GIS-prostorne analize, tematskog kartiranja i konceptualnih dijagrama.

Rezultati potvrđuju sve hipoteze. WBUPP-ovi predstavljaju zasebnu tipologiju. Kriteriji se mogu organizirati prema modelu održivosti s tri stupa. Analizom reprezentativnih WBUPP primjera utvrđeno je 16 dodatnih kriterija specifičnih za WBUPP-ove, koji nisu bili zastupljeni u literaturi, čime je oblikovan konačni okvir od 66 okolišnih, društvenih i gospodarskih kriterija. Disertacija donosi sintetiziranu bazu teorijskih spoznaja, strukturirani sustav kriterija, globalni inventar i skup podataka za selekciju WBUPP-ova te ponovljivu metodologiju prostorne analize temeljene na GIS-u. Okvir pruža prilagodljiv alat za transformaciju napuštenih obalnih područja u otporne i uključive javne prostore.

Ključne riječi: urbani javni parkovi na obalnim brownfield područjima (WBUPP); regeneracija brownfield područja; transformacija obalnih područja; urbani javni parkovi; urbanistički kriteriji; održivi urbani razvoj; GIS prostorna analiza.

Abbreviations

The following abbreviations are used in this doctoral thesis:

Abbreviation	Meaning
3D	Three-dimensional
AECOM	AECOM — multinational infrastructure consulting firm
AHP	Analytic Hierarchy Process
B/W/PP/S	Brownfield/Waterfront/Public Park/Sustainability
BBPDC	Brooklyn Bridge Park Development Corporation
BREEAM	Building Research Establishment Environmental Assessment Method
CABERNET	Concerted Action on Brownfield and Economic Regeneration Network
CBA	Cost-Benefit Analysis
CEMAT	European Conference of Ministers responsible for Regional Planning / *Conférence Européenne des Ministres responsables de l'Aménagement du Territoire*
CIRCLE SCAN	Circle City Scan Tool
CO2	Carbon dioxide
COVID-19	Coronavirus Disease 2019
DGNB-UD	German Sustainable Building Council for Urban Districts
DIY	Do it yourself
DLR	Docklands Light Railway
DUMBO	Down Under the Manhattan Bridge Overpass
EKLIPSE	Knowledge and Learning Mechanism on Biodiversity and Ecosystem Services
EP	English Partnerships national regeneration agency
EPA	U.S. Environmental Protection Agency
EU	European Union
EUR	Euro, the currency sign/abbreviation used for the euro
GDP	Gross Domestic Product
GIS	Geographic Information System
GRIHA-LD	Green Rating for Integrated Habitat Assessment for Large Developments
HOMBRE	Holistic Management of Brownfield Regeneration
IBA	Internationale Bauausstellung, International Building Exhibition
ISPU	Informacijski sustav prostornog uređenja / Spatial Planning Information System
IUWM	Integrated urban water management
LCA	Latent Class Analysis
LDDC	London Docklands Development Corporation
LEED	Leadership in Energy and Environmental Design
LEED-ND	Leadership in Energy and Environmental Design for Neighborhood Development
M4H	Merwe Vierhavens, Rotterdam
MAES	Mapping and Assessment of Ecosystems and their Services
MCA	Multi-Criteria Analysis
MCA	Multiple Correspondence Analysis PAGE 251
MIT	Massachusetts Institute of Technology

MOU	Memorandum of Understanding
MRT	Mass Rapid Transit
MTA	Metropolitan Transport Association
MVVA	Michael Van Valkenburgh Associates
NBS, NbS	Nature-based solutions
NDC	Nationally Determined Contribution
NN	Narodne Novine, national pubblication Republic of Croatia
NYC	New York City
NYCCWP	New York City Comprehensive Waterfront Plan
OSM	OpenStreetMap PAGE 271
PAH	Polycyclic Aromatic Hydrocarbons
PGOUB	Plan General de Ordenación Urbana de Bilbao, municipal General Urban Plan
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses
PUMA	Public Use Microdata Area
QGIS	Quantum Geographic Information System
RAP	Remedial Action Plan
RDM	Rotterdamsche Droogdok Maatschappij
RENFE	Red Nacional de los Ferrocarriles Españoles
RESCUE	Response of the Earth System to overshoot, Climate neUtrality and negative Emissions
S, M, L, XL	Small, Medium, Large, Extra-Large
SCOPUS	Elsevier's abstract and citation database
SDG	Sustainable Development Goal
SEPES	Spanish public land company (*Entidad Pública Empresarial de Suelo*)
SIPRIUS	Multi-criteria indicator system
TE2100	Thames Estuary 2100
TECO	Tren expreso de contenedores, container express train
TIMBRE	Tailored Improvement of Brownfield Regeneration in Europe
TRCA	Toronto and Region Conservation Authority
TTC	Toronto Transit Commission
UCL	University College London
UK	United Kingdom
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UPV/EHU	University of the Basque Country
URA	Urban Development Authority
USA	The United States of America
USF	Urban Sustainability Framework
UV	Ultraviolet
WBUPP	Waterfront Brownfield Urban Public Park
WEDG	Waterfront Edge Design Guidelines
WSUD	Water Sensitive Urban Design
WSUD	Water sensitive urban design
ZHA	Zaha Hadid Architects

1 INTRODUCTION

The waterfronts in cities are strategically important urban areas, historically occupied by industry and infrastructure to a significant extent. Since those uses were abandoned, related brownfields have become available for spatial redevelopment and accessible to the public. Creating public parks, within the process of waterfront regeneration, rehabilitates degraded land that serves as a multifunctional public space. Those kinds of parks integrate ecological restoration, social engagement, wellness, and generally improve urban living standards. They implement urban sustainability principles. The research aims to analyze the integrated waterfront and to identify the factors of the parks to be further analyzed, using literature review and analyzing selected example cases. The literature review explores the main factors of the parks and studies criteria from scholarly sources. It creates the basis for the research subject analysis, which is conducted on two levels. The first level analyzes a broader range of example cases to provide an overview and classification that helps identify key Waterfront Brownfield Urban Public Park (WBUPP) characteristics. The second level examines five specific representative example cases in detail to verify the setup criteria set and provide additional information useful for establishing urban-planning criteria for developing and designing public city parks in the revitalization of waterfront brownfields. Urban-planning criteria for planning and designing public city parks in the regeneration of waterfront brownfields are developed and organized according to sustainability dimensions.

1.1 Research Problem and Research Topic

The research topic concerns public spaces located in areas adjacent to water that are currently abandoned after previous use as industrial, port infrastructure, or other related functions. The category of public space in question has not been established, even though it is highly specific and requires a complex planning and design approach. The number of these areas is increasing as heavy production and cargo handling activities are abandoned within urban neighborhoods. The considered waterfront areas also include reclaimed land, landfills, and other former infrastructure or mixed-use areas. These are included because of their characteristics, and the required planning

and design complexity align with those previously mentioned. The WBUPPs research foundation encompasses more than public parks, waterfront areas, or brownfield-related knowledge, especially when guided by the principles of sustainability it aims to implement. It is necessary to define a framework for the planning and design of urban public parks within waterfront brownfield regeneration that integrates a multilevel approach with urban-planning expertise that incorporates different WBUPP aspects. Scientific literature explores individual components of the subject, such as urban public parks, waterfront regeneration, brownfield regeneration, and sustainability, but does not present holistic research that integrates all these topics or aspects.

1.2 Conceptual Definitions

This section provides operational definitions for the five core concepts structuring the research: waterfront brownfield, urban public park, waterfront regeneration, criteria for planning and design, and sustainability. These definitions present the terminological basis for the research of WBUPPs and the development of urban-planning criteria set.

1.2.1 Waterfront Brownfield

Waterfront brownfields are a specific type of brownfields, defined by their location next to water bodies. They were historically known for hosting industrial, port, or infrastructural activities. Li (2017) defines waterfront brownfields as previously developed land along rivers, lakes, or coastal areas affected by former industrial, commercial, or infrastructural uses. The author further defines they are currently underutilized, abandoned, or contaminated, and that they require an intervention to be regenerated. Hysa, Löwe, and Geist (Hysa et al., 2025) define waterfront sites as part of the urban blue-green infrastructure networks. They further define them as places where urban development intersects with water ecosystems.

Vale de Paula and Gonçalves (2024) describe how waterfront brownfields are placed on important urban locations and often contain disused infrastructure and contaminated ground and water. They often present challenges with having more than one owner, and advantages such as visual or recreational amenity potential, and proximity to city center. Generally, they possess the capacity to reconnect residents

with urban waterfronts. Rey, Laprise, and Lufkin (Rey, 2022) define waterfront brownfields as substantial land reserves for urban regeneration, placing them in the European metropolitan areas context. They state how their transformation requires integrated approaches that address multiple sustainability dimensions such as heritage related, environmental, economic, and public space interventions.

1.2.2 Urban Public Park

Urban public parks are open spaces within urban environments that are publicly owned or managed, freely accessible to all users, and designed to provide recreational, aesthetic, ecological, and social benefits. Chiesura (2004) defines urban parks as green spaces with significant vegetation and open natural areas, managed by public entities, serving multiple functions including recreation, environmental quality improvement, biodiversity conservation, and enhancement of urban livability.

Binushka and Dharmasena (2018) emphasize the role of urban parks in supporting neighborhood well-being by providing spaces for physical activity, social interaction, stress reduction, and connection with nature. Larson, Jennings, and Cloutier (2016) describe public parks as accessible green spaces that deliver measurable benefits to urban populations, with effectiveness depending on factors such as size, proximity, design quality, maintenance, safety, and programmatic diversity.

Song et al. (2025) extend this definition to urban coastal parks, highlighting the distinctive characteristics of parks located along waterfronts, which combine traditional park functions with water-related recreational opportunities, visual amenities, and ecological roles specific to aquatic-terrestrial transition zones.

1.2.3 Waterfront Regeneration

Waterfront regeneration is the transformation of underutilized, abandoned, or degraded waterfront areas using integrated interventions that involve physical, economic, social, and environmental aspects. Vale de Paula and Gonçalves (2024) define waterfront regeneration as a multifaceted process that involves the redevelopment of obsolete port, industrial, or infrastructural areas along water bodies, with the goal to create new urban functions, improve environmental quality, improve

public access to water, and enhance economic and social aspect of waterfront communities.

Pinto and dos Santos (2022) note that waterfront regeneration often takes place within broader urban development strategies, including mega-events such as the Olympic Games, which act as catalysts for large-scale transformation. Their analysis of Olympic waterfronts shows that successful regeneration requires long-term planning frameworks extending beyond event-driven timelines, with attention to legacy uses, community needs, and sustainable management structures.

1.2.4 Criteria for Planning and Design

Urban-planning criteria are the standards, principles, or attributes by which planning alternatives are evaluated and planning decisions are judged. Even though they are frequently used in planning practice, literature review does not show a universally accepted definition of what constitutes "criteria" in planning discourse. Many frameworks focus on indicator design and leave the related criteria non-specified (Castelletti et al., 2007; Marina et al., 2012).

In urban-planning contexts, criteria are described as attributes or factors that express the interests and values of decision-makers and stakeholders, organized hierarchically from broad root criteria to specific leaf criteria, allowing complex planning goals to be decomposed into manageable evaluation dimensions (Nesticò et al., 2020; Hardi and Maatouk, 2023). Urban-planning criteria represent what is judged in planning decisions – for example social equity, environmental quality, accessibility, historical-architectural value – and serve to frame goals and objectives for planning interventions (Martinelli et al., 2015; Nesticò et al., 2020).

Indicators are the procedures, indices, or measures that implement criteria by specifying how to measure performance, providing observable evidence used to assess current conditions or progress toward goals (Programme, 2009; Hardi and Maatouk, 2023). While criteria define what should be achieved and are primarily qualitative and normative, indicators are operational and measurable tools that quantify or qualify performance relative to established criteria.

The distinction is described as: criteria set what matters and frame goals, while indicators provide the empirical basis for assessment, comparison, and monitoring

(Dželebdžić, 2013). This research adopts this distinction, developing criteria that articulate desired WBUPP qualities.

1.2.5 Sustainability

Sustainability is defined by the Brundtland Commission (Brundtland and Khalid, 1987; Bahale and Schuetze, 2023) as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs," establishing intergenerational equity as a core ethical principle. This definition represents sustainability as a normative goal and also as an operational framework for balancing present needs with future opportunities.

Wendling et al. (2018) describe sustainability as "an ecosystem's capacity to maintain diversity and productivity over time," emphasizing temporal dimensions and ecological interconnections. Cohen (2017) frames sustainability as bringing society within planetary boundaries while ensuring basic living standards, linking environmental limits with social justice concerns and recognizing that sustainability must address both ecological integrity and persistent poverty and inequality.

Urban sustainability assessment frameworks typically use a three-pillar approach that includes environmental, economic, and social dimensions, sometimes supplemented by institutional, spatial, and temporal considerations (Cohen, 2017). Valdivia-Loro (2019) notes that urban sustainability requires "improving economic, social, and environmental aspects, increasing citizen participation, and efficient resource use," presenting sustainability as an ongoing process of improvement and adaptation rather than a static end state.

The United Nations Sustainable Development Goals (SDGs), adopted in 2015, embody this integrated approach through seventeen interconnected goals covering poverty eradication, health, education, gender equality, clean energy, sustainable cities, climate action, and ecosystem protection (Cucuzzella et al., 2021). The SDGs provide a common framework for aligning sustainability efforts across nations, sectors, and scales, and serve as a reference for evaluating the sustainability performance of urban interventions, including waterfront brownfield urban public parks.

1.3 Research Questions and Objectives

1.3.1 Main Research Question

The central research question guiding this doctoral study is:

What are the urban-planning criteria for the planning and design of urban public parks within waterfront brownfield regeneration, and how can these criteria be identified, classified, and systematized?

1.3.2 Specific Research Questions

To address the main research question comprehensively, the following specific research questions have been formulated:

1. What theoretical frameworks and conceptual approaches relate to the planning and design of WBUPPs, and which urban-planning criteria emerge from existing sources as relevant to WBUPPs development?
2. What relationships and interdependencies exist among different urban-planning criteria in the context of waterfront brownfield regeneration? How can they be systematized?
3. What methodological approaches are appropriate for verifying and developing the criteria by which WBUPPs are realized, which have not been found in the literature?

1.3.3 Research Objectives

Based on the research questions outlined above, this doctoral research pursues the main (general) objective, together with three auxiliary (specific) objectives.

O: To develop the urban-planning criteria for planning and designing public city parks in the regeneration of waterfront brownfields.

The main objective fulfills the primary dissertation goal by establishing urban-planning criteria for planning and designing public city parks in the regeneration of waterfront brownfields. The objective develops a method for the urban-planning criteria

framework establishment that is based on scientific literature and empirical analysis. The method consists of criteria identification, filtering and integration, and elaboration.

O1: To establish the theoretical and empirical knowledge base for WBUPP research

This objective fulfills the need to understand WBUPPs as complex entities. They intertwine multiple knowledge domains, including those related to sustainability principles, waterfront specificities, previous use heritage, contamination issues, and public use needs. The objective includes defining key concepts (waterfront brownfields, urban public parks, waterfront regeneration, urban-planning criteria, and sustainability) and synthesizing existing knowledge about brownfields, waterfront regeneration, public space and public parks, and sustainability by carrying out a systematic literature review. This objective aims to compile urban-planning criteria related to WBUPP development using the analysis of academic literature and other available sources. It identifies gaps in current research.

O2: To develop a structured classification system that organizes urban-planning criteria into scientifically grounded categories and to explore the relationships and interdependencies among criteria in the context of waterfront brownfield regeneration.

This objective continues the processing of criteria identified in Objective 1. It addresses the challenge of organizing diverse, often overlapping planning requirements into a logical, usable structure. The classification system must take into consideration the functional, spatial, temporal, and sustainability aspects of WBUPP development. This involves developing scientifically grounded categories based on the reason and the way the criteria are applied in the planning and design process. The framework must be wide, enough to be applicable to diverse contexts, but flexible enough to allow application on different projects with specific conditions related to environmental, social and economic dimensions.

O3: To validate the identified criteria framework through the two-level analysis of WBUPP example cases and to develop the analysis methodology that integrates the assessment methods on how criteria are implemented.

This objective moves from theoretical framework development to empirical analysis. It includes selecting WBUPP example cases and representative WBUPP example cases of realized WBUPPs for the two-level analysis. The example cases are situated in

different geographic, climatic, cultural, and regulatory contexts. They present different external aspects with different outcomes. The analysis of scientific and other sources that include studying planning documents, design features, implemented solutions, and post-occupancy performance analysis results when available. This objective validates the applicability of scientific literature derived criteria, as well as identifies additional criteria from realized WBUPP example cases that are not documented in scientific literature. The validation methodology must determine the individual criterion's implementation character regarding specific spatial context and sustainability principles. This includes analyzing spatial patterns, establishing evidence-based relationships between WBUPP factors, and identifying challenges and innovative solutions in criteria implementation.

When these objectives are achieved, the result helps in advancing the academic knowledge about urban-planning principles in the context of WBUPP development.

1.4 Scientific Hypotheses

Based on the research questions and objectives, this doctoral research presents the main (general) hypothesis and three auxiliary hypotheses.

H: Urban-planning criteria for planning and designing public city parks in the regeneration of waterfront brownfields can be developed through literature and spatial analysis.

H1: WBUPPs are a specific typology characterized by unique characteristics whose urban-planning and design criteria emerge from the intersection of its factor's domains: brownfields, urban waterfront, public park, and sustainability principles.

H2: Urban-planning criteria related to waterfront brownfield regeneration can be organized according to a classification system with scientifically grounded categories that recognize their relationships and interdependencies.

H3: The identified criteria framework can be validated through analysis of WBUPP example cases using the developed analysis methodology.

1.5 Research Framework and Scope

This research explores WBUPPs built on previously used, abandoned land located next to rivers, seas, or lakes. These projects are interesting because of the way they are forced to face multiple challenges simultaneously. Those challenges include restoring the citizens' physical and transcendent connection to the waterfront, cleaning up land that has been exposed to long-term contamination, and creating spaces with multifunctional and multidimensional characteristics.

WBUPPs are an integrated system, which not a simple collection of features, and the scope of the research is showing their functioning as integrated systems. The analysis uses a holistic spatial approach, examining how WBUPPs elements are interconnected and how they are connected to their surrounding neighborhood. The scope of the research is to show how WBUPPs participate in broader areas' sustainability development by being a part of the city's green infrastructure network.

The research has three main components. First one is identifying urban-planning criteria through systematic literature review of academic research, grey sources, and realized example cases. Second is classifying these criteria into scientifically grounded categories that show how they relate to each other. Third is validating criteria through the analysis of realized projects using the established criteria sets on a two-level research scale.

The detailed research focuses on contemporary realizations over the past three decades in cities whose countries have more developed economies. It focuses on public parks whose characteristics of being outdoor, publicly accessible, vegetation-dominated spaces are used for recreation, social interaction, and environmental functions. The approach uses qualitative methods including literature review, document analysis, and example cases analysis.

Brownfields are previously developed, underutilized sites that are actually or perceivably contaminated from past industrial or commercial activities (P. Tedd, 2001, in Dan He, 2024). They are characterized by challenges such as legal complexities, negative perceptions, expensive cleanup and obsolete structures. They also present positive opportunities such as being located in central urban areas with existing infrastructure, being the subject that prevents further urban sprawl, and having the transformation power that can initiate neighborhood revitalization (Rey et al., 2022).

Waterfront brownfields represent precious ecosystems, so their redevelopment has to integrate the ecological restoration with the efforts to reconnect nearby neighborhoods to the waterfront and improve daily access (Krieger, 2004; Lino, 2016). They offer rebranding opportunities for cities (Doorne, 1998; Hutton, 2009) and provide heritage elements that help strengthen the sense of place in public spaces (Gordon, 1999; Hoyle, 2000).

Public parks are important spaces that provide recreation, social gathering, and exercise in dense urban areas. They contribute to public health and local economic vitality and enhance the quality of the environment (Gascon et al., 2015a; Li et al., 2023). Contemporary parks have to adapt to diverse user needs, respond to evolving climate pressures, and retain within limited budgets. They have to make sure that underserved communities can have access to high-quality green and blue spaces (Kabisch et al., 2017; Jones et al., 2022). Parks have additional functions on the waterfronts: they help by creating the physical and social connections between the city and the water. They can present and highlight the area’s industrial and maritime past (McCormack et al., 2010; Jennings and Gaither, 2015; Jennings et al., 2017; Remme et al., 2021).

Blue-green infrastructure is a useful framework for this work. It is focused on multifunctional, integrated spaces in ecological terms, that support resilience and the needs of city residents (Pouso et al., 2021; Hysa et al., 2025). Urban sustainability connects together three key dimensions that reinforce the others when planning is thoughtful (Martine Laprise, 2018; Wendling et al., 2018; Dan He et al., 2024). Urban resilience is the capacity to resist and adapt to disturbances while maintaining core functions, highlighting the importance of diversity, flexibility, and responsive feedback systems (Meerow et al., 2016; Serbanica and Constantin, 2023). Waterfront parks contribute to public health by providing space for physical activity, supporting mental well-being, encouraging social interaction, and improving local environmental conditions. The downside is that access to these benefits raises questions of equity and inclusion, since those conditions are not always met (Wolch et al., 2014; Venter et al., 2020).

Many cities offer valuable lessons. London's Thames regeneration demonstrates how important is to be connected and to implement flood management solutions (City of London, 2024). Barcelona's waterfront shows how a neighborhood can be re-

integrated through urban restructuring and providing waterfront access (Pistone, 2023). Toronto is a good example of long-term planning implementing sustainability standards (Waterfront Toronto, 2025). Hamburg's HafenCity shows how quality design and flood protection can be integrated (Üzümcüoğlu, 2023). New York's project guidelines show an innovative adaptive reuse and community engagement principle (Marrella et al., 2021).

Although great knowledge about brownfield regeneration and waterfront transformation is present, an important gap shows that no research has systematically identified, classified, and systematized urban-planning criteria for WBUPPs using a holistic spatial approach. Accessible knowledge is dispersed in different domains and different disciplines. Key gaps are evident in limited research of the WBUPP's criteria mutual relationships and insufficient validation of these criteria's implementation in realized WBUPPs, a small number of research studies that view parks as integrated system, as well as a small number of comparative example cases analysis which provide lessons applicable in other cases in different contexts.

The scope of this research is to address these gaps by developing a comprehensive framework identifying relevant criteria, creating a classification system revealing relationships, validating criteria application through a two-level systematic analysis of realized projects, applying a holistic spatial approach that considers WBUPPs as integrated systems within broader urban contexts, and synthesizing findings about WBUPP example cases to provide lessons applicable in other cases in different contexts. By addressing this gap, the research aims to deepen scholarly understanding of WBUPP within urban-planning context from sustainability perspective. It also aims to consolidate analytical approaches which support highly systematic methods based on found evidence.

1.6 Methodology, Research Methods, Research Design

This research used a qualitative, multi-method approach. It combined systematic literature review, document analysis, and comparative example case analysis to identify, classify, and validate urban-planning criteria for WBUPP. The matrix presenting the interrelations between the corresponding Research question-

Hypotheses-Research method-Result-Conclusion-Scientific contribution is shown in Table 1.

Methodology is composed of two mutually intertwined and interdependent research sections shown in Figure 1, literature review and example cases analysis, each divided in cycles or phases. Doctoral dissertation research methodology diagram is presented in Figure 3.

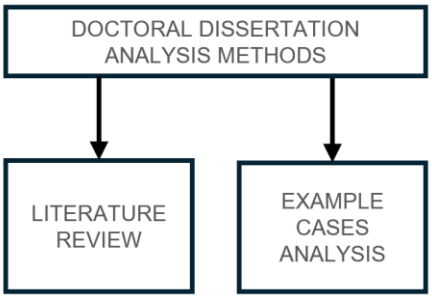


Figure 1 Doctoral dissertation main methodological approaches, M. Gudac Cvelic

The first research section focuses on a literature review of WBUPP and its factors, followed by two analysis phases. The second research section addresses urban-planning criteria related to WBUPP. These two sections occur almost simultaneously but progress through their phases at different rates. Findings from the second section become research tools for the first section.

The basis of both research sections is literature review. Literature reviews in both sections use systematic search procedures across two major databases, Web of Science and Scopus, applying keyword combinations organized into thematic clusters: site characteristics (waterfront, brownfield, post-industrial), intervention types (public park, green space, regeneration), and planning concepts (urban-planning, design criteria, sustainability). The literature search focuses on the following sectors: BROWNFIELDS, URBAN WATERFRONT, PUBLIC SPACE / PUBLIC PARK, SUSTAINABILITY, and URBAN-PLANNING CRITERIA (related to WBUPP), as shown in Figure 2. Sources published in the past 30 years, primarily in English, as well as in other spoke by the author (Italian, Spanish, Croatian) or easily translatable languages, are screened using inclusion and exclusion criteria. Information relevant to the research is extracted and synthesized thematically to identify patterns and gaps in existing knowledge.

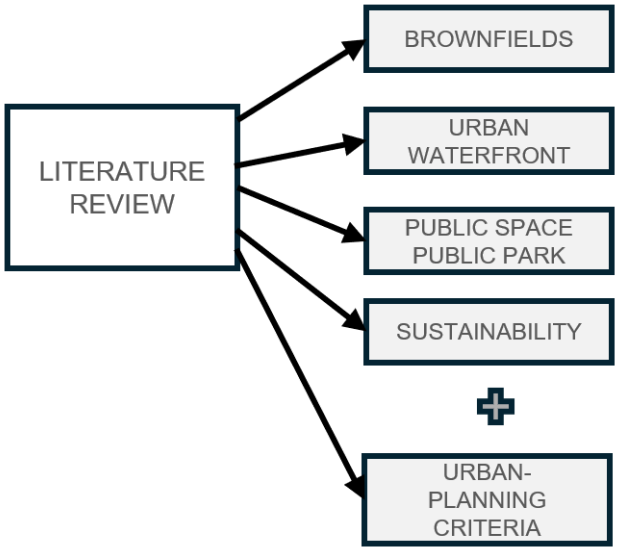


Figure 2 Literature review domains based on WBUPP factors' domains: brownfields, urban waterfront, public park, and sustainability principles, M. Gudac Cvelic

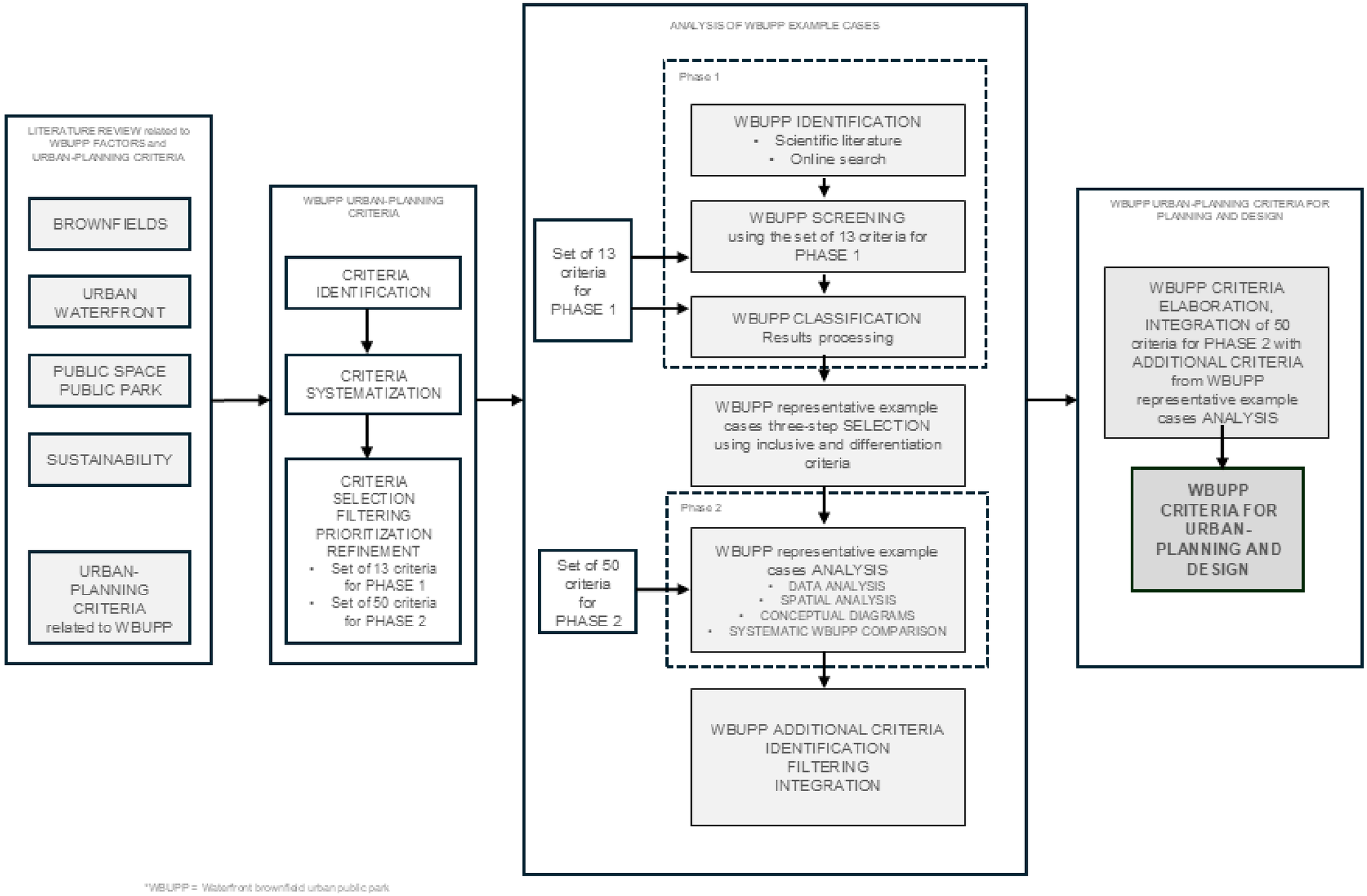


Figure 3 Doctoral dissertation research methodology diagram, M. Gudac Cvelic

Table 1 Research question-Hypotheses-Research method-Result-Conclusion-Scientific contribution matrix, M. Gudac Cvelic

RESEARCH QUESTION		HYPOTHESES		RESEARCH METHODS	MAIN RESEARCH METHOD	RESULT	CONCLUSION	ORIGINAL SCIENTIFIC CONTRIBUTION	
MAIN RQ	What are the urban-planning criteria for the planning and design of public city parks within waterfront brownfield regeneration, and how can these criteria be identified, classified, and systematized?	**MAIN H**	H: Urban-planning criteria for planning and designing public city parks in the regeneration of waterfront brownfields can be developed through literature and spatial analysis.	• analytical and synthetic method: content analysis and spatial analysis, • descriptive method, • classification method, • case study method, • field research method, • comparison method, • method of integrating the theoretical–methodological WBUPP framework, • systematization method	• method of integrating the theoretical–methodological WBUPP framework	• Urban-planning WBUPP criteria set with indicators • Development of the method of integrating the theoretical–methodological WBUPP framework, • WBUPP-related knowledge base establishment • GIS-related analysis method and dataset compilation	Hypotheses is confirmed by the development of an urban-planning criteria set used for planning and designing public city parks in the regeneration of waterfront brownfields.	**MAIN SC**	**SC:** Development of urban-planning criteria for the planning and design of public city parks within waterfront brownfield regeneration.
RQ1	1. What theoretical frameworks and conceptual approaches relate to the planning and design of WBUPPs, and which urban-planning criteria emerge from existing sources as relevant to WBUPPs development?	**H1**	H1: WBUPPs are a specific typology characterized by unique characteristics whose urban-planning and design criteria emerge from the intersection of its factor's domains: brownfields, urban waterfront, public park, and sustainability principles.	• analytical and synthetic method: content analysis, descriptive method, • comparison method, • classification method, • systematization method	• analytical and synthetic method: content analysis	• Brownfields, Urban waterfront, Public park, and Sustainability principles knowledge base establishment • Interconnection of various thematic domains defining WBUPP • Identification of over 400 criteria, of which 375 is later systematized	Hypotheses is confirmed by establishing the WBUPP knowledge base related to compounding domains, which demonstrates that WBUPP is a specific typology characterized by unique attributes.	**SC1**	**SC1:** Establishment of a theoretical and empirical knowledge base consisting of synthesized findings analyzed from the urban-planning perspective, providing insights into the four compounding WBUPP domains: brownfields, urban waterfront, public park, and sustainability principles.
RQ2	2. What relationships and interdependencies exist among different urban-planning criteria in the context of waterfront brownfield regeneration? How can they be systematized?	**H2**	H2: Urban-planning criteria related to waterfront brownfield regeneration can be organized according to a classification system with scientifically grounded categories that recognize their relationships and interdependencies.	• analytical and synthetic method: content analysis, • descriptive method, • comparison method, • systematization method, • classification method, • method of integrating the theoretical–methodological WBUPP framework	• analytical and synthetic method: content analysis	• Definition of criteria • Identification of methodological approaches for classifying WBUPP aspects • Methods for the systematization of urban-planning WBUPP criteria • Development of a table comprising 50 WBUPP criteria	Hypotheses is confirmed by the development of an urban-planning criteria classification system with scientifically grounded categories that recognize their relationships and interdependencies.	**SC2**	**SC2:** Development of a structured classification system that organizes urban-planning criteria into scientifically grounded categories. Application of the classification system to the compilation of urban-planning criteria, showing the relationships and interdependencies among criteria in the context of waterfront brownfield regeneration.
RQ3	3. What methodological approaches are appropriate for verifying and developing the criteria by which WBUPPs are realized, which have not been found in the literature?	**H3**	H3: The identified criteria framework can be validated through analysis of WBUPP example cases using the developed content and spatial analysis methodology.	• analytical and synthetic method: content analysis and spatial analysis, • descriptive method, • classification method, • case study method, • field research method, • method of integrating the theoretical–methodological WBUPP framework, • systematization method	• analytical and synthetic method: spatial analysis	• Validation of the 50 criteria through the analysis of representative WBUPP case studies • GIS-based analysis method • GIS dataset compilation • WBUPP representative example cases schematic diagrams • Development of 16 new urban-planning criteria for WBUPP	Hypotheses is confirmed by establishing a WBUPP content and spatial analysis model, conducting the analysis, and supplementing the criteria framework with empirically derived components.	**SC3**	**SC3:** Creation of the first WBUPP global inventory dataset and systematic comparative analysis of WBUPPs with overview, using the established screening analysis methodology. Establishment of a GIS-based spatial analysis method and its integration within the detailed representative WBUPP example cases analysis methodology. Creation of a detailed representative WBUPP example cases database using the established methodology, which will be made available and accessible online.

WBUPP example cases are analyzed on two complexity levels, in the first and in the second phase of the dissertation research. Each level applied a specific methodological framework. The two analysis levels are shown in Figure 4.

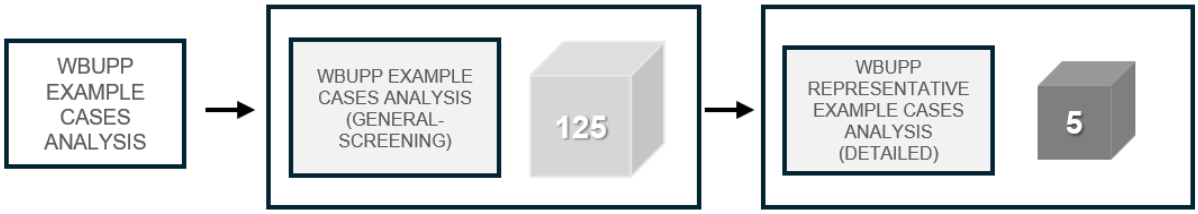


Figure 4 WBUPP example cases analyzed on two complexity levels – screening and detailed, M. Gudac Cvelic

The first phase of the first research section (I-1) consists of WBUPP IDENTIFICATION, WBUPP SCREENING, and WBUPP CLASSIFICATION. WBUPP identification compiles an initial inventory of 151 WBUPP examples worldwide, drawing from academic literature, professional publications, online databases, and targeted web searches. Basic information for each park – including location, size, development period, and site history – is documented. WBUPP screening analyzes 125 example cases that meet the screening criteria and further refines the number of WBUPP example cases to be classified to 99.

The first phase of the second research section (II-1), called CRITERIA IDENTIFICATION, compiles an inventory of about 400 criteria found through academic literature search. Criteria are analyzed, verified for authenticity through scientific sources, and refined so that the final number proceeding to the second phase is 375. The second phase of the second research section (II-2), called CRITERIA SYSTEMATIZATION, organizes the criteria according to three sustainability principles: economic, environmental, and social. The third phase of the second research section (II-3), called CRITERIA SELECTION, FILTERING, PRIORITIZATION, REFINEMENT, consists of multiple iterative processes that result in the establishment of two distinct criteria sets. Set 1 consists of 13 criteria that guide the first phase of the first research section: WBUPP example cases screening (I-1). Set 2 consists of 50 criteria that guide the second phase of the first research section: WBUPP representative example cases analysis (I-2).

The process conducted between the first and second phases of the first research section (between I-1 and I-2) is the three-step SELECTION of WBUPP representative example cases using inclusive and differentiation criteria. This process identified WBUPP representative cases that would be analyzed in the second phase of the first research section (I-2). Cases are selected through intentional sampling to cover representative WBUPP realizations across the most common scales, waterfront types, and development periods. They are also chosen to represent diversity of regions and design approaches.

The second phase of the first research section (I-2), called WBUPP representative example cases ANALYSIS, consists of CONTENT ANALYSIS, SPATIAL ANALYSIS, creation of CONCEPTUAL DIAGRAMS, and SYSTEMATIC WBUPP COMPARISON. The method is presented graphically in Figure 5. The analysis is guided by criteria set 2 (50 criteria) developed in the third phase of the second research section (II-3). The five WBUPP representative example cases are holistically analyzed using a structured protocol that analyses the WBUPP project context, planning and design processes, site characteristics and programs, criteria application, sustainability dimensions (environmental, social, economic, institutional), results and impacts, as well as potential valuable information for future use. The analysis uses multiple sources, including planning documents, design documentation, project descriptions, visual materials, evaluations, site visits when possible, and secondary sources. Spatial analysis establishes a digital GIS mapping method that produces thematic maps, translating criteria into multiple unique graphic composition sets. This enables data extraction, data comparison, and conclusions based on WBUPP's physical elements. Conceptual diagrams, based on Kevin Lynch’s principles (Lynch, 1960), abstract WBUPPs factors to make specific spatial elements more visible. Conceptual diagrams make conclusions about organizational logic possible. Comparative analysis of WBUPP representative example cases identifies patterns in criteria application, contextual influences, and relationships between criteria and WBUPP outcomes. This phase (I-2) produces WBUPP ADDITIONAL CRITERIA that are IDENTIFIED, subsequently FILTERED, and INTEGRATED when appropriate.

Based on this empirical research, the initial urban-planning criteria (set 2 from II-3) are supplemented with additional criteria found using spatial analysis of realized WBUPP

example cases. This provided a more thorough and nuanced framework that integrates theoretical knowledge and practical experience.

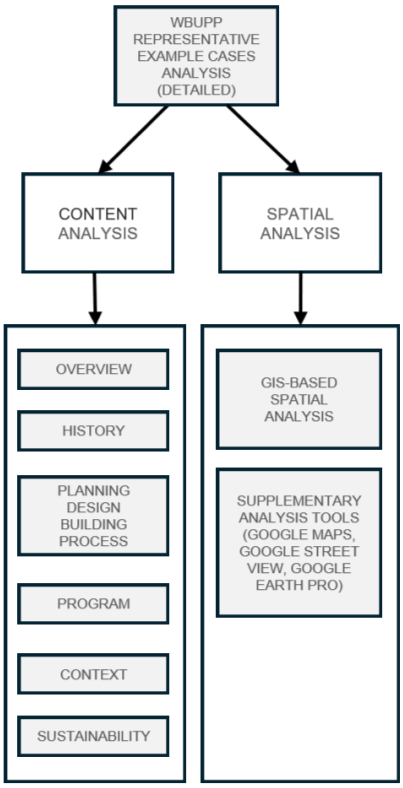


Figure 5 WBUPP representative example case detailed analysis method, M. Gudac Cvelic

The final, integrating phase, called WBUPP URBAN-PLANNING CRITERIA FOR PLANNING AND DESIGN, synthesizes findings to develop the sought criteria framework. Urban-planning criteria from two sources (literature-based and case-based) are INTEGRATED through comparison, reconciliation of mismatching terminology, gap supplementation, and assessment of validity. The WBUPP URBAN-PLANNING CRITERIA FOR PLANNING AND DESIGN set is ELABORATED and SYSTEMATIZED through classification into dimensions (broad aspects such as Environmental, Social, Economic). Figure 6 illustrates the quantitative distribution of criteria sources and their systematization based on the three sustainability pillars.

Strategies that make sure that the quality of research is achieved are applied in all phases of the two research sections. Systematic and transparent procedures for searches and analysis are applied. Multiple evidence sources providing triangulation are searched. Explicit specified selection and evaluation criteria are used. Refinement

processes are repeated multiple times, based on emerging findings. Peer review and expert consultation is performed. Numerous reflections acknowledged the researcher's interpretive role.

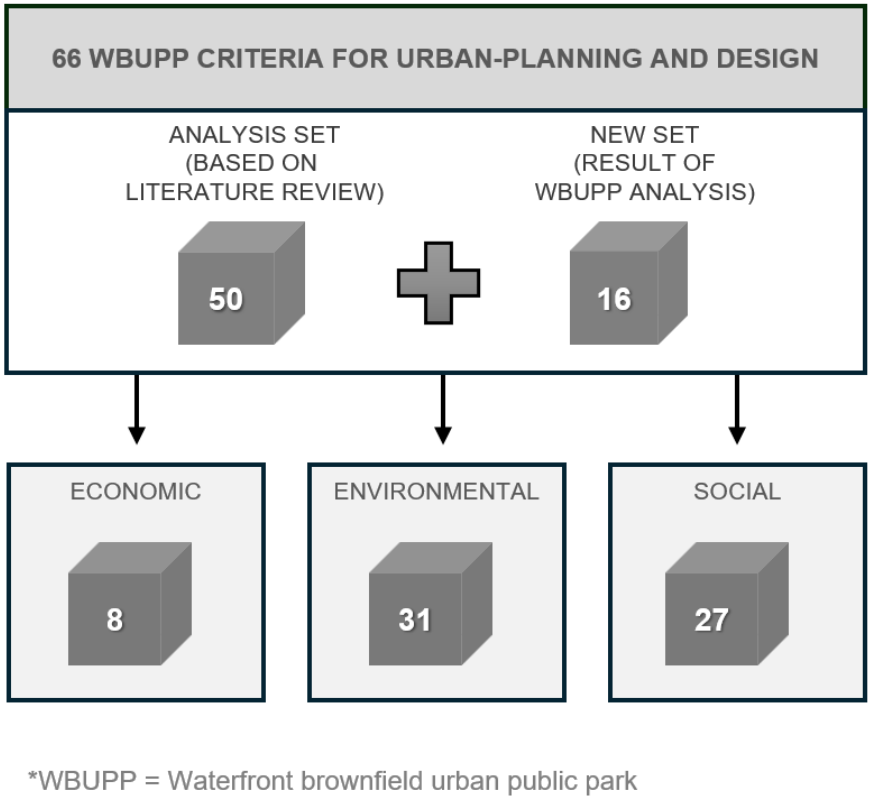


Figure 6 WBUPP urban-planning criteria for planning and design: resulting criteria naming their source were systematized according to the three sustainability pillars. The figure shows the corresponding number of criteria. , M. Gudac Cvelic

1.7 Expected Results and Applicative Possibilities

Expected result of this doctoral research is to establish a comprehensive urban-planning framework specific for WBUPPs. Integrated knowledge about the WBUPP compounding factors can serve as a detailed guide in the form of and urban-planning criteria set. The set organizes 66 planning criteria and relates to their mutual relationship. Each criterion has a clear definition, is elaborated from a scientific background, is validated on a representative WBUPP case by analyzing its application and offers guidance for other criteria relationship contextualization. The urban-planning

criteria set created an asset, combining the criteria's scientific literature foundation integrated with additional criteria obtained through analysis and validation of realized project applications.

Expected result of this doctoral research is to develop a classification method and present the method's application result. It can serve to help understand the existing diversity within WBUPPs. The classification includes 125 filtered WBUPPs according to their scale, the type of waterfront they occupy, their previous use, and other factors, according to the total of 13 classification criteria. This classification system can serve a practical purpose: it can enable cities to learn from one another by identifying comparable projects and using or adjusting planning strategies to their specific contexts and goals.

Expected result of this doctoral research is the detailed analysis of five representative WBUPP example cases. It shows how urban-planning criteria are used in actual planning and design. For example, the analysis shows which sustainability criteria are used in successful WBUPP realizations, what happens when environmental goals related to restoration cannot be balanced with the required recreational activities, or how certain specific conditions such as culture or climate gain priority one over another. The studied representative WBUPP example cases can reduce the gap between theory found in scientific literature and realized examples, including on-site research that results in user's feedback regarding implemented WBUPP factors and elements. The established analysis methods can be used in future research.

Expected result of this doctoral research is the establishment of the methodology for the representative WBUPP example cases analysis. This methodology represents an innovation that can be applied outside of this specific project type. By combining conceptual analysis with systematic screening of example cases worldwide, strategic selection of diverse example cases for detailed analysis, and analysis using a created criteria framework, the research presents how complex urban phenomena can be studied. The various source's integration of spatial data analysis, GIS mapping, specific thematic maps creation, and conceptual abstract diagramming with frameworks based on scientific literature, provides a methodology that other researchers can adapt to study related urban spaces. The methodology is also developed and refined further.

The practical applications of this research can reach different stakeholders in urban development. Teaching and further research can make use of it within the academic and educational community. The criteria framework can serve as a checklist as well as a thinking tool for urban planners and landscape architects. Standards for waterfront regeneration and brownfield redevelopment can be developed by policymakers and planning authorities using this research as a foundation or help during the development. Developers can use the urban-planning criteria framework for obtaining user expectations and requirements in regards of funding and program decisions. Community groups and initiatives can use this research to help residents, planners and officials better understand each other's needs and challenges. International organizations and professional networks that relate to sustainable urban development can use this research to help develop guidelines, to spread knowledge, and to help with waterfront brownfield regeneration processes when local authorities lack required field expertise.

1.8 Scientific Contribution

Expected scientific contributions respond to the dissertation research sections and levels, which are mutually interdependent. They are structured to align with the research questions, objectives, and hypotheses. The main scientific contribution is complemented by three auxiliary contributions.

SC: Development of urban-planning criteria for the planning and design of urban public parks within waterfront brownfield regeneration.

SC1: Establishment of a theoretical and empirical knowledge base consisting of synthesized findings analyzed from the urban-planning perspective, providing insights into the four compounding WBUPP domains: brownfields, urban waterfront, public park, and sustainability principles.

SC2: Development of a structured classification system that organizes urban-planning criteria into scientifically grounded categories. Application of the classification system to the compilation of urban-planning criteria, showing the relationships and interdependencies among criteria in the context of waterfront brownfield regeneration.

SC3: Creation of the first WBUPP global inventory dataset and systematic comparative analysis of WBUPPs with overview, using the established screening analysis methodology. Establishment of a GIS-based spatial analysis method and its integration within the detailed representative WBUPP example cases analysis methodology. Creation of a detailed representative WBUPP example cases database using the established methodology, which will be made available and accessible online.

1.9 Limits of the Research

There is not a lot of related scientific literature, especially sources that refer to WBUPP example cases. Information on WBUPP example cases is mostly found in grey and other literature. Empirical data from field research, direct user experience, and informal practices is limited. Financial and temporal constraints, together with the broad WBUPP spatial coverage, limit the potential for field research and therefore orient the analysis toward a systematic review method and GIS-based spatial analysis. Spatial analysis is based on open databases that were supplemented by the author using supplementary digital tools and triangulation with other sources. This research is not focused on user satisfaction and user perception factors, or WBUPP governance aspects. The established urban-planning criteria set is not oriented towards developing quantitative measures or indicators. Criteria validation is not performed using quantitative methods. The main goal research does not consider institutional or governance dimensions and does not explore maintenance aspects. The chosen timeframe does not present objective long-term economic, environmental, or policy conditions. Detailed WBUPP analysis was done on recent example cases so it does not present the detailed analysis of older WBUPP cases.

WBUPP example cases' evaluation of sustainability aspects used available documentation and spatial analysis done by the author, because there was no availability of documented environmental monitoring, social impact assessment, or economic analysis for relevant WBUPP example cases. The research is primarily based on English-language sources, complemented by the author's speaking languages: Croatian, Italian, and Spanish.

The research aims to develop a comprehensive framework of urban-planning criteria, while remaining open to further refinement, extension, and contextual adaptation in future research. The urban-planning criteria framework reflects the current state of knowledge, but it is open to future refinement and expansion.

The evaluation is based on literature analysis and example cases analysis results. The criteria evaluation is a subjective expert judgment that intends to acknowledge their importance, applicability, and other aspects. This process is documented in detail for enhanced transparency. The interactions between criteria are interpreted with the intention of covering their complexity.

There are numerous different directions for future research that the limitations of this research suggest. The research remains open to further extensions, such as extending the work to new contexts, developing additional methods or refining the established ones, updating in respect to developing new knowledge and deepening the understanding of any specific research aspect.

1.10 General Structure of the Doctoral Dissertation

This doctoral dissertation consists of ten chapters. It starts with conceptual basis, followed by empirical analysis, and ends with the development of urban-planning criteria for the planning and design of urban public parks within waterfront brownfield regeneration. The structure starts with broad theoretical base, then narrows through systematic example cases identification and analysis, and ends with interpreting the results into an integrated framework.

Chapter 1 introduces the research problem and defines key terms that create the conceptual base for the research: waterfront brownfield, urban public park, waterfront regeneration, criteria for planning and design, and sustainability. It poses research questions, objectives, and hypotheses. Research framework and scope are explained, followed by the methodology, research methods, and research design presentation, aided with a diagram. It outlines expected results with applicative possibilities, contributions, and limitations of the research. Chapter 1 ends with dissertation structure overview.

Chapters 2–5 explore the theory of WBUPPs' factors. Each chapter focuses on one of the four domains: brownfields, urban waterfronts, public space/public parks, and sustainability. Each chapter contains the domain's conceptual evolution, reviewing correspondent international examples, and extracting urban-planning criteria. Each chapter concludes with remarks summarizing the findings.

Chapter 6 consolidates criteria from the four domains into a coherent system. It explains the distinction between criteria and indicators and systematizes existing criteria in economic, environmental, and social dimensions. It elaborates on the creation of the screening criteria set (used to assemble and classify the global WBUPP sample) and the analysis criteria set (used for in-depth evaluation). It specifies the scientific literature foundation and the establishment process for each criterion.

Chapter 7 presents the global screening and classification of WBUPPs, describing how an initial pool of 151 example cases was narrowed to 125, and then refined to ninety-nine cases after analysis. It presents distributions and cross-tabulations by thirteen screening criteria: region, size, timeframe, water body type, water-contact intensity, morphology, previous use, green space quantity, infrastructural relationships, and GDP per capita.

Chapter 8 presents five representative WBUPP example cases– Abandoibarra (Bilbao), Jubileumsparken (Gothenburg), Brooklyn Bridge Park (New York City), Jurong Lake Gardens (Singapore), and Biidaasige Park (Toronto)—selected through maximum-variation, information-oriented sampling, followed by a detailed three-step selection process. Each example case is examined through a consistent seven-part structure covering history, planning and design processes, program, context, sustainability, and detailed spatial analysis. Using QGIS-based mapping, thematic layers, and conceptual diagramming inspired by Kevin Lynch, the chapter visualizes each project's position within wider urban systems, morphology, accessibility and movement, environmental and health features, social and well-being programs, mixed uses, and spatial organization principles, culminating in cross-case comparison and an operative synthesis of recurrent patterns and emergent criteria.

Chapter 9 presents the dissertation's primary original contribution: a comprehensive WBUPP-specific urban-planning criteria framework. It documents how criteria were developed. In addition to consolidating known criteria, the chapter defines sixteen new

WBUPP-specific criteria developed from WBUPP representative example cases detailed (spatial) analysis, that are insufficiently captured by the initially proposed framework. All criteria are defined and systematized into the same three-pillar hierarchical structure.

Chapter 10 discusses the findings considering the initial research questions and hypotheses, reflects methodological innovations, and discusses the urban-planning criteria framework development. At the end, it concludes the dissertation by synthesizing the overall contributions.

The appendices support the main chapters with a comprehensive criteria inventory within their respective process phases, extended case documentation, methodological tools, and the full WBUPP screening reference list.

2 BROWNFIELDS

2.1 Brownfield concept, definition, History overview

2.1.1 Brownfield Concept

The term "brownfield" was introduced for abandoned and contaminated urban sites that presented challenges and opportunities for sustainable urban redevelopment. The United States Environmental Protection Agency (EPA) first introduced the term in 1992, and defined brownfields as "abandoned, idled, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination" (P. Tedd, 2001, in Dan He, 2024).

The EPA's definition influenced urban-planning and environmental policy because the contamination (real or perceived) signed the negative notion associated with former uses. The perceived pollution can create a barrier to redevelopment same as actual pollution. This distinction is important in contemporary brownfield discourse, involving the economic and psychological dimensions of brownfield regeneration together with technical environmental dimension (Yount, 2003, in Dan He, 2024).

2.1.2 Brownfield Definition Evolution

There is no common, official definition of brownfield in Europe or in the Americas (Lee Oliver, 2005). The CABERNET (Concerted Action on Brownfield and Economic Regeneration Network) project, a European initiative, offered a broader definition in 2006, stating that brownfields are "sites that have been affected by the former uses of the site and surrounding land; are derelict and underused; have real or perceived contamination problems; are mainly in developed urban areas; and require intervention to bring them back to beneficial use" (CABERNET, 2006).

The CABERNET (CABERNET, 2006) definition added dereliction, underutilization, and the need for intervention to contamination. It positioned brownfields in the existing urban fabric, described as urban problems that require holistic solutions.

The urban nature of the CABERNET definition has been discussed in various national contexts. In Estonia, the definition is focused on urban areas but does not include

numerous abandoned agricultural complexes located outside settlements (Jiří Tintěra, 2014). This demonstrates the importance of establishing brownfield definitions within specific historical, political, and economic contexts. The term has later been applied to abandoned spaces in rural areas as well (Matković and Jakovčić, 2019a).

The French philosopher Gilles Clément's (Clement, 2020) concept of tiers paysage (third landscape) embraces the multiple meanings of the term. According to the author, brownfield refers to something "abandoned" but also, more rarely, to something "reserved." The first category includes abandoned lands formerly used for agricultural, industrial, urban, or touristic purposes, while the second includes unexploited sites whose exploitation is impossible or economically unfeasible (Clement, 2020).

2.1.3 Historical Context of Brownfields

The increase of brownfield sites is a consequence of economic changes and political transformation. In Central and Eastern Europe, brownfields appeared in large numbers as the secondary sector transitioned to tertiary and quaternary economies, and when traditional industries were restructured in the 1990s (Bohumil Frantal, 2015). These changes included deindustrialization, de-agrarization, and demilitarization associated with geopolitical shifts (Jan Hercik et al., 2014). The collapse of socialist economies and their transition to market-based systems resulted in abandonment of industrial and military facilities, as well as agricultural complexes that were integrated into the previous economic order (Matković and Jakovčić, 2019a).

The 1990s represent a critical juncture in the brownfield narrative, particularly in post-socialist contexts, where the industrial decline was greater than the capacity of planning systems and markets to absorb and redevelop abandoned sites (Jigoria-Oprea and Popa, 2017). Brownfield challenges and regeneration strategies are recognized around the world, as these sites are characterized by environmental contamination and complex ownership structures, unclear legal frameworks, and social memories of economic displacement (Rey et al., 2022).

2.1.4 National Definitions: A Comparative European Perspective

Brownfield definitions vary between European countries and the United States, reflecting different national regulatory frameworks, environmental priorities, and approaches to urban development. In the Czech Republic, brownfields are defined as non-permanent (derelict) objects and zones that have been neglected or abandoned and are endangered by industrial, agricultural, or other activities, with the important condition that regeneration processes cannot be forced (Bohumil Frantal, 2015).

Croatia's definition, established at the national level in 2017 by a special working group of the Ministry of Regional Development and EU Funds, defines brownfields as sites that have been inadequately utilized, abandoned, or could not be adequately used, with reference to locations suitable for Integrated Territorial Investment (ITI) mechanisms. This definition is tied to the operational framework of EU funding mechanisms within the "Competitiveness and Cohesion" Operational Programme 2014–2020, showing how brownfield definitions can be influenced by financing structures and policy instruments (Funds, 2014).

Latvia defines a brownfield site as any location where industrial production has been degraded, including former industrial areas, degraded communal areas, abandoned waste depositories, abandoned chemical and pesticide storage facilities, and former Soviet military bases. This definition shows Latvia's historical experience with Soviet-era industrialization and militarization, acknowledging the diverse brownfield previous uses (Noviks, 2009).

Germany's definition are sites that are not utilized and where production has ceased, or that require reorganization (German Federal Ministry for the Environment, 2015). This concise definition emphasizes functional cessation and the need for structural change. Poland defines brownfields as degraded production sites where utilization of land is impeded (Ministry of Environment, 2015).

Romania defines brownfields as contaminated sites (Ministry of Water and Environment, 2015). This definition prioritizes the environmental dimension. The United States EPA defines brownfields as non-permanent sites whose development, renewal, or other utilization could be environmentally or economically compromised,

explicitly acknowledging both environmental and economic barriers to redevelopment (U.S. Environmental Protection Agency EPA, 2016).

2.1.5 Brownfield in Croatia

In Croatia, brownfields are defined and incorporated into the spatial planning legal framework. They are recognized in registers and development policies that connect them to EU cohesion funding (Ministry of Physical Planning, 2025). The current Physical Planning Act (Zakon o prostornom uređenju) defines brownfield (brownfield areas) as “an abandoned area and/or property that is not used for its primary purpose, is underused or degraded, and is available for repurposing, urban transformation, urban rehabilitation, and reuse. Such an area is registered in the Brownfield Areas Register of the spatial planning information system.” (Ministry of Physical Planning, 2026).[1]

This links the legal recognition of brownfields to both their functional status (abandoned, underused, or degraded) and their formal registration in the national brownfield register within the spatial planning information system. Presentations on spatial planning by the Ministry of Physical Planning, Construction and State Assets (Ministarstvo prostornoga uređenja, graditeljstva i državne imovine, MPGI) and recent reform packages explicitly identify brownfield areas as locations where new development, such as housing or business facilities, are directed “if the purpose is compatible with the environment”[2], together with underused production zones and special-purpose areas (Ministry of Physical Planning, 2025).

The Brownfield Areas Registry (Registar brownfield područja) was established in 2018 within the ISPU (Informacijski sustav prostornog uređenja – Spatial Planning Information System) by the Croatian Institute for Spatial Development (now the Institute for Spatial Development of the Ministry of Spatial Planning, Construction, and State Property), in accordance with the obligation prescribed by the Spatial Development Strategy of the Republic of Croatia (Informacijski sustav prostornog

[1] “Napuštena površina i/ili nekretnina koja se ne koristi u svojoj osnovnoj namjeni ili je nedovoljno iskorištena odnosno degradirana te je slobodna za prenamjenu, urbanu preobrazbu, urbanu sanaciju i ponovnu uporabu, i kao takvo područje evidentirano u Registru brownfield područja informacijskog sustava prostornog uređenja.”
[2] "ako je namjena usklađena s okolinom"

uređenja (ISPU)), published in Official Gazette 106/17. The Registry contains spatial data on areas designated for urban transformation, with a precisely defined data model that, in addition to general information, includes details on ownership, infrastructure, jurisdiction, and key elements from the spatial plan. Data are entered into the Registry by the spatial planning institutes of the counties and the City of Zagreb, certain local government units, and county development agencies, while the Ministry of Spatial Planning, Construction, and State Property maintains it. The data are available for viewing on the ISPU Geoportal, for download via a web download service, and are intended for the professional public and potential investors (Informacijski sustav prostornog uređenja (ISPU)) (Hrvatski sabor, 2017).

The City of Zagreb brownfield overview links brownfield renewal to the Operativni program Konkurentnost i kohezija (Operational Programme Competitiveness and Cohesion) and ITU (Integrated Territorial Investment) mechanism, with a specific EU cohesion objective “6e2 Renewal of brownfield locations (former military and/or industrial areas)”[3] and funding allocation for inventory, remediation and regeneration projects (GeoHub Zagreb, 2023).

Policy documents emphasize activities such as inventory and database creation, project preparation for revitalization, remediation of ecologically contaminated sites, and regeneration of former industrial and military zones for economic and social uses (Ministry of Physical Planning). Table 2**Error! Reference source not found.** includes key policy instruments.

2.1.6 Characteristics of Urban Brownfields

Urban brownfields are defined by specific conditions that distinguish them from other types of underutilized or vacant land. Those spaces exhibit an imbalance, reflecting a mismatch between the site's potential and the activities conducted there, which results in dysfunction, escheat, or obsolescence. This imbalance underscores a fundamental disconnect between the site's inherent locational and physical attributes and its current use or lack of use. Additionally, urban brownfields often experience prolonged periods without investment, significantly reducing the site's value in use – or even its exchange

[3] "6e2 Obnova brownfield lokacija (bivša vojna i/ili industrijska područja)"

value – in the foreseeable future. Breaking this cycle requires deliberate intervention, often through public sector leadership, financial incentives, or regulatory reforms to change market perceptions and stimulate redevelopment interest (Rey, 2022).

Table 2 Key policy instruments in Croatia, M. Gudac Cvelic

National Development Strategy of the Republic of Croatia until 2030 (Nacionalna razvojna strategija Republike Hrvatske do 2030. godine)	- national strategic planning document, emphasizing green and digital transition	Official Gazette (NN) 13/2021 https://hrvatska2030.hr/
Spatial Development Strategy of the Republic of Croatia (Informacijski sustav prostornog uređenja (ISPU))	-core national document for directing spatial development	Official Gazette (NN) 106/2017 https://narodne-novine.nn.hr/clanci/sluzbeni/2017_10_106_2423.html
Physical Planning Act (Zakon o prostornom uređenju)	- regulates national spatial planning system	Official Gazette (NN) 155/25 https://www.zakon.hr/z/689/zakon-o-prostornom-uredenju https://mpgi.gov.hr/
Building Act (Zakon o gradnji)	-governs design, construction, use, and maintenance of buildings	Official Gazette (NN) 155/25 https://www.zakon.hr/z/690/zakon-o-gradnji https://mpgi.gov.hr/
Programme for the Development of Circular Economy in Space and Buildings 2021-2030 (Program razvoja kružnog gospodarenja prostorom i zgradama 2021.-2030.)	-strategic program (2021–2030) to promote sustainable cities via circular principles	Official Gazette (NN) 143/21 https://mpgi.gov.hr/UserDocsImages/dokumenti/EnergetskaUcinkovitost/Program_razvoja_KG_prostorom_i_zgradama_2021-2030.pdf
Brownfield Areas Registry (Registar Brownfield područja)	-national database inventorying contaminated/vacant industrial, military, or tourist sites	Geoportal National Spatial Data Infrastructure 13.12.2017. https://geoportal.nipp.hr/geonetwork/srv/hrv/catalog.search#/metadata/b7920366-fb88-430f-8509-2bb8616470bd https://registri.nipp.hr/izvori/view.php?id=1794

2.2 Brownfield Categories Overview and Category Characteristics

2.2.1 Classification Systems and Typologies

The diversity of brownfield sites has necessitated the development of classification systems to support analysis, policy formulation, and regeneration strategies. Classifications based on the origins of brownfields typically include categories such as industrial, railway, military, institutional, commercial, cultural, and leisure (Yakhlef, 2019 in Rey, 2022). These origin-based typologies reflect the historical functions that created brownfield conditions and often correspond to specific contamination profiles, spatial configurations, and redevelopment challenges.

Building on previous research and considering recent societal changes, particularly the energy transition, Rey, Laprise, and Lufkin (2022) propose a classification with eight categories: industrial, railway, military, waterfront, infrastructural, commercial, energy, and diverse (Rey and Lufkin, 2015 in Rey, 2022). This updated classification recognizes emerging brownfield types, especially those related to energy infrastructure, reflecting ongoing transitions in energy systems and the obsolescence of fossil fuel-based facilities.

Industrial brownfields are sites where industrial activity or production once occurred but are now almost or completely abandoned. Their structures still exist, are demolished, or have undergone reconversion (Güthling, 2009; Lusso, 2013). Railway brownfields include former rail yards, maintenance facilities, warehouses, and related infrastructure that have become obsolete due to changes in transportation technology, logistics systems, or network configurations (Rey, 2022).

Military brownfields became a significant category after geopolitical changes, particularly the end of the Cold War and subsequent demilitarization (Jan Hercik et al., 2014). These sites include former barracks, training grounds, airfields, storage facilities, and weapons production or maintenance facilities. Military brownfields often feature distinctive architectural and spatial characteristics, such as large open spaces, specialized buildings, and infrastructure designed for security and operational purposes. Their contamination profiles can be particularly complex, potentially

including munitions residues, fuel contamination, and hazardous materials from weapons systems or maintenance activities. In post-socialist countries, former Soviet military bases represent a substantial portion of military brownfields, often with unclear ownership and limited documentation of activities and potential contamination (Noviks, 2009 in Matković and Jakovčić, 2019).

Waterfront brownfields are located along rivers, canals, lakes, or coastlines and are typically associated with port activities, shipbuilding, military, maritime industries, or waterfront manufacturing (Tiano, 2010; Lotz-Coll, 2018 in Rey, 2022),(Alihodžić Jašarović et al., 2021). Infrastructural brownfields include former utility sites, treatment facilities, distribution centers, military infrastructure, and other infrastructure installations that have become obsolete or relocated (Jacek et al., 2022; Rey, 2022). Commercial brownfields consist of former retail centers, office complexes, hotels, and other commercial facilities that have been abandoned or significantly underutilized due to economic changes, shifting consumer patterns, or obsolescence (Maya, 2013 in Rey, 2022). Energy brownfields represent an emerging category reflecting ongoing energy transitions (Rey and Lufkin, 2015).

The "diverse" category includes brownfield sites that do not fit neatly into other classifications or that combine multiple previous uses. This category acknowledges the complexity and heterogeneity of brownfield situations and the limitations of rigid classification systems (Rey, 2022). It includes residential brownfields, health brownfields, prison brownfields, recreational brownfields, and others (Lotz-Coll, 2018 in Rey, 2022).

2.2.2 Landfills as Brownfields

Landfills are not commonly classified as standard brownfield categories. Therefore, they are discussed separately to clarify their specific characteristics and to justify their inclusion in this research under previous brownfield uses.

The U.S. Environmental Protection Agency (EPA) recognizes landfills as potential brownfield sites (U.S. Environmental Protection Agency EPA, 2016). Brownfield sites include landfills, among other types (Wang et al., 2020). The United Kingdom's National Planning Policy Framework addresses this distinction, excluding from

brownfield classification "land that has been developed for minerals extraction or waste disposal by landfill purposes where provision for restoration has been made through development control procedures" (Government of the United Kingdom, 2012).

A landfill qualifies as a brownfield if it is polluted. The presence of hazardous substances and other contaminants from waste disposal converts a landfill from a planned restoration site into a contaminated brownfield requiring remediation (Megharaj, 2017). Wang et. al. (2020) state that „municipal solid waste landfill is a typical kind of brownfield distributed in lots of urbanized areas around the world“.

The distinction between brownfield and non-brownfield landfills depends on their activity. Active landfills with ongoing waste management operations and regulatory oversight are not abandoned or derelict (De Sousa, 2002), as they remain in intended use with established management protocols. In contrast, abandoned or closed landfills without adequate management, remediation plans, or where contaminants pose uncontrolled risks to human health and the environment qualify as brownfields (Zhang et al., 2024).

Scientific literature documents cases where large-scale landfill sites are transformed into extensive public parks incorporating environmental restoration, recreational areas, and habitat creation (Harnik, 2006).

2.3 Urban Brownfield Regeneration

The concept of urban regeneration has undergone significant evolution since World War II, initially focusing almost exclusively on the physical transformation of urban areas through reconstruction processes, and today representing an organic metaphor for the complex process of enhancing the economic, social, and environmental vitality of cities (Menchawy, 2008).

Urban regeneration is defined as the transformation of urban areas financed by private (corporate) investors, public actors, or by public-private partnership. This principle is regularly connected to societal changes, especially in evolving situations. The basis for this link lies in the emergence of new urban actors replacing traditional ownership models and the evolving political and state dynamics (Matković and Jakovčić, 2019b).

Many urban reconstructions were implemented in developed nations post-1950s, revitalizing cities marked by wartime damage. The 1980s emphasized acupunctural urban projects aimed at enhancing public spaces to induce surrounding improvements. By the 1990s, urban regeneration became characterized by comprehensive interventions targeting neglected urban areas. The Dictionary of Spatial Development, presented at the 2006 CEMAT session in Lisbon, defined urban regeneration as transformation of the obsolete socio-economic basis of certain urban areas by attracting new activities and companies, modernizing urban fabric, improving environmental quality, and diversifying social.structure (Council of Europe, 2006) in (Matković and Jakovčić, 2019b).

Perović and Kurtović Folić (2012) understand brownfield regeneration as a process that transforms devastated surfaces and landscapes into new attractive, inclusive, and multifunctional environments, strengthening the spirit of place and respecting the characteristics of the local community (Perovic and Kurtović Folić, 2012).

The EU project RESCUE (Regeneration of European Sites in Cities and Urban Environments) defined sustainable brownfield regeneration in 2002 as the management, rehabilitation, and reuse of brownfields while ensuring permanent satisfaction of human needs of present and future generations in an environmentally favorable, economically sustainable, institutionally strong, and socially acceptable manner (Martin Franz et al., 2006). This definition was adopted by other European projects: HOMBRE (Holistic Management of Brownfield Regeneration) in 2014 and TIMBRE (Tailored Improvement of Brownfield Regeneration in Europe) in 2014 (Erika Rizzo et al., 2016) in (Matković and Jakovčić, 2019b).

Đokić and Šumpor (2010) determined that long-term support is essential for brownfield reuse, preferably from an active and informed public, and this is particularly true in the context of achieving long-term social benefits (Irena Đokić and Šumpor, 2010). One of the early definitions of sustainable brownfield regeneration by the American Society for Testing and Materials (2011) from 1984 focused precisely on the participation of significant stakeholders, defining brownfield regeneration as a process involving landowners, investors, public administration, and the community with the aim of long-term and fruitful brownfield reuse (American Society for Testing and Materials, 1984).

The physical manifestation of brownfield regeneration can involve different approaches to improving conditions in space, including retention of existing built structures and spatial organization, with return to original condition or introduction of new uses (reconstruction and revitalization procedures); and partial or complete removal of existing built structures, with partial or complete change of spatial organization (replacement construction and urban transformation procedures). Brownfield regeneration partially overlaps with the process of ecological remediation. Abandoned areas of previous industrial, infrastructural, or other related use are often contaminated (Matković and Jakovčić, 2019b).

According to the document of the German Federal Ministry of Environment, Nature Conservation and Nuclear Energy, "Study on the Re-use of Former Military Lands" from 1997, the brownfield regeneration process can be most concisely presented through division into three key stages: orientation, conceptualization, and realization (German Federal Ministry of Environment, 1997). Matković and Jakovčić (2019b) summarize and present the brownfield regeneration process phases in a table.

The orientation phase is initial for brownfield regeneration. Perović and Kurtović Folić (2012) stress the necessity of a comprehensive strategy that includes legislative, sustainability, innovation, scientific, and preventative elements. It also requires policy articulation, awareness about brownfield potential, and integration into strategic documents (Perovic and Kurtović Folić, 2012).

Clark's approach involves investigating locations, including archaeological and historic sites, to assess intervention feasibility, with an emphasis on heritage in European waterfronts (Clark, 2005). Perović and Kurtović Folić (2012) stress the significance of contamination assessment for effective planning and cost estimation, establishing organizational structures in local governments, developing new use concepts, and implementing spatial planning measures. Đokić and Šumpor (2010) focus on predicting models and appropriate methodologies during this phase.

The conceptualization phase includes determining the financing sources, planning the novel use, and defining administrative documents and organization that's supposed to render it possible (German Federal Ministry of Environment, 1997). Perović and Kurtović Folić highlight consultations with stakeholders and site utilization opinions to ensure inclusive engagement (Perovic and Kurtović Folić, 2012). Đokić promotes

identifying underutilized sites, evaluating their potential, and assessing risks, particularly relevant in post-socialist contexts (Irena Đokić and Šumpor, 2010) in (Matković and Jakovčić, 2019b).

Clark underscores the importance of political decision-making and masterplan development with community engagement and public interest (Clark, 2005). Establishing a financial framework is crucial, with Perović and Kurtović Folić addressing financial context activation (Perovic and Kurtović Folić, 2012).

The realization phase entails preparatory actions for new uses, with Perović and Kurtović Folić focusing on site reconstruction and transformation (Perovic and Kurtović Folić, 2012). Đokić (2010) stresses creating conditions for future functional capacity, whereas Clark (2005) suggests marketing new zones for tourism and education. Both the German study and Clark acknowledge marketing as integral to the realization stage.

Perović and Kurtović Folić (2012) delineate phases and intervention scopes, while Đokić (2010) emphasizes enabling testing and verification processes. Clark advocates for meticulous planning of independent development stages (Clark, 2005). Đokić identifies ongoing verification as vital for ensuring brownfield projects achieve long-term economic and social viability (Irena Đokić and Šumpor, 2010).

The goals of urban space regeneration necessitate meticulous preparation and planning. A definitive financing policy, action program, and implementation methodology are essential for the project's success. Unplanned interventions are to be eschewed. It is crucial to establish clear objectives when addressing space regeneration and remediation. Common objectives include revitalizing city centers, renewing neglected areas, enhancing housing conditions, eradicating slums, preserving quality urban structures, addressing traffic issues, constructing new public amenities, restoring lost identities, promoting existing and new public spaces, increasing public park areas, and managing gentrification trends. Each objective warrants comprehensive analysis and is often intertwined with others in practical scenarios (Jukić, 2016).

One of the undesired effects of brownfield regeneration, especially those on attractive locations near city centers, can be gentrification and loss of the spirit of place. It occurs, for example, when planning exclusive housing as a new use at the expense of

affordable housing (Cizler, 2012). However, European experiences show that the phenomenon of gentrification is possible even in successful examples of brownfield regeneration through so-called soft methods such as temporary use. In any case, a participatory approach and inclusion of all stakeholders in the earliest stage of project conceptualization reduces the possibility or extent of its occurrence (Matković and Jakovčić, 2019b).

Gentrification primarily manifests in the housing segment because it directly affects changes in the structure of residents. Gentrification as a process was considered mainly related to real estate markets of developed countries and their leading cities, but today it takes on a global form and becomes an urban strategy that transcends liberal urban policy and characteristics of sporadicity and locality. Smith considers that gentrification is a fundamental feature of new urbanism characteristic not only of Europe and North America but increasingly of post-socialist countries as well, where the term "post-socialist gentrification" is used to describe special processes characteristic of the transformation of that society (Smith, 2002).

Successful brownfield regeneration requires systematically gathering and organizing data on the spatial distribution and characteristics of brownfield sites, including past land use and geological features, ideally using GIS technologies. The quality of the process depends on incorporating geographical context and urban structure factors, legislative clarity, public-private collaboration, and stakeholders' capacity to implement urban regeneration initiatives (Matković and Jakovčić, 2019a).

2.3.1 Urban Brownfield Regeneration, Presence in Scientific Literature

According to the SCOPUS (Elsevier, 2026b) scientific database, there has been a clear overall increase in articles on urban brownfield regeneration. The first article was published in 1999. The number exceeded 10 per year in 2006 but fluctuated until the 2020s, when the total number of articles per year did not drop below 20. The total number of publications found is 339. The most active countries are the United Kingdom, with 82 published scientific articles; Italy, with 42; and the Czech Republic,

with 33. China, Switzerland, and the United States have each published over 20 articles in total.

2.4 Brownfield Regeneration Examples

Examples of Brownfield regeneration are selected based on their historical significance and other forms of recognition, including official heritage listing, awards, scholarly attention, or grey literature presence. Where these factors are absent, cases are chosen that are internationally renowned, popular tourist destinations and attractive, intensively used spaces. Brownfield regeneration examples data summary with aerial photos of the actual and early 21st century state (sourced from (Google, 2026a)) is presented in Table 3.

2.4.1 Gas Works Site, Seattle, USA

Gas Works site in Seattle, USA pioneered brownfield regeneration in the 1970s by transforming a 19-hectare coal gasification plant, operational from 1905 until 1956 and heavily contaminated, into an innovative adaptive reuse landscape that preserved industrial relics rather than erasing them through total demolition. Landscape architect Richard Haag's seminal design used bioremediation, planted native species for long-term phytostabilization, and repurposed gasholders and cracking towers as monumental follies, creating a 7.5-hectare public realm blending post-industrial sublime aesthetics with picnicking lawns, kite hills, and sundials powered by gasification residue. This minimal-disturbance method reduced remediation costs by 40-50% in comparison to full excavation, while establishing visual heritage as a value driver, influencing EPA's early brownfield pilots nationwide (City of Seattle, 2025). The Park is a City of Seattle Landmark (1999) (The City of Seattle Landmarks Preservation Board, 1999). It is listed in the National Register of Historic Places (2013) (Sawyer, 2020),(National Park Service, 2013).

2.4.2 22@Barcelona, Barcelona, Spain

The 22@ district transformed Poblenou from Barcelona's declining manufacturing heartland into a model for creative economy development. Emerging as an industrial center in 1850, the neighborhood suffered severe decline after logistics and transport displaced manufacturing in the late 1960s. The 2000 initiative targeted transformation by 2020 into a region of excellence anchored in information technology, multimedia, energy, biotechnology, and design sectors. Within twenty years, more than 4000 businesses established operations generating over 45.000 jobs and more than €2.500 billion in gross added value. Green infrastructure including bike lanes, car-sharing, and solar panels reduced emissions, while preservation of industrial structures maintained authentic character. In recent times, the demolition of old buildings raised concerns about cultural identity and local character. Balancing redevelopment with heritage preservation is claimed essential for maintaining the district's historical charm and cultural vitality (Escalé, 2023).

2.4.3 King's Cross Redevelopment, London, UK

King's Cross represents one of Europe's largest regeneration projects, transforming 27 hectares of brownfield surrounding the Grade I listed 1852 railway station into 750.000 m^2 of mixed-use development. It renovated 20 historic buildings and built 50 new ones, with programs including offices, shops, restaurants, galleries and bars, as well as leisure and educational uses with two schools and a university. The almost €631.500 million redevelopment maintained continuous rail operations while constructing Europe's largest single-span roof structure rising twenty meters and spanning 150 meters.

Heritage conservation shaped every design decision. The architectural team utilized federated 3D modeling merging heritage survey data with infrastructure requirements, enabling precise coordination between historical and contemporary elements while incorporating photovoltaic arrays. This collaborative approach became foundational to avoiding mainline service cancellations (Urban Land Institute, 2024; AEC Magazine, 2020; Adelfio et al., 2020).

2.4.4 Battersea Power Station, London, UK

The £9 billion Battersea regeneration transforms 17 hectares into 750.000 m^2 of mixed-use development comprising apartments, retail, offices, and 7,7 hectares of public parkland. The first phase, Circus West Village (completed in 2017), houses 800 residents alongside cultural facilities and entertainment venues, with the Thames Clipper jetty establishing a water-based transport landmark. Innovative precast construction techniques accelerated development on the constrained site placed between the Thames, the power station, and active railway lines. Double-skin façades called "wintergardens" required sophisticated condensation risk assessment through thermal modeling. Flood risk mitigation unlocked development potential through technical innovation rather than defensive barriers (Buro Happold, 2026).

2.4.5 Emscher Park, Ruhr Region, Germany

Emscher Park represents Europe's most comprehensive regional brownfield transformation, moving beyond single-site remediation to systemic landscape renewal across 800 square kilometres of post-industrial territory. Beginning in 1989, the International Building Exhibition (IBA) Emscher Park initiated 117 integrated projects addressing industrial site closure, contamination, and social fragmentation. The Emscher Landscape Park functioned as a regional "green connector," linking seventeen towns through coherent infrastructure that expanded existing greenbelts into comprehensive regional networks. Cultural repurpose has transformed industrial monuments into destinations: Zeche Zollverein became a cultural hub featuring museums, exhibitions, concerts, and theatre attracting over one million annual visitors. Once the world's most polluted industrial region, Emscher Park now hosts thriving green infrastructure and recreational networks across the entire region (Brighton;, 2026; Federal Institute for Research on Building; Lusso, 2013; Support;, 2026).

2.4.6 Fives Cail, Lille, France

The TAST'in FIVES project demonstrates how food systems catalyze urban regeneration in deprived neighborhoods. Located in Lille's working-class Fives district with 30% poverty rates, the 35-hectare brownfield required integrated economic and

social intervention. The innovative approach introduced productive food-related activities including a community kitchen, professional kitchen incubator, and urban farming within a renovated 2,050 square-meter industrial hall. The temporary experimental site operated with 350 events attracting 6,900 participants, while a summer food court drew 58,000 visitors, demonstrating significant place-making potential. However, tensions emerged between commercial success and social inclusion: despite affordable pricing, most food products remained unaffordable for residents, and marketing strategies targeted affluent consumers rather than underserved communities. This revealed how commercial success can diverge from equity objectives (Houk, 2019).

2.4.7 Trento Brownfield, Trento, Italy

The Trento brownfield illustrates how ecosystem service assessment informs ecological planning, prioritizing green infrastructure delivering multiple environmental and social benefits. Rather than conventional density-focused redevelopment, planners mapped cooling effects from urban green infrastructure, recreation opportunities, and carbon storage capacity to prioritize interventions at landscape scale. This ecosystem service approach recognized that different brownfield locations offer distinct ecological opportunities depending on surrounding urban conditions. By spatially clustering priorities, planning strategies allocated limited resources toward maximum environmental-social impact rather than treating each site in isolation. The 13 urban redevelopment sites range in size from 0.5 to 9.9 ha and cover a total area of 44 ha. This represented a shift from contamination-focused management toward ecological asset framing aligned with nature-based solutions (Cortinovis and Geneletti, 2018).

2.4.8 Arsenal Brownfield, Cluj-Napoca, Romania

The Arsenal Brownfield represents Romania's largest urban reconversion initiative, transforming the 13-hectare Carbochim industrial platform into integrated mixed-use community. The former factory, which utilized only 30% of its land for manufacturing, became available for comprehensive regeneration following relocation and upgrading

of operations. The €500+ million private investments established a destination integrating 115,000 square meters of retail, cultural facilities, office spaces, 52,000 square meters of landscaped green space, and 4,800 parking spaces. Heritage conservation proved central: two monumental buildings—the 1949-1952 brick Carbochim administrative building and the arcade hall—were preserved and converted into cultural venues. Infrastructure investment introduced ecological connectivity into urban fabric: a new four-lane bridge with sidewalks and bicycle lanes crossed the Someș River, complemented by 3,200 meters of bicycle infrastructure and connections with the Feroviarilor green corridor. A record €400 million green loan is financing the ongoing project, targeting highest sustainability standards (Atterbury Europe, 2025; Romania Insider & Across Magazine, 2022).

2.4.9 Espenhain Coal Site, Leipzig, Germany

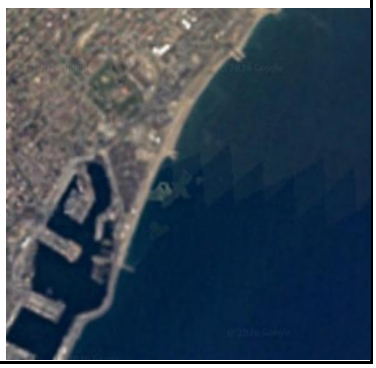
The Espenhain solar park exemplifies how renewable energy reclaims heavily contaminated coal mining sites. Located 30 kilometres south of Leipzig, Espenhain was a former lignite ash settling area unsuitable for conventional development. The site's southern location provided intense sun radiation—offering solar energy as alternative reuse pathway. The 5-megawatt solar power plant, comprising 33,500 modules, commenced operation in 2004. The €26.5 million development required remediation: lignite waste underwent burial under soil, creating stable substrate for solar supports preventing worker contamination exposure. The facility avoided approximately 3,700 tonnes of annual greenhouse gas emissions, directly contributing to Germany's Kyoto commitments. Eastern Germany became a renewable energy leader through similar projects, transforming exhausted mining landscapes into clean infrastructure (PATT, 2004; PowerMag, 2015).

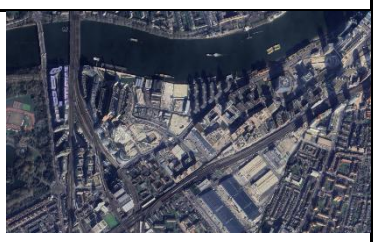
2.4.10 Zollverein, Essen, Germany

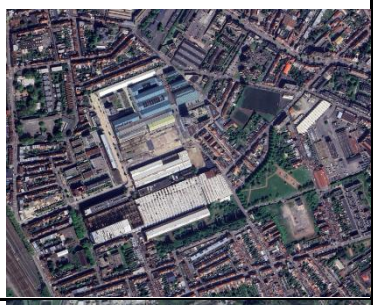
Zollverein Coal Mine Industrial Complex is considered to be Europe's most architecturally significant industrial heritage site. Founded in 1847, Zollverein mined coal continuously from 1851 until December 23, 1986. Shaft 12, opened in 1932 in New Objectivity style, emerged as the complex's iconic centerpiece—described as the

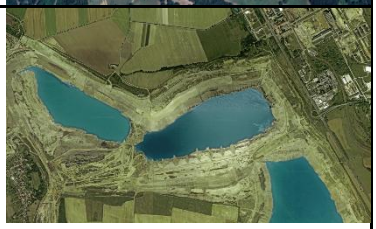
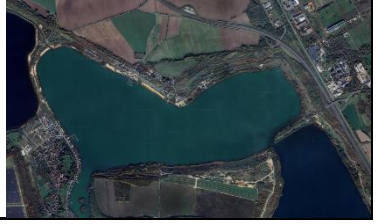
"most beautiful coal mine in the world". The site achieved UNESCO World Heritage listing on December 14, 2001, designating it as an anchor point on the European Route of Industrial Heritage. The Zollverein Foundation manages the property as cultural destination rather than industrial facility, implementing preservation of buildings, coking plants, railway lines, and miners' housing as legible landscape testimony to industrial history (UNESCO World Heritage Centre, 2018).

Table 3 Brownfield regeneration examples, M. Gudac Cvelic

Project	Location	Development Period	Key Features	Primary Drivers	Photo (actual state, early 21st century state; source: Google Earth 05.09.2025.)
Gas Works Site	Seattle, USA	1970s	industrial remnants from a former coal gasification plant, including a, now-fenced-off, former "play barn"	industrial heritage preservation, public recreation, scenic urban views	 
22@Barcelona	Barcelona, Spain	2000-ongoing	high-tech industry clustering, adaptive reuse of industrial heritage, green public spaces	economic transformation and knowledge clusters, sustainable urbanism and quality of life	 

Project	Location	Development Period	Key Features	Primary Drivers	Photo (actual state, early 21st century state; source: Google Earth 05.09.2025.)
					*low quality image (only available)
King's Cross Redevelopment	London, UK	2001-2023	public realm and open spaces, heritage restoration, mixed-use development	major transport hub, derelict industrial site regeneration, mixed-use district	 
Battersea Power Station	London, UK	2012-2022	360-degree glass chimney lift, public space and amenities	mixed-use regeneration, infrastructure investment	 

Project	Location	Development Period	Key Features	Primary Drivers	Photo (actual state, early 21st century state; source: Google Earth 05.09.2025.)
Emscher Park	Ruhr Region, Germany	1989-1999	ecological renaturation of the Emscher River, conversion of industrial slag heaps, extensive cycle network	ecological reconstruction and water management, heritage preservation (adaptive reuse), regional connectivity and quality of life	  *low quality image (only available)
Fives Cail	Lille, France	2017-2019	industrial heritage preservation, food hall, social inclusion and community focus, urban farming	economic and urban revitalization, sustainable development and eco-transition, heritage preservation	 
Trento Brownfield	Trento, Italy	1999-2010	microclimate regulation through soil de-sealing and re-greening, reducing surface temperatures, reclaiming abandoned spaces for recreation	urban reconnection and permeability, knowledge and cultural economy, environmental sustainability and "green" branding	

Project	Location	Development Period	Key Features	Primary Drivers	Photo (actual state, early 21st century state; source: Google Earth 05.09.2025.)
					
Arsenal Brownfield	Cluj-Napoca, Romania	2000-2010	military heritage transformation, open-air museum	economic diversification, urban sustainability and greening, strategic planning	 *low quality image (only available) 
Espenhain Coal Site	Leipzig, Germany	1991-2010	solar power pioneering, flooding and lake formation, environmental remediation, infrastructure for tourism	structural change, energy transition, public safety and legal mandate	 

Project	Location	Development Period	Key Features	Primary Drivers	Photo (actual state, early 21st century state; source: Google Earth 05.09.2025.)
Zollverein	Essen, Germany	2001-2010	UNESCO world heritage site, adaptive reuse of "modernist" industry, industrial forest and park, multifunctional campus	structural change, heritage preservation, Zollverein foundation	

2.5 Urban-Planning Criteria in the context of Brownfields Literature Review

Criteria found in scientific literature while researching brownfields include scientific articles and books. The criteria lists identified in the literature are presented in Tables 15-17 in Appendix 2: Urban-planning criteria. They are organized by name within their respective groups, with the source or author cited. When available, they are supplemented with an indicator, requirement, standard, or description.

Rey et al. (2022) discuss neighborhoods in transition and brownfield regeneration in European metropolitan areas. Their book introduces urban brownfields, their historical development, and their role as strategic inner-city areas requiring redevelopment. It addresses key issues of regeneration projects and sustainability at the neighborhood scale, including social, environmental, and economic dimensions. The book also presents and tests an operational monitoring and multi-criteria evaluation tool on several European case-study neighborhoods to support planners, architects, and policymakers in guiding brownfield areas toward sustainable neighborhoods. The authors establish criteria related to Context, Project, and Governance for brownfield regeneration phases. Context criteria address factors outside the site's physical boundaries. Project criteria focus on site-specific issues related to built and unbuilt areas. Governance criteria, developed to address the fourth sustainability pillar, include Management and Process sections. The authors developed lists of indicators based on literature and certification systems. These indicators assess impact, balance, quality, efficiency, management, and processes, with reference values linked to specific project phases (Rey et al., 2022). These criteria are presented in Table 17, Appendix 2: Urban-planning criteria.

Burinskiene et al. (Burinskienė et al., 2017) research brownfield redevelopment strategies in urban areas, specifically the significance of criteria contributing to decision making. They highlight six development strategies: residential, green, commercial, recreational, industrial, and reserve land. Geographic Information System (GIS) tools are used to gather spatial data and establish initial criteria. After expert evaluation of the criteria using statistical methods and the Delphi technique, conducted by the authors, they assessed their significance. The study identifies the most important

criteria for brownfield redevelopment scenarios in Vilnius, Lithuania, classified into four groups: Economic, Urbanistic, Social, and Environmental Criteria. These criteria are presented in Table 15, Appendix 2: Urban-planning criteria.

Matković and Jakovčić's (2019a) article on brownfield areas and their regeneration explores "previously used but now abandoned areas," definitions, and approaches to their reuse. The paper discusses and clarifies the concept of brownfields and highlights the inconsistent use of the term, suggesting possible classifications based on different criteria. It also analyzes success factors in brownfield redevelopment projects. The authors combine other scientific sources with their own proposed set of criteria, suggesting possible brownfield categories corresponding to each criterion. These criteria are presented in Table 16, Appendix 2: Urban-planning criteria.

2.6 Concluding Remarks on Brownfields

The term "brownfield" responds to a growing recognition of abandoned, underutilized, and contaminated urban sites that present both challenges and opportunities for sustainable urban development. The meaning of brownfield varies worldwide, and the one definition that could be considered global is the CABERNET definition (CABERNET, 2006).

Changes in political structures, political systems, industrial evolution, and urban development all contribute to the creation of brownfields. Many countries recognize brownfields, name them, and establish frameworks for brownfield regeneration, defining what the term refers to and how it is managed. Their varying definitions reflect national priorities regarding contamination severity, functional utilization capacity, and the relationship between environmental and economic considerations in brownfield characterization. They also illustrate the shift in brownfield consideration from environmental concerns toward more integrated approaches that include economic viability, social impacts, and spatial planning objectives. Some countries incorporate these decisions and processes into their legislation, create regional and national registers, and increase awareness of brownfields to regenerate real estate and attract developers. Investments can be private, public, or partnerships. The process requires great financial commitments, and according to the literature, the greatest asset of these

derelict spaces is their land. Regeneration's financing methods include selling portions of land to private investors. Some governing bodies manage the intervention directly, while others establish public or mixed entities to oversee the whole process.

The characteristics of urban brownfields depend on their specific conditions and those of the surrounding area. Various classification systems and typologies exist, most often based on the site's original or previous use. Different authors propose brownfield categories, with the number and qualitative understanding evolving over time. Rey at al.'s (2022) categorization most commonly appears in scientific literature, although it does not include landfills. The distinction between a landfill brownfield and a landfill that does not meet the definition set by relevant authorities depends on factors such as activity, pollution, and other related criteria.

The evolution of urban regeneration from post-World War II physical reconstruction to today's comprehensive, multidimensional transformation reflects a profound shift in understanding cities as living, interconnected systems. The progression from 1980s acupunctural interventions to 1990s comprehensive area-based approaches, culminating in the EU's holistic RESCUE definition of 2002, demonstrates growing recognition that successful regeneration must meet present needs without compromising those of future generations.

The orientation-conceptualization-realization framework structures successful regeneration through early stakeholder engagement, contamination assessment, and strategic planning, with long-term viability requiring active participation from landowners, investors, public administration, and communities from the outset. Brownfield regeneration demands adaptive methodologies, ranging from heritage-preserving reconstruction to complete spatial reorganization, tailored to site-specific conditions and community objectives. Scientific literature shows sustained growth since 1999, with research expanding from Western Europe to post-socialist and developing nations, confirming its universal relevance.

Urban regeneration involves economic, social, and environmental dimensions. They are integrated into the physical transformation. The RESCUE, HOMBRE, and TIMBRE projects represent European standards that require multidimensional solutions. Gentrification has evolved from a localized phenomenon into a global urban problem that affects housing markets across different countries.

The ten brownfield cases show varied regeneration approaches. They share success factors described below. Gas Works Park was the first that introduced heritage valorization, that helped in reducing remediation costs by 40–50%. 22@Barcelona and King's Cross created employment opportunities and attracted investment but provoked criticism related to heritage preservation. Emscher Park's regional approach transformed 800 square kilometers through 117 projects, converting Europe's most polluted region into green infrastructure. Zollverein demonstrates how architectural significance attracts heritage tourism, while Espenhain's solar park shows how contaminated sites can transform into renewable energy sites. TAST'in FIVES presents contradictions in commercial success that attracts a lot of visitors and products unaffordable for residents. This tension between market viability and social inclusion shows that participatory governance is not enough to achieve equity without additional affordability mechanisms. The examples show that technical innovation, heritage conservation, ecological restoration, and economic revitalization are achievable, but require continuous political commitment, capital, and protection against gentrification.

3 URBAN WATERFRONT

3.1 Definition; Concept

Urban waterfronts are defined as spaces where water meets urbanized land, creating a unique spatial interface that includes the water's edge and adjacent terrestrial areas. This zone is not only a simple linear boundary and it involves ecological, social, and economic relationships that characterize the urban-aquatic area.

Waterfronts, described as the “shimmering theatre” of the world by Meyer (1999), are complex areas because they have a lot of aspects. The character of strategic urban waterfronts is defined by their location, historical role, economic and social importance, and their multitude of functions over extended periods. Waterfronts serve as crucial components in urban adaptation to challenges such as competitiveness, social and environmental sustainability, and the preservation of historical legacies associated with former industrial, port, and other activities (Vale de Paula and Manuel Gonçalves, 2024).

The term “waterfront” can refer to lakefronts, riverfronts, harbor-fronts, beaches, and coastal zones. Its meaning varies based on the surrounding landscape and environmental conditions of a city (Cheung and Tang, 2015).

Waterfronts represent the continuity of the urban historical context, from early human settlements through their industrial character, to regenerated recreational urban destinations. They are pivotal to the reconstruction of the historical identities of cities, perceived as collective accumulations of the experiences of many generations (Petrtýlová and Matej, 2022).

3.2 History/Development

Urban waterfronts that are going through a transformation represent a significant aspect of contemporary urban development, reflecting changes in economic structures, technological capabilities, and social values.

The relationship between cities and their waterfronts has changed over recent decades. Until the second half of the 20th century, coastal areas primarily served utilitarian functions, such as transit infrastructure, energy generation, and waste disposal (Davidson, 2009). These uses shaped urban landscapes that were designed to maximize the exploitation of resources related to water. They had a port-industrial character that defined coastal cities. Industrial waterfronts included port facilities, cargo-handling docks, piers and wharves connected to the coast, basins for cargo operations and vessel maneuvering, buildings serving as warehouses or storage, shipyards, and facilities for production. Those elements were usually organized in a sectoral manner that separated urban spaces from industrial zones they served (Vale de Paula and Manuel Gonçalves, 2024).

Since the late 1960s, the decline of port and industrial activities has shifted waterfront usage, marking the separation that Schubert (2010) identifies as the beginning of a spatial and functional decoupling between ports and city centers. Driven by global economic restructuring and technological innovations in shipping and cargo handling, this shift created opportunities for cities to compete for development on a global scale. Advances in logistics and containerized cargo have influenced operating activities, leading to the relocation of harbor functions (Löbe, 1979; Witthöft, 2000, in Schubert, 2010). Schubert (2010) coined the phrase "from ships to chips" to describe the waterfront transition reflecting the economic shift from goods movement to information processing. Water-adjacent urban areas with former port, industrial, or related land uses have been redeveloped after abandonment into examples of postindustrial urbanism (Davidson, 2009). Traditional forms of coastal space resources have evolved, providing new prospects and challenges for planners and stakeholders.

Waterfront urbanization has created a sharp division between densely populated coastal areas and those with lower population density. Highly urbanized zones experience substantial activity concentration (Pan et al., 2016; Bertolo et al., 2012; Vallega, 2001, in Papatheochari Theodora, 2019) and serve as major attractors and development anchors. They integrate tourism, fishing, transport, industry, and natural resources with sensitive ecosystems (Barragán and de Andrés, 2015, in Papatheochari Theodora, 2019). While urban centers share similarities, coastal cities

are distinguished by the interaction between land and sea activities (Papatheochari Theodora, 2019).

3.3 Waterfront Regeneration (Brownfield)

Brownfield waterfronts are previously developed industrial or port areas that have become underutilized or abandoned. They often require remediation before future use. Non-brownfield waterfronts include natural shorelines, active port areas, or developed urban waterfronts that maintain their original use. These are approached differently based on their characteristics and challenges.

A substantial portion of major port cities considered and planned waterfront redevelopment during the 1970s and 1980s, since port facilities became redundant and presented the opportunity of revitalizing and expanding city centers onto areas that already possessed their sense of place along with recreational possibilities (Gordon, 1999; Hoyle, 2000). Many cities regenerated their brownfield waterfronts, creating commercial, residential, and recreational areas (Xie and Gu, 2015). Worn out industrial structures on waterfronts became environments suitable for cities' rebranding through spatial interventions (Doorne, 1998; Hutton, 2009), as cited in (Xie and Gu, 2015).

Urban regeneration has become a focus of urban-planning in various cities, driven either by the need to recover degraded areas or as an alternative to the consumption of new land (Vale de Paula and Manuel Gonçalves, 2024). The rebranding of urban waterfronts has achieved its success and reached new levels of commercialization through the creation of themed landscapes, becoming a global trend. Major examples include Docklands in London, the Baltimore waterfront in the United States, Tokyo Waterfront City (TokyoOdaiba) in Japan, and riverfront development in Singapore (Robert Wood, 1999; Vallega, 2001; M. Murayama, 2006; Xie and Gu, 2015). Preceding projects in Baltimore, Boston, and Toronto were influential around the world, although when their models were replicated in other countries the results weren't considered successful (Gordon, 1999; Ute Lehrer and Laidley, 2008; Jajamovich et al., 2025).

Contemporary waterfront regeneration includes diverse planning approaches and project types. Planning is a prominent topic in the literature, with urban waterfront regeneration associated with different scales and types of planning, from metropolitan planning (Oakley, 2021) to local planning (Thorning, 2019), with emphasis on integrated plans (Theodora and Spanogianni, 2022) and event planning as a catalyst for waterfront regeneration (Pinto; and Santos, 2022), as cited in (Vale de Paula and Manuel Gonçalves, 2024).

Project typologies addressed in the literature reveal great diversity: mega event projects (Jones and Ponzini, 2021), contemporary mega projects (Perić, 2022), industrial areas and brownfield projects (Leger, 2016), sustainable city projects (S. Shamsuddin et al., 2012), projects related to cultural and naval heritage (Clark, 1999), business district projects (Furlan et al., 2019), creative district projects (Sepe, 2013), and projects related to informal areas (Attia and Ibrahim, 2018), as cited in (Vale de Paula and Manuel Gonçalves, 2024). Each typology presents specific characteristics tied to the context of waterfront regeneration initiatives.

Research on waterfront regeneration includes multiple dimensions, such as “changing political-economic frameworks, urban revitalization, planning and design, spatial and land-use transformation in waterfront districts, the role of history and heritage in regeneration, and ecological and environmental issues concerning waterfronts” (Gordon, 1999; McCarthy, 2004; Aiesha and Evans, 2006; Xie and Gu, 2015).

Today’s waterfront brownfields often exhibit a separation of urban, harbor, and industrial areas, extending beyond original city limits into metropolitan regions due to urban sprawl (Vale de Paula and Manuel Gonçalves, 2024). Their conversion is a slow and complex process that requires spatial reorganization and penetration points insertion, to create public spaces related to diverse stakeholders of the metropolitan region (Tiano, 2010; Lotz-Coll, 2018), as cited in .

Waterfront regeneration initiatives often present conflicts and tensions. Lino (Lino, 2016), as cited in (Papatheochari and Coccossis, 2019), identifies three primary types of conflict that typically emerge on waterfronts: Port-City Conflicts, Public Space Conflicts, and Planning Framework Conflicts. Tensions between port operations and urban functions are reflected in competing spatial and functional demands. Competition between demands for the use of public space on land versus at sea

highlights the needs and desires for waterfront resources whose identity is not easy to define. Sectoral planning is not always aligned with spatial planning, demonstrating discrepancies between procedural and institutional processes (Lino, 2016), as cited in (Papatheochari and Coccossis, 2019).

Waterfront sites generally face multiple challenges, including “jurisdictional conflicts, environmental constraints, poor local infrastructure, and political disputes over public access, parks, social housing, and economic development” (Gordon, 1999).

Beyond these spatial and jurisdictional conflicts, Lino (Lino, 2016) proposes a framework for understanding relationships among regeneration actions, identifying three distinct types: Type 1: Conflict Relationships, which involve direct conflicts from differing goals and actions related to regeneration. Conflicts appear in social, economic, production, environmental, and public-private interests. Type 2: Separation Relationships, which represent dysfunction in decision-making due to planning instruments ignoring reciprocal choices. Type 3: Complementarity Relationships, which present a positive scenario where actions complement each other despite differing visions and goals (Lino, 2016).

Given the complexity of waterfront regeneration and the multiple conflicts and challenges involved, guiding principles become essential. Krieger (Krieger, 2004) articulates ten principles designed to maximize opportunities offered by the water’s urban edge and ensure success in new development, presented in Table 4 Principles for Successful Waterfront Development.

Table 4 Principles for Successful Waterfront Development (Krieger, 2004), adapted by M. Gudac Cvelic

Thematic Dimension	Principle	*Title*	Description / Key Idea
Temporal and Cultural Dimensions	1	*Recurring Transformation*	Urban waterfront transformation recurs throughout a city’s life, often triggered by major economic or cultural shifts that lead to competing urban visions.
	2	*Enduring Aura*	The city’s aura resides largely along its waterfront, allowing transformation while retaining essential character and sense of place.
	3	*Inherent Stability*	Despite change, the waterfront maintains inherent stability through the enduring

Thematic Dimension	Principle	*Title*	Description / Key Idea
			water–land interface that provides continuity.
Balancing Preservation and Innovation	4	*Preservation versus Reinvention*	Successful waterfront projects balance the desire to preserve heritage with the need to reinvent and adapt to contemporary demands.
Spatial Conceptualization	5	*Beyond the Thin Line*	The waterfront should not be treated as a simple boundary but as a rich, layered zone requiring design responses to its transitional nature.
Temporal and Economic Perspectives	6	*Long-term Value*	Redevelopment should prioritize sustainable, long-term value over short-term profit; enduring projects yield better outcomes.
Functional Mix and Vitality	7	*Living, Not Just Visiting*	Revitalized waterfronts thrive when they support residential and everyday uses, fostering vibrant and sustainable communities.
Public Access and Democratic Space	8	*Public Access to the Water's Edge*	Ensuring public access often means overcoming historical barriers and protecting the waterfront as a shared, democratic space.
Environmental Integration	9	*Land–Water Interrelationship*	The success of waterfront development depends on the balanced relationship between land and water uses and on environmental quality.
Urban Identity and Competitiveness	10	*Distinctive Physical Environments*	The distinctive spatial qualities of a waterfront can counteract the homogenizing effects of modern development, giving the city a stronger identity and competitive edge within its region or against rival cities.

Governance and Implementation Challenges

Waterfront regeneration presents complex governance and implementation challenges. Specialized redevelopment authorities often manage and coordinate these projects, but many developments still avoid traditional planning methods (Gordon, 1999). Planning agencies must manage three critical areas simultaneously: politics, finance, and urban design (Gordon, 1999), while collaborating across multiple

jurisdictions, sectors, and scales (Paula and Gonçalves, 2024). Local communities require a holistic and integrated approach to waterfront development (Papatheochari and Coccossis, 2019). Port cities worldwide face challenges in redeveloping urban waterfronts as they pursue economic growth, place enhancement, and tourism (Xie and Gu, 2015).

3.3.1 Urban Waterfront Regeneration, Presence in Scientific Literature

According to the SCOPUS (Elsevier, 2026d) scientific database, there has been an increase in articles on urban waterfront regeneration. The first four were published in 1989; the number exceeded 10 per year in 2012 and surpassed 20 per year starting in 2021. The total number of publications found is 336. The most active countries are the United Kingdom, with 73 published scientific articles; Italy, with 46; and China, with 31. Australia, Portugal, the United States, Spain, the Netherlands, and Malaysia have each published more than 10 articles.

3.4 Waterfront Development Strategies

Waterfront development strategies are developed at multiple scales and use various planning instruments, ranging from city regulatory documents to master plans. Successful transformation requires coordination across planning levels, as well as integration of policy objectives, spatial design, and implementation mechanisms. This section examines three strategic approaches. Urban-planning documents establish the regulatory framework and guidelines that must be followed during the design process. City development strategies coordinate transformation within broader municipal objectives, encompassing goals at multiple levels. Master plans are detailed documents that translate strategic visions into concrete spatial design solutions.

3.4.1 Urban-Planning Documents

Urban-planning is a profession that plans, regulates, and manages space and resources within its boundaries, considering for economic, social, and environmental significance (Milad Haghani et al., 2023). It is a multidisciplinary technical profession whose goal is to plan or preserve the quality of urban space. Urban-planning practice includes physical surveys, design, mapping, and infrastructure engineering (Frenchman, 2017; Taylor, 1998; in Milad Haghani et al., 2023). Taylor (1998) points out that the foundational generation of urban-planning consisted of "master" plans or "blueprints," which illustrated land use, urban morphology, and their spatial arrangements. Frenchman (2017) stated that the evolution of urban-planning in the United States emerged from surveying engineering and real estate development practices, integrated with civil engineering addressing challenges related to transportation and other infrastructural advancements. The discipline includes landscape planning and the interrelations among social, economic, political, and environmental dimensions within urban-planning science. In the past fifty years, the urban-planning domain has progressively advanced toward themes of resilience, smart city initiatives, and the incorporation of urban green spaces (Milad Haghani et al., 2023). Urban-planning intersects various disciplines beyond theory and research, highlighting its historical roots in the arts and crafts of architecture, as well as the significance of applied sciences and evolving specializations such as cybernetics, decision theory, geography, and social sciences, which collectively enhance its role in addressing spatial conflicts through effective communication and mediation (Huxley, 2009).

Urban-planning documents provide regulation and policy for spatial development. They include zoning, design guidelines and restrictions, as well as environmental protection measures in written and graphic form.

3.4.2 City Development Strategies

City-level development strategies coordinate waterfront transformation with broader urban development objectives, integrating economic, social, and environmental goals across municipal systems. These strategies often arise from major catalytic events,

economic restructuring pressures, or recognition of waterfront areas as strategic assets for urban competitiveness. Successful city development strategies establish clear visions, governance structures, and implementation mechanisms that ensure continuity across political cycles and economic fluctuations (Evans et al., 2025; The World Bank, 2018; Davidson, 2009).

3.4.2.1 New York City Comprehensive Waterfront Plan

New York City's Comprehensive Waterfront Plan (NYCCWP) addresses the complexity of governance structures across multiple jurisdictions, establishing coordination mechanisms among city, state, and federal agencies that share regulatory authority over waterfront areas (NYC - Department of City Planning, 2020). The document emphasizes multi-jurisdictional oversight, waterfront-specific zoning codes, and environmental regulatory processes that reflect the unique conditions of coastal development (Marrella et al., 2021). The New York City Comprehensive Waterfront Plan, published in 2021, includes a ten-year plan to realize a vision based on the principles of Equality, Resilience, and Health. Equality is reflected in a coastal area accessible to all residents and visitors, whether through living in affordable housing, working in well-paid positions, or enjoying safe, clean, comfortable, and nature-related public spaces. Surrounding neighborhoods that are physically unable to access the water are to be provided with connectors of various types for pedestrians, people with disabilities, cyclists, and others. Achieving a resilient waterfront means implementing physical and psychological strategies to address the effects of climate change, such as coastal storms, high tide flooding, intense precipitation, and extreme heat, impacting both people and the environment. Creating or maintaining salt marshes, riprap formations, natural vegetation areas, and bioswales make the coastal area more resilient. Introducing passive impermeable barriers in the ground around buildings, structurally reinforcing building cores, elevating primary living and working spaces above ground level, and using wetland plantings, porous paving, and structural soil help protect built structures from flooding and improve quality of life in the floodplain. The Health principle is respected by encouraging physical activity along the waterfront, which has also been cleaned of pre-existing conditions from former industrial areas. The Covid-19 pandemic in 2020 demonstrated how access to open space and fresh

air supported mental health, as the coastline also served as an anchor for the USNS Comfort hospital ship and was crucial for maintaining the supply chain when other routes were cut (Marrella et al., 2021).

The first of three NYCCWPs was published in 1992 to encourage collective thinking about New York City's waterfront and to create a vision for the next decade and beyond. The second followed in 2010 (Waterfront Alliance Staff, 2022). The latest and third NYCCWP was published thirty years after the first, during which parts of the city's waterfront have been redeveloped for housing, commercial, and public space. These achievements shaped future planning, demonstrating a successful, livable waterfront and incorporating direct community experience. The document's six sections are organized by topic and are all equally interdependent: Climate Resiliency and Adaptation, Waterfront Public Access, Economic Opportunity, Water Quality and Natural Resources, Ferries, and Governance. The fact that Ferries has its own chapter highlights the importance of water-based public transport, whose evolution is strongly supported (Marrella et al., 2021).

The plan aims to adapt flood structures to make the space climate-resistant and sustainable while serving community needs and using natural elements wherever possible. Infrastructure improvements have led to fewer power and water outages during or after natural disasters. Green infrastructure reduces the urban heat island effect. Extensive information is provided to residents about dangers and actions to take during floods or heat waves. Valuable locations of degraded flora and fauna are restored and expanded. The use of renewable energy sources is supported. The coastal area, with a total length of 836 km, is approached comprehensively and through multidisciplinary methods. The principles mentioned above are legally integrated into design rules, and expedited approval of administrative processes for design and construction is encouraged (Marrella et al., 2021).

3.4.2.2 The City of London Riverside Strategy

The Thames Estuary 2100 (TE2100) Plan focuses on mitigating tidal flood risks, thereby enhancing safety for people and property. Its goal is to ensure high functionality of essential services such as schools, healthcare facilities, and transportation infrastructure. As sea levels rise, the need to reshape riverbanks

presents an opportunity to incorporate additional socio-economic and environmental features. These include recreational spaces, improved public health through increased green areas, and the creation of wildlife habitats. The plan implements natural carbon sequestration and preserves historical landmarks. The Environment Agency and its partners collaborate to achieve these objectives, which are central to the TE2100 framework. The City of London Riverside Strategy (2024), first published in 2021, integrates flood defense enhancements with public space improvements, community involvement, and alignment with local planning regulations (Department for Environment, 2023).

The City of London Corporation implements the Riverside Strategy using a structured approach designed to balance long-term flood resilience and the short-term demands of urban development. The timeframe is divided into three stages—2021–2034, 2035–2050, and post-2050—which is aligned with the Environment Agency's Thames Estuary 2100 Plan. By segmenting requirements, the City aims to make sure that infrastructure investment remains proportional to the evolving threats of sea-level rise and climate change (City of London, 2024).

The primary implementation model integrates flood defense upgrades directly into the planning process for riverside properties. During Stage 1 (present to 2034) developers are required to submit technical assessments demonstrating how their sites can accommodate future height increases. They are encouraged to raise defenses to the 2100 target level to avoid future retrofitting, but the minimum requirement is to ensure current safety while protecting the "footprint" for future elevation. In Stage 2 (2035–2050), the requirements become stricter. Major new developments must physically raise defenses to at least the 2050 statutory level and provide an engineering solution that reaches the 2100 height (City of London, 2024).

Additional to developmental, cyclical replacement and maintenance protocols are in place. Since many sections of the river wall are privately owned or historic, the City enforces a feasibility study for defense raising for any major repair or structural replacement. This "opportunistic engineering" ensures that when a wall is already under construction, it is upgraded to modern standards, reducing the long-term cost and disruption of separate, dedicated flood works (City of London, 2024).

For Thames river portions where individual upgrades are not practical, the City uses a major works approach. This involves coordinated planning with the Environment Agency and neighboring London boroughs to implement solutions that maintain the continuity of the flood barrier and the Thames Path for the whole area. The mechanism for direct intervention serves as a safeguard; if a section of the defense has not been upgraded through development or maintenance ten years prior to a statutory deadline– for instance, by 2040 for the 2050 milestone– the City Corporation will use its authority to make sure the owners meet their legal obligations, which prevents weak links in the Square Mile's tidal protection (City of London, 2024).

3.4.2.3 San Francisco Waterfront Land Use Plan

The Port of San Francisco's Waterfront Land Use Plan serves as a comprehensive framework for managing and developing the city's 12 km waterfront, starting from Fisherman's Wharf and ending at India Basin. The Waterfront Plan Advisory Board conducted a six-year planning process that included public participation, resulting in the creation of this document. It is designed to address the interests of diverse stakeholders, including citizens, developers, and maritime operators, by outlining the Port's vision and objectives. The Plan is organized into five chapters that provide historical context, strategic goals, land use policies, subarea development plans, and implementation processes. The document aims to facilitate informed decision-making while ensuring the sustainable integration of public access and maritime activities along the waterfront (Cook et al., 2009).

The goals of the Waterfront Land Use Plan are: "a working waterfront; a revitalized port; a diversity of activities and people; access to and along the waterfront; an evolving waterfront, mindful of its past and future; urban design worthy of the waterfront setting; and economic access that reflects the diversity of San Francisco" (Cook et al., 2009). Waterfront Land Use Plan is a framework that serves for development of the San Francisco waterfront. Waterfront Plan's implementation is planned through two main avenues. First, the policies and objectives outlined in the Plan should be integrated in regulatory framework that governs land use using legislation. Second, enhancements to the waterfront, when aligned with the Plan, should be realized through a site-specific development methodology (Cook et al., 2009).

3.4.2.4 Toronto Waterfront Revitalization Initiative, Waterfront Toronto Rolling Five-Year Strategic Plan

Toronto's waterfront revitalization strategy is North America's largest urban redevelopment project, covering 800 hectares of brownfield land along Lake Ontario. The initiative involves strategic planning that addresses environmental remediation, flood protection, affordable housing development, and economic revitalization through integrated governance structures (Waterfront Toronto, 2025).

The Waterfront Secretariat, part of the City Planning division, leads the Waterfront Revitalization Initiative on behalf of the City of Toronto. Secretariat staff collaborate with their partners and Waterfront Toronto, as well as other stakeholders, to ensure quality and inclusive cooperation among all parties. Waterfront Toronto is a public-public partnership corporation established in 2001 (Waterfront Toronto, 2025).

Waterfront Toronto’s initiative focuses on developing parks, community amenities, affordable living spaces, innovative solutions, and reestablishing the connection between people and the waterfront through extensive revitalization projects, new infrastructure, ecological restoration, and designs that prioritize community engagement. The main goals include creating green communities, improving public transit and economic vitality, and providing public amenities (Waterfront Toronto, 2022).

The Human-Centric goal is to reconnect Toronto residents with the waterfront by prioritizing parks, public spaces, and universal accessibility. The Innovation & Sustainability goal involves using advanced design principles, environmentally conscious building practices, intelligent technology, and climate-resilient strategies such as flood mitigation. The Equitable Development goal focuses on facilitating affordable housing, fostering economic opportunities, and ensuring that developments benefit all stakeholders. The Design Superiority goal aims to create a globally recognized destination with distinctive features (Waterfront Toronto, 2025).

Waterfront Toronto’s principal initiatives and projects include revitalizing neighborhoods into sustainable, mixed-use districts with ambitious affordable housing targets, establishing new or restored naturalized habitats, and constructing essential infrastructure such as transportation networks, sewage systems, and flood defenses

to support new developments and enhance waterfront accessibility (Waterfront Toronto, 2022).

3.4.3 Masterplan

Master plan, as defined by Merriam-Webster (2025), is “a plan providing overall guidance.” The Cambridge Dictionary (2025) describes it as “an organized set of decisions made by one person or a team of people about how to do something in the future.” The concepts of master plan and strategic plan are frequently used synonymously. The strategic plan is sometimes interpreted as “the response to the inquiry ‘where do we aspire to go?’ while a master plan serves as the framework illustrating the pathway to reach that destination” (Losonczy, 2025). These perspectives contrast with one another. The UK Department for Transport (2008) and Notteboom (2022) suggest that a port master plan encompasses a timeline of 20 to 30 years. A master plan is distinct from a business plan, which is defined as “the document that summarizes and communicates the main results of the analyses and evaluations carried out before launching a new business” (Masciocchi, 2020). It can be inferred that a master plan originates from a long-term vision and informs shorter-term decision-making, while a business plan typically comprises a collection of projects. In the absence of a universally accepted definition, the term strategic plan is frequently applied interchangeably to either of the two.

Successful waterfront planning integrates gray, green, and blue infrastructure, with master plans explicitly specifying the physical infrastructure systems that enable waterfront functions (Samant and Brears, 2017). Waterfront master plans consider continuous infrastructural systems, treating the waterfront as socio-ecological infrastructure, thereby embedding infrastructure planning in the master plan framework (Frigerio, 2018).

There are three cities that, in at least one of their waterfront transformations, adopted a master plan as a guiding document. Baltimore is one of the earliest examples of a systematic waterfront intervention worldwide. Rotterdam represents a pioneering case of integrating sustainability principles into mixed-use district development. Barcelona

exemplifies one of the most successful waterfront regenerations initiated by the Olympic Games. A brief comparative overview of their main characteristics is presented.

3.4.3.1 Baltimore

The Baltimore Inner Harbor evolved through an entrepreneurial, phased master plan spanning the Inner Harbor plan (1967–2005), building on Charles Center precedents and using public-private investments to create a tourist- and culture-oriented waterfront that became an international model for subsequent projects (del Rio, 2018; Millspaugh, 2001). Baltimore focused on landmark attractions, promenades, and cultural institutions to rebrand the city and stimulate private investment, producing a consolidated leisure and commerce spine around historic harbor basins (del Rio, 2018; Millspaugh, 2001). Comparatively, Baltimore served as an early catalytic prototype that influenced European practice but relied on a market-led aesthetic boosterism (Millspaugh, 2001; Magrinyà Torner et al., 2014).

3.4.3.2 Rotterdam

Rotterdam's Kop van Zuid was framed as a municipally steered urban regeneration project, converting derelict port lands into a mixed-use district intended to reconnect north and south Rotterdam and deliver both social and economic returns, implemented across multiple phases from late twentieth-century regeneration agendas into the 2000s (Köksüz and Baz, 2019; Doucet et al., 2011b). Kop van Zuid emphasized mixed housing, offices, cultural buildings, and improved transport links to physically and socially bridge the river divide, although gentrification pressures were acknowledged and moderated by municipal social objectives (Köksüz and Baz, 2019; Doucet et al., 2011b). Rotterdam shows that municipal leadership can embed social aims into flagship redevelopment, though unequal benefits remain contested (Köksüz and Baz, 2019; Doucet et al., 2011b).

3.4.3.3 Barcelona

Barcelona's waterfront, catalyzed by the 1992 Olympic program, underwent continuous transformation from the 1980s through the early 2010s via strategic plans and participatory workshops that reclaimed port edges for public space, tourism, and

city-port integration, while producing contested claims over uses and benefits (Jauhiainen, 1995; Pinto; and Santos, 2022). Barcelona prioritized shoreline opening, new public realms, and legacy infrastructure from the Olympics, achieving new centralities and enhanced public access but generating debates about appropriation and long-term governance (Jauhiainen, 1995; Pinto; and Santos, 2022). Barcelona demonstrates how mega-event-driven planning can accelerate waterfront reintegration, yet requires sustained participatory governance to reconcile competing economic and social claims (Jauhiainen, 1995; Pinto; and Santos, 2022).

3.5 Waterfront Transformation Examples

The transformation of brownfield waterfront zones into attractive, accessible urban areas is one of the most challenging trends in contemporary urban-planning. After deindustrialization and port containerization in the mid-twentieth century, cities worldwide faced the task of repurposing abandoned waterfront land. These brownfield sites, once engines of urban prosperity, became barriers separating cities from their maritime heritage. The ten regeneration projects analyzed in this text illustrate various approaches to reconnecting urban populations with waterfront spaces. Each case provides insight into adaptive reuse, public-private partnerships, and the creation of mixed-use urban environments that serve multiple stakeholder interests.

Waterfront transformation examples data summary with aerial photos of the actual and early 21st century state (sourced from (Google, 2026a)) is presented in Table 5.

3.5.1 Rheinauhafen, Cologne, Germany

The Rheinauhafen development in Cologne is Germany's most ambitious waterfront regeneration project, transforming a derelict nineteenth-century harbor into a mixed-use district that applies contemporary urban design principles. Since its opening in 1898, Rheinauhafen served as a goods transshipment site, but like many European ports, it declined as containerization shifted maritime activities to more suitable locations (Vida Maliene et al., 2012). The significance of the Rheinauhafen project extends beyond its local impact; it is especially notable given the prominence of

Hamburg and Bremen as the nation's principal ports. The site's strategic location within walking distance of Cologne's city center, stretching approximately two kilometers to the Südstadt district, made it a key element in the city's broader revitalization strategy. The development covers about 15.4 hectares of land and 5.7 hectares of water, with completion targeted for 2010 and an estimated total cost of 650 million euros (Vida Maliene et al., 2012).

The project was designed as a mix of housing, work, and culture, including 146,000 square meters of office space distributed among three iconic Cranehouses and six additional office buildings, 700 residential units, underground parking, museums, leisure, and retail units. The development was expected to create 2,500 jobs. Since regeneration began, the area has generated positive effects across cultural, commercial, and residential property sectors, validating the mixed-use approach (Vida Maliene et al., 2012).

The architectural centerpiece of Rheinauhafen– the three Cranehouses – demonstrates an innovative approach to industrial heritage preservation. The design reinterprets the historic harbor cranes as new mixed-use towers, creating iconic structures that both honor the site's maritime past and signal its contemporary transformation. This adaptive reuse approach differs from other waterfront developments that prioritized wholesale clearance, showing how industrial heritage can be reimagined as a design asset. The Rheinauhafen project illustrates how waterfront regeneration can drive broader urban renewal while maintaining connections to historical identity. The sustainability of the investment remains debatable. Rheinauhafen aims to attract multinational enterprises such as Microsoft Germany to enhance its competitiveness against major global cities like Berlin, Munich, and Frankfurt (Vida Maliene et al., 2012).

3.5.2 London Docklands, United Kingdom

The London Docklands Development is one of the biggest waterfront regeneration projects in European history. It includes an area of about twenty-two square kilometers in East London that consists of abandoned docklands. The project transforms the area into a district with prevalent business and residential use.

In the 1930s, the area's port infrastructure reached its operational peak. The Royal Docks achieved maximum economic productivity in the 1950s. In the 1960s, Greater London lost significant employment in public, commercial, infrastructure, and industrial sector. The arrival of containerization and related changes in maritime logistics influenced the docks' ultimate decline. The Port of London Authority's decision about upriver dock's redundancy was made in the late 1960s. The West India and Millwall Docks ceased their activity in 1980. The Royal Docks' closed for cargo operations by the end of 1981, when their operations were transferred to Tilbury. The disused docklands, together with 1960s United Kingdom manufacturing decline, resulted in left East London deindustrialization with poor working and living conditions (Fatma Tanis and Erkok, 2016).

The regeneration process had three phases that were initiated based on strategic decisions. It was decided to keep the dock basins, since the valuable water feature and existing maritime heritage could contribute to the site's attractiveness. Isle of Dogs was set to be the regeneration focus that could enhance East End's economic growth. Marketing actions were oriented towards different stakeholders. East London had to be connected to the center, so Docklands Light Railway (DLR) was planned as a part of infrastructure development strategy (Fatma Tanis and Erkok, 2016).

Meyer (1999) stated that the Isle of Dogs development had three important elements: spatial component including a variety of open public spaces, creation of a new city center called Canary Warf, and improved transportation connectivity achieved through interventions such as Jubilee Underground line extension. Heritage principles were strongly implemented, maintaining the water areas, docks conservation, and Wapping, Surrey, and Greenland Docks water debris removal (Al Naib, 2002 in Fatma Tanis, 2016).

London Docklands Development Corporation (LDDC), active since 1981, managed the disused and degraded area's regeneration which transformed the urban image, resulting in gentrification. Private developers bought land and financed the intervention, but local residents were displaced since the intervention was not inclusive. The London Docklands project is an example of transformation potential and the social issues that often occur in waterfront regeneration interventions where capital is prioritized (Fatma Tanis and Erkok, 2016).

3.5.3 Genoa Expo '92, Italy

The regeneration of Genoa's Porto Antico that happened because of EXPO ’92, the 1992 Columbian Exposition, represents a landmark example of event-driven waterfront transformation driven by cultural development and commercial objectives (Seassaro, 1989). Genoa was as an important node in Italian industrial development in 1850s, when maritime transport facilities and related industries made the city one of the world's most industrialized urban centers. It was considered as part of the Italy's "industrial triangle" (Bobbio, 2005).

The old port's decline began in the 1950s, culminating in 1965 with the construction of a viaduct highway that represented a physical barrier and separated the port from the old town (Jauhiainen, 1995). Modern facilities built in the 1990s increased the cargo and users’ traffic, but physical separation prevented reintegration of the city and port. The causes of decline extended beyond infrastructure: maritime activities were not enough for economic prosperity; deindustrialization eliminated the factories and fuel industry; and residential neighborhoods were impacted negatively from the port infrastructure operations (Bobbio, 2005).

Genoa's first big rehabilitation initiative revolved around Expo '92, organized to commemorate the quincentennial of Christopher Columbus's arrival in America. Primary objective of reestablishing connections between the port and the historical city center was enabled through cultural development in Porto Antico that could happen for the Expo event. Architect Renzo Piano was commissioned to develop the design that treated different areas and factors in a unified way (Fatma Tanis and Erkok, 2016).

The Expo '92 objectives included regenerating previous port functions, such as remodeling the passenger terminal (100,000 m^3) to create a port grill (6,000 m^3) and a cruising center with shopping and sports facilities (180,000 m^3); developing water-related services through the creation of a multicenter accommodating hotels, a shopping center, housing, marina, and parking (360,000 m^3), a culture and exhibition center including a marine research institute, university library, museum, and public parking (400,000 m^3); as well as expanding the service infrastructure through a specialized project (416,000 m^3) (Seassaro, 1989).

Genoa Expo '92 is an example of 1990s event-based waterfront transformation that influenced similar interventions. The project introduced mixed-use activities through museums, restaurants, and entertainment facilities, regenerating the waterfront's character and function. The project was criticized for the demolition of some historic buildings. Genoa's development is a vision of a single architect, resulting in greater design coherence but less architectural variety. The project demonstrated how major cultural events could catalyze waterfront transformation while raising questions about the balance between preservation and renewal in historic port districts (Fatma Tanis and Erkok, 2016).

3.5.4 HafenCity, Hamburg, Germany

HafenCity Hamburg is the largest inner-city development project in Europe, transforming 157 hectares of former port land into a sustainable, mixed-use urban district that exemplifies adaptable waterfront design principles. Hamburg’s urban fabric has experienced multiple transformations throughout its history, including unplanned changes from the Great Fire of 1842 and extensive World War II destruction. The most recent transformation– the functional conversion of the former port area into HafenCity – marks a planned response to the abandonment of sheds and warehouses that characterized the area in the late twentieth century (Fatma Tanis and Erkok, 2016).

HafenCity’s master plan has been revised several times to achieve optimal development outcomes, with the initial plan established in 2000 and a major revision completed in 2010. The updated plan redesigned the eastern part of the city to accommodate diverse uses across three distinct districts. The Baakenhafen neighborhood focuses on varied housing types and recreation; Oberhafen is designated as a creative and cultural district where older warehouses are adaptively reused and waterside sports facilities are provided; and the Elbbrücken neighborhood serves as the entrance, featuring taller buildings and a mix of offices, residential units, and shopping facilities (Schubert, 2015 in Fatma Tanis, 2016).

The project’s core objectives center on architectural quality and urban landscape sustainability. The master plan evolved through extensive public discussion facilitated by exhibitions and engagement events, reflecting a commitment to democratic

planning. The area's spatial pattern has been substantially transformed from the previous configuration of rectangular sheds aligned along the Elbe's fingers. The new master plan emphasizes vertical building forms that contrast with Speicherstadt's horizontal character, based on mixed-use principles that generate innovative façade designs throughout HafenCity. Numerous sub-projects have achieved ecological certifications based on concepts of flexibility, redundancy, diversity, compactness, mixed use, and perspectives of adaptation and resilience (Schubert, 2015 in Fatma Tanis, 2016).

HafenCity is the example of an adaptable waterfront design through its transformation of a former industrial port into a dynamic, mixed-use urban district highly responsive to changing needs and conditions. The development's modular phasing allows incremental growth and adaptation over time, ensuring the district can evolve in response to shifting urban demands and economic factors. The integration of residential, commercial, cultural, and recreational spaces fosters vibrancy, reduces commuting, and encourages community engagement. Sustainability and ecological considerations are integral to the design, featuring green roofs, sustainable building practices, and measures addressing rising sea levels to enhance climate change resilience (Üzümcüoğlu, 2023).

The Übersee Quarter neighborhood plays an important role, integrating contemporary development with port heritage. Before it was disused, HafenCity area was viewed from the River Elbe as the warehouse district Speicherstadt: an important element of the city's visual identity. In the modern era, Lake Alster became more prominent, with planning and building activities concentrating around it. The current HafenCity project serves to reintroduce the value of the former port area and make the previously neglected space accessible for public use, implementing social and cultural factors into building (Fatma Tanis and Erkok, 2016). Community engagement was included in the planning process. Residents and stakeholders were involved in development to make sure it implements community needs and desires. HafenCity's waterfront incorporates resilient infrastructure, including flood protection systems and elevated building designs to mitigate river flooding risks (Üzümcüoğlu, 2023).

3.5.5 Baltimore Inner Harbor, Maryland, United States of America

Baltimore's Inner Harbor regeneration represents a pioneering American example of waterfront revitalization, that established a model, replicated later across North America and within wider global context. Baltimore was a major seaport since the 1700s, but its waterfront declined after World War II with the arrival of containerization. The Inner Harbor's piers and docks became derelict. Downtown Baltimore experienced residential population decline as suburbanization process evolved (Miller, 2011).

The Inner Harbor's revitalization was intertwined with Charles Center Project, a 22-acre urban renewal initiative in Baltimore's inner city that was initiated in the late 1950s. This project established a public-private partnership model and achieved notable success. It included four large office buildings, built by 1963, and additional structures planned soon after that. The Charles Center's success provided momentum and a proven model for the more ambitious Inner Harbor transformation (Millspaugh, 2001 in Miller, 2011).

Based on the Charles Center experience, Baltimore began extensive Inner Harbor revitalization planning in 1964, when the Inner Harbor Master Plan was created. Within the next two decades, the Harbor was transformed by the development of high-profile attractions, including the World Trade Center, Baltimore Convention Center, National Aquarium, James Rouse's Harborplace festival marketplace, and the first waterfront hotel: Hyatt Regency Baltimore. At the end of 1970s the Inner Harbor was a recreational destination for Baltimore residents and a high-volume tourism attractor, which established a new economic foundation for the waterfront (Millspaugh, 2001 in Miller, 2011).

The Inner Harbor project's encouraged the revitalization of Baltimore's downtown core. By 2000, more than forty downtown projects had begun construction or were completed, demonstrating the project's effects throughout the city. The city showed its commitment to the Inner Harbor's continued enhancement by hiring a New York urban design team to create a new plan with goals such as strengthening connections between the waterfront and central business district, preserving and enhancing public spaces, creating additional gateways to the waterfront, as well as ensuring adequate traffic flow and parking options (Millspaugh, 2001 in Miller, 2011).

Baltimore's Inner Harbor model that includes festival marketplaces, mixed-use development, and great number of visitor attractions, influenced waterfront development strategies around the world throughout the 1980s and 1990s. The model was also criticized for prioritizing tourism and consumption over residential needs and social equity, questioning the balance between economic development and inclusive urbanism. The project's focus on public-private partnerships and anchor attractions established a template that subsequent projects would both endorse and critique (Miller, 2011; del Rio, 2018; P. David Bramble, 2025).

3.5.6 Kings Waterfront, Liverpool, United Kingdom

Kings Waterfront in Liverpool showcases the transformation of a long-neglected industrial site into a mixed-use destination through strategic public-private partnership. The former Kings Dock, adjacent to the Grade I listed Albert Dock, remained derelict after its closure in 1972, highlighting a contrast to Liverpool's maritime heritage. The Merseyside Development Corporation's interim solution converted the site into a car park, which operated through the late 1990s. However, this did not address the challenge of reconnecting the city with its waterfront. Covering 14.6 hectares, the site was the largest undeveloped parcel in Liverpool's city center for decades and was owned by the national regeneration agency English Partnerships (EP). Realizing the strategic vision for "an international visitor destination with world-class facilities" required coordinated investment from five public organizations and five private partners. This collaborative framework enabled the €450 million mixed-use development that would fundamentally reshape Liverpool's waterfront identity (Vida Maliene et al., 2012).

Construction began in 2005 on the 50,000 square meter site, with Kings Waterfront opening to the public in January 2008. The development program integrated large-scale leisure and conference facilities: a 10,600-seat arena (Echo Arena), a 3,600 square meter multi-purpose hall, and a 1,350-seat conference auditorium with associated breakout rooms. Supporting infrastructure included a 1,600-space multi-story car park, while the central public plaza occupied 25% of the site, emphasizing the project's commitment to accessible public space. The residential component comprised 1,800 housing units, and two three-star-plus hotels with 442 rooms

addressed the accommodation needs of the anticipated visitor economy. The Kings Waterfront project demonstrates how brownfield regeneration can catalyze broader urban revitalization when anchored by significant cultural and leisure infrastructure. The development's emphasis on creating a "critical mass" of attractions within a coherent public realm follows the successful model established by earlier waterfront regenerations such as Baltimore's Inner Harbor. By prioritizing public space allocation and integrating residential uses with visitor attractions, Kings Waterfront aimed to create a sustainable mixed-use environment rather than a single-purpose tourist enclave, addressing one of the key criticisms of earlier festival marketplace developments. The initiative has been recognized as vital for the city's future, but the sustainability achieved remains in question, as it depends on revenue generated from visitors. It represents a step toward accomplishing urban renaissance, but since every brownfield location is unique, it does not offer a universal solution for success (Vida Maliene et al., 2012).

3.5.7 Barcelona's Coastal Transformation, Spain

Barcelona's coastal transformation is one of the most influential examples of urban regeneration driven by the Olympic Games. It reshaped the city's relationship with the Mediterranean through social planning, infrastructure development, and strategic event hosting. Over the past half-century, the Barcelona coast has undergone substantial transformations, and became an important model for social and culture-led planning process that integrate the local community and its activities with economic and environmental considerations (Degen and García, 2012 in Pistone, 2023).

The urban coastline is marked by beach elements, whose usage increased since the 1960s. That created pressures between social expectations and public and private interests in economic and productive development (Pistone, 2023). Until the 1980s, most local beaches experienced ecological and environmental degradation that severely limited usability, caused by extensive coastal privatization that removed land from public use. The socialist political transition of 1979 redirected coastal interface planning toward greater protection of community needs and spatial justice, representing an important step in creating the future "Barcelona model." The creation of new public spaces and the qualitative transformation of existing ones became tools

for promoting social cohesion, reflecting the intention to integrate society's needs within governance processes (Blakeley, 2005 in Pistone, 2023).

The 1986 nomination for the 1992 Olympics shaped community area development in Barcelona. Although the city had already begun the urban and coastal transformation, it provided national and regional economic resources to realize ambitions for city growth. Projects included infrastructural interventions that improved accessibility to coastal areas and the implementation of sports and leisure facilities. The primary objective was opening the city to the sea, distributing public facilities and services along the urban coastline following a holistic approach (Degen, 2008 in Pistone, 2023).

The intervention in Port Vell created a multifunctional recreational area. The Passeig Marítim became one of Barcelona's first major redevelopment projects, transforming a previously degraded urban coastline into an attractive public area (Pistone, 2023). Introduction of the pedestrian zone improved its usability from both visual and physical perspectives, making it permeable toward the sea. Open spaces between buildings allowed social interaction and functional flexibility, supporting coastal recreation and diverse relationships among users in a heterogeneous spatial context (Degen, 2008 in Pistone, 2023). The Passeig Marítim promenade established connections between the Olympic Village and the popular Barceloneta area (Crespi-Vallbona and Mascarilla-Miró, 2018 in Pistone, 2023).

Barceloneta beach spans over four hundred meters in length, implements inclusive access and provisions for users with reduced mobility. The bathing area accommodates sports activities. Planning of this city-sea interface was influenced by private investment which resulted in developing tourism facilities . The area and nearby Somorrostro beach historically related to poor urban settlements with approximately 15,000 inhabitants. Although the urban restoration improved its quality, it also altered the community composition (Crespi-Vallbona and Mascarilla-Miró, 2018 in Pistone, 2023).

Conservative city management resulted in gradual opening toward waterfront interventions by private investors, such as the Diagonal-Mar area and the Poblenou coastal zone (Pistone, 2023). This former industrial area was converted into higher standard accommodation and recreational facilities serving wealthy social groups. Planners developed the Universal Forum of Cultures, a four-month international event

in 2004 located in a working-class neighborhood. The urban project created a large coastal public space of approximately 200,000 square meters with associated public facilities and buildings, directing the event's cultural roots into an economic perspective that aimed to waterfront development (Casellas and Pallares-Barbera, 2009 in Pistone, 2023). Diagonal-Mar intervention represented a private initiative linked to urban marketing that produced exclusive urban models, while Forum operations were public initiatives. The large empty spaces and unused buildings show how a strategy can be unsuccessful. The Forum area includes an artificial sea access point with beach activities on approximately 11,000 square meters of paved surface has significant environmental value, including over five hundred identified marine species (Pontes et al., 2021 in Pistone, 2023).

3.5.8 Toronto's Waterfront Evolution, Canada

Toronto's waterfront regeneration is a multi-decade initiative marked by institutional experimentation, interdisciplinary scientific research, and ongoing efforts to address jurisdictional fragmentation. The transformation unfolded in phases, each contributing to current understanding of sustainable waterfront development. The first phase began in 1972, when the federal government created the Harbourfront Corporation to redevelop the central waterfront. This initiative started as a 1972 federal election promise for a waterfront park but evolved into mixed-use development after six years of intergovernmental debate. The Harbourfront Development Framework of the late 1970s incorporated advanced planning practices, including medium-rise, high-density urban fabric, mixed uses, historic building preservation, and mixed-income non-profit housing. However, Harbourfront Corporation faced significant challenges and ultimately failed to realize its comprehensive vision. The corporation was disbanded in 1991 and reconstituted as Harbourfront Centre, a non-profit organization with a limited mandate to operate cultural programming on a 10-acre site (Eidelman, 2013; Gordon, 2014; The Centre for Environmental Design Research and Outreach, 2001).

The Royal Commission on the Future of the Toronto Waterfront (1988-1992), led by former mayor David Crombie, was the most comprehensive scientific study of waterfront redevelopment to date (Crombie, 1992). Established as a federal inquiry in 1988 and expanded to a federal-provincial commission in 1989, the Commission

conducted extensive research and public consultation. Its final report, "Regeneration: Toronto's Waterfront and the Sustainable City" (1992), established the ecosystem approach as the core framework for sustainable waterfront development, recognizing the interdependence of environmental and economic systems and arguing that "economic development and good quality of life cannot be sustained in an ecologically deteriorating environment." The Commission identified 47 institutional actors with potential jurisdiction over the waterfront, highlighting governance complexity (Crombie, 1992). Key scientific principles established included integrating environmental protection with economic development, recognizing watershed-scale ecological connectivity, emphasizing public access and democratic participation, and prioritizing long-term sustainability over short-term economic gains. Following the Royal Commission's recommendations, the Waterfront Regeneration Trust was established (1992-2001) as a successor agency to continue waterfront regeneration, focusing on creating a comprehensive greenway system along the Lake Ontario shoreline and advancing ecosystem-based planning approaches (Trust, 1995; Trust, 2026).

Toronto's candidature for the 2008 Olympic Games initiated a contemporary era. It was unsuccessful, but it started the formation of the Toronto Waterfront Revitalization Task Force in 1999, which led to the creation of Waterfront Toronto (initially the Toronto Waterfront Revitalization Corporation) in 2001. This tri-government corporation was the first successful institutional solution to the jurisdictional fragmentation that had previously impeded comprehensive waterfront development. Waterfront Toronto's approach is based on scientific planning principles contained in the Central Waterfront Secondary Plan, which has four principles: “removing barriers and making connections; building a network of exceptional waterfront parks and public spaces; promoting a clean and green environment; and creating dynamic, diverse new communities” (Gordon, 2014; Waterfront Toronto, 2026; White, 2016).

3.5.9 Sydney's Darling Harbour, Australia

Darling Harbour in Sydney exemplifies mixed-use contemporary commons development, transforming a neglected port area into one of Australia's leading urban entertainment and cultural hubs. Located on the western edge of Sydney's Central Business District, it has served as a port area since the city's inception. The

construction of a new port facility to the south at Botany Bay in the late 1970s, intended to alleviate congestion in Sydney Harbour's port activities, made a significant portion of land at the southern end of Darling Harbour available for redevelopment. In 1984, the state Premier announced the government's plan to develop Darling Harbour to attract the increasing number of global tourists visiting Sydney. The redevelopment included the exhibition and conference center, coastal market and shopping district, hotels, Chinese garden, and maritime heritage museum. A casino was incorporated to cover a great portion of the development costs (Spike Boydell and Searle, 2010).

Darling Harbour represents a leading example of waterfront planning in Australia. The area, once a neglected industrial zone, was revitalized after abandonment. The flexible design includes exhibition and convention centers, entertainment venues, public spaces, and commercial spaces that can be reconfigured and adjusted to meet different demands. This area features a variety of uses, integrating historical locations, leisure activities, catering facilities, gathering and natural areas, creating a place that can host diverse users. Darling Harbour's design implements sustainability and ecological principles, including green spaces, sustainable construction, and water-sensitive solutions. Community engagement guided the development. Local residents, businesses, and stakeholders collaborated during the planning process to guarantee fulfillment of their goals and expectations. Darling Harbour implements resilient infrastructure, including flood prevention strategies and climate-adaptive architecture. It has significantly contributed to Sydney's economic advancement, tourism attractiveness, and urban life quality (Üzümcüoğlu, 2023).

3.5.10 Rotterdam's Waterfront Transformation, Netherlands

Rotterdam's waterfront transformation is one of Europe's most extensive and long-term urban regeneration processes, progressing through multiple phases from the nineteenth century to the present. The city's waterfront transformation began with the New Waterway Era (1863–1920s), initiated by the construction of the New Waterway (Nieuwe Waterweg) between 1863 and 1872, engineered by Pieter Caland. This 18-kilometer canal provided direct deep-water access between Rotterdam and the North Sea, altering the port city's development trajectory and enabling larger steamships to

reach Rotterdam, reducing transport time between the port and the Ruhr area from several months to 48 hours (Hartwich, 2009).

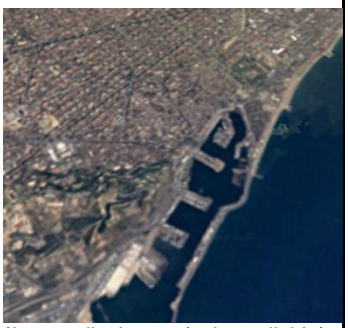
The New Waterway required harbor development on the Maas River's southern bank, including the construction of new docks such as Rijnhaven, Maashaven, and Waalhaven, using innovative "wet dock" designs (Hartwich, 2009). This period made Rotterdam into a major European port. After massive World War II destruction and the port modernization that followed and left disused areas within the city, Rotterdam began its first major waterfront regeneration period in the 1980s until the 2000s. The landmark Kop van Zuid project, approved in 1986 under master planner Riek Bakker, became the flagship development (URBED, 2006; Custers and Willems, 2024).

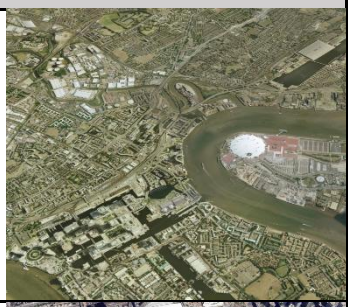
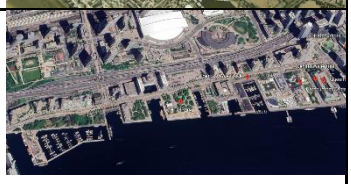
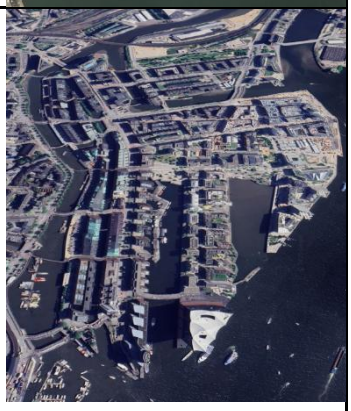
A public master plan was developed, with private investors undertaking individual projects that resulted in high-quality, mixed-use area with an active waterfront and high-level architecture (Custers and Willems, 2024). The Kop van Zuid project covered 125 hectares on the south bank opposite Rotterdam's city center, aiming to transform abandoned port areas into mixed-use development, reconnect north and south Rotterdam, and change the city's image from industrial to "Manhattan on the Maas." Infrastructure investments included the construction of the iconic Erasmus Bridge (1996), a new Metro station, and tram lines, with the Erasmus Bridge alone receiving €150 million from the national government. The development was planned to accommodate 15,000 residents and 18,000 workers by 2010, attracting high-quality architectural projects by renowned architects such as Norman Foster, Renzo Piano, and Rem Koolhaas, transforming Rotterdam's urban image (URBED, 2006).

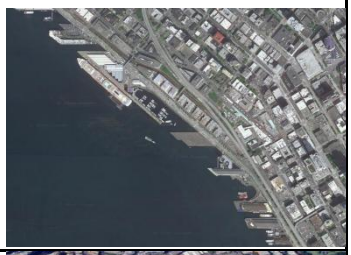
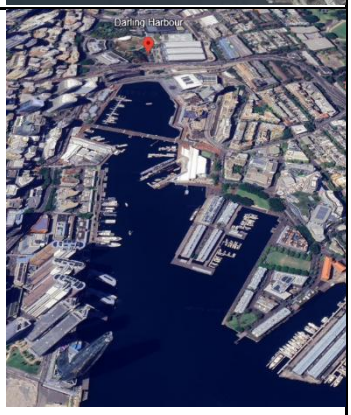
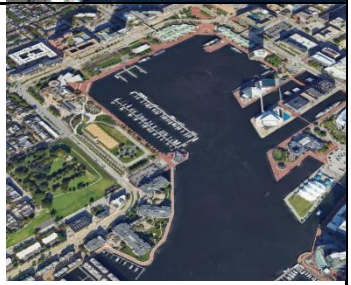
Rotterdam started the Stadshavens (CityPorts) project in 2002, representing a more integrated approach to port-city relationships (Daamen and Vries, 2013; Sánchez, 2015). The Rotterdam CityPorts Development Company was established in 2004 as a joint venture between the municipality and port authority, covering 1,500 hectares of waterfront area that included four port areas: the south bank’s Waalhaven and Eemhaven, and the north bank’s Merwehaven and Vierhavens. The strategy prioritized mixed-use development combining port and urban functions through a 50/50 partnership between the Port of Rotterdam Authority and the municipality. The most recent phase focuses on the Rotterdam Makers District, comprising Merwe Vierhavens (M4H) and Rotterdamsche Droogdok Maatschappij (RDM), officially designated in

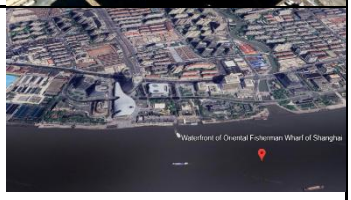
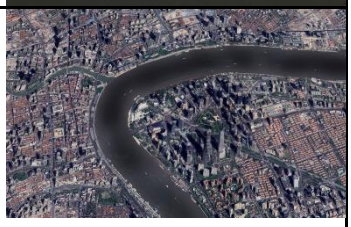
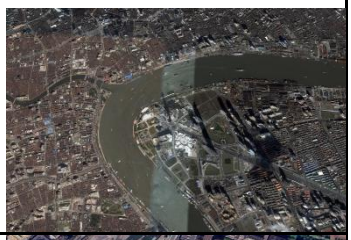
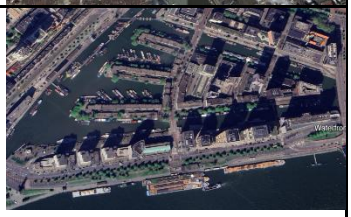
2018, representing a shift toward innovation ecosystems and creative manufacturing (Azadeh Arjomand Kermani et al., 2020; Jansen et al., 2021). M4H has transitioned from fruit and vegetable handling to creative industries (Azadeh Arjomand Kermani et al., 2020). The Keilewerf complex provides 6,000 m² for 80 entrepreneurs in former wharfs. RDM Campus transformed a former shipyard into an education and innovation campus through a partnership between Rotterdam University of Applied Sciences and Albeda College, focusing on maritime innovation, technical education, and port-related research (Jansen et al., 2021).

Table 5 Urban Waterfront regeneration examples, M. Gudac Cvelic

Project	Location	Development Period	Key Features	Primary Drivers	Photo (actual state, early 21st century state; source: Google Earth 2025-09-05)
Barcelona Waterfront/Port Vell	Barcelona, Spain	1980s-1992 Olympics	Europe's largest aquarium specializing in Mediterranean marine life, featuring an 80-meter underwater tunnel with sharks and other species, 60-meter-tall iron column	Olympic Games 1992, promoting environmentally friendly mobility, enhancing connectivity between areas, improving public spaces for people	  *low quality image (only available)
London Docklands	London, UK	1981-1998	Financial district, residential, DLR transport	Port decline, containerization, urban renewal	

Project	Location	Development Period	Key Features	Primary Drivers	Photo (actual state, early 21st century state; source: Google Earth 2025-09-05)
					
Toronto Waterfront	Toronto, Canada	2001-ongoing	mix of urban beaches, the extensive Water's Edge Promenade and Boardwalk, unique Wavedecks, cultural attractions	housing crisis, waterfront access, flood protection	 
Hamburg HafenCity	Hamburg, Germany	1999-ongoing (2020s completion)	Elbphilharmonie landmark, innovative green architecture (including timber buildings), 15-minute city layout prioritizing pedestrian-friendly, transit-oriented development	sustainable, climate-resilient architecture, innovative smart mobility solutions	 

Project	Location	Development Period	Key Features	Primary Drivers	Photo (actual state, early 21st century state; source: Google Earth 2025-09-05)
Seattle Waterfront	Seattle, USA	2019-2025	1.2-mile protected bike lane, new parks (Pier 58, 62), the Seattle Great Wheel, Aquarium expansion	infrastructure replacement, public space creation	 
Sydney Darling Harbour	Sydney, Australia	1984-ongoing	mixed-use, entertainment, tourism focus	tourism, urban renewal, commercial development	 
Baltimore Inner Harbor	Baltimore, USA	1960s-ongoing	mixed-use, adaptive reuse of industrial heritage, cultural and recreational amenities	post-industrial transformation, urban renewal, economic diversification, public accessibility, placemaking and identity	

Project	Location	Development Period	Key Features	Primary Drivers	Photo (actual state, early 21st century state; source: Google Earth 2025-09-05)
					
Yangpu Waterfront, Shanghai	Shanghai, China	2000s-ongoing	industrial heritage preservation, "3-WAYS" system and connectivity, "Brainbelt" innovation and talent hub	Huangpu river development, heritage preservation	 
Suzhou Creek, Shanghai	Shanghai, China	1996-2020	heritage sharing framework, adaptive reuse	historic preservation, public accessibility	 
Rotterdam Waterfront	Rotterdam, Netherlands	1980s-ongoing	climate adaptation, industrial site transformation	climate change adaptation, sustainable development	 

3.6 Urban-Planning Criteria in the context of Urban Waterfront Literature Review

Criteria identified in the scientific literature during research on Urban Waterfronts include scientific articles, conference proceedings, and design guideline documents. The criteria found in the literature are listed in Table 18, Appendix 2: Urban-planning criteria. They are presented by name, within their respective groups, citing the source or author, in a unified table. When available, they are supplemented with an indicator, requirement, standard, or description. Criteria are organized into categories based on their area of influence or action, rather than by sustainability pillars.

Giovinazzi and Moretti (2010) discuss Port Cities and Urban Waterfronts, highlighting the transformations and opportunities that waterfront revitalization, as a significant urban renewal trend, can bring. The Centre Cities on Water in Venice, Italy, studied best practices for waterfront revitalization and identified essential factors that contribute to successful port-city coexistence. In collaboration with Wasserstadt GmbH, Berlin, they developed the Ten Principles for Sustainable Development for Urban Waterfronts. These principles are applicable to a wide range of spatial planning and design processes and include Historic Identity Significance, Mixed-Use Priority, Public Access Prerequisite, Water and Environment Quality Recovery, Public Participation Benefit, and Redeveloping Waterfronts Step by Step as a Long-Term Project (Giovinazzi and Moretti, 2010). These criteria are presented in Table 18, Appendix 2: Urban-planning criteria.

The Guide to Riverfront Development: Connecting Communities to the Riverlife is a design guideline by Riverlife Pittsburgh . The document’s key content includes principles for reconnecting communities to Pittsburgh's rivers, based on over 15 years of riverfront projects. It provides practical guidance on connections, built form, character, public art, sustainability, and activating riverfronts. The guide also features successful examples of completed projects for trails, plazas, materials, street grids, and integrating development with parks and water access. The scale and level of detail of the guidelines vary, as do the planning, project,

and realization phases, each with a corresponding level of elaboration. The Guide was originally created in 2014 and published online as a PDF on the Riverlife website in 2016 (Riverlife). These criteria are presented in Table 18, Appendix 2: Urban-planning criteria.

Qiang, Ye, and Zhang (2022) base their research on urban waterfronts as key elements of a city's spatial structure. Their paper involves measuring urban integrated development of waterfronts and creating a multi-sourced data index for integration evaluation. Waterfront areas are complex due to the interplay of physical space and social systems. The study examines Shanghai, Guangzhou, Wuhan, and Ningbo, focusing on socio-economic and physical aspects to create an evaluation system. Socio-economic indicators include points of interest and population density from location-based services, while physical indicators cover walking and vehicle travel potential. The Analytic Hierarchy Process method is used to determine the weights of the indicators. The criteria derived from this source are linked to transportation connectivity and the evaluation process of different waterfront factors (Qiang; et al., 2022). These criteria are presented in Table 18, Appendix 2: Urban-planning criteria.

Üzümcüoğlu (2023) presents a framework for crafting adaptable waterfront designs in urban environments, which are challenged by climate change and urban growth. The research uses an interdisciplinary approach and analyzes global case studies for insights. The author suggests that stakeholders can enhance waterfront resilience by implementing flexible designs. The framework relies on community engagement to align designs with local needs, promoting inclusive development. Adaptable Waterfront Design Indicators are proposed, situated between Waterfront Design Principles and Adaptable Design Principles, and include criteria such as Mixed-Use Development, Access and Connectivity, Modularity, Resilient Building Design, Sustainable Transportation, and others (Üzümcüoğlu, 2023). These criteria are presented in Table 18, Appendix 2: Urban-planning criteria.

Technical Review of the Waterfront Alliance's Waterfront Edge Design Guidelines (WEDG) Program (2023) is organized by the Science and Resilience Institute at Jamaica Bay for the Waterfront Alliance. The document presents a national rating

system and credit-based manual (similar to LEED for waterfronts) developed by the Waterfront Alliance to guide resilient, accessible, and ecologically sound design of urban waterfront edges. Lessons from existing systems are applied to enhance WEDG's technical strengths nationwide. The program is structured around six categories containing 143 performance criteria, with a total of 37 achievable credits. The categories are: “Site Assessment & Planning, Climate & Hazard Resilience, Community Access & Connections, Edge Composition, Natural Resources & Sustainability, and Innovation” (Science and Resilience Institute at Jamaica Bay for the Waterfront Alliance, 2023). All projects must involve multidisciplinary teams, community engagement, and monitoring plans. The benefits of active living and connection to nature are emphasized. Innovation credits reward notable departures from standard practices and public sharing of results. Examples of criteria include: “Provide Quality Public Access Areas on the Waterfront; Design Sites to Improve Visual or Other Sensory Connections to the Water; Support Industrial Water-Dependent Uses; Reduce Industrial Impacts to Human Health; Preserve and Increase Ecosystem Connectivity; Utilize Green Infrastructure for Stormwater Management; Provide a safe public access point within one half mile of the site (e.g., creating an overlook or a pocket park by extending an adjacent shoreline street end); Ensure the site plan demonstrates that waterfront public space comprises at least 20 percent of the total site area, or 80 percent for parks; Ensure marine transportation accounts for (or will account for) 25 percent or more of inbound/outbound goods or equipment movement”, among others (Science and Resilience Institute at Jamaica Bay for the Waterfront Alliance, 2023). These criteria are presented in Table 18, Appendix 2: Urban-planning criteria.

Zaman et al. (2024) propose an integrated framework for waterfront development that incorporates nature-based solutions (NBS) in urban areas. This research introduces a framework that merges Water Sensitive Urban Design (WSUD) with integrated urban water management (IUWM), emphasizing governance, management, and stakeholder involvement. The proposed method highlights the need for a comprehensive framework for planning and designing waterfront development projects, providing specific criteria for a water-sensitive approach.

It serves as a checklist for planning or designing such projects. The list contains criteria with corresponding detailed attributes (and scientific sources), organized under four aspects: Governance, legislation, and management; Stakeholder perception, participation, and hydro-social contract; Urban built planning and design with a vision of multipurpose benefits; and Sustainable use of water and water resources (Zaman et al., 2024). These criteria are presented in Table 18, Appendix 2: Urban-planning criteria.

Yassin, Bond, and McDonagh (2011) develop guidelines for riverfront developments in Malaysia, focusing on unsuccessful examples that contribute to increased water pollution and youth-related problems. Findings are based on interviews with government officials, developers, and community members from three case studies, along with surveys sent to property companies. A total of 18 attributes were identified to assist future riverfront projects. Statements for riverfront development guidelines include, among others: Maintenance and rehabilitation costs are shared between stakeholders; Upgrading and maintaining the sewage system; Providing flood mitigation (e.g., by planting more trees); Integrating both modern and heritage aspects into development; Protecting natural resources (environment); Encouraging economic activities; Providing sufficient public facilities and amenities (such as pedestrian paths, landscaping, access ways, recreation areas, etc.); and Maintaining personal security through policing, surveillance cameras, etc. (Yassin; et al., 2011). These criteria are presented in Table 18, Appendix 2: Urban-planning criteria.

3.7 Concluding Remarks on Urban Waterfront

Urban waterfront regeneration often brings positive change to cities through economic growth, improved safety, environmental enhancement, and social benefits. These transformations introduce complex challenges that require careful consideration and adaptive solutions.

Traffic patterns change in regenerated waterfronts, since limited daily circulation that characterized industrial or port activities is different than today’s higher volumes of both vehicles and pedestrians. Water transport managed much of the

cargo movement unlike today’s road cargo transportation. Worker commutes were organized differently comparing to today's individual vehicle use. Meeting modern traffic demands requires specialized network solutions that integrate with existing city infrastructure, especially – a connection that often did not exist before regeneration.

The financial demands of waterfront projects require strategic funding approaches. Land sales become crucial for maintaining project momentum, creating an iterative process in which this valuable resource helps developments become self-sustaining. Although sustainability is considered during planning and construction in some projects, the actual environmental outcomes remain questionable, as noted by Vida Maliene in 2012 (Vida Maliene et al., 2012). Gentrification remains a concern in many regeneration efforts.

Economically, these projects prove effective by creating jobs and generating appeal that attracts users, which in turn supports commercial and hospitality sectors. Some developments rely too much on tourism and visitors, both in planning and managing the completed intervention. Historical and heritage elements receive inconsistent treatment– sometimes preserved authentically, other times reinterpreted through new construction that expresses historical character in contemporary forms.

Different cities have adopted various planning approaches. Hamburg's HafenCity followed a comprehensive master plan, while Baltimore pioneered a model that many cities tried to replicate. Although Baltimore achieved initial success and remains historically significant, its tourism-focused model and gentrification issues have drawn criticism, proving unsustainable in the long term under current conditions. Cities that copied this model without local adaptation largely failed.

Successful waterfront transformation depends not only on physical design but even more on institutional structures. Early regeneration failures resulted primarily from jurisdictional fragmentation rather than design flaws. Toronto's experience illustrates this clearly: 47 identified institutional actors created coordination challenges until tri-government cooperation through Waterfront Toronto was established in 2001. Specialized development corporations such as LDDC, Waterfront Toronto, and HafenCity GmbH provide the institutional

continuity and cross-jurisdiction authority that traditional planning agencies cannot achieve.

Modern practices have evolved to incorporate gray, green, and blue infrastructure into master plans, shifting from traditional engineering focused on single purposes to a more holistic approach. Toronto's Royal Commission between 1988 and 1992 pioneered the "ecosystem approach" (Gordon, 2014), establishing that economic development cannot be sustained in ecologically deteriorating environments– a principle now foundational but revolutionary at its introduction.

Comparative analysis of major regeneration projects reveals distinct approaches: landmark-driven tourism models like Baltimore and Liverpool; event-catalyzed transformations such as Barcelona's Olympics and Genoa's Expo '92; incremental mixed-use districts like HafenCity and Rotterdam; and ecosystem-based comprehensive planning exemplified by Toronto. The most successful projects combine elements across these typologies, with Barcelona sustaining Olympic momentum through participatory governance, HafenCity maintaining architectural diversity through competitions, and Toronto learning from governance failures to create effective institutional structures.

Contemporary waterfront regeneration must address climate pressures while maintaining accessibility and livability. New York City's Comprehensive Waterfront Plan establishes equality, resilience, and health as co-equal principles with specific design standards. London's Riverside Strategy demonstrates staged implementation aligned with long-term flood defense requirements, while San Francisco and Toronto illustrate alternative governance models emphasizing either legislative policy incorporation or adaptive management through regular updates.

The accumulated evidence shows that successful waterfront regeneration requires continuous political commitment, adequate public investment in infrastructure and public space, balanced regulatory frameworks, meaningful community engagement, and adaptive governance structures coordinating multiple jurisdictions. Global practice provides guidance, but local adaptation

requires the principles of calibration to specific ecological conditions, cultural contexts, governance capacities, and community priorities.

4 PUBLIC SPACE / PUBLIC PARK

4.1 Definition / Concept of Public Space / Public Parks

Public spaces are understood as all open, outdoor parts of the built and natural public environment, in both urban and rural areas, where people enjoy free, though not always unlimited, access. This includes streets, squares and other public routes, regardless of their residential, commercial or social role and their level of design, as well as open park areas and publicly accessible open spaces in private ownership to which access is not restricted (Carmona et al., 2008) in (Krmpotić Romić, 2025). The official definition of Public Space was adopted by United Nations on May 18, 2013, in Rome at the final session of the II Biennial of Public Space, states: “Public spaces are all places publicly owned or of public use, accessible and enjoyable by all for free and without a profit motive. Each public space has its own spatial, historic, environmental, social and economic features.” (Istituto Nazionale di Urbanistica, 2013).

Carr et al. (1992) define general public space categories as Public parks, Squares and plazas, Memorials, Markets, Streets, Playgrounds, Community open spaces, Pedestrian parks, Atrium public spaces, Everyday spaces, and Waterfront spaces. Stanley et al. (2012) distinguish Food production spaces, Parks and gardens, Recreational spaces, Squares and streets, Transport spaces, and Incidental spaces. Parks are a part of the vast open public places category of land uses that serve the needs and interests of diverse population groups (Neal et al., 2015). Parks, Plazas, and Streets are broad public area types of families that can be public, private or owned by a public-private partnership. Their purpose is to satisfy the leisure, recreational, and educational needs of people with different economic or social standard (Lozano, 1990) in (Sadeghian and Vardanyan, 2015).

Park is “a piece of public land in or near a city that is kept free of houses and other buildings and can be used for pleasure and exercise”, according to The Britannica Dictionary (2025b) definition. Wikipedia describes a Park as “an area of natural, semi-natural, or planted space set aside for human enjoyment and recreation or for the protection of wildlife or natural habitats” (Wikipedia, 2025e).

Contemporary definition by UN-Habitat states that “Parks are open spaces inside a municipal territory. Their objective is to provide free air recreation and contact with nature. Their principal characteristic is a significant proportion of green areas. In many parts of the world, parks are also used for a diversity of cultural events and activities” (UN-Habitat, 2018).

The idea of a 'public park' is based on the principle of openness and accessibility for individuals to visit and appreciate. The concept of a ‘park' is sometimes used in the same context with terms such as garden, square, or analogous expressions. Identity of historic urban parks is based on their composing elements such as “vegetation, architectural elements, water features, paths, or topography”. These components enhance their character, seasonal appeal, shade, and spatial and visual identity (ICOMOS, 2017).

Urban parks are planned green spaces meant for residents to encounter natural environment. They have extensive dual ecology and recreational function that enhances user’s health benefits (Li et al., 2023).

Rupprecht and Byrne (2014) drew a typology of liminal, “quasi-public green spaces” called Informal urban green space (IGS), a socio-ecological entity that comprises any urban space that has been disturbed by human and is covered fully or partly with vegetation. Out of the nine distinguished subtypes, two are related to this research, defining the categories of spaces the WBUPPs are or were before regeneration intervention. Brownfields are defined, within the Informal urban greenspace typology, as landfill, post-use factory grounds, or industrial parks. Their “vegetated area is presently not used for industrial or commercial purposes”. Public access and use are restricted, in majority of cases. Maintenance and vegetation removal is scarce or inexistent. Brownfields are classified as medium to large spaces with blocks ranging over one hectare. Watersides are defined, within the Informal urban greenspace typology, as rivers, canals, or water reservoir edges. The type comprises “vegetated area within ten meters of water body” that doesn’t belong to another category, where occasional maintenance happens in the form of vegetation removal to maintain flood protection and structural integrity. It ranges from small to large with linear surface

from ten square meters up to one hectare. Public access and use are possible in many occasions, but certain restrictions apply (Rupprecht and Byrne, 2014).

4.2 Historical Overview and Theory of Public Space / Public Parks

4.2.1 Historical Overview

For urban space historians such as Carr et al. (1992), Madanipour (2003), and Carmona et al. (2008), ancient Greek urban spaces often symbolize democratic practice, with the agora representing the public sphere. Roman forums and religious plazas are also notable ancient spaces. Historical narratives often move directly to medieval Europe, where plazas adjacent to churches served a wide range of socioeconomic and recreational functions. The Renaissance and Enlightenment introduced a focus on secular values, reflected in urban open spaces such as residential squares. Urban parks, serving as recreational spaces, began to develop in the 19th century (Cranz, 1989; Carr et al., 1992; Stanley et al., 2012).

Cranz (1989) provides a historical overview of urban parks in America, illustrating changes in their objectives, designs, and demographics from the mid-1800s to the late 1900s, leading to sustainable models. She identifies four types– pleasure grounds, reform parks, recreation facilities, and open space systems– each associated with distinct social aims, designs, and stakeholders. These types reflect a shift from expansive scenic parks on city peripheries to complex, interconnected open spaces integrated into urban life.

The pleasure grounds stage in the second half of the 19th century defined parks as expansive areas exceeding forty hectares, intended to promote health and social reform through nature. These parks primarily benefited the upper-middle class, supported by health advocates and real estate interests. The reform parks stage at the beginning of the 20th century saw parks as smaller urban areas designed for children's play and immigrant integration during the Progressive Era, featuring structured activities for working-class families and emphasizing social

intervention. In the mid-20th century, recreation facilities marked a shift as parks became service-oriented spaces for active recreation in suburbs, focusing on standardized sports equipment and efficiency for suburban families as part of welfare programs. Since the 1960s, the open space system has envisioned a network of interconnected parks that enhance community involvement and urban revitalization, serving diverse users and promoting inclusivity among various stakeholders (Cranz, 1989).

Open spaces are critically important to all urban groups, offering a unique perspective on urbanism within the historical timeframe. This perspective refers to non-roofed spaces that are not exclusively public and do not focus on buildings or political economics (Stanley et al., 2012). Open space can be classified by physical form, with “green space” referring to vegetated land and “grey space” to paved or packed dirt surfaces. Green space includes all natural landscaped surfaces, water, and geological features in urban areas. Grey space refers to “urban squares, marketplaces, and other paved or hard landscaped areas” (Al-Hagla, 2008, in Stanley et al., 2012). Stanley et al. (2012) presents a transdisciplinary typology of urban open spaces, identifying seven major open space types and dividing spatial scale into three categories: city, intermediate, and individual building. A third dimension of analysis distinguishes between “green” and “grey” space. This additional dimension, applied across the seven open space types and three spatial scale categories, provides important guidance for “planning research, urban ecology, and human-environment relations” (Jenerette et al., 2011). City scale is linked to institutional control at the national or municipal level or to spaces serving a substantial number of residents. Cultural significance is also considered; for example, a small park is classified at the city scale if its sponsoring institution has broad influence. Conversely, a large private garden serves only one family and thus functions at the building scale (Stanley et al., 2012). The author assigns the historical role of royal parks and gardens that became public after a change in government, as well as large urban cemeteries, to the Parks and Gardens type at the city spatial level, based solely on governance. This research appears to focus on the Parks and Gardens type at the city scale, resulting in Major Formal Park and Garden Space, defined as a

green space by the third dimension of Stanley et al.'s (Stanley et al., 2012) transdisciplinary typology of urban open spaces. Considering all the components of WBUPPs, one can easily align them with a complex urban public park like Central Park in New York City. The wide variety of spaces – including institutionally landscaped gardens, recreational ball fields and courts, streets used for transportation and recreation, semi-wild forested areas, parking lots, gray space plazas, and adjacent spaces along fences – demonstrates the multi-purpose nature of many open space types (Stanley et al., 2012). Such places are highly valued for their cultural significance but cannot be classified into only one of the proposed categories.

UN-Habitat provides a hierarchical classification of public open spaces by size and spatial influence, ranging from local or pocket spaces to neighborhood, district or city, regional, and metropolitan open spaces or parks. These spaces accommodate a variety of uses, depending on their scale and range, including recreation, sports, basic amenities, relaxation, and enjoyment of nature (UN-Habitat, 2018).

An integrated study aimed at proposing a guideline for planning open green space systems was conducted by Berfin Şenik (2022), who analyzed ecological, recreational, and disaster response criteria. The classification includes Recreational, Functional, Natural/semi-natural, and Open green spaces requiring landscape restoration. The objective of classifying recreational open green spaces is to identify public spaces that meet citizens' recreational needs, using a holistic approach at different scales. The park hierarchy includes Urban parks, among others. Functional open green spaces serve specific urban functions for land use types that are not recreational, such as burial grounds, production spaces, institutional spaces, or national disaster relief spaces. Natural/semi-natural open green spaces exclude recreational areas and include water structures and other features, such as woodlands. Water structures include coastlines (e.g., sea, lake, channel) and wetlands (e.g., swamps, marshes). Open green spaces requiring landscape restoration encompass land that has deteriorated due to natural or human-induced causes. Rehabilitation and restoration of these areas are possible. Some subtypes include solid waste

landfills and areas damaged by erosion, sedimentation, or hydrological landscape changes (Şenik and Uzun, 2022).

4.2.2 Theory of Public space / Public park

The concept of public space has evolved from nineteenth-century artistic values to contemporary frameworks that prioritize social interaction and experiential dimensions. Camillo Sitte's City Planning According to Artistic Principles (1889) established a theory based on spatial composition and sensory perception, advocating organically configured plazas designed to stimulate engagement through vistas and structural definition. Sitte positioned public squares as scaled environments that create spatial intimacy, emphasizing that "the most important is not the architectural shape or form of each building, but the inherent creative quality of urban space, the whole as much more than the sum of its parts" (Sitte, 1889).

In the twentieth century, modernist urbanism marked a rupture by instrumentalizing public space as functional zones separated by programmatic use rather than fostering social vitality (Hamel, 1993). This simplification persisted until mid-century interventions by Jane Jacobs (1961) and Henri Lefebvre (2024) reoriented discourse toward the social character of spatial experience. Lefebvre's "social production of space" (1991) constituted an epistemological shift, arguing that space emerges as a socially constituted reality through three dimensions: spatial practice (collective production through work and leisure rhythms), representations of space (planners' and architects' conceptions), and representational spaces (lived experience shaped by symbols and emotions) (Makinde and Amao, 2024). Lefebvre's critique extended to urban governance and the spatial evolution of capitalism. He argued that capitalism survives by reproducing social relations through spatial means, with city centers as fundamental sites for reproducing production relationships (Makinde and Amao, 2024).

Jan Gehl's empirical investigations into "life between buildings," beginning with his 1971 research, operationalized methods for examining how design shapes

essential activities, chosen activities, and spontaneous social events (Gehl and Koch, 2006). Gehl's principle, “First life, then spaces, then buildings," demonstrated that environmental conditions correlate with social vitality, providing planners with evidence-based tools to evaluate urban environments through observable patterns of use and encounter (Gehl and Koch, 2006).

Carmona (2015),(2018) and Carr et al. (1992) developed layered conceptualizations of "publicness" incorporating ownership, permeability, programmatic function, and relational encounter. Carr's (1992) framework defines public spaces where three dimensions guide design: users' essential needs, spatial rights, and the meanings they seek. International guidelines emphasize that parks should be free to access, equitably distributed, and designed to meet diverse needs through measurable criteria such as walking-distance access and amenity provision (Carmona, 2015),(Carmona, 2018).

Carmona's (2015),(2018) integrative framework– synthesizing design governance, economic structures, and cultural-social dynamics– articulates that public space quality results from iterative sociopolitical processes encompassing rights allocation, stewardship regimes, and responsive appropriation. Research links well-designed, accessible public spaces to strengthened neighborhood ties, trust, and social capital through design that enables mixed-use, intergenerational, and culturally diverse activities (Carmona, 2015),(Carmona, 2018).

Contemporary discourse revolves around Lefebvre's (Makinde and Amao, 2024) "right to the city," which frames public space as essential to urban democracy. Lefebvre (1991) claims a citizen’s collective right to inhabit, appropriate, and shape urban space. This right is "a cry and a demand" (Lefebvre, 1991) for renewed urban life, for inhabitants have the power to participate in making and governing space additional to the capital's right. Contemporary public space theory tracks a trajectory from Sitte's design aesthetics through modernism's functionalism toward diverse frameworks emphasizing spatial fairness, community involvement, and collaborative creation of place (Sitte, 1889; Lefebvre, 1991; Gehl and Koch, 2006; Carmona, 2018; Carmona, 2015). This evolution reconstitutes public parks as democratic venues where collective life-worlds are created, recognizing both the material conditions of spatial production

and political struggles over urban inhabitance (Carmona, 2018; Carmona, 2015; Makinde and Amao, 2024). The trajectory reveals increasing recognition that public space quality must encompass social relations, power dynamics, and participatory processes through which urban environments become meaningful, accessible, and genuinely public (Carmona, 2018; Carmona, 2015).

4.3 Public Park, Factors and Influence

Urban parks are strategically planned green spaces that allow city dwellers to engage with nature, serving both ecological preservation and recreational purposes while significantly enhancing mental well-being (Gascon et al., 2015a; Li et al., 2023). As urban centers around the world expand, public parks are considered essential components of green urban infrastructure, contributing not only to recreation but also playing a pivotal role in urban sustainability, climate adaptation, and population health (Remme et al., 2021). Urban environments are complex systems that include highly interconnected constructed infrastructure and natural green and blue spaces. Semi-natural areas encompass green spaces such as parks, street trees, and meadows; blue spaces like rivers and lakes; and hybrid grey-green-blue infrastructures such as green roofs and living walls (Jones et al., 2022). Elements known as Green Infrastructure (GI) provide numerous co-benefits to city residents through the ecosystem services they offer, support biodiversity, and are increasingly promoted to address various interconnected social and environmental challenges (Jones et al., 2022),(Kabisch et al., 2017).

Public parks provide a range of ecosystem services, including temperature regulation, habitats for diverse species, mental health benefits, and spaces for leisure and physical activity, while also serving as important community gathering places. This perspective redefines parks from isolated amenities to critical infrastructure that enhances urban livability and climate resilience. Urban parks offer regulating services such as air pollution removal, mitigation of urban heat islands, stormwater management, and noise reduction. Vegetation helps lower air pollution and urban temperatures, reducing physiological stressors linked to respiratory, cardiovascular, and heat-related illnesses (Remme et al.,

2021),(Bowler et al., 2010). Cultural services include opportunities for recreation, engagement with nature, aesthetic enjoyment, social interaction, and cultural activities that promote stress relief, attention restoration, social cohesion, and improved mental health (Remme et al., 2021),(Jennings et al., 2017). Supporting and provisioning services include biodiversity habitats, pollination support, and, in some cases, food production through community gardens, indirectly contributing to nutrition, local biodiversity resilience, and educational opportunities (Jennings and Gaither, 2015).

The extent of health benefits associated with parks is largely influenced by a variety of interrelated factors. The tangible characteristics of parks are especially important, as larger, more diverse, and well-equipped parks often support a wider range of activities and perceived benefits (Hunter et al., 2021), (Cohen et al., 2007). Features such as park size, vegetation diversity, water elements, and amenities like walking trails, sports courts, and playgrounds enhance parks' ability to meet users' varied needs. Well-maintained parks with clean facilities, adequate lighting, and clear signage encourage frequent visits and longer stays, which are linked to improved health outcomes. Maintenance practices also affect the ecological functions of parks, ensuring they continue to provide essential ecosystem services such as air purification and temperature regulation (McCormack et al., 2010). Proximity to urban parks can positively influence mental well-being by promoting physical activity, fostering social connections, reducing stress, and lowering noise levels (Li et al., 2023). However, perceived proximity and park quality often predict use and well-being more effectively than measured distance alone (Liu et al., 2017). Accessibility involves not only physical distance but also transportation options, physical barriers, entrance visibility, and the availability of safe routes, which are especially important for people with mobility challenges, older adults, and families with young children (Wolch et al., 2014).

The social dynamics within and around parks also affect their use and health benefits, as factors such as safety, programming, cultural significance, and social norms determine whether parks promote social cohesion and mental health improvements (Jennings et al., 2017). Community perceptions of safety and

access shape use patterns. This was highlighted during the COVID-19 pandemic, as differing safety and access concerns influenced who continued to visit parks (Venter et al., 2020). Perceived safety includes factors such as crime, traffic safety on routes to parks, the presence of other visitors, and environmental aspects like lighting and visibility. Parks perceived as unsafe or unwelcoming for certain groups worsen health inequalities, emphasizing the need for culturally relevant and inclusive design to ensure parks benefit the entire community. Assessing safety in urban public parks through multi-criteria decision-making has become a significant research focus, as the quality of park environments– including maintenance, cleanliness, facility conditions, and visual appeal– directly affects both visitation patterns and the psychological benefits derived from park experiences (Edmundas Kazimieras Zavadskasa, 2019), (McCormack et al., 2010).

Parks affect health through multiple, interacting mechanisms at both individual and community levels (Remme et al., 2021). Physical health pathways include enabling physical activity, as parks provide spaces that promote walking, exercise, and active recreation, which are linked to improved physical fitness and reduced disease risk. Studies show dose-response relationships between park use, physical activity levels, and health outcomes (Shanahan et al., 2016), (Sallis et al., 2012). Vegetation in parks reduces ambient air pollution and urban heat, lowering physiological stressors associated with respiratory, cardiovascular, and heat-related illnesses. Parks offer cooler microclimates during heat waves, which can decrease heat-related morbidity and mortality (Bowler et al., 2010). Green spaces also reduce urban noise pollution, which is linked to stress, sleep disturbances, and cardiovascular effects. Vegetation absorbs sound and creates natural sound buffers, supporting physiological recovery in acoustically tranquil environments (Gidlöf-Gunnarsson and Öhrström, 2007).

Mental health and psychological mechanisms are equally important. Contact with natural elements reduces perceived stress and mental fatigue, improving mood and cognitive function (Jennings et al., 2017). Attention Restoration Theory suggests that natural environments provide "soft fascination," allowing directed attention mechanisms to rest and recover, offering relief from the cognitive

demands of urban environments and supporting psychological restoration (Kaplan, 1995). Regular park use is associated with reduced symptoms of depression and anxiety, improved mood, and greater overall life satisfaction. Time spent in parks and active use show dose-response relationships with wellbeing, while park attributes and perceived quality moderate these effects (Gascon et al., 2015b), (Liu et al., 2017),(Shanahan et al., 2016). Social mechanisms function as parks facilitate social interactions, trust, and community engagement, which buffer loneliness and support mental health. These benefits depend on safety and inclusive design, with public parks serving as "third places" where informal social connections form and strengthen, contributing to community resilience (Jennings and Gaither, 2015).

The disparity in park distribution is most apparent in residential choices, with individuals from lower socioeconomic backgrounds facing disadvantages in accessing green spaces. Low-income and racially marginalized communities often have fewer parks, which are typically of lower quality or poorly maintained, further exacerbating health disparities (Wolch et al., 2014), (Venter et al., 2020). Land ownership dynamics and accessibility are critical in determining who benefits from the ecosystem services provided by parks, highlighting the need for focused evaluations of fairness and distribution frameworks. Equitable distribution of green spaces can improve mental health by fostering positive psychological responses and encouraging physical activity (Edmundas Kazimieras Zavadskasa, 2019),(Jennings and Gaither, 2015). To prevent the unintended exclusion or displacement of target populations, spatial justice and anti-displacement measures are essential, especially given the challenge of "green gentrification," where park improvements increase property values and displace long-term residents, posing a significant obstacle to fair park planning (Wolch et al., 2014). Publicly accessible, productive green infrastructure, such as community gardens, offers substantial benefits to vulnerable groups by promoting social connectivity, food security, and skill development. Programs that specifically target underserved communities, provide free activities, and address access barriers are vital for ensuring equitable distribution of park benefits (Jennings and Gaither, 2015).

The methodology for assessing the safety of urban public parks through multi-criteria decision-making has become more sophisticated, now encompassing ecological, social, health, and governance factors (Edmundas Kazimieras Zavadskasa, 2019). Integrating parks into citywide green infrastructure networks enables multi-scalar benefits and resilience, requiring collaboration across planning, ecology, and public health sectors. Effective park planning and evaluation necessitate the integration of health impact assessments, ecosystem service valuations, and social equity analyses (Jones et al., 2022), (Nieuwenhuijsen et al., 2017). Evidence-based design principles from environmental psychology, public health, and landscape ecology can enhance park effectiveness, with features such as diverse plant life, water elements, clear signage, varied activity zones, and comfortable seating associated with increased usage and benefits (Kaplan, 1995).

Public parks are a critical component of urban infrastructure, providing a wide range of synergistic benefits to city residents. These systems function as multifaceted social-ecological frameworks that deliver essential ecosystem services, promote physical and mental wellness through various pathways, and create spaces for social engagement and community development. The effectiveness of parks in delivering these benefits depends on factors such as physical design, accessibility, safety, quality, and the broader social and governance context (Edmundas Kazimieras Zavadskasa, 2019), (Hunter et al., 2021). However, the distribution of park benefits is not equitable, with systematic inequities in access and quality leading to environmental health disparities. This underscores the need for intentional planning that prioritizes equity, involves affected communities, and implements measures to prevent displacement (Jennings and Gaither, 2015), (Wolch et al., 2014). As urban centers face increasing challenges related to climate change, population growth, and health concerns, the role of parks as nature-based solutions becomes increasingly important. Future research and practice are expected to develop integrated frameworks that link park design and management with measurable social-ecological outcomes, ensuring that the benefits of urban greening are equitably

shared among all communities (Jones et al., 2022), (Edmundas Kazimieras Zavadskasa, 2019).

4.3.1 Urban Public Park, Presence in Scientific Literature

According to the SCOPUS (Elsevier, 2026c) scientific database, there has been a clear overall increase in articles on urban public parks. The first two articles were published in 1962. The number reached a steady level of more than 10 per year in 1991. Rapid growth is notable from 2002, with the number exceeding 100 in 2006, 200 in 2013, and nearly 500 in 2020. It has continued to increase rapidly. The total number of publications found is 7,788, with 878 publications in 2025. The most active countries are the United States with 1,640 published scientific articles, China with 1,275, and the United Kingdom with 620. Australia, authors listed as Undefined, Italy, and Canada have each published over 300 articles in total.

4.4 Examples –Public Park

The selection of public parks in this chapter aims to present an overview of contemporary realizations, not classify or assign importance to the given achievement. Composing factors and their interrelations provide information that can be used in this research framework. Public park regeneration examples are listed in Table 6. Their data summary with aerial photos of the actual and early 21st century state (sourced from (Google, 2026a)) is presented in Table 7.

Table 6 Public Park regeneration examples list, M. Gudac Cvelic

Public Park regeneration examples
• Gas works park, Seattle, USA
• Houtan park, Shanghai, China
• High line, New York City, USA
• Gardens by the bay, Singapore
• Freshkills Park, New York, USA
• Queen Elizabeth Olympic Park, London, United Kingdom
• Parc de la Vilette , parc Citroen, Paris, France
• Landschaftspark Duisburg-Nord, Duisburg, Germany
• Barangaroo Reserve:, Sydney, Australia
• Žnjan, Split, Croatia

4.4.1 Gas Works Park, Seattle, USA

Gas Works Park, located in Seattle, occupies 19.1 hectares on the northern edge of Lake Union and was built on the historic site of the Seattle Gas Light Company's coal gasification facility, which operated from 1906 to 1956. Acquired by the city in 1962 and opened to the public in 1975, the park was designed by landscape architect Richard Haag as one of the first major projects in the United States to adaptively reuse a heavily contaminated industrial site as public green space while deliberately preserving key structures and ruins of the former plant (O-R-S; University of Washington; Whitehouse, 2019). Haag's design philosophy emphasized retaining the materiality of industrial apparatus– the cracking towers, compressor buildings, and boiler house– not as monuments to extraction but as aesthetic and experiential anchors that would help visitors engage with the transformed function of the site and its history (The Cultural Landscape Foundation, 2001–2025; William Estes and Way, 2026; Wikipedia, 2025b).

What distinguishes Gas Works Park from other brownfield-to-park conversions is its pioneering use of bioremediation to address on-site soil contamination. Haag developed a methodology that mixed contaminated soil with organic matter, sawdust, and oil-degrading enzymes to stimulate natural microbial breakdown of petroleum hydrocarbons (O-R-S; Whitehouse, 2019). The most contaminated material was engineered into the "Great Mound," a land-formed amphitheater capped with eighteen inches of hard-packed clay, whose steep slopes and rain infiltration created a self-cleansing hydrological system. Selected structures, such as the boiler house and exhauster-compressor building, were repurposed as a picnic shelter and children's play barn, transforming the operational apparatus of pollution into playful public infrastructure (William Estes and Way, 2026; Raasch, 2026).

The project proved controversial: Seattle residents initially opposed retaining the gas works structures as ugly relics of pollution. Haag's campaign to gain public acceptance relied on reframing the industrial ruins as aesthetically compelling objects comparable to modernist sculptures, while emphasizing the park's commanding views of downtown Seattle, Lake Union, and the Olympic Mountains (William Estes and Way, 2026; Whitehouse, 2019). Gas Works Park was

designated a City of Seattle Historic Landmark in 1999, listed on the Washington State Historic Register in 2002, and added to the National Register of Historic Places in 2013, cementing its recognition as a paradigmatic twentieth-century park that opened international conversations about the design, remediation, and celebration of post-industrial landscapes (The Cultural Landscape Foundation, 2001–2025; Wikipedia, 2025b).

4.4.2 Houtan Park, Shanghai, China

Houtan Park in Shanghai is a 14-hectare linear waterfront park on a former industrial riverfront along the Huangpu River, developed for the 2010 World Expo as a prototype of ecological urbanism and landscape-based infrastructure. Conceived by Turenscape as "landscape as a living system," the park reuses a heavily degraded brownfield site to demonstrate how constructed wetlands, terraced topography, and productive planting can remediate pollution while providing high-quality public space (ArchDaily, 2026b; Nancy Rottle et al., 2011). Its planning objectives included treating contaminated river water, buffering urban flooding, improving riparian habitat, and showcasing low-energy landscape processes as alternatives to hard engineering. The 1.7-kilometer stepped wetland sequence, floodable terraces, recycling of industrial materials, and integration of boardwalks allow visitors to physically experience water purification and ecological succession (2015; Yu, 2015).

The park's design strategy employed a series of constructed wetland terraces that descend from the urban level to the river's edge, creating a gradient of ecological zones that naturally filter polluted river water through biological processes. The wetland system processes approximately 2,400 cubic meters of Huangpu River water daily, removing nitrogen, phosphorus, and other pollutants through phytoremediation– the use of plants to absorb and break down contaminants (Rottle, 2011; ArchDaily, 2026b). Native wetland vegetation, including reeds, rushes, and aquatic plants, were selected for their water purification capabilities, aesthetic qualities, and ability to provide urban wildlife habitat. The terraced design also serves a critical flood management function, accommodating the six-meter tidal fluctuation of the Huangpu River and

protecting adjacent urban areas (American Society of Landscape Architects; Yu, 2015).

Houtan Park received international recognition, winning the 2010 ASLA Honor Award in General Design, with the jury praising its "simple, elegant solution to a complex problem" and noting that it "demonstrates how landscape architecture can be a regenerative force" (American Society of Landscape Architects). The project has influenced subsequent waterfront regeneration efforts across China and internationally, establishing a precedent for using ecological infrastructure as the primary organizing principle for post-industrial site transformation and demonstrating the potential of landscape architecture to address multiple urban challenges simultaneously (The Interdisciplinary Research Network Urban Waters, 2015; ArchDaily, 2026b).

4.4.3 The High Line, New York City, USA

The High Line in New York City is a 2.3-kilometer elevated linear park created on a disused 1930s freight viaduct on Manhattan's West Side, opened in phases between 2009 and 2014 as a landmark project of adaptive reuse and post-industrial landscape design. Initiated by the grassroots organization Friends of the High Line, the project sought to preserve historic rail infrastructure, create a distinctive public promenade, and catalyze economic and social revitalization in the surrounding Chelsea and Meatpacking District neighborhoods (Millington, 2015; Richard Plunz and Moskalenko, 2017; Harvard University Graduate School of Design). Designed by James Corner Field Operations with Diller Scofidio + Renfro and Piet Oudolf, the park's "agri-tecture" language translates the spontaneous vegetation of the abandoned tracks into a choreographed mosaic of concrete planks, planting beds and overlooks the blur boundaries between path and garden (Beroš, 2010; Littke et al., 2013).

The High Line's planting design, led by Dutch horticulturist Piet Oudolf, draws inspiration from the wild meadow-like vegetation that colonized the abandoned railway during its decades of disuse. The planting palette includes more than 500 species of perennials, grasses, shrubs and trees selected for their multi-season

interest, drought tolerance and ability to thrive in the challenging conditions of shallow soil depth, wind exposure and temperature extremes (Millington, 2015; Richard Plunz and Moskalenko, 2017). The design's emphasis on texture, form and seasonal change rather than floral color creates a dynamic landscape that evolves throughout the year, influencing a generation of landscape designers worldwide.

The High Line's economic impact has been substantial and controversial. Property values within one block of the park increased by approximately 103% between 2003 and 2011, compared to 18% for Manhattan overall, while surrounding neighborhoods experienced rapid commercial and residential development (Littke et al., 2013; Jo Black and Richards, 2020). This dramatic transformation has generated intense scholarly debate about the relationship between public space investment and gentrification, with critics arguing that the High Line's success in attracting affluent residents and tourists has displaced long-term residents and fundamentally altered the social character of the neighborhoods it serves, exemplifying both the transformative potential and problematic consequences of high-profile urban greening initiatives (Beroš, 2010; Littke et al., 2013).

4.4.4 Gardens by the Bay, Singapore, Singapore

Gardens by the Bay in Singapore is a 101-hectare waterfront horticultural and leisure complex built on reclaimed land at Marina Bay, conceived as a flagship project for the city-state's "City in a Garden" strategy and its global positioning as a biophilic, high-tech metropolis. Developed by the National Parks Board and designed by Grant Associates with WilkinsonEyre, the park integrates three waterfront gardens, two large cooled conservatories, and a 22-structure "Supertree Grove" to create a year-round destination for residents and international tourists (GX Outdoors, 2026; Davey et al., 2010; ArchDaily, 2026a). Its objectives extend beyond recreation to include biodiversity conservation, energy-efficient climate control, integrated stormwater management, and environmental education, using landscape and architectural spectacle to

communicate sustainability narratives to a mass audience (ISDM Landscape Architecture Solutions, 2025; Gardens by the Bay, 2025).

The Supertrees, ranging from 25 to 50 meters in height, are vertical garden structures that support more than 162,900 plants from over 200 species, including ferns, vines, and tropical flowering climbers. Beyond their horticultural function, the Supertrees incorporate photovoltaic cells that harvest solar energy, collect rainwater for irrigation and fountain displays, and serve as ventilation ducts for the nearby conservatories (GX Outdoors; Davey et al., 2010). This integration of multiple environmental systems within a single architectural element exemplifies Singapore's approach to sustainable urban design, where technological innovation and ecological function are combined to create visually striking and functionally efficient infrastructure (ISDM Landscape Architecture Solutions; Gardens by the Bay, 2025).

The two conservatories represent another distinctive feature, recreating cool-dry Mediterranean and cool-moist tropical highland climates within energy-efficient glass structures in Singapore's hot, humid equatorial environment. The Flower Dome, covering 1.2 hectares, is the world's largest columnless greenhouse, while the Cloud Forest features a 35-meter indoor waterfall and a mountain clad in epiphytes, orchids, and ferns (Onniboni, 2024; ArchDaily, 2026a). These conservatories employ advanced horticultural technology and climate control systems that minimize energy consumption while maintaining precise environmental conditions, demonstrating how botanical gardens can serve as platforms for environmental education and climate change awareness. Gardens by the Bay attracts more than 50 million visitors annually, establishing it as one of Asia's most visited public attractions (ISDM Landscape Architecture Solutions; GX Outdoors).

4.4.5 Freshkills Park, New York City, USA

Freshkills Park on Staten Island is an ongoing 890-hectare transformation of the former Fresh Kills Landfill– once the world’s largest municipal waste dump– into New York City’s largest park and one of the most ambitious landfill-to-landscape

projects globally. Guided by a long-term master plan by Field Operations, the project aims to cap and stabilize four massive waste mounds, restore extensive tidal marshes and grasslands, and create a network of trails, waterways, and program areas that will open in phases through 2036 (The Freshkills Park Alliance, 2026; Stamp, 2012). Planning objectives include ecological restoration of coastal habitats, long-term environmental monitoring and risk management, provision of regional-scale recreation, and rebranding a stigmatized site as a symbol of urban resilience and environmental stewardship (Loewe, 2024; Wikipedia, 2026b).

The scale of the Freshkills transformation is unprecedented: the site received approximately 150 million tons of municipal solid waste between 1948 and 2001, creating four artificial hills that rise up to 68.5 meters above sea level– taller than the Statue of Liberty (The Freshkills Park Alliance, 2026; Stamp, 2012). The engineering challenge of converting these waste mounds into safe, accessible parkland requires sophisticated containment systems, including multi-layer caps composed of soil, drainage layers, geotextiles, and vegetation that prevent water infiltration while allowing methane gas to be captured and converted to energy. The site currently generates enough methane to heat approximately 22,000 homes, with plans to expand renewable energy generation through solar arrays and wind turbines as park development progresses (Loewe, 2024; Wikipedia, 2026b).

The Freshkills Park master plan envisions diverse program zones, including restored wetlands and grasslands, sports fields, waterways for kayaking and canoeing, mountain biking trails, art installations, and educational facilities that will tell the story of waste, consumption, and urban metabolism (The Freshkills Park Alliance, 2026; Stamp, 2012). The phased opening strategy allows the park to evolve gradually as landfill stabilization and ecological restoration progress, with early-access programs providing opportunities for public engagement and feedback that inform subsequent design decisions. This adaptive, long-term approach acknowledges that transforming such a massive, complex site requires decades of intervention, monitoring, and adjustment (The Freshkills Park Alliance, 2026; Loewe, 2024).

4.4.6 Queen Elizabeth Olympic Park, London, United Kingdom

Queen Elizabeth Olympic Park in London covers more than 100 hectares of formerly industrial land in the Lower Lea Valley, which was remediated and re-landscaped to host the 2012 Olympic and Paralympic Games and to drive long-term regeneration in East London. The project consolidated fragmented brownfields, scrapyards, and polluted waterways into a continuous park landscape, designed by a consortium led by LDA Design and Hargreaves Associates under strict environmental performance targets (Burdett, 2018; Green Flag Award). Its planning objectives combined event-time needs with a legacy framework that provides new neighborhoods, employment space, and accessible everyday green spaces managed by the London Legacy Development Corporation. Distinguishing features include the restoration and naturalization of the Lea River and its canals, expansive floodable meadows, habitat creation for urban biodiversity, and the integration of stadiums and arenas into a network of promenades, playgrounds, and community facilities (Dawson; NLA London, 2022).

The environmental remediation of the Olympic Park site was one of the most extensive brownfield cleanup operations in European history, involving the removal of 800,000 tons of contaminated soil, the demolition of 200 derelict buildings, and the clearing of 52 electricity pylons (Burdett, 2018). The project prioritized soil washing and on-site treatment over disposal, with 80% of contaminated material cleaned and reused within the park, significantly reducing the carbon footprint of the remediation process. The restoration of the Lea River and its tributaries transformed heavily polluted, channelized waterways into naturalized river corridors with diverse aquatic and riparian habitats, improving water quality and creating new ecological corridors that connect the park to the wider Thames River watershed (Green Flag Award; NLA London, 2022).

The legacy transformation has created new residential neighborhoods, including East Village, cultural institutions such as the London Stadium and the Copper Box Arena, and educational facilities including the UCL East campus, all embedded within an extensive network of public open spaces (Burdett, 2018;

Dawson). However, critical analyses have raised concerns about the governance structure and social impacts of the regeneration process, including the displacement of existing communities, the privatization of formerly public land, and the creation of new residential developments that remain unaffordable for many East London residents (NLA London, 2022).

4.4.7 Parc de la Villette and Parc André-Citroën, Paris, France

Parc de la Villette in Paris is a 55-hectare cultural park developed on the site of the former municipal slaughterhouse and meat-packing complex on the city's northeastern edge, following an international competition launched in 1982. Bernard Tschumi's winning design rejected traditional picturesque models and instead proposed a "park for the twenty-first century," organized by a superimposed system of red steel follies (points), paths (lines), and lawns and gardens (surfaces) that treat the brownfield as an open, programmable field (Omrania, 2017; International Union of Architects, 2026; Souza). The park's objectives were to create a new metropolitan destination combining cultural institutions, exhibition halls, and everyday recreation, while using abstract architectural devices to structure movement, encounters, and events rather than relying on scenic nature. Its deconstructivist formal language, the 120-meter grid of follies, large event lawns, and integration with existing industrial relics such as the Grande Halle distinguish Parc de la Villette as a canonical example in landscape urbanism discourse (Architects, 2019; Souza; Griffiths, 2022).

Parc André-Citroën is a 14-hectare contemporary park on the left bank of the Seine, created in the early 1990s on the cleared site of the former Citroën automobile factory as the centerpiece of a new mixed-use district. Designed by landscape architects Gilles Clément and Alain Provost, with architects Patrick Berger and Jean-François Jodry, the project was intended to express a technologically influenced, minimalist vision of nature, reconnect the dense urban fabric to the river, and provide both large open lawns and intimate garden rooms within a single composition (Kroll; Travel France Online; Wikipedia, 2026f). The park's organization around a vast central lawn, flanking water basins,

greenhouses, and a sequence of twelve small "serial gardens" themed around colors and elements reflects an experimental approach to representing nature within a highly controlled geometric frame (van der Velde and de Wit, 2015).

Both parks represent distinctly different approaches to post-industrial landscape transformation within the same city. Parc de la Villette emphasizes architectural abstraction, programmatic flexibility, and cultural infrastructure, in contrast to Parc André-Citroën's focus on horticultural experimentation, geometric order, and contemplative space (Kroll, Griffiths, 2022). Yet both projects share a rejection of naturalistic landscape conventions and an embrace of contemporary design languages that foreground artifice, materiality, and conceptual frameworks over picturesque scenery. They are both exemplars of twentieth-century French design philosophies that emerged when landscape architects transformed obsolete industrial sites into public spaces (van der Velde and de Wit, 2015).

4.4.8 Landschaftspark Duisburg-Nord, Duisburg, Germany

Landschaftspark Duisburg-Nord in Duisburg, Germany, is a 230-hectare public park set within a redesigned industrial landscape, developed on the site of a former ironworks and steel production facility that operated from 1901 to 1985. It stands as one of Europe's most influential examples of industrial heritage preservation and adaptive landscape reuse. Designed by landscape architect Peter Latz and opened in phases from 1994 onward, the park deliberately retains the massive blast furnaces, ore bunkers, gas tanks, and rail infrastructure of the former Thyssen steelworks, transforming them into recreational and cultural amenities while allowing natural succession vegetation to colonize and soften the industrial structures (Latz, 2001; Miles, 2019; Duisburg Kontor Hallenmanagement GmbH, 2026). The project's planning philosophy rejected complete demolition and conventional remediation in favor of a strategy Latz termed "syntactic design"– the layering of new uses and ecologies onto existing industrial structures without erasing the material evidence of the site's productive past. This approach created a unique landscape where rock climbing walls occupy former ore bunkers, scuba divers explore flooded gasometers, gardens

grow in former slag heaps, and theatrical lighting transforms blast furnaces into nocturnal spectacles (Latz, 2001; Stilgenbauer, 2005).

The park's ecological strategy embraced natural succession processes rather than imposing conventional landscape restoration, allowing pioneer plant species to colonize contaminated soils, slag heaps, and vertical surfaces of industrial structures, creating novel ecosystems that blur boundaries between nature and culture (Rosenberg, 2009; Miles, 2019). This approach, informed by emerging ecological theories of disturbance ecology and novel ecosystems, challenged traditional assumptions that brownfield remediation requires the complete removal of contaminated material and the imposition of predetermined planting schemes. The park's gardens, including the Piazza Metallica and the Sinter Gardens, occupy former industrial process areas where specialized plant communities adapted to extreme soil conditions create distinctive horticultural experiences that communicate the site's industrial history through ecological metaphors (Rosenberg, 2009).

Landschaftspark Duisburg-Nord has become a major cultural destination and regional park, attracting more than one million visitors annually for recreation, cultural events, industrial tourism, and environmental education. The park hosts concerts, art installations, outdoor film screenings, and festivals within and around the preserved industrial structures, establishing a new model for cultural programming in post-industrial landscapes (Visit Duisburg, 2026; Duisburg Kontor Hallenmanagement GmbH, 2026). The project's influence on international landscape architecture has been profound, inspiring subsequent generations of designers working on brownfield reclamation projects worldwide and establishing a new aesthetic and ethical framework for engaging with industrial heritage as palimpsests that reveal the layered histories of industrial production, ecological transformation, and cultural memory (Stilgenbauer, 2005; The European Heritage Awards / Europa Nostra Awards, 2025).

4.4.9 Barangaroo Reserve, Sydney, Australia

Barangaroo Reserve in Sydney is a 6-hectare waterfront park located on the northern section of the 22-hectare Barangaroo precinct. It transforms a former container terminal on the historically industrial East Darling Harbour docklands into a reconstructed pre-European headland landscape. Designed by Peter Walker and Partners Landscape Architecture (2025) in collaboration with Johnson Pilton Walker and completed in 2015, the project is one of Australia's most scientifically rigorous examples of ecological restoration within an urban waterfront regeneration context (Pham, 2017; Toland, 2017). The park's planning objectives included restoring the 1836 pre-colonial shoreline and topography, recreating indigenous Sydney sandstone bushland vegetation communities, providing public access to Sydney Harbour after more than a century of industrial enclosure, and establishing a new model for soil reconstruction and ecological restoration on heavily degraded urban sites (Pham, 2017; PWP Landscape Architecture, 2025; Infrastructure NSW, 2020).

The innovative creation of an "Anthroposol" at Barangaroo Reserve used 80% recycled materials from local excavation, resulting in a highly successful soil profile that achieved a 99% plant establishment rate for 76,000 native plants, far surpassing typical project loss rates (Toland, 2017). The plantings included 83 native species, primarily specific to Sydney Harbour foreshore ecology, organized into a three-layered vegetation structure that created five micro-ecosystems (PWP Landscape Architecture, 2025).

The physical restoration of the site involved the reuse of 48,000 cubic yards of sandstone blocks quarried from the site and adjacent excavations, used to reconstruct the 1836 pre-colonization shoreline through a series of stacked terraces strategically oriented in a northeast to southwest direction, aligned with Sydney's natural geological fault line (Toland, 2017). The park attracted over 250,000 visitors during the first three months of operation, with 95% of surveyed visitors reporting satisfaction, demonstrating exceptional public acceptance of the ecological restoration approach (Toland, 2017; Izzo, 2025).

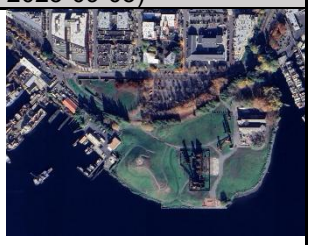
4.4.10 Žnjan Beach Park, Split, Croatia

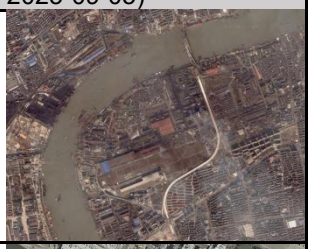
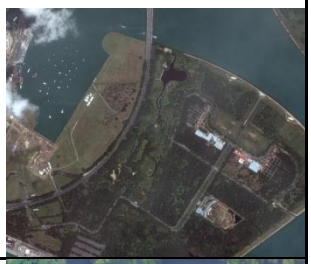
Žnjan Beach Park in Split, Croatia, is a coastal public park and beach complex located about 2 kilometers southeast of Split's historic city center, representing a significant example of Mediterranean coastal park development and recreational infrastructure. The park covers approximately 22 hectares of waterfront land along the Adriatic Sea, featuring a 2-kilometer-long pebble beach, extensive promenades, sports facilities, playgrounds, and landscaped green spaces that serve both local residents and the millions of tourists who visit Split annually (TZ Split, 2026; Žnjan d.o.o., 2026). The site's development history reflects Croatia's transition from Yugoslav socialist planning to post-independence market-oriented development, with the park evolving from informal beach use and fragmented recreational facilities into a more coherent public landscape through incremental improvements and infrastructure investments over the past three decades. Planning objectives have emphasized improving public access to the waterfront, providing diverse recreational amenities, protecting coastal ecosystems, and managing the intensive seasonal use pressures characteristic of Mediterranean tourist destinations (Bogdan, 2024).

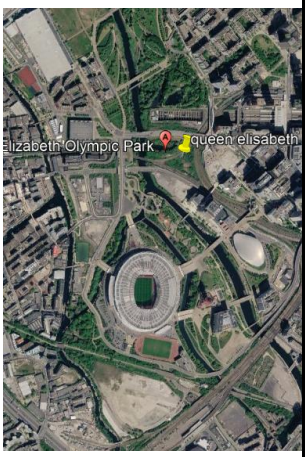
Žnjan Beach Park's landscape is characterized by its integration of natural coastal features– including pebble beaches, rocky shorelines, and remnant Mediterranean maquis vegetation– with developed recreational infrastructure such as beach volleyball courts, children's play areas, outdoor fitness equipment, cafes, and seasonal beach clubs. The park's promenade system provides continuous pedestrian and cycling connections along the waterfront, linking Žnjan to adjacent coastal neighborhoods and beaches, and forming part of Split's broader coastal greenway network. The beach is divided into distinct zones that accommodate different user groups and activities, from family-friendly areas with shallow water access and playground facilities to more active zones with water sports equipment rentals and beach volleyball tournaments. This spatial differentiation helps manage conflicts between different recreational uses while maintaining the beach's character as an inclusive public space accessible to diverse social groups (Bogdan, 2024; Žnjan d.o.o., 2026).

The park faces ongoing challenges related to seasonal overcrowding, water quality management, coastal erosion, and the tension between public access and private commercial development. During peak summer months, Žnjan Beach can accommodate tens of thousands of visitors, creating pressures on parking, sanitation facilities, waste management, and water quality that require intensive seasonal management and infrastructure investment (Ljubičić, 2026; Bogdan, 2024). Recent development proposals have included plans for new hotels, beach clubs, and commercial facilities that have generated public debate about the appropriate balance between tourism development and the preservation of public beach access, reflecting broader challenges facing Mediterranean coastal cities (Sinanović, 2026; Bogdan, 2024).

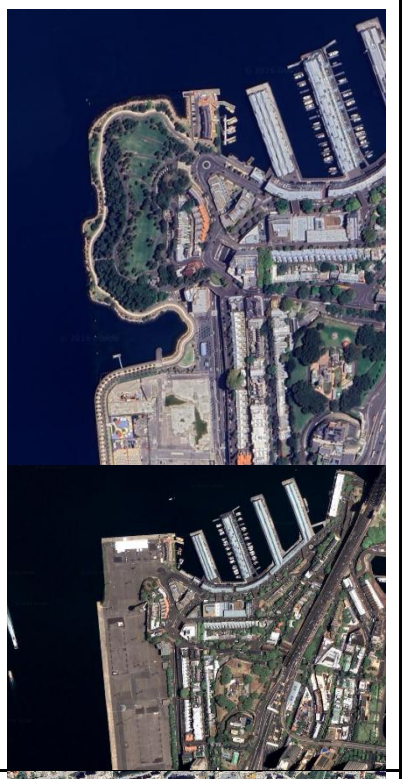
Table 7 Public Park examples data summary, M. Gudac Cvelic

Project	Location	Development Period	Key Features	Primary Drivers	Photo (actual state, early 21st century state; source: Google Earth 2025-09-05)
Gas Works Park, Seattle	Seattle, Washington USA	1962-1975	pioneering use of bioremediation, Great Mound, City of Seattle Historic Landmark	heritage conservation with ecological remediation	 
Houtan Park, Shanghai	Shanghai, China	2010	1.7 km stepped wetland sequence, floodable terraces, recycling of industrial materials and integration of boardwalks	World Expo	

Project	Location	Development Period	Key Features	Primary Drivers	Photo (actual state, early 21st century state; source: Google Earth 2025-09-05)
					
The High Line, New York City	New York, USA	2009-2014	Sun Deck, 10th Avenue Square, viewing spurs	historic rail infrastructure preservation, distinctive public promenade, eco-gentrification	 
Gardens by the Bay, Singapore	Singapore	2006-2012	world's largest glass greenhouse, a mist-filled mountain with a massive indoor waterfall, 188-foot tall vertical gardens with solar tech	biodiversity conservation, energy-efficient climate control, integrated stormwater management and environmental education	 
Freshkills Park	New York City, USA	2008-ongoing	expansive grasslands, tidal creeks, and sustainable infrastructure, such as methane gas harvesting	transformation of the 2,200-acre decommissioned landfill into a massive public recreational space, environmental remediation of the tidal wetlands, and sustainable energy generation	

Project	Location	Development Period	Key Features	Primary Drivers	Photo (actual state, early 21st century state; source: Google Earth 2025-09-05)
					
Queen Elizabeth Olympic Park	London, UK	2008-2014	extensive parklands with 6.5km of waterways, iconic ArcelorMittal Orbit sculpture, the London Stadium	major sports, concerts, and events at the London Stadium, free, accessible public parkland, thriving commercial/residential hub	 
Parc de la Villette, Parc Citroen	Paris, France	1984-1992	massive, cultural, and entertainment hub, featuring 35 red "follies" designed	industrial reconversion, cultural and multi-disciplinary hub	

Project	Location	Development Period	Key Features	Primary Drivers	Photo (actual state, early 21st century state; source: Google Earth 2025-09-05)
			by Bernard Tschumi		 
Landschaftspark Duisburg-Nord	Duisburg, Germany	1989-2002	walking/cycling paths, climbing garden in old ore bunkers, diving gasometer	blending industrial heritage of former ironworks with nature	 *low quality image (only available) 

Barangaroo Reserve	Sydney, Australia	2012-2015	replicated native landscape, underground, column-free cultural venue	reconnect people with the harbour, transform a former industrial concrete container terminal into a thriving public space	
Žnjan	Split, Croatia	2024-2025	1.5 km promenade, landscaped beaches, sports fields, an open-air amphitheater	modern, year-round, eco-friendly, and accessible coastal, recreational hub	

4.5 Urban-Planning Criteria in the context of Public Space and Public Parks Literature Review

Criteria found in scientific literature, while researching Public Space and Public Parks includes scientific articles, books, and doctoral dissertations. The criteria found in literature are in Tables 19-22, in Appendix 2: Urban-planning criteria. They are presented by name, within their belonging group, citing source or author. They are supplemented with an indicator, requirement, standard or a description, when the information is available.

Krmpotić Romić (2025), while researching temporary interventions in Public spaces, made a summary of existing criteria that concern her subject. She categorized them according to Spatial morphology, Program / Function, Economic factors and apace management, Socio-cultural and user perception, and Location and space status. Carmona, with co-authors, (2001; 2003) is the author that repetitively researches and produces scientific work about public space, therefore he appears multiple times within four classified criteria groups. Sitte (1889), Zucker (1959), together with Carmona and co-authors (2001; 2003), determine Spatial morphology criteria categories for public spaces. Carr (1992), Stanley (2012), Gehl (2008), together with Carmona (2001; 2003), determine the categories that regard Program or Function of public spaces. Carmona (2001; 2003) classifies general public spaces and general spaces according to economic factors and the way in which a space is managed. Dines and Catell, Foucault, Lefebvre, and Soja (Foucault and Miskowiec, 1986; Soja, 1996; Dines et al., 2006; Lefebvre, 1991) consider socio-cultural and user perception of space, determining differently layered categories. Lehtovuari and Ruoppila (2012) write about Location and space status criterion, defining current usage related significance of general public space. These criteria are presented in Table 19, Appendix 2: Urban-planning criteria.

The Matrix of sustainable design principles (Carmona et al., 2003) brings together ten principles proposed by various authors (Bentley, 1990; Evans, 2001; Frey, 1999; Hough, 1984; Rogers, 1997; Commission of the European Communities, 1990; Breheny, 1992a; Barton, 1996; URBED, 1997), which Carmona organizes into a complex framework for sustainable urban design. These principles are Stewardship, Resource efficiency, Diversity and choice, Human needs, Resilience, Pollution reduction, Concentration, Distinctiveness, Biotic support, and Self-sufficiency.

Stewardship relates to improvement through transformation, cohesive planning, revitalization of town centers, and a collective sense of responsibility for the environment. Resource efficiency relates to cost-effectiveness, energy conservation, reduced travel, public transportation, and the preservation of land as well as other resources. Diversity and choice relate to variety, permeability,

mixed-use development, and diverse functions that improve urban experience and accessibility. Human needs relate to clarity, aesthetic appeal, security, appropriate scale, social diversity, and low crime rates. Resilience includes processes of change, flexibility, adaptability, and the capacity to evolve over time. Pollution reduction includes cleanliness, the use of vegetation to mitigate pollution, and the regulation of climate, water, and air quality. Concentration relates to vibrancy, compact development, containment, critical mass, and densities that support services. Distinctiveness relates to regional identity, heritage, innovative and organic design, and a sense of place. Biotic support relates to the importance of open spaces, urban greenery, biodiversity, and interconnected green networks. Self-sufficiency relates to environmental awareness, local independence, democratic processes, consultation, and community engagement (Carmona et al., 2003).

The compiled table with multiple authors' criteria, presented in Table 21, Appendix 2: Urban-planning criteria, contains urban-planning criteria for public parks from various scientific sources. It presents a multifaceted framework that includes integrated planning, environmental resilience, accessibility, health promotion, safety, social cohesion, physical design, sustainability, and monitoring. Authors such as Şenik and Uzun (2022) treat hierarchical classification, ecological functions, and quantitative standards. Zhang et al. (2023) treat health impacts through restorative environments and spaces for social interaction. Authors Ibes (2014), Sabri and Ponrahono (2024), Wendel et al. (2022), Project for Public Spaces (Spaces, 2008), Zavadskas et al. (2019), and the Chesco Planning Commission (2020) treat ecosystem services, universal design principles, safety measures, and multi-criteria evaluation tools. These criteria are presented in Table 21, Appendix 2: Urban-planning criteria.

Mrak et.al. (2022) write about holistic spatial planning approach, focusing on sustainable development of urban voids. Urban voids are small, unused urban spaces whose defining feature is a lack of function. Though they do not strictly imply the research subject is public space, the proposed case study requalification involves creating it. Consequently, the criteria considered are perceived as applicable to public space. The criteria are not named but are

numbered. They do not contain indicators, but guidelines, sometimes one or two, sometimes multiple per criterion. The criteria are related to urban development goals (UN SDGs) and pertaining criteria. These criteria are presented in Table 22, Appendix 2: Urban-planning criteria.

4.6 Concluding Remarks on Public parks

Urban parks have evolved from elite pleasure grounds serving the upper-middle class into complex social-ecological infrastructures that provide measurable health benefits, climate adaptation, biodiversity support, and community cohesion for diverse populations. Public space quality depends on more factors than just physical design, which is recognized by authors in scientific literature throughout history, from Sitte (1889) and Lefebvre (1991) to Carmona (2003; 2010; 2018). The United Nations (2013) define public spaces as places "accessible and enjoyable by all for free and without a profit motive". Well-designed public parks can reduce stress, strengthen social connections, and help in mitigating urban heat, among other wellbeing outcomes.

The three-phase orientation-conceptualization-realization framework structures successful park redevelopment through comprehensive stakeholder engagement, contamination assessment, and strategic planning before implementation, with long-term viability requiring active community participation from inception to mitigate gentrification risks and preserve cultural identity. Urban parks function as multifaceted social-ecological systems delivering regulating services such as air pollution removal, urban heat island mitigation, and stormwater management; cultural services including recreation, aesthetic enjoyment, and social interaction promoting mental health; and supporting services providing biodiversity habitats and pollination support. Park effectiveness depends on interrelated factors including physical characteristics such as size, vegetation diversity, and amenity provision; accessibility encompassing proximity, transportation options, and barrier-free design; maintenance quality affecting both user experience and ecological function; and

social dynamics including safety perceptions, inclusive programming, and cultural relevance. Systematic inequities in park distribution and quality disproportionately affect low-income and racially marginalized communities, creating environmental health disparities that necessitate spatial justice frameworks and anti-displacement measures to prevent green gentrification, where park improvements increase property values and displace long-term residents.

Scientific literature that treats urban public parks presents increase from two articles in 1962 to 878 publications in 2025. United States, China, and the United Kingdom lead the subject's research production. Cranz's (Cranz, 1989; Cranz and Boland, 2004) typology follows American park evolution through four stages: pleasure grounds, reform parks, recreation facilities, and open space systems. Changes in objectives evolve from elite nature enjoyment to immigrant integration, suburban recreation, and networked community infrastructure promoting inclusivity. Stanley's (2012) transdisciplinary typology is based on different uses and their factors. Attention Restoration Theory (Kaplan, 1995) explains how natural environments provide "soft fascination," allowing cognitive recovery from urban demands (Kaplan, 1995). It shows how regular park use creates dose-response relationships with reduced depression and anxiety symptoms, improved mood, and greater life satisfaction, influenced by park attributes and perceived quality.

Gas Works Park and Landschaftspark Duisburg-Nord initiated the use of industrial heritage as aesthetic and experiential attractors. It showed that contaminated sites can become public amenities by integrating bioremediation and structured design with existing structures. Houtan Park and Barangaroo Reserve are examples of successful ecological restoration. Houtan shows the result in built wetlands that use phytoremediation to clean a substantial river water volume daily. Barangaroo shows the result in using an innovative soil type containing 80% of recycled materials that covers most of its area. Gardens by the Bay and Queen Elizabeth Olympic Park are publicly funded projects that represent cities globally using advanced horticultural technology and Olympic legacy infrastructure, respectively. Gardens by the Bay's successful intervention

attracts over 50 million annual visitors. Queen Elizabeth Olympic Park remediated 800,000 tons of contaminated soil on a 100 hectares area.

High Line intervention presents a successful public space investment that is criticized in relation to gentrification, since it caused displacement and the transformation of the neighborhood's social character. Parc de la Villette and Parc André-Citroën introduced different conceptual frameworks based on geometric or programmable principles. Freshkills Park is the world's largest municipal landfill transformation that implements specific solutions adapted to its unique character. Žnjan Beach Park is a Mediterranean coastal park facing challenges such as seasonal overcrowding, water quality management, coastal erosion, and tensions between public access and private commercial development. The issues generate discussion about tourism development being prioritized over public beach preservation.

5 SUSTAINABILITY

5.1 Definition / Concept

Brundtland Commission defined sustainable development in the 1987 "Our Common Future" report. The commission's official title is World Commission on Environment and Development. One of the most generally known and cited definitions says that "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland and Khalid, 1987),(Bahale and Schuetze, 2023).

Wendling et al. (2018) define sustainability as "an ecosystem's capacity to maintain diversity and productivity over time". They include the temporal aspect and the relationships between ecological systems. The authors express the need to respect future generations, and integrate social, economic, environmental, and governance dimensions (Wendling et al., 2018).

Cohen (2017) defines sustainability as bringing society within planetary boundaries while providing basic living standards. This definition connects environmental requirements with social problems, such as poverty and inequality. Rockström and colleagues (2009) identify nine Earth system processes that make the planetary boundaries framework. It sets quantitative boundaries that help regulate the planet's stability and resilience (Cornet, 2016).

In the urban context, sustainability takes on particular significance given that cities are simultaneously major contributors to environmental degradation and potential engines of sustainable transformation. Urban sustainability evaluation process, within the urban context that degrades the environment and provides opportunities for transformation, often uses environmental, economic, and social dimensions known as a three-pillar approach. That approach is complemented in certain cases with additional dimensions, such as governance or institutional, spatial, chronological, and logical (Cohen, 2017).

Valdivia-Loro (2019) claims that urban sustainability requires "improving economic, social, and environmental aspects, increasing citizen participation, and efficient resource use".

Ethical aspect is also integrated in concept of sustainability. As Wendling et al. (2018) write, sustainability "implies intergenerational equity".

Contemporary sustainability incorporates the link between global challenges and the need for integrated solutions. The United Nations Sustainable Development Goals (SDGs), adopted in 2015, contain the integrated approach in 17 interconnected goals including poverty eradication, health, education, gender equality, clean energy, sustainable cities, climate action, and ecosystem protection (Cucuzzella et al., 2021). The SDGs offer a framework available to different nations, sectors, and scales. They represent a global agreement on sustainability.

5.2 Sustainability Development Overview

5.2.1 History

The development of sustainability shows that society is aware of the complex relationships between economic progress, ecological balance, and social well-being (Ben Purvis et al., 2019)., Conservation actions at the crossing between the nineteenth and twentieth century tried to influence the impacts of industrial expansion by protecting natural resources (Callicott and Mumford, 1997). Economic growth after the second World War resulted in great environmental problems, shown by Rachel Carson's 'Silent Spring'. The book presented how industrial processes cause ecological destruction (Carson, 1962). Environmental protection became a political concern in 1970s, when international conferences were held and the development of governance frameworks started (Rome, 2003). Brundtland Report introduced the concept of sustainable development in the 1980s, linking environmental preservation to economic progress (Brundtland and Khalid, 1987).

The 1992 Rio Earth Summit further defined sustainable development, producing documents such as the Rio Declaration and Agenda 21. It introduced the principle of "common but differentiated responsibilities," accepting that different nations have different capacities to cope with environmental challenges (Declaration, 1992). Various sustainability assessment tools were developed in the1990s, such as the Ecological Footprint and LEED certification that promoted green architecture (Wackernagel and Rees, 1998).

In the 2000s Millennium Development Goals addressed global challenges and prioritized climate action (Waage et al., 2010; United Nations Development Programme, 2003). In the 2010s, the 2030 Agenda and the Paris Agreement made international commitments to sustainability stronger (Satterthwaite, 2017; Valencia et al., 2019; Wendling et al., 2018; Cucuzzella et al., 2021).

Contemporary sustainability discourse is characterized by several themes. First, there is interest in approaches that integrate different sustainability issues and the importance of coming up with holistic beneficial solutions (Panagiotopoulou et al., 2020; Depietri, 2022; Wendling et al., 2018). Second, technology and governance advancements are important for achieving sustainability transitions. Third, current solutions do not achieve long-term sustainability, based on scientific research results. Therefore, an urgent need for action regarding climate change and biodiversity loss exists (Kharrazi et al., 2016; Marzio et al., 2026).

The COVID-19 pandemic, which began in 2020 and ended in 2023 (United Nations, 2023), has confirmed the connections among environmental health, social equity, and economic resilience. It also showed how global systems are vulnerable and unable to transform rapidly in crisis. The pandemic has shown the need for systems that can resist shocks while maintaining essential functions and protecting vulnerable communities (Zeng et al., 2022).

Sustainability has evolved from a marginal issue to a foundational organizing principle for development policy, corporate strategies, and civic initiatives. This evolution shows how environmental and social interactions are understood, and how societal values regarding justice, responsibility, and the relationship between humanity and the natural world have changed. Translate the conceptual evolution

into actual implementation of systemic changes is the future challenge (He and Reith, 2022; Xie et al., 2022; Satterthwaite, 2017).

5.2.2 Sustainability Pillars

Understanding sustainability that channels through multiple interconnected pillars has become a dominant framework for sustainable development implementation. The most widely used model identifies three pillars: environmental, economic, and social, even though various formulations exist. It is often referred to as the "triple bottom line" or "three pillars of sustainability". The model provides a structure for analyzing sustainability challenges and designing integrated solutions (Ben Purvis et al., 2019; Mensah, 2019).

Environmental sustainability involves protecting the vitality and durability of ecosystems essential for life. To maintain an ecosystem, society must effectively manage renewable resources, protect biodiversity and reduce pollution levels. It is important to respect the Earth's limits to protect basic planetary system operations (Cornet, 2016; Mensah, 2019; Wendling et al., 2018).

Economic sustainability focuses on implementing economic systems that provide prosperity and opportunity while respecting environmental limits and promoting social well-being. This principle involves generating wealth through quality growth, enhancing resource efficiency, and ensuring long-term resilience by adapting to changing conditions. It also integrates circular economy concepts that aim to minimize waste and keep resources in use, moving away from traditional linear consumption models (Zhai and Chang, 2018; Vargas and Cooper, 2024; Lobo et al., 2015).

Social sustainability involves creating equitable, inclusive, and healthy societies that meet human needs for security and well-being. It addresses inequalities in resources and opportunities to ensure that current and future generations have equal access. It also involves promoting health, social cohesion, cultural diversity, and education to empower communities and encourage participation in sustainable development. Social sustainability aims to build strong communities that thrive on trust, inclusivity, and cultural vitality (Guo, 2017; Gray, 2010; Daly, 1992; Kumar et al., 2014).

The three-pillar framework offers analytical clarity, but the pillars are not independent but interconnected. Environmental degradation affects economic productivity and social well-being; economic inequality can drive unsustainable resource exploitation; and social instability can hinder effective environmental governance. Cornet (2016) describes sustainability pillars as "nested," with "economy within society, within the environment," emphasizing that economic and social systems ultimately depend on environmental foundations.

Effective sustainability strategies must address interactions and compromises across pillars. Navigating these complexities requires integrated assessment frameworks and participatory decision-making processes that can identify synergies and manage trade-offs (Depietri, 2022).

Many contemporary frameworks extend the three-pillar model to include governance as a fourth dimension or an overall intersecting organizing factor. Governance includes institutions, policies, processes, and power relationships through which societies make and implement decisions. Effective governance is recognized as essential for achieving sustainability across all pillars, requiring transparency, accountability, participation, and adaptive capacity (Martine Laprise, 2018), (Dan He et al., 2024), (Wendling et al., 2018).

5.2.3 Sustainability Dimensions and Thematic Categories

Urban sustainability assessment frameworks often go beyond the basic three-pillar model to include additional dimensions that reflect the complexity of urban systems. Dan He’s (Dan He, 2024) systematic literature review of brownfield sustainability includes forty studies and confirms the strong prevalence of indicators classified within the three basic economic, environmental, and social dimensions. Cohen (2017) and Michalina (2021) note that urban sustainability assessment commonly includes not only environmental, economic, and social dimensions but also "institutional, spatial, chronological, and logical" considerations. They refer to this as the institutional dimension, whose domain significantly overlaps with what is called Governance, which is presented as the fourth dimension in other studies (Venter, 2020, Martine Laprise, 2018, Dan He, 2024). This expansion recognizes that sustainability outcomes depend on

governance structures, spatial configurations, temporal dynamics, and the logical coherence of interventions.

5.2.3.1 Thematic Categories within Sustainability Dimensions

Within each major dimension, sustainability frameworks typically identify specific thematic categories that provide operational focus for assessment and intervention. In Michalina et al.'s (2021) research comparing Urban Sustainability Indicator Frameworks, most frameworks were categorized by thematic areas rather than explicitly by sustainability dimensions.

Table 8 synthesizes key thematic categories commonly used in urban sustainability frameworks, based on contemporary assessment tools and scholarly literature (Bahale and Schuetze, 2023; Chauhan, 2025; Cohen, 2017; Kimic and Fekete, 2022; Denis Michalina et al., 2021; Pakzad and Osmond, 2016; Panagiotopoulou et al., 2020; Sharifi, 2021; Wendling et al., 2018; Zeng et al., 2022).

Table 8 Thematic Categories within Sustainability Dimensions, M. Gudac Cvelic

Sustainability Dimension	Thematic Category	Key Indicators and Concerns	Description
Environmental	Climate and Energy (incl. CO_2 emissions, climate change)	Greenhouse gas emissions, renewable energy use, energy efficiency, climate adaptation measures	Evaluates contributions to and mitigation of climate change through energy systems, efficiency levels, and emission control.
	Water	Water use, consumption, and quality; wastewater management	Monitors sustainable water usage, quality control, and conservation to protect freshwater ecosystems.
	Mobility and Transport	Modal split, vehicle emissions, sustainable mobility options	Measures accessibility and environmental impacts of transport systems promoting low-carbon mobility.
	Waste and Materials	Waste generation and recycling, circular economy, material productivity	Assesses waste prevention, recycling rates, and material loops toward resource efficiency.
	Air Quality	Pollutant concentration (NO_x, $PM_{2.5}$, O_3), emission sources	Tracks air pollutants harmful to health and ecosystems, guiding cleaner production and mobility policies.
	Land Use and Spatial Development	Land consumption, brownfield regeneration, sprawl control	Evaluates efficiency of land use and protection of ecological and agricultural land.
	Biodiversity and Ecosystems	Habitat connectivity, green space availability, species richness	Monitors ecological health and resilience through

Sustainability Dimension	Thematic Category	Key Indicators and Concerns	Description
			ecosystem services and biodiversity conservation.
	Noise and Environment	Ambient noise levels, sources, mitigation measures	Measures urban noise pollution impacts on health and habitat quality.
	Natural Disaster Resilience	Flood risk, disaster preparedness, adaptation strategies	Evaluates vulnerability and adaptive capacity to natural hazards in planning and design.
	Soil and Ecological Footprint	Soil quality, degradation, ecological footprint	Tracks soil health and overall environmental impact of human consumption and land use.
Economic	Economic Performance and Structure	GDP growth, employment rate, income distribution, economic diversity	Tracks prosperity, resilience, and inclusiveness of the local economy.
	Employment and Labor	Unemployment rates, job quality, labor participation	Measures the availability and quality of employment and economic inclusion.
	Resource Efficiency	Energy, water, and material productivity; lifecycle cost efficiency	Assesses how efficiently resources are used to generate economic output while minimizing waste.
	Infrastructure and Mobility Systems	Transportation networks, utilities, digital infrastructure	Evaluates robustness and sustainability of physical and digital infrastructure supporting growth.
	Economic Opportunity and Innovation	Entrepreneurship, technology adoption, skills development	Reflects innovation capacity, diversification, and transitions toward green jobs and industries.
	Sustainable Finance	Green investment, environmental accounting, lifecycle costing	Measures economic systems' alignment with sustainability via finance and responsible investment.
Social	Health and Well-being	Life expectancy, access to healthcare, quality of life	Assesses population health and equitable access to well-being determinants.
	Education and Knowledge	Literacy, education access, lifelong learning	Monitors human capital development and capacity to innovate and participate.
	Equity and Social Justice	Income distribution, social inclusion, participatory rights	Measures fairness and inclusion in socioeconomic systems.
	Housing and Living Conditions	Housing affordability, accessibility, and quality	Evaluates adequacy of shelter and essential services, including sanitation.
	Safety and Security	Crime rate, traffic safety, risk preparedness	Tracks safety conditions affecting human security and resilience.
	Social Cohesion and Culture	Community engagement, cultural vitality, social capital	Assesses strength of community networks and cultural life supporting social resilience.

Sustainability Dimension	Thematic Category	Key Indicators and Concerns	Description
	Green and Public Spaces	Access to parks, recreation, public facilities	Evaluates environmental and recreational well-being through inclusive public space provision.
Institutional / Governance	Institutional Capacity and Governance	Policy coherence, administrative efficiency, regulatory reliability	Assesses effectiveness and capability of institutions governing sustainable development.
	Participation and Transparency	Civic engagement, stakeholder inclusion, public accountability	Measures inclusiveness of governance and public trust-building mechanisms.
	Urban Planning and Environmental Management	Integrated planning, local environmental frameworks	Evaluates how spatial, environmental, and socio-economic systems are coordinated toward sustainable development.
	Finance and Policy Integration	Budget allocation, cross-sectoral coordination	Measures fiscal capacity and alignment of local policies with long-term sustainability objectives.
	Adaptive Governance and Innovation	Monitoring, policy learning, flexibility	Tracks responsiveness and adaptability of governance systems to emerging sustainability challenges.

5.2.3.2 Indicator Frameworks and Assessment Systems

The operational assessment of sustainability dimensions requires specific, measurable indicators. Sharifi (2021) reviews urban sustainability assessment literature and emphasizes the need for standardization amid numerous indicator frameworks. Key considerations in indicator development include relevance and validity, data availability and quality, aggregation and weighting, and stakeholder relevance. Indicators must accurately reflect the sustainability dimensions they measure. Verma et al. (2018) address the challenges of ensuring that indicators capture essential sustainability aspects rather than being merely quantifiable. Ameen and Mourshed (2019) highlight the importance of local relevance in selecting urban sustainability assessment tools. Due to historical economic disparities, developing countries prioritize economic and social development over environmental quality, in contrast to the environmental focus of developed nations (Phillis et al., 2017; Mori and Christodoulou, 2012). Indicator frameworks must balance comprehensiveness with data availability. Kharrazi et al. (2016) discuss the potential of urban big data for creating innovative sustainability indicators while acknowledging challenges in data standardization and access.

Assessment frameworks often combine individual indicators into composite indices. Valdivia-Loro (2019) analyzes various aggregation techniques for urban sustainability indices and suggests that the harmonic average provides optimal sensitivity to underperformance in any dimension. Indicator frameworks must be relevant to a diverse range of stakeholders, such as policymakers and communities, requiring a balance between technical precision and effective communication. Not all methodologies can be applied in complex environments with diverse stakeholders who have varied requirements, principles, and authorities (Mrak et al., 2022).

Specialized assessment frameworks have been developed for various contexts and scales. Systems such as LEED-ND, DGNB-UD, and GRIHA-LD evaluate neighborhood sustainability, with LEED-ND emphasizing transportation and DGNB-UD providing a balanced approach (Bahale and Schuetze, 2023). Pakzad et al. (2016) design sustainability indicators for green infrastructure, highlighting its multifaceted benefits that require integrated assessments. Wendling et al. (2018) align nature-based solution assessments with SDG indicators, demonstrating how specialized frameworks can address broader sustainability goals while targeting specific interventions. Sustainability assessment recognizes the importance of spatial and temporal factors. Challenges and opportunities vary by scale and location, necessitating adaptable frameworks to ensure coherence (de Oliveira et al., 2023). Sustainability also encompasses short-term impacts and long-term trajectories, requiring frameworks to balance urgent needs with extended time horizons for benefits.

Zeng et al. (2022) develop integrated frameworks that assess both sustainability dimensions (social, economic, environmental) and resilience capacities (adaptive, absorptive, transformative), offering a more comprehensive approach to evaluating urban system performance.

5.2.4 Resilience vs. Sustainability

Resilience and sustainability are different but interconnected concepts that relate to complex environmental, social, and economical systems. They define the system's states, but they use different analytical methods. Clarifying the

differences and similarities between resilience and sustainability is important for further research.

Urban sustainability is defined by the Brundtland Report. It is a development that meets the user generation's present needs "without compromising the ability of future generations to meet their own" (Brundtland and Khalid, 1987). It's an active integration process and an evolving interplay of city-making systems across spatial and temporal scales (Cristina Serbanica, 2023), (Imperatives, 1987). In contrast, urban resilience is the capacity of an urban system and its factors, during different timeframes and between various physical spaces, to maintain or rapidly restore functions when disturbed, adapt to change, and change in response to the adaptive capacity state (Meerow et al., 2016). Although both concepts have been extensively theorized and operationalized, they share many overlapping factors. Their non-equivalence becomes clear when considering the temporal nature of the environmental phenomena they address resilience is typically associated with acute shocks such as landslides or droughts, while sustainability is more closely related to long-term, cumulative stresses such as climate change, persistent economic inequality, and declining social cohesion (Meerow et al., 2016). Empirical analysis of cities participating in the 100 Resilient Cities initiative shows how hazards and acute shocks act differently from chronic stresses. The two diversities distinguish urban resilience and urban sustainability. The intersection of these dimensions highlights a set of latent challenges that can be interpreted as an urban safety and inclusiveness dimension (Cristina Serbanica, 2023). Meanwhile, the concept of brownfield sustainability has shifted from a narrow focus on contamination clean-up and industrial reuse to a more holistic understanding that couples environmental remediation with economic revitalization and social inclusion, as seen in the evolution from early brownfield regeneration principles to systematic reviews of brownfield sustainability dimensions and stakeholders (Hollander et al., 2010), (Dan He, 2024). Legislative and policy developments such as the U.S. Small Business Liability Relief and Brownfields Revitalization Act and more stringent European Union remediation standards further underscore this shift, addressing liability, enforcing higher environmental performance, and encouraging the integration of sustainable

practices in redevelopment (Vanheusden, 2009). Waterfront regeneration literature complements these debates by pointing out how environmental aspects – including sustainable urbanism, soil decontamination, climate and flooding risks, coastal ecosystem protection, and the quality of the urban landscape – are important when resilience and sustainability, as well as urban safety and inclusiveness are discussed (Vale de Paula and Gonçalves, 2024).

Zeng et al. (2022) define urban resilience as having adaptive, absorptive, and transformative characteristics. Each factor is associated with specific indicators that enable cities to respond to disturbances. The authors emphasize that resilience highlights system dynamics, adaptation, and potential transformation, while sustainability focuses on maintaining key system characteristics within acceptable limits. They argue that effective urban strategies integrate both, for example, through multifunctional green infrastructure that simultaneously enhances resilience and advances sustainability objectives. They also highlight important tensions– such as efficiency versus redundancy, stability versus transformation, and short- versus long-term perspectives – demonstrating that resilience interventions do not automatically align with sustainability goals. Therefore, integrated assessment frameworks are needed to jointly evaluate sustainability dimensions and resilience capacities in urban development practice (Zeng et al., 2022).

5.2.5 International Sustainability Documents

Worldwide sustainability protocols and agreements provide essential guidance and coordination systems for global initiatives whose target involves achieving sustainable development goals. These documents represent a mutually agreed consensus among countries regarding sustainability goals, priorities, and implementation methods.

The 2030 Agenda and Sustainable Development Goals (SDGs)

The 2030 Agenda for Sustainable Development, endorsed by all United Nations member states in September 2015, is the most comprehensive international framework for contemporary sustainability. Its includes 17 Sustainable

Development Goals (SDGs) and 169 specific targets, forming an integrated framework that addresses the economic, social, and environmental dimensions of sustainable development (United Nations, 2015).

The SDGs represent a significant advancement from the previous Millennium Development Goals (2000-2015), applying universally to all nations and explicitly encompassing economic, social, and environmental aspects while emphasizing interconnectedness and the need for integrated strategies (Wendling et al., 2018; Cucuzzella et al., 2021). This framework is grounded in the principle of sustainable development, as articulated by the World Commission on Environment and Development (Brundtland and Khalid, 1987), and acknowledges the "Leave No One Behind" principle, which calls for focused attention on marginalized and vulnerable groups (Cucuzzella et al., 2021).

SDG 11 focuses on developing cities that prioritize inclusivity, safety, resilience, and sustainability. Satterthwaite (2017) notes that SDG 11 includes targets related to housing, transportation, air quality, and waste management (Satterthwaite, 2017). Key targets include ensuring access to adequate housing and essential services, establishing sustainable transportation systems, promoting participatory planning, safeguarding cultural and natural heritage, reducing negative environmental impacts, and ensuring universal access to safe, inclusive, and accessible green and public spaces, especially for women, children, the elderly, and individuals with disabilities (Satterthwaite, 2017; Cucuzzella et al., 2021). Achieving SDG 11 requires competent and accountable urban governance in collaboration with local civil society (Satterthwaite, 2017).

SDG 15 (Life on Land) focuses on the protection and restoration of terrestrial ecosystems, conservation of biodiversity, and sustainable forest management, while SDG 6 (Clean Water and Sanitation) addresses the management of water resources vital for waterfront development (Cucuzzella et al., 2021).

A challenge for the SDGs is translating global objectives into actionable local initiatives. Valencia et al. (2019) examine the process of adapting the SDGs to the city level, emphasizing that effective localization requires contextualizing global targets to fit local circumstances, strengthening local capacities for implementation and monitoring, and encouraging participation from local

stakeholders. Kharrazi et al. (2016) highlight the opportunity to leverage urban big data to develop innovative and timely indicators for monitoring SDG progress at the city level.

The Paris Agreement

The Paris Agreement, adopted in December 2015, is the most comprehensive international framework for addressing climate change, setting a goal of keeping the global temperature rise well below 2°C above pre-industrial levels and striving to limit the increase to 1.5°C. It requires all parties to submit nationally determined contributions (NDCs), with mechanisms for gradually enhancing commitments over time (United Nations Framework Convention on Climate Change UNFCCC, 2015).

The New Urban Agenda

Adopted at the United Nations Conference on Housing and Sustainable Urban Development (Habitat III) in Quito, Ecuador, in October 2016, the New Urban Agenda establishes a comprehensive framework for sustainable urban development over a two-decade period (United Nations, 2016). Satterthwaite (Satterthwaite, 2017) notes that it highlights the importance of National Urban Policies as tools to leverage the benefits of urbanization while addressing its challenges. Valencia et al. (Valencia et al., 2019) state that the New Urban Agenda complements the SDGs by providing more specific guidance for urban contexts, focusing on urban form, governance structures, and funding mechanisms.

European Union Sustainability Frameworks

The European Union has developed comprehensive sustainability frameworks that guide policy across its member states:

The European Green Deal, launched in 2019, sets out the EU's overarching strategy for achieving climate neutrality by 2050 while transforming the economy to be more sustainable, resource-efficient, and competitive, with significant implications for urban development (European Commission, 2019).

The EU Biodiversity Strategy for 2030 establishes goals for protecting and restoring ecosystems, particularly by promoting investments in green and blue

infrastructure and encouraging the systematic integration of healthy ecosystems and nature-based solutions into urban-planning. The EU's green infrastructure strategy defines green infrastructure as "a strategically planned network of natural and semi-natural areas along with other environmental features designed and managed to deliver a broad array of ecosystem services" (European Commission, 2020b). This includes city parks, green roofs, sustainable drainage solutions, and other features that provide benefits such as water purification, improved air quality, recreational opportunities, and climate regulation (Naumann et al., 2011).

Article 8 of the EU Nature Restoration Regulation, that answers to key commitments made under the EU Green Deal and EU Biodiversity Strategy, sets targets for urban ecosystems. It requires Member States to ensure no net loss of urban green space and urban tree canopy cover by 2030 compared with 2024, with further improvement trends required from 2031 onward (International Union for Conservation of Nature (IUCN), 2024).

The Circular Economy Action Plan outlines steps for transitioning from linear to circular economic models, affecting resource management in cities, waste systems, and industrial ecology (European Commission, 2020a).

European policies emphasize the need to incorporate natural capital considerations into planning processes. Natural capital accounting methods quantify the economic value of ecosystem services, providing tools to justify investments in green infrastructure (European Commission, 2012). For example, Birmingham City Council's Natural Capital Planning Tool estimated £400 million in benefits from green infrastructure over 25 years (Hölzinger and Grayson, 2019).

Nature-Based Solutions Frameworks

International frameworks increasingly recognize nature-based solutions (NbS) as essential strategies for achieving sustainability and resilience goals. Wendling et al. (Wendling et al., 2018) discuss assessment schemes such as MAES (Mapping and Assessment of Ecosystems and their Services) and EKLIPSE, which provide frameworks for evaluating the performance of NbS across environmental, social, economic, and governance dimensions. These frameworks show that NbS can

address multiple sustainability challenges simultaneously, often delivering more cost-effective and co-benefit-rich solutions than traditional gray infrastructure (Wendling et al., 2018).

Urban Sustainability Assessment Frameworks

The World Bank's Urban Sustainability Framework (USF) (The World Bank, 2018) offers a comprehensive approach to assessing and planning urban sustainability, identifying six key dimensions: governance and integrated urban-planning, fiscal sustainability, urban economies, natural environment and resources, climate action and resilience, and inclusivity and quality of life. The USF uses a four-stage methodology – diagnosis, vision development, financing, and monitoring – providing a structured approach for integrating sustainability principles into urban development processes (The World Bank, 2018).

Assessment and Certification Systems

Global assessment and certification systems establish benchmarks for evaluating sustainability performance. LEED (Leadership in Energy and Environmental Design), BREEAM (Building Research Establishment Environmental Assessment Method), and DGNB (German Sustainable Building Council) provide certification frameworks for buildings and communities based on sustainability standards, translating sustainability concepts into actionable criteria (Bahale and Schuetze, 2023).

Challenges and Opportunities

Although international sustainability frameworks offer guidance, several challenges remain. Implementation gaps highlight difficulties in financing, capacity, political will, and coordination. Effective monitoring and accountability require robust data systems and clear reporting. Context sensitivity requires adapting frameworks to local conditions while balancing standardization and flexibility. Greater integration and coherence are needed among the rapidly expanding frameworks (Kharrazi et al., 2016; Valencia et al., 2019).

5.3 Sustainable Waterfront Development Strategies

City waterfronts connect urban areas with aquatic habitats. Many have transformed from industrial sites into vibrant mixed-use areas that integrate various functions (Theodora and Spanogianni, 2022; Paula et al., 2023). A holistic framework is essential for the long-term development of waterfront zones to address environmental, financial, social, and climate challenges (Wendling et al., 2018).

Nature-based solutions (NbS) contribute to multiple sustainability goals. NbS support environmental recovery through soil and habitat restoration and promote biodiversity (Kabisch et al., 2017). For climate adaptation, NbS help reduce flood risks, provide cooling benefits, and enhance resilience to climate-related challenges. Socially, NbS create accessible public spaces, recreational areas, and improve health and environmental education. Economically, NbS increase property values, attract investment, create jobs, and reduce infrastructure costs (Wendling et al., 2018; Marzio et al., 2026).

Wendling et al. (2018) observe that NbS strengthen economic resilience and foster social inclusion in urban areas. Their evaluation of NbS against SDG indicators demonstrates how these projects achieve various sustainability objectives.

Effective waterfront sustainability requires integrated planning aligned with citywide strategies and prioritizing ecological considerations. Key principles include mixed-use development, public access, ecological integration, climate adaptation, and stakeholder engagement (Samant and Brears, 2017).

Li et al. (2019) present a framework for assessing the sustainability of brownfield regeneration, as illustrated by Port Sunlight River Park. This framework includes soil remediation, adaptive reuse of structures, ecosystem restoration, and ensuring social equity in benefits.

Pakzad et al. (2016) develop indicator sets for evaluating green infrastructure on waterfronts, focusing on stormwater management and public space. Their framework assesses environmental, social, and economic impacts. Key metrics

include ecological factors (water quality, biodiversity), social elements (public access, community participation), economic aspects (real estate values, job creation), and governance factors (stakeholder involvement, policy alignment) (Pakzad and Osmond, 2016).

Niemann and Werner (2016) examine the relationship between waterfronts, cities, and sustainability by establishing criteria for sustainable urban waterfront development. Important criteria include environmental protection, integration with the existing urban structure while preserving historic character, mixed-use development to attract diverse users, and accessible public spaces with maintained sight lines to the water. Strategic requirements highlight community involvement in planning, long-term stakeholder commitment, flexible master plans, and knowledge transfer through international networks to successfully develop sustainable waterfront districts (Niemann and Werner, 2016).

5.3.1 Waterfront Regeneration Examples: Sustainability Aspects Application Overview

Successful projects integrate multiple functions, implement adaptive solutions, allow public access, incorporate green infrastructure and habitat restoration, address flood risk, involve different stakeholders, and establish institutions with multidisciplinary experts able to oversee the development (Samant and Brears, 2017). Samant and Brears (2017) note that "distinctiveness and authenticity derived via meaningful engagement with local context and participatory design processes is of increasing relevance".

Waterfront sustainability is multidimensional, requiring integrated frameworks, commitment, adaptive management, and stakeholder engagement. As climate change intensifies, sustainable waterfront strategies become critical (Zaman et al., 2024; Marzio et al., 2026).

HafenCity Hamburg transformed 157 hectares of former port land, integrating energy efficiency in high-performance buildings, climate resilience solutions through elevated flood-resistant structures, and social sustainability by building 6,000 apartments with public waterfront access (Samant and Brears, 2017).

Rotterdam is an example of a holistic sustainability approach by introducing circular economy principles, and regenerating degraded industrial areas integrating them into the urban metabolism. Water City 2035 applies solutions for rising sea levels through multiple stakeholders governance (Esteban et al., 2020; Nanco Dolman, 2024).

Waterfront Toronto applies sustainability principles through brownfield remediation, ecological restoration by renaturalizing the Don River and creating wetlands, and implementing naturalized flood management solutions (Santos, 2021; Rajabali and Agrawal, 2022).

Barcelona integrates greening operations into coastal networks that support climate mitigation, adaptation, and resilience. Green infrastructure provides temperature regulation, stormwater management, and biodiversity support (Pons Giner, 2016; Ramírez Agudelo, 2022). Criticism over tourism prioritization over social equity is present (Ballester, 2018).

Baltimore Inner Harbor initiated systematic public planning, achieved social revitalization with public spaces, and produced economic benefits (del Rio, 2018).

Sydney's Darling Harbour applies green urbanism principles, integrating renewable energy and ecological design (Lehmann, 2014).

London Docklands presents successes and failures (Sellers et al., 2006; Villella et al., 2006). Thames Barrier Park is a successful regeneration into urban greenspace (Villella et al., 2006). Russia Dock and Bow Creek wetlands failed within years due to complex designs requiring intensive maintenance and inadequate funding, showing how sustainability requires long-term governance and funding (Sellers et al., 2006).

Rheinauhafen Cologne presents social sustainability through mixed-use brownfield regeneration, creating accessible waterfront spaces (Vida Maliene et al., 2012).

Genoa Porto Antico presents social sustainability through regeneration of public spaces that enhance civic integration (Jauhiainen, 1995; Camerin, 2016).

5.4 Sustainable Parks

Urban parks play important roles in sustainable cities by providing ecosystem services, supporting biodiversity, enhancing human health and well-being, and contributing to climate adaptation and mitigation. As urbanization intensifies and environmental challenges grow, the planning, design, and management of urban parks based on sustainability principles have become even more essential.

5.4.1 Sustainability Principles in Urban Park Planning

The scientific discourse on sustainable urban parks encompasses diverse theoretical frameworks and empirical investigations. Research has focused on developing assessment methodologies that capture the environmental, social, and economic dimensions of park sustainability. Urban green spaces are increasingly recognized as essential infrastructure for climate change adaptation in residential neighborhoods, with eco-spatial indices serving as effective tools for evaluating their performance (Ferreira et al., 2022; Giedych et al., 2024; Ghavimi et al., 2025). The literature emphasizes that urban parks contribute to environmental sustainability through responsible water management, improved air quality, and mitigation of urban heat island effects, while also supporting biodiversity and providing various ecosystem services (Kimic and Fekete, 2022). Furthermore, scholarly attention has expanded to include the role of urban parks in achieving the United Nations Sustainable Development Goals, with evidence gap mapping revealing that most studies focus on health and wellbeing impacts, as well as environmental mitigation of pollution and heat island effects (Tate et al., 2024).

Researchers have developed integrated evaluation frameworks that assess landscape functions and ecological performance through comprehensive indicator systems (Zhang et al., 2014). The Ratio of Biologically Vital Areas has emerged as a quantifiable measure of park sustainability, representing the proportion of park area occupied by ecologically functional land cover types relative to hard structures (Kimic and Fekete, 2022). The literature also documents innovative approaches to urban park development, including the

transformation of brownfield sites into functional ecological landscapes and the integration of nature-based solutions for climate adaptation (Zhang et al., 2014; Santiago Fink, 2016). The scholarly contributions establish sustainable urban parks as vital components of urban environmental infrastructure, offering measurable benefits for biodiversity conservation and recreational opportunities (Myalkovsky et al., 2023).

5.4.2 Sustainable Parks, Presence in Scientific Literature

According to the SCOPUS (Elsevier, 2026a) scientific database, there has been an increase in articles on sustainable parks. The first article was published in 1974. The number reached a level of more than 10 per year in 1990. Rapid growth is notable from 2002, with the number greater than 100 in 2003, 200 in 2009, and exceeding 500 in 2018. It has continued to increase rapidly. The total number of publications found is 12,216, with 1624 publications in 2025. The most active countries are China with 2,340 published scientific articles, the United States with 1,497, and the United Kingdom with 817. Italy, Australia, and Indonesia have each published over 500 articles in total.

5.4.3 Sustainable Urban Public Park Examples

Examples of Public park regeneration are selected based on their sustainability factors implementation. Composing factors and their interrelations provide information that can be used in this research framework.

Public park examples' sustainability aspect summary is presented in **Error! Reference source not found.**.

5.4.3.1 High Line, New York City, USA

The High Line transformed a 1.45-mile elevated freight railway (built 1929–1934) into an urban park through adaptive reuse (Gulsrud and Steiner, 2019). The design preserves the railway structure and incorporates naturalized plantings inspired by self-seeded vegetation (Happold, 2024). More than 450 plant species were selected, including over 120 native to New York City boroughs, using seeds

from the original landscape. Sustainable materials include energy-efficient LED lighting, sustainably forested ipê wood, and precast concrete benches. An innovative drainage system uses egg-crate panels, crushed pea gravel, filter fabric, and gravel mulch (LaFarge, 2024).

Socially, the park resulted from grassroots activism led by Friends of the High Line, a nonprofit that raises 100% of the operating budget (Gulsrud and Steiner, 2019). Community engagement includes a Youth Corps that provides paid summer training and year-round teen employment programs (LaFarge, 2024). The park attracts 4–5 million visitors annually (Roo et al., 2011; Happold, 2024).

Economically, construction generated substantial impacts: Sections 1–2 ($238.5 million) created 2,251 jobs, while Section 3 ($90 million) created 706 jobs. By 2010, 2 million visitors generated $1.3 billion in spending, creating 15,848 jobs. Property values increased 79–95% (land) and 41–108% (market) between 2007and 2011 (Song, 2013). The project spurred over $2 billion in private investment, creating 12,000 jobs, 2,558 residential units, and 1,000 hotel rooms (Roo et al., 2011). However, these gains catalyzed gentrification, displacing long-term residents (Gulsrud and Steiner, 2019).

5.4.3.2 Gas Works Park, Seattle, USA

Gas Works Park, designed by Richard Haag Associates, transformed a heavily contaminated coal and oil gasification plant (operations ceased in 1956) into a public park that opened in 1976 (Turney and Goerlitz, 1989). The site had severe contamination: soil PAHs exceeded 100,000 µg/kg, volatile organic compounds reached up to 200 mg/L in groundwater, and cyanide concentrations ranged from 0.01 to 8.6 mg/L (Sabol et al., 1988). Remediation used multiple techniques: benzene was treated with air sparging and soil vapor extraction; PAHs were reduced through bioremediation and capping with 12–18 inches of clean soil (Weir, 2015). In 1974, sludge was mixed with sawdust and tilled into the soil; contaminated areas were covered with clean fill in 1984 (Sabol et al., 1988).

Designer Richard Haag pioneered the use of humus to improve soil and the cultivation of microorganisms to naturally degrade pollutants in less-contaminated areas (Yan and Wenbo, 2015). Endophyte-assisted

phytoremediation using willow shrubs was later proposed for remaining PAHs (Weir, 2015). The park preserved historic gas plant structures as focal points, integrating industrial heritage into the landscape (Turney and Goerlitz, 1989). Social acceptability studies showed high public support for phytoremediation (mean rating 4.16 out of 5), with informational plaques suggested to explain the site's history and ongoing remediation. Phytoremediation proved significantly less expensive than traditional excavation methods while maintaining public access (Weir, 2015).

5.4.3.3 Freshkills Park, Staten Island, New York City, USA

Freshkills Park is transforming the world's largest landfill (890 hectares) into New York City's largest park– three times the size of Central Park– with full opening scheduled for 2030 (Wilczkiewicz, 2017). Methane gas from landfill decomposition is captured, cleaned, and converted to pipeline-quality gas, generating hundreds of millions of dollars in revenue (New York City Department of Parks & Recreation, 2026). Landfill mounds are capped with impermeable plastic and clay, and biogas and leachate are collected through extensive pipe and drainage systems (Huang, 2023).

Environmental restoration includes revegetation to create diverse native habitats, with experimental woody plant patches testing ecological function. Birds have naturally dispersed thousands of native woody species seeds, facilitating ecological succession (Clemants et al., 2006). The dynamic succession strategy leverages birds and insects to restore wetlands (Lipschitz, 2014).

The park incorporates renewable energy infrastructure through the Land Art Generator Initiative, featuring site-specific public artworks designed to generate clean energy for the city's utility grid (Ozgun et al., 2015). These installations create economically beneficial hybrid utility systems (Klein et al., 2013).

The park is being developed in phases with extensive community input (New York City Department of Parks & Recreation, 2026). Planned amenities include mountain biking, canoeing, kayaking, soccer fields, riding trails, playgrounds, and wetlands for environmental education (Lipschitz, 2014). The methane-to-energy

system and natural water treatment processes save approximately $145,000 annually (Rottle and Yocom, 2011).

5.4.3.4 Houtan Park, Shanghai

Houtan Park, designed by Kongjian Yu for the Shanghai Expo 2010, features a 14-hectare constructed wetland on a former industrial brownfield along the Huangpu River (Yu, 2011). It serves as ecological infrastructure, implementing multifaceted sustainability features (Rottle and Yocom, 2011). The wetland treats 634,000 gallons of polluted river water daily, improving water quality from Grade V (heavily polluted) to Grade II (suitable for recreation). After treatment, water quality achieves pH 6–9, ammonia nitrogen less than 1 mg/L, potassium permanganate less than 6 mg/L, five-day BOD less than 4 mg/L, nitrogen less than 1 mg/L, and phosphorus less than 0.2 mg/L (Nancy Rottle et al., 2011). The system uses cascades to oxygenate water and wetland plants to absorb pollutants through natural filtration and biological processes (Breeding, 2012).

The park's design incorporates permeable riprap for ecological flood control and applies "let nature do its work" principles (ArchDaily). The wetland ecosystem supports 93 plant species and over 200 animal species, demonstrating biodiversity restoration. The system sequesters 242 tons of carbon annually (Nancy Rottle et al., 2011).

Economically, the natural water treatment system saves $116,800 annually in water costs at Expo Park, totaling approximately $145,000 in annual savings. Material reuse saved $17,300 by recycling 37 tons of steel and 34,000 bricks (Nancy Rottle et al., 2011). The park served as a key ecological demonstration for Expo 2010, showcasing green technologies to millions of visitors and functioning as an educational tool for sustainable agricultural practices (Breeding, 2012).

5.4.3.5 Gardens by the Bay, Singapore

Gardens by the Bay features 18 iconic Supertrees ranging from 25 to 50 meters tall, serving as vertical gardens with integrated sustainability systems (Reid, 2013). Each Supertree incorporates photovoltaic cells that harvest solar energy

for lighting and solar thermal collectors that absorb external heat to power dehumidifier plants in the conservatories. Rainwater is collected in reservoir tanks within the Supertrees, generating electricity via turbines and providing irrigation water (Wang et al., 2016). The large canopies moderate temperature, facilitate hot air evacuation, and support water cooling (Rowe and Hee, 2019).

The complex includes two climate-controlled conservatories: the Flower Dome, the world's largest column-less greenhouse, and the Cloud Forest, both engineered for energy efficiency (Rowe and Hee, 2019). The Supertrees sustainably cool these large conservatories while offering panoramic views from an aerial walkway and an elevated café (Reid, 2013). The entire complex occupies reclaimed land and houses 80% of the world's plant species (Göbel and Maslow, 2013).

Socially, the park attracted 6.4 million visitors in 2014, serving as a major tourist attraction and educational venue. The site features an animated light and sound show in the Supertree Grove. The park operates on an annual budget of approximately $58 million (Rowe and Hee, 2019). The project demonstrates Singapore's broader green infrastructure strategy, including the Skyrise Greenery initiative, which subsidizes green roofs, walls, and balcony gardens (Newman, 2014).

5.5 Urban-planning Criteria in the context of Sustainability Literature Review

Criteria found in scientific literature, while researching Sustainability includes criteria from scientific articles and sustainability related documents. The criteria lists found in literature are in Tables 23-26, in Appendix 2: Urban-planning criteria. They are presented by name, within their belonging group, citing source or author. They are supplemented with an indicator, requirement, standard or a description, when the information is available.

SDG Project Assessment Tool Vol. 1: General Framework is a UN-Habitat document related to the SDG Project Assessment Tool for the Global Future

Cities Programme. It lists all "Sustainability Principles" aligned with the SDGs. Focused on Urban-planning, Transport, and Resilience, addresses issues like climate change and human rights. The document categorizes principles under key drivers for technical and effective aspects, acting as Volume 1 of the SDG Tool. Volume 2 (User Guide) details how to apply this framework for project assessments in urban-planning and implementation. The technical key drivers are “Social Inclusion, Spatial Planning, Environmental Resilience, and Economic Development” ((UN-Habitat), 2020). The effectiveness key drivers are: “Data-driven Management, Capacity Building, Urban Governance, and Financial Strategies” ((UN-Habitat), 2020). Table 23 in Appendix 2: Urban-planning criteria contains criteria extract that refers to WBUPP, SDG Targets it relates to, and the corresponding Principle with Description ((UN-Habitat), 2020). These criteria are presented in Table 23, Appendix 2: Urban-planning criteria.

Michalina et al. (2021) write about Sustainable Urban Development. They review the Urban Sustainability Indicator Frameworks across environmental, social, economic, and institutional dimensions. The authors compare the selection and grouping of indicators across different frameworks. Key findings identified common themes like environment, society, economy, and governance, along with frequently used indicators such as water and air quality. The document highlights substantial differences in framework structure and indicator selection, that cause inconsistencies in assessments. It points out significant gaps in analytical frameworks, quantitative assessments, data availability, and attention to regional differences.

The article synthesizes existing frameworks to clarify their strengths and weaknesses in urban sustainability indicators (Denis Michalina et al., 2021). These criteria are presented in Table 24, Appendix 2: Urban-planning criteria.

Doick et al. (2009) propose sustainability objectives for brownfield regeneration aimed at greenspace creation. They argue that brownfield greening is supported by EU/UK policy, but projects often fail due to poor objectives and competing priorities. The authors organized objectives in three pillars. Examples of Economic pillar objectives are Promote attractive, functional landscapes; and Promote social affluence and community prosperity. Examples of Social pillar

objectives are Encourage social inclusion and cohesion; and Promote health and well-being. Examples of Environmental pillar objectives are Minimize the use of un-recycled resources; Promote land, water, soil and air quality; Protect biodiversity and the natural environment; and Conserve natural and cultural heritage (Doick et al., 2009). These criteria are presented in Table 25, Appendix 2: Urban-planning criteria.

Dan He et al. (2024) analyze brownfield sustainability in the review using dimensions, indicators, and stakeholders as lenses. The authors identify a shift from the traditional triple bottom line to ecological resilience and cultural preservation in brownfield redevelopment. They examine the complexity of sustainability indicators and the need for standardization, presenting quantitatively the researched articles in PRISMA flowchart. Mapping key stakeholders like governments and community groups and their sustainable urban priorities, the authors organized the comparative summary in a table with Authors, project Phase, No. of Indicators, Sustainability Dimensions, criteria Categories (if applicable), and Citation counts (Dan He et al., 2024). These criteria are presented in Table 26, Appendix 2: Urban-planning criteria.

Contemporary research on sustainable brownfield redevelopment presents a holistic framework that integrates multiple interconnected dimensions. Recent studies have demonstrated the implementation of this multidimensional approach through various indicator systems (Dan He et al., 2024). For example, integrated assessment models have used 23-indicator frameworks to evaluate brownfield sustainability (Maximilian Morio, 2013). The development of sustainability measurement tools is shown in the expansion of the SIPRIUS indicator system, which increased from 42 to 55 indicators with the addition of a governance dimension (Martine Laprise, 2018). Analysis of the scholarly literature shows that 87.5% of studies focus on the core economic, environmental, and social dimensions, while 27.5% go further to address additional aspects such as cultural heritage preservation, community cohesion, regulatory frameworks, strategic urban-planning, biodiversity conservation, and spatial design considerations (Dan He et al., 2024). Cultural aspects and ecological concerns have become

prominent in recent scholarship, showing changes of priorities in sustainable brownfield regeneration (Mateus et al., 2017; Cappai et al., 2019; Chen and Yang, 2022).

Table 9 Public Park examples' sustainability aspect, summary, M. Gudac Cvelic

Project	Location	Development Period	Key Sustainability Features
Gas Works Park, Seattle	Seattle, Washington USA	1962-1975	innovative soil bioremediation to clean up toxic contamination, adaptive reuse of structures, sustainable landscape management
Houtan Park, Shanghai	Shanghai, China	2010	1.7 km stepped wetland sequence, floodable terraces for flood resilience, recycling of industrial materials
The High Line, New York City	New York, USA	2009-2014	native, drought-tolerant landscaping that supports urban biodiversity, advanced green roof system for stormwater management, organic maintenance practices
Gardens by the Bay, Singapore	Singapore	2006-2012	energy-efficient, cooled conservatories powered by biomass, extensive solar harvesting through "Supertrees,", closed-loop water management system
Freshkills Park	New York City, USA	2008-ongoing	multilayered landfill cap (soil, geotextiles, geomembrane) to contain waste and gas, biofuel energy generation, stormwater management

5.6 Concluding remarks on Sustainability

This chapter demonstrates sustainability evolution from the 1987 Brundtland to the multi-dimensional operational system that guides global development policy today. The expansion of the traditional three-pillar model to the fourth dimension of governance shows how institutional capacity and participatory processes are important for achieving sustainable results. This means that governance

structures and long-term institutional commitment need to accompany technical solutions.

Sustainability pillars are mutually integrated. For example, the economic aspects are integrated within society, and within the environment. That and other related examples show they are not independent domains. This understanding leads to assessment and intervention requiring integrated frameworks that address interactions simultaneously. The SDGs' 17 interconnected goals allow principle implementation around the world. The distinction between resilience (addressing acute shocks) and sustainability (addressing chronic stresses) must be recognized and respected in projects.

Nature-based solutions are often financially favorable than traditional infrastructure solutions. They address multiple sustainability challenges at once, including economic value creation, environmental restoration, climate adaptation, and social equity. Houtan Park's achievement in water quality improvement provides measurable evidence of this multi-benefit potential.

Although sustainable development has evolved in the past half of a century, a great inconsistency of criteria and indicator frameworks is present. The research reveals that 87.5% of brownfield studies apply core dimensions, but the indicator selection differs in various frameworks and creates incomparable assessments. That represents an implementation barrier in a field considered to be already mature. The governance dimension only recently emerged as a formal dimension, even though previous learnings showed that effective institutions and policies are required for successful sustainability outcomes.

Non adequate maintenance planning and long-term funding result in an intervention failure, even though environmental principles and technical design excellence are implemented. That is shown on the example of London's Russia Dock and Bow Creek wetlands. Financial sustainability and institutional commitment are equally important as design quality. This is not respected in examples that prioritize innovation. Political cycles influence decisions related to sustainability that respond to short-term needs, although long-term planning that rises above political shifts is required to balance implemented solutions successfully.

6 URBAN-PLANNING CRITERIA

Urban-planning criteria were identified from various scientific sources by reviewing literature related to WBUPP factors. The goal is to determine existing criteria relevant to urban-planning for WBUPP. Analysis of four theoretical sections conducted in Chapters 2-5, provided more than 350 possible criteria, supplemented by additional criteria found during research on WBUPP urban-planning criteria, presented in Chapter 6. The total number of 400 found criteria are analyzed, verified for authenticity through scientific sources, and refined so that the final number proceeding to the following phase is 375. A comprehensive table listing 375 identified criteria from the literature review is presented in Table 29, Appendix 2: Existing Urban-Planning Criteria Related to Waterfronts, Brownfields, Urban Public Parks, and Sustainability, summarized. Criteria were identified through a literature review of WBUPP factors: the chapter on Brownfields, the chapter on Urban Waterfronts, the chapter on Public Space and Public Parks, and the chapter on Sustainability, supplemented by criteria found when researching the terms criterion, criteria, urban-planning standards, indicators, sustainability principles, and other related concepts described in section 6.2. After refinement, the criteria are organized according to three sustainability dimensions and presented in Table 30, Appendix 2: Existing Urban-Planning Criteria Related to Waterfronts, Brownfields, Urban Public Parks, and Sustainability, systematized.

6.1 Urban-Planning Criteria Definition

A systematic review of the literature reveals a notable gap: there is no universally agreed-upon, explicit definition of what constitutes "criteria" in general planning discourse, nor specifically what constitutes "urban-planning criteria." Many published indicator frameworks focus primarily on indicator design and measurement, with less consistent emphasis on explicit, theory-grounded definitions of the underlying criteria (Marina et al., 2012; Castelletti et al., 2007).

This inconsistency complicates comparison and the creation of transferable evaluations between different planning contexts (Marina et al., 2012).

Reviews of evaluation practice identify a persistent challenge in clearly defining evaluation questions and criteria before indicator selection, indicating that criteria are often under-specified or left implicit in many planning contexts (Castelletti et al., 2007). Practitioners often must translate broad, normative criteria into context-specific subcriteria and indicators, but this translation is uneven and not always fully documented in the literature.

Defining Criteria

Despite the absence of a standardized definition, the general concept of "criterion" provides a foundation for understanding its application in urban-planning contexts. The term criterion denotes a standard or principle by which something is judged, measured, or evaluated– an attribute or characteristic used to assess value, quality, or performance (Bilušić, 2024).

In urban-planning literature, criteria are described as the attributes or factors by which the performance of a planning alternative is judged; they express the interests or values of decision-makers and stakeholders and are not inherently quantitative (Hardi and Maatouk, 2023). Criteria are often organized hierarchically, from broad root criteria to more specific leaf criteria, allowing complex planning goals to be decomposed into manageable evaluation dimensions (Nesticò et al., 2020).

Urban-planning criteria can thus be understood as the technical and policy-based guidelines for urban space development. They represent what is judged in planning decisions– such as social equity, environmental quality, accessibility, or historical-architectural value– and serve to frame goals and objectives for planning interventions (Martinelli et al., 2015).

Examples from urban-planning documents show criteria framed by thematic domains (e.g., social, economic, environmental, historical-architectural), with subcriteria tailored to the specific planning context and scale (Nesticò et al., 2020; Bilušić, 2024). Hoover et al. (2023) demonstrate how planning procedures for

green infrastructure align with specific criteria used for projects, illustrating the role of criteria in translating policy goals into spatial implementation strategies.

Defining Indicators

Indicators are defined as the procedures, indices, or measures that associate a criterion with a value expressing the degree to which that criterion is satisfied; they operationalize criteria by specifying how to measure performance (Hardi and Maatouk, 2023). An indicator is a measurable tool– often quantitative or qualitative data– that tracks or reflects specific aspects of urban conditions or processes. Indicators provide observable evidence used to assess the current state or progress toward goals (UN-Habitat, 2009).

Indicator sets in urban-planning range from simple quantitative metrics (e.g., percentage of urban population with access to clean water, air pollution levels) to qualitative assessments or composite indices, and are selected or designed to allow monitoring, benchmarking, and comparison of plans or projects against stated criteria (Wong, 2015; UN-Habitat, 2009; Dželebdžić, 2013). Indicators help monitor, evaluate, and compare performance over time or across places, providing the empirical basis for assessing whether planning objectives are being met.

Indicator design practice often involves assembling structured datasets in which indicators map to sub criteria and objectives for specific planning contexts (Wong, 2015; Kenny, 2010). The selection and construction of indicators is a step that operationalizes abstract planning goals into concrete, measurable outcomes.

Distinguishing Criteria from Indicators

While criteria and indicators are closely related and often used together in planning evaluation, they serve distinct functions. Criteria define what should be achieved– the standards, principles, or requirements used to judge or evaluate urban-planning decisions, proposals, or outcomes. They represent the desired qualities or conditions against which plans, projects, or policies are assessed, and guide decision-making by setting expectations such as sustainability, safety, or accessibility (UN-Habitat, 2009; Nesticò et al., 2020).

Indicators, by contrast, are the specific measurements or data points used to assess *whether* those criteria are met. They are the operational tools that quantify or qualify performance relative to the established criteria (Hardi and Maatouk, 2023; UN-Habitat, 2009).

The relationship can be summarized as follows in Table 10.

Table 10 Criteria and Indicators comparison summary, adapted by M. Gudac Cvelic

Aspect	Criteria	Indicators
Definition	Attribute or factor used to judge alternatives; expresses stakeholder interest and values (Nesticò et al., 2020)	Procedure or index that assigns a value expressing how much a criterion is satisfied (Hardi and Maatouk, 2023)
Nature	Primarily qualitative and normative; value-laden and hierarchical (Nesticò et al., 2020)	Operational and measurable (quantitative, qualitative, or composite); implements criteria into data (Hardi and Maatouk, 2023)
Role in evaluation	Sets what matters and frames goals and objectives for planning decisions (Hardi and Maatouk, 2023)	Provides the empirical basis for assessing performance, comparison, and monitoring (Dželebdžić, 2013)
Operationalization	Does not by itself define measurement method; requires decomposition into subcriteria (Nesticò et al., 2020)	Specifies measurement method, units, data sources, and aggregation rules (Hardi and Maatouk, 2023; Wong, 2015)
Typical use	Scoping, goal definition, stakeholder negotiation, weighting	Data collection, scoring, benchmarking, trend analysis, and index construction (Wong, 2015; Dželebdžić, 2013)

In practical terms, a criterion is phrased as *the plan must ensure equitable access to public transport*, while corresponding indicators includes *percentage of population within 500 meters of a transit stop* or *average waiting time for public transport by neighborhood income level* (International Association of Public Transport UITP, 2019). The goal of this research is to establish WBUPP urban-planning criteria with corresponding indicators.

6.2 Urban-Planning Criteria, Literature Review

Criteria identified in the scientific literature during research on urban-planning criteria and general term criteria include scientific articles and doctoral dissertations. These criteria are additional to and distinct from those found in research on brownfields, urban waterfronts, public space/public parks, and sustainability. The lists of criteria from the literature are provided in Tables 27 and 28 in Appendix 2: Urban-planning criteria. Each criterion is presented by name, within its respective group, with the source or author cited. When available, each criterion is supplemented with an indicator, requirement, standard, or description.

Bilušić (2024), in the study “Urban Renewal Planning Criteria for Small Historic Towns,” presented the "Guidelines on the Evaluation of Cultural Assets Proposed for Entry into the Register of Cultural Assets of the Republic of Croatia" in tabular form. The table outlines evaluation criteria for cultural heritage assets, grouped into Property (originality, rarity, representativeness, diversity, integrity, environmental value, aesthetic-artistic value), Significance and Function (cultural role within context), Timeframe (age, preservation status), and Special Criteria (purpose/use, design, material uniqueness, surroundings, construction, craftsmanship, cultural significance, living/intangible value). Each criterion includes a concise description defining its scope and historical, functional, or environmental contributions (Bilušić, 2024). These criteria are presented in Table 27, Appendix 2: Urban-planning criteria.

Mrak (2011; 2013), in research on multicriteria evaluation for cultural heritage management from a sustainable spatial development perspective, summarized criteria and indicators based on analysis of literature and internet sources. The

table compiles cultural heritage evaluation criteria from various international sources (Cecchini and Plaisant, 2005; de la Torre, 2013; Girard and Nijkamp, 2009; Howard and Ashworth, 1999; Kalman and Létourneau, 2020; National Park Service, 2013; Throsby, 2001) and Croatian frameworks, organized thematically to assess heritage assets. Criteria cover aesthetic/symbolic values (artistic content, authenticity, cultural diversity), contextual integration (localization, environment, historical center), functional/social aspects (fruition, diversity of uses, heritage user groups), degradation challenges (dysfunctional spaces, spatial fragmentation), and economic/practical factors (financing, risk reduction, utilities) (Mrak, 2011; Mrak, 2013). These criteria are presented in Table 28, Appendix 2: Urban-planning criteria.

6.3 Review and Systematization of Existing Criteria that relate to WBUPP Components (B/W/PP/S)

6.3.1 Theoretical Foundation of the Systematization Method

Organizing urban-planning criteria by sustainability dimensions began with environmental assessment methods and expanded to include social and economic concerns as sustainability thinking entered urban-planning practice, especially from the early 2000s when urban sustainability assessment became mainstream in policy and research contexts (Lautso et al., 2002; Li Meng, 2015). Foundational methodological texts trace this evolution from single-discipline environmental appraisal to multi-dimensional evaluation frameworks and systems-thinking approaches that integrate environmental, social, and economic analyses (Lautso et al., 2002; Lichfield, 1970; Leopold, 1971).

Researchers classify standards as environmental, social, and economic to enable integrated evaluation and decision support (Lautso et al., 2002; Spiekermann and Wegener, 2004; Mrak, 2013). This tripartite framework has become the dominant organizing structure in academic and practice literature, valued for its conceptual clarity, methodological consistency, and institutional recognition (Shen et al., 2013; Spiekermann and Wegener, 2004).

The dominance of the three-pillar model is due to several factors. Conceptual clarity offers planners a concise, communicable partitioning of sustainability that aligns with policy objectives and stakeholder concerns, facilitating interdisciplinary dialogue and indicator selection (Spiekermann and Wegener, 2004). Methodological fit allows direct linkage to established tools – such as Analytic Hierarchy Process (AHP), Multi-Criteria Analysis (MCA), Cost-Benefit Analysis (CBA), Geographic Information System (GIS), and hierarchical indices – so each domain can be measured, weighted, and combined within decision support systems, even though expert opinion often forms the basis and full measurability is not always achieved (Moroke et al., 2020; Shen et al., 2013). Institutional and project adoption has reinforced the model: large EU projects, city Key Performance Indicator programs, and international assessment tools embed the three domains from sustainability as the organizing structure, producing widespread templates and benchmarks for assessment practice (Jha, 2025; Miyawaki and Tenkayala, 1980; Spiekermann and Wegener, 2004). Practical flexibility allows for extension, such as adding governance or institutional dimensions, while retaining the familiar core triad, enabling researchers and practitioners to adapt it to context without abandoning the common framework (Jha, 2025; Rincón, 2019).

Urban sustainability assessments organize indicator sets into three domains so scenarios and priorities can be compared. Examples include integrated models that couple land-useand transport models with indicator modules and use multicriteria analysis or cost–benefit analysis to address different pillars appropriately (Spiekermann and Wegener, 2004). Indicator systems are commonly structured as hierarchical indices (domains → themes → indicators) to enable aggregation, weighting, and spatial analysis, and are implemented with methods such as Analytic Hierarchy Process (AHP), Multi-Criteria Analysis (MCA), and Geographic Information System (GIS)-based metrics (Hunter et al., 2021; Shen et al., 2013; Wang and Huang, 2024).

6.3.2 WBUPP Urban-Planning Criteria Systematization Process and Methodology

Criteria are developed through an in-depth literature synthesis, beginning with the evaluation of scientific sources segmented into specific domains that together form the research framework, outlining the initial research focus: waterfront brownfield urban public park. Additional criteria are identified by reviewing literature specifically related to criteria or similar interpretations of established standards that can identify or guide the physical and intangible spatial components of WBUPP.

The identified criteria could not be compared or classified according to a common principle. Some standards are elaborated with corresponding indicators, while others do not specify the measurement method for each implementable standard. Some follow a particular principle, while others are not formally linked to any principle by their authors. Certain criteria share the same or very similar names but are interpreted differently by various authors. Some criteria refer to brownfields, some to waterfronts, some to public spaces, general spaces, central public spaces, cultural heritage, sustainability principles, or public parks, corresponding to one or sometimes multiple research topics simultaneously.

Certain groups of criteria, mostly identified from individual sources, are defined by two, three, four, or more components. Some criteria sets are classified by type, category, section, theme, process of use, impact, or by different perspectives through which the subject is analyzed, researched, or evaluated: Spatial (Sitte, 1889; Zucker, 1959; Mrak et al., 2022; Şenik and Uzun, 2022), Programmatic (Rey et al., 2022; Carr et al., 1992; Gehl and Gemzøe, 2008; Stanley et al., 2012; Carmona, 2015), Time-specific (Rey et al., 2022; Bilušić, 2024), User-specific (Howard and Ashworth, 1999; Doick et al., 2009; Martine Laprise, 2018; Mrak et al., 2022; Üzümcüoğlu, 2023), Identity-oriented (Throsby, 2001; Luigi Fusco Girard, 2009; Giovinazzi and Moretti, 2010), or Sustainable (Haughton and Hunter, 1994; Frey, 1999; Carmona, 2001; Ibes, 2016; Mrak et al., 2022; Rey et al., 2022). A significant portion of criteria sets are associated with sustainability principles: the three pillars – economic, social, and environmental components. These correspond to that classification even when their connection to

sustainability is not explicitly stated in the scientific source. For example, an article about brownfields presents criteria grouped as Economic, Urbanistic, Social, and Environmental Criteria (Burinskienė et al., 2017).

Carmona et al. (2003) develop a matrix of sustainable design principles, where principles such as Stewardship, Resource efficiency, Diversity and choice, Human needs, Resilience, Pollution reduction, Concentration, Distinctiveness, Biotic support, and Self-sufficiency are scientifically elaborated by eleven authors. Not every author considers every principle, but the overview demonstrates the diversity within principle analogies.

Some criteria found in scientific literature determine the property, timeframe, and uniqueness of the observed space. Many criteria have specific names, and one set is defined by numbers.

Since sustainability principles are the primary lens in this research, in addition to using these principles for categorizing criteria, the three sustainability dimensions most commonly used in urban-planning indicator sets are selected for systematizing urban-planning criteria. Economic, Environmental, and Social impacts, as grouped dimensions, are chosen to classify the identified criteria.

Many criteria could not be easily classified into a single category and are therefore placed in one category but marked as having characteristics that could potentially fit two or even three categories. The decision about systematization methods and the way the criteria were placed in one or more categories was determined specifically for this research. Placing a criterion into at least one of the three categories was the authors' decision, which allowed the integrity of the selected systematization system to be maintained.

The criterion ALL YEAR USE can belong to both the ECONOMIC and SOCIAL categories. When considered from a financial perspective – how a WBUPP can achieve SELF-SUFFICIENCY – the economic aspect dominates. When viewed from a social perspective – how users are encouraged to use the WBUPP year-round, and how amenities and services remain available and open throughout all seasons – the social aspect dominates.

The criterion PROCESS can belong to both the ECONOMIC and ENVIRONMENTAL categories. When considered from a financial perspective – how the planning and design process of a WBUPP is conducted – the economic aspect dominates. When considered from an environmental perspective, which is the category where all urban-planning criteria would be classified, the environmental aspect dominates.

The criterion PEDESTRIAN AND CYCLING PATH NETWORK is ambiguous because it can be considered either a social or environmental category. Non-motorized trails are paved or unpaved but are marked with distinctive, relatively durable materials within landscaped areas. Hard, obstacle-free surfaces are easily accessible to the elderly, people with disabilities, and parents with strollers, and are considered inclusive. Pebbled paths do not guarantee stability but are viewed as more natural and aligned with environmental practices. Named traffic routes usually generate programs, whether amenities or services, making program elements accessible. Programs offer opportunities to satisfy basic human needs, provide health-related features for recreational and sports activities, and include social objects that promote interpersonal interaction. This criterion can significantly improve or degrade economic efficiency, depending on the quality of connectors within the WBUPP area. In conclusion, this criterion can be part of all category groups, but placement within the Environmental category is considered optimal, given the urban public park's primary characteristic as a component of green infrastructure.

The criterion MOBILITY, initially classified as Environmental, and ACCESSIBILITY (PUBLIC TRANSPORT), classified as Social, were merged into one criterion within the Social sustainability pillar. The origins of the two, as gathered from scientific sources, are complex and share many similarities. Their composition or what they refer to can be interpreted in different ways, and depending on the context, cannot always be unified. Both criteria were used throughout sections of this research to analyze WBUPPs, but it was concluded that their physical components and application results are too similar.

6.3.3 Systematization Result

The systematization process created an inventory of WBUPP urban-planning criteria organized according to the three sustainability dimensions. Table 29 in Appendix 2 presents the complete list of identified criteria with their sources, definitions, indicators (where available), and sustainability dimension classification. The systematization revealed both the richness and challenges of existing criteria frameworks. Criteria were identified from multiple disciplinary perspectives (urban-planning, landscape architecture, environmental science, economics, sociology), from different geographic contexts (European, North American, Asian case studies), and from various types of sources (peer-reviewed articles, professional guidelines, policy documents, certification systems). Some sources provide high-level principles, such as "promote sustainability" (Doick et al., 2009; UN-Habitat, 2018; Mrak et al., 2022), while others offer detailed, measurable indicators, such as "percentage of population within 500 meters of public transport stop" (Rey et al., 2022). The systematization confirmed that many criteria cannot be neatly assigned to a single sustainability dimension. Accessibility, connectivity, mixed-use development, and resilience are examples of criteria that can fall into multiple dimensions. The systematization process made these overlaps explicit rather than imposing artificial boundaries. Criteria that are critical in one context, such as flood resilience for coastal waterfronts, are less relevant in another, such as inland brownfield parks. The systematization process retained this contextual information to support appropriate selection and adaptation for specific WBUPP projects. Comparison of criteria from different time periods reveals evolving priorities in urban-planning, as shown in Table 29 in Appendix 2. Recent sources place greater emphasis on climate resilience, nature-based solutions, social equity, and community participation (UN-Habitat, 2022; Mrak et al., 2022; Üzümcüoğlu, 2023; Zaman et al., 2024) compared to earlier frameworks that focused more on physical and economic factors (Giovinazzi and Moretti, 2010; Mrak, 2013).

Criteria selection and refinement, after systematization according to the three sustainability pillars, was performed in two steps to allow further research development as shown in Figure 3. The number of criteria in each step was

adjusted to the needs of the research segment. The intended size of the final WBUPP urban-planning criteria set for planning and design aligns with scientific literature reviews. Dan He et al. (2024) found and processed 1,423 scientific papers from the WoS and Scopus databases regarding brownfield sustainability and systematically reviewed 40 articles, showing that the number of evaluation standard components within those studies ranges from 10 to 63.

The WBUPP screening criteria set presented in Table 11 is composed of thirteen criteria derived from scientific literature. The original criteria were modified, refined, and integrated to create a standard for conducting the screening process. Screening is the process of examining data according to the 13 WBUPP screening criteria, to identify WBUPP qualities. The WBUPP representative example case analysis criteria set is composed of fifty criteria.

6.4 WBUPP Screening Criteria Set

Table 11 WBUPP analysis and classification criteria list, M. Gudac Cvelic

WBUPP ANALYSIS AND CLASSIFICATION CRITERIA LIST
Countries by Region
Park size
Water Body type
Park shape
Park content type
Park green spaces
Timeframe completion
Water Body contact intensity
Park/City relationship
Park/Neighborhood relationship
Park/Infrastructure relationship
Previous land use
GDP per capita ranking

Countries by Region criterion was established by the author as a base criterion, considering that the research scope covers the entire world and that there are no similar location-based criteria that can show the frequency of WBUPP example cases by region. The regional identity promoted by the Commission of the

European Community (1990) refers to the distinct cultural, social, and political characteristics specific to regions. This concept is included in the Matrix of sustainable design principles developed by Carmona et al. (2003), classified under the Distinctiveness principle. Mrak et.al. (2022), in their criterion C16, identify the mix of uses determined by the role and position of an urban area in the regional and local context as an important factor for achieving success in the sustainable development of urban voids as historic urban landscapes from the perspective of urban resilience. For the purpose of this screening, regions are defined as continents or commonly generalized continent sets: Africa, Asia, Australia and Oceania, North America, South America, and Europe (Britannica, 2025a).

Park size criterion was found in the scientific article by Matković and Jakovčić, (2019a) about brownfields. While they proposed a broader scale using a descriptive method (individual abandoned building, single construction plot, smaller construction complex, large, abandoned industrial, military, or traffic complexes, abandoned zones at the level of city districts, entire cities, and regions), the categories for this research were modified and defined according to the WBUPP area. Four numerical categories are established: S small (0–5 ha), M medium (5–20 ha), L large (20–100 ha), and XL extra-large (100+ ha). These categories are specified after the WBUPP size quantification and relate to differences in size connected to the complexity involved in designing and managing an area of such proportions.

Water body type criterion refers to the kind of water surface adjacent to and oriented toward the WBUPP. Its variants are derived from research analysis and specify the actual type of water body next to the areas. There are three categories: lake, sea, and river.

The relevance of this criterion is supported by various scientific sources that emphasize the importance of spatial elements in defining overall space. Mrak et.al. (2022), in developing criteria C26 and C29, highlight how the definition of a waterfront is determined by interventions and other characteristic spatial elements, whether utilizing existing resources or planning future ones that will shape the waterfront. Zaman et al. (2024) identify the criterion of preserving the

natural flow of the water body. While the article primarily addresses water restoration and preservation, it notes that no intervention can be considered without defining the water flow, which largely corresponds to the definition of the water body.

Park shape criterion contains four categories, defined after the analysis of the initial WBUPP example cases. Central, Irregular, Linear, and Longitudinal shapes comprise the four WBUPP types, serving as a common denominator by which all selected examples can be organized.

The diversity criterion within the Property criteria group, referring to cultural heritage (Bilušić, 2024), implies the presence of multiple structures, shapes, colors, and content. Carmona et al. (2003) break down and summarize the Distinctiveness principle within the Matrix of sustainable design principles as the unique feature that sets a particular place apart from others, including its architecture, layout, and local details. Sense of place captures the emotional and psychological connection people feel with a location, shaped by cultural, social, and physical attributes. The Matrix includes Frey's (1999) Sense of centrality and sense of place, highlighting how the experiential quality of a location, shaped by physical form and other factors, contributes to meaning and identity in urban environments.

Park content type criterion distinguishes two categories: mostly homogeneous and mostly heterogeneous. Mostly homogeneous WBUPP is characterized by limited, specialized functions. Mostly heterogeneous is characterized by a diversity of uses and a functional mix of cultural, environmental, and social assets. No category is exclusively one or the other, hence the use of the term " mostly."

Rey et al. (2022) define the degree of functional mix as an indicator of sociocultural diversity within urban parks, evaluating how parks serve a range of functions beyond recreation– such as culture, services, and tourism. The presence of diverse uses is directly correlated with a richer sense of place, stronger community relevance, and enhanced resilience. Hauri (2011) claims that merging density and functional mix reduces the geographical gap between activities and supports the creation of a "short-distance territory." Girard and

Nijkamp (2009), and Hough (1984) further emphasize the importance of use diversity for creating vibrant, adaptive environments. One of Hough's five ecological design principles is diversity, which is the basis for environmental and social health (Hough, 1984). Randall and Baetz (2015) introduce the Land Use Diversity Index as a possible urban sustainability criterion. The term "land-use diversity" is proposed as representative of many physical attributes of neighborhood form. Breheny (1992b) and Bentley (1990) elaborate on variety as the choice of experiences, and mixed use as essential physical design criteria within strategies for sustainable development design. They promote permeability (the extent to which a park is visually and physically accessible) and functional diversity, arguing that these attributes directly improve social interaction, economic vitality, and security. Frey (1999) adds the dimension of a hierarchy of services and facilities, linking mixed-use diversity to infrastructure. Recent work by Mrak et al. (2022) focus on resilience-oriented infrastructure and public use predominance as defining traits of heterogeneous parks. Their criteria support multifunctionality and adaptability, ensuring parks respond to environmental and social challenges. URBED (1997), Evans (2001), and others extend these concepts to urban networks, advocating for integration, permeability, and variety. These qualities foster connected public spaces and rich user choices.

Park green spaces criterion quantifies natural surfaces within the WBUPP area. Three categories are established after the screening assessment to diversify analyzed example cases. A rough estimate is performed by visual inspection using Google Earth Pro, Google Maps, and Google Street View (LLC, 2025; LLC, 2026a; LLC, 2026b), along with other internet sources. The Minimal (0–10%) category includes parks with between zero and ten percent green surface coverage. The Medium (10–30%) category includes those with between ten and thirty percent. The Significant (31–100%) category comprises WBUPP with predominant vegetation.

Green surfaces are defined as the proportion of green surface area (grass, natural bodies of water, biotopes, etc.) relative to the total potential surface area (Jacques Teller, 2014). This serves the Biodiversity criterion in the Environmental Balance group of project criteria and indicators found in Rey et al. (2022). Urban

green infrastructure is important for various ecosystem services and the maintenance of biodiversity (María Teresa Gómez-Villarino, 2021). Mrak et al. (2022) mention this in the process of creating criterion C37, Percentage of Green Area, in accordance with SDG Goal 11 (United Nations, 2015). Green area within the city (forests, parks, gardens, etc.) per inhabitant (m²/inhabitant) is one of the most popular indicators of sustainability in the thematic category Green Space, within the Social Dimension (Michalina et al., 2021).

Timeframe completion criterion contains three categories, set after analysis of the initial WBUPP example cases. The categories— 2nd half of the 20th century, Early 21st century, and the Last decade – comprise the timeframe for WBUPP example case selection, reflecting contemporaneity. The evolution of sustainability principles, climate change effects, and evolving mitigation implementation were decisive factors in setting the time period when selected WBUPP example cases were completed.

The criterion Age is found in Bilušić's (2024) doctoral dissertation, where she cited the document instructing an official government body on how to evaluate cultural heritage. It states that the age or period of creation is important for the evaluation of cultural goods (Ministry of Culture, 2004).

Water Body contact intensity criterion determines how much of the WBUPP example case's area is directly influenced by water. The criterion contains four categories, set after screening analysis of the initial WBUPP example cases. Water body contact is evaluated by analyzing the length of the coastline in proportion to the size and shape of the WBUPP. Minimal contact intensity is established for up to 25% of the example case's edge in direct contact with the water surface. Medium is between 25% and 40%. Intense contact is assigned to cases where approximately 40–60% of the perimeter directly adjoins the water. Longitudinal or linear-shaped, simply formed WBUPPs are prevalently classified within the Intense category. Cases with the most intense water contact have more than 60% of their boundary on the river, sea, or lake and are characterized as Full immersion. Longitudinally shaped WBUPPs with more complex forms, such as piers, peninsular landforms, or promontories, are prevalently classified within the Full immersion category.

The criterion is derived from multiple studies referenced by Coss and Keller (Richard Gerrit Coss, 2022) that highlight how a variety of restorative environments, including waterscapes and urban parks, have aesthetic value, restore attention, and lower physical tension and heart rate (Chun-Yen Chang, 2008; Staats, 2003; Agnes Van den Berg, 2003; Hartig, 1991). Pouso et al. (2021), in a study on the influence of the COVID-19 pandemic, concluded that contact with nature provides many intangible benefits and can protect against the negative consequences of lockdown measures on mental health. They also cite other scientific sources confirming that spending time outdoors in blue-green spaces, or even just visually enjoying blue spaces (water bodies), provides significant wellbeing benefits (Daniel Nutsford et al., 2016; Joanne K. Garrett et al., 2019; Mathew P. White et al., 2019; Seraphim Dempsey et al., 2018).

Park/City relationship criterion was found in Matković and Jakovčić's (2019a) scientific article about brownfields. While they suggested a wider range of brownfield positions within a city (brownfield with a central position in urban/rural structure, brownfield located in the contact zone between urban/rural structure, brownfield with a peripheral position in an urban/rural structure), the criterion is modified for the purpose of this research and reduced to two categories: Within the urban tissue and Outside the urban tissue. It does not define whether the WBUPP example case is located within city limits, but it does indicate if the wider area of its position is relatively densely built.

Park/Neighborhood relationship criterion classifies how a park physically and functionally relates to its surrounding urban fabric, defining three categories: Contact, Distant, and Integrated. When a WBUPP is located next to the neighborhood it serves, it is characterized as Contact. If the WBUPP example is physically detached from its surrounding urban tissue, the corresponding category is Distant. For example, when the WBUPP area is on significantly lower terrain than the buildings or is separated by a heavily trafficked highway with sparse connections, it is classified as Distant. WBUPPs whose shape causes their ground perimeter to be mostly surrounded by built areas, or whose shape is irregular and encircled by urban tissue, are classified as Integrated.

Mrak et al. (2022) emphasize the proximity and integration of public spaces with workplaces, services, and housing. SDG Goal 11.7 (United Nations, 2015), which calls for universal access to safe, inclusive, and accessible green and public spaces, is integrated into various sustainability principles developed by the United Nations Human Settlements Programme. Some of the performance criteria that formed the basis for the Park/Neighborhood relationship criterion align with the Key Driver Spatial Planning. Appropriate urban density, urban regeneration, and planned city extensions ensure a compact and sustainable city form that promotes compact (re)development based on a human scale with walkable distances.

"Public space as a citywide network ensures equitable distribution and continuity of ecosystems, recommending that public spaces be placed within a walking distance of 400 m, equivalent to a 5-minute walk" (UN-Habitat, 2018).

Park/Infrastructure relationship criterion classifies how a park physically and functionally relates to noticeable infrastructure in three categories: Contact, Distant, or Intersecting. It was derived from scientific sources that highlight the importance of transport connectivity, a well-connected urban structure, and investments in infrastructure.

Carmona et al. (2003) emphasize public transport and reduced traffic volumes as key aspects of a more sustainable urban form and public-space networks. Frey (1999) also argues that a clear movement hierarchy and priority for walking, cycling, and public transport underpin energy- and land-efficient infrastructure. Carmona et al. (2003) classify contemporary public spaces as positive (e.g., public open spaces, civil spaces), negative (transport spaces, service spaces, leftover spaces, unsustainable spaces), ambiguous (exchange and public–private spaces, internal public spaces, display and heavy spaces, border and teleological user spaces), and private (private economic and internal/external private spaces). Burinskienė et al. (2017) studied criteria that contribute to decision-making strategies for the redevelopment of brownfield land in urban areas. They concluded that investments in infrastructure and the cost of new real estate are the most significant criteria from the economic group.

Previous Land Use criterion classifies WBUPPs in six categories according to their previous land use: Port Infrastructure, Industrial, Port Infrastructure – Industrial, Landfill, Reclaimed Land, and Mixed Use. The criterion evolved from those found in scientific literature to the final categories established after the WBUPP example case screening analysis.

The original criterion was found in Matković and Jakovčić (2019a), a scientific article about brownfields. Perović and Kurtović Folić (2012) outline key categories including industrial zones, military complexes, mining installations, railway complexes, coastal areas, and municipal public service facilities. Kranjčević (2016) mentions residential brownfields and tourism brownfields. The final Previous Land Use criterion categories listed in Matković and Jakovčić (2019a) include industrial brownfields, military brownfields, exploitation fields and mines, railway and other transport complexes, port areas, utility buildings and surfaces, residential brownfields, tourist brownfields, and brownfields without previous use, such as never-completed buildings and complexes.

The GDP per capita ranking criterion classifies WBUPPs into one of four categories of the economic development index, based on their position relative to a country's income per person (Wikipedia, 2025b). This criterion is grounded in scientific literature that examines the nature of economic resources. To meet the objectives outlined in these reference criteria, investing stakeholders must demonstrate economic proficiency. Therefore, this criterion groups the example cases by country within an economically defined category.

Rey et al. (2022) propose economic efficiency indicators that distinguish direct costs (investment costs, gross rental yield), indirect costs (annual operating costs, level of occupancy), and external costs (such as environmental or social externalities), along with flexibility measured as the degree of building or spatial adaptability.

Mrak et al. (2022) emphasize urban design based on long-term circular economy principles, promoting the reuse of land and materials, extended service life of structures, and reversible or flexible layouts that can accommodate future functions.

Within the Resource Efficiency principle, Carmona et al. (2003) highlight the prudent use of land and infrastructure as part of good urban design, linking compact form and efficient networks to reduced costs and higher quality. Hough's (1984) and Haughton and Hunter's (1994) discussions of "economy of means" in sustainable cities literature propose doing more with less– minimizing material and energy inputs, reusing existing assets, and integrating ecological processes– thereby aligning economic criteria with environmental limits rather than short-term profit alone.

6.5 WBUPP Analysis Criteria Set

After systematization of the 375 WBUPP criteria sourced in scientific literature, the selection of criteria for WBUPP representative example cases analysis began. This required a group process to select those referring to the same subject range, which was not clearly defined. After the initial selection phase, 102 criteria were identified as possible, and in many cases, variants of the same criterion appeared. These proposals had to be refined to define the scope and range of each individual criterion, which had to possess a unique meaning to avoid duplication of criteria range or objectives.

The final phase before starting the WBUPP representative example case analysis was to modify the criteria to obtain clear definitions with targets that are usable in the analysis and recognizable in example case data and spatial component layers. WBUPP representative example cases analysis criteria distribution by three pillar sustainability model dimensions is shown in Figure 7. WBUPP representative example cases analysis criteria are presented in Table 12.

Table 12 WBUPP representative example cases analysis criteria, M. Gudac Cvelic

DIMENSION	WBUPP REFERENCE CASES ANALYSIS CRITERIA	CRITERIONs SCIENTIFIC SOURCE
ECONOMIC	PLANNING	Giovinazzi, O. and Moretti, M. (2010); Mrak et.al. (2022); Rey, E., et.al. (2022)
	PROCESS	Rey, E., et.al. (2022); Mrak et.al. (2022)
	SELF-SUFFICIENCY	Doick et al. (2009)
	EMPLOYMENT OPPORTUNITIES	Doick et al. (2009)
	LOCAL/REGIONAL ECONOMIC REGENERATION	Doick et al. (2009)
	ALL YEAR USE	Mrak et.al. (2022)
	CIRCULARITY CONSTRUCTION	Mrak et.al. (2022); Williams J. (2021)
	IMPLEMENT TOURIST ACTIVITY	Mrak et.al. (2022)
SUM	8	5
ENVIRONMENTAL	SIZE	(Matković and Jakovčić, 2019a)
	POSITION WITHIN NATIONAL TERRITORY	(Matković and Jakovčić, 2019a)
	POSITION WITHIN URBAN/RURAL STRUCTURE	(Matković and Jakovčić, 2019a)
	PREVIOUS USE	Perović, Kurtović Folić, 2012; Kranjčević, 2016; (Matković and Jakovčić, 2019a)
	SPACE MANAGEMENT	Carmona (2010a); Ching, F.D. (1979)
	HISTORICAL AND CULTURAL VALUE	(Matković and Jakovčić, 2019a); Throsby D. (2001)
	SPATIAL MORPHOLOGY	Sitte (1889); Zucker (1959); Carmona (2014) in Krmpotić Romić, I. (2025)
	ACCESSIBILITY	Giovinazzi, O. and Moretti, M. (2010); UN-Habitat, (2020)
	NATURE-BASED SOLUTIONS IMPLEMENTATION	Bin Z. (2024)

DIMENSION	WBUPP REFERENCE CASES ANALYSIS CRITERIA	CRITERIONs SCIENTIFIC SOURCE
	WATER-SENSITIVE URBAN DESIGN (WSUD) INTEGRATION	Bin Z. (2024); Mrak et.al. (2022)
	CLIMATE CHANGE ADAPTATION AND MITIGATION INTERVENTIONS	(Zhang et al., 2023); Nordin et al. (2024). Greening the city: criteria and...; Ibes, D.C. (2016). Integrating Ecosystem Services Into Urban…; Mrak et.al. (2022); Doick et al. (2009)
	PEDESTRIAN AND CYCLING PATH NETWORK	Doick et al. (2009); Mrak et.al. (2022)
	URBAN DESIGN (WELL-BEING OFFERED BY URBAN DESIGN)	Mrak et.al. (2022)
	PUBLIC RESTROOMS	Mrak et.al. (2022)
	DRINKING WATER FOUNTAINS (ACCESS TO DRINKING WATER)	Mrak et.al. (2022)
	RENEWABLE ENERGY SOURCES	Mrak et.al. (2022)
	ADAPTABLE SPACES	Mrak et.al. (2022); Michael Hough (1984), Ian Bentley (1990), Haughton and Hunter (1994), URBED (1997), Evans et al. (2001), Frey (1999)
	PUBLIC TRANSPORT - resting places every 300m	Mrak et.al. (2022)
	WAYFINDING	Mrak et.al. (2022), Jamshidi, S. Ensafi, M. Pati, D. (2020); Chen et al. (2009)
	VISUAL IMPACT	Mrak et.al. (2022); (Zhang et al., 2023)
	SUSTAINABLE WASTE MANAGEMENT	Mrak et.al. (2022); Üzümcüoğlu, D. (2023) ; Williams J. (2021)
	GREEN AREAS HETEROGENEITY.	Mrak et.al. (2022); Carmona et.al. (2001/2003) (editor?), Commission of the European Community (1990), Breheny (1990), Blowers (1993), Hugh Barton (1996), Evans et al. (2001), Frey (1999)
	SPORTS/RECREATION AREAS HETEROGENEITY	Mrak et.al. (2022); Fusco Girard, L. & Nijkamp, P. (1997)
	OTHER PUBLIC AREAS HETEROGENEITY	Mrak et.al. (2022)
	REDUCE MARINE AND COAST POLLUTION	Mrak et.al. (2022)
	ECOSYSTEM PRESERVATION/RESTORATION	Mrak et.al. (2022); Doick et al. (2009);); Zhang, C., Su, Q., & Zhu, Y. (2023);

DIMENSION	WBUPP REFERENCE CASES ANALYSIS CRITERIA	CRITERIONs SCIENTIFIC SOURCE
	MIXED USE, FUNCTIONAL DIVERSITY	Fusco Girard, L. & Nijkamp, P. (1997); Mrak et.al. (2022); Rey et al. (2022) Hauri (2011); Michael Hough (1984), Michael Hough (1984) . Randall & Baetz (2015) Bentley (1990) Breheny (1992) Frey (1999) Mrak et al. (2022) URBED (1997), Evans et al. (2001), Şenik, B., & Uzun, O. (2022)
	RESILIENCE	Mrak et.al. (2022); Carmona et.al. (2001/2003) (editor?), Michael Hough (1984), Ian Bentley (1990), Haughton and Hunter (1994), URBED (1997), Evans et al. (2001); (Iturriza et al., 2020); (Wang and Foley, 2021)
SUM	28	33
SOCIAL	PROGRAM / FUNCTION	Carr et al (1992); Stanley (2010);(Gehl and Gemzøe, 2008); Carmona (2015) in Krmpotić Romić, I. (2025); Fusco Girard, L. & Nijkamp, P. (1997)
	PROXIMITY OF SOCIAL (SCHOOL FACILITIES, HOME FOR ELDERLY, HEALTH FACILITIES)	Rey, E., et.al. (2022)
	PROXIMITY OF COMMERCIAL FACILITIES	Rey, E., et.al. (2022)
	WELL-BEING	Rey, E., et.al. (2022); Zhang, C., Su, Q., & Zhu, Y. (2023);
	SECURITY (SAFETY)	Rey, E., et.al. (2022); Üzümcüoğlu, D. (2023); Mrak et.al. (2022)
	HERITAGE	Rey, E., et.al. (2022) ; ~~*Giovinazzi, O. and Moretti, M. (2010);*~~ Üzümcüoğlu, D. (2023); Ashworth (1999), Mrak et.al. (2022), Mrak (2013, Mrak (2014), Bilušić M. (2024), Andrew Blowers (1993), and Doick et al. (2009)
	DIVERSITY / SOCIAL INCLUSION	Rey, E., et.al. (2022); *Doick et al. (2009); Fusco Girard, L. & Nijkamp, P. (1997); Mrak et.al. (2022),*
	PARTICIPATION	Rey, E., et.al. (2022); Üzümcüoğlu, D. (2023); Bonney et al., (2023); Green, (2023); Hoyle, (1999); Zakirzianova, (2021); (Moore, 2016)
	EDUCATIVE FACILITIES/SERVICES	Doick et al. (2009)

DIMENSION	WBUPP REFERENCE CASES ANALYSIS CRITERIA	CRITERIONs SCIENTIFIC SOURCE
	ACCESSIBILITY (PUBLIC TRANSPORTATION) / MOBILITY	Rey, E., et.al. (2022); Mrak et.al. (2022)
	INTERVENTIONS THAT DEFINE WATERFRONT	Mrak et.al. (2022)
	SHELTER AREAS	Mrak et.al. (2022)
	VITALITY/ CONCENTRATION	Carmona et.al. (2001/2003) (editor?), Bentley (1990), Commission of the European Community (1990), Breheny (1990), Haughton and Hunter (1994), Barton (1996), URBED (1997), Rogers (1997), Evans et al. (2001), Frey (1999)
	SENSE OF PLACE	Carmona et.al. (2001/2003) (editor?), Commission of the European Community (1990), Andrew Blowers (1993), Haughton and Hunter (1994), URBED (1997), Evans et al. (2001), Frey (1999); *Giovinazzi, O. and Moretti, M. (2010)*
SUM	14	30
	TOTAL 50	

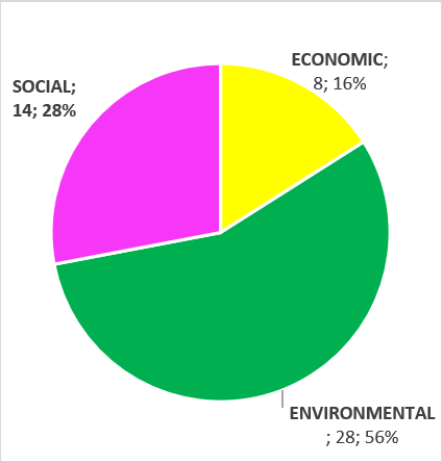


Figure 7 WBUPP representative example cases 50 analysis criteria, distribution by three pillar sustainability model dimensions, M. Gudac Cvelic

6.5.1 Economic

6.5.1.1 Planning

Planning for urban areas that include public spaces requires a strategic, comprehensive approach that integrates sustainability objectives across environmental, social, economic and governance dimensions. Giovinazzi and Moretti (2010) discuss long-term investment planning as the multi-generational and multi-character approach required in waterfront redevelopment, independently of short-term interests. Rey et. al. (2022) created a list of criteria and indicators to meet the fourth pillar of sustainability, Governance. Commissioning, as an indicator listed within Management section, relates to the qualitative analysis of the commissioning plan and the interdimensional information it contains. It complements the Planning criterion established for this research. Mrak et.al. (2022) state that the activities of urban-planning of the subject area must share the same principles applied for the wider urban area planning.

The Planning criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that was planned through the process of public design competition. No is assigned to the WBUPP example case that was commissioned directly, regardless of any previous complex process of executor selection, whether public or private. The Yes is marked with a dot. No is not marked.

6.5.1.2 Process

The process of developing urban spaces involves structured collaboration between municipal authorities, design professionals, community representatives and scientific experts to ensure decisions are transparent, evidence-based and responsive to local needs (Mrak et al., 2022; Rey, 2022). Forming the Governance criteria and indicators list, within the Process section, Rey et. al. (2022) point out the importance of Collaboration: conducting iterative design workshops that incorporate public participation from early conceptual stages through construction, enabling residents and stakeholders to influence outcomes and build ownership. Technical assessment protocols should systematically

evaluate site-specific opportunities and constraints—physical elements quality, heritage significance, ecological potential—to inform context-responsive design (Mrak et al., 2022).

The Process criterion in this research, for the purpose of WBUPP representative example cases analysis, has four categories: 1. Regional plan, 2. City Zoning, 3. Masterplan, and 4. Individual plot planning. The WBUPP example case is classified in a certain category according to its planning and realization process that involved a wider regional, city, neighborhood area, or an individual plot. The category is written in the corresponding table cell as the analysis result.

6.5.1.3 Self-Sufficiency

Self-sufficiency is a criterion derived from multi-pillar background regarding sustainability principles. Self-sufficiency of public spaces refers to the capacity of sites to generate economic, ecological and social value without perpetual external subsidy or resource importation. Ecological self-sufficiency can be achieved through nature-based systems that reduce dependence on external inputs and minimizing the use of sources that cannot be recycled (Doick et al., 2009). Economic self-sufficiency emerges when an urban space hosts diverse revenue-generating activities such as cafés, markets, educational programming and event hosting that contribute to maintenance costs while activating spaces (Carmona et al., 2003). An area can present a partial energetic self-sufficiency, especially useful in cases of emergency (Mrak et al., 2022). Social self-sufficiency develops through community stewardship, local volunteer groups and user associations that share responsibility for space activation and maintenance, reducing dependence on municipal staff (Carmona et al., 2003).

The Self-sufficiency criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that exhibits presence of chargeable amenities and services within its program. No is assigned to the WBUPP example case that doesn’t. The Yes is marked with a Dot sign. The No is not marked.

6.5.1.4 Employment Opportunities

Regeneration project generates employment across multiple sectors and skill levels, from construction trades through permanent management and maintenance positions to knowledge-sector jobs attracted by improved neighborhood quality (Rey, 2022). Doick et al. (2009) define the criterion Provide employment opportunities as one of the objectives for sustainable brownfield greening projects. Burinskienė et al. (2017) list the criterion The level of unemployment amongst the Social Criteria, for how its decrement influences the overall social perception. Rey et. al. (2022) list Employment criterion as a part of Economic impact set, within Context criteria and indicators. It refers to a Net employment density, that increases with creating spaces that, if not creating hiring opportunities in situ, need maintenance and management.

The Employment Opportunities criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that exhibits presence of amenities and services that require employees within its program. No is assigned to the WBUPP example case that doesn't. The Yes is marked with a Dot sign. The No is not marked.

6.5.1.5 Local/Regional Economic Regeneration

Brownfield regeneration stimulates local and regional economies through several mechanisms, including property value appreciation, tax revenue generation, business attraction, and increased consumer spending. One of the economic pillar objectives for sustainable brownfield greening projects is to promote local and regional economic regeneration. These objectives are derived from literature sources that identify conditions for achieving sustainability in brownfield regeneration for hard-end uses, while noting that those for soft-end uses have not been studied (Doick et al., 2009). Dair and Williams (2004) included the objective to promote the local economy within the economic group, referring to brownfield land regeneration projects for hard-end uses.

The Local/Regional Economic Regeneration criterion in this research, for the analysis of WBUPP representative example cases, has two categories: 1. Yes, and 2. No. "Yes" is assigned to a WBUPP example case that shows evidence of

economic regeneration on a local or regional scale in analyzed sources. "No" is assigned to a WBUPP example case that does not. "Yes" is marked with a dot, while "No" is not marked.

6.5.1.6 All Year Use

All-year use ensures that public spaces remain active, vibrant and economically productive throughout seasons and weather conditions, maximizing community benefit and minimizing unused infrastructure. Mrak et.al. (2022) claim the importance of all year use possibility through activities based on universal design. They distinguish primary all year use and secondary uses which depend on different seasons. A percentage should be designated for private activities that ensure all year use. Existing resources analysis and evaluation, based on natural, cultural, and social environment, is crucial in elaborating interventions proposal that define waterfronts and other characteristic spatial elements which allow, as well as encourage all year use (Mrak et al., 2022).

The All-year use criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that exhibits presence of amenities and services that can be used all year long within its program. The combination of the WBUPP program features is analyzed, it doesn't have to relate to only one amenity. No is assigned to the WBUPP example case that doesn't. The Yes is marked with a Dot sign. The No is not marked.

6.5.1.7 Circularity Construction

The circularity construction in urban parks builds on the understanding that the human environment is part of the general environment and participates in continuous exchange cycles of resources and energy. Circular organization in urban environments offers varied benefits, suggesting that multiple circular strategies should be used jointly. If these improvement investments are inadequately framed, they can induce gentrification and lead to social polarization, creating long-term sustainability deficits despite environmental gains (Mrak et al., 2022). Williams (2021), in the study about Circular cities, states how Amsterdam demonstrates an advanced city-regional approach to looping construction and organic waste, linking producers and users of "waste" through

smart data platforms and online marketplaces that facilitate continuous material exchange. This system is supported by material passports, flow-mapping databases such as CIRCLE SCAN and PUMA, and resource banks that provide storage space for recycling goods and thus enable systematic circular construction processes. Paris has adopted similar measures, using material flow data, digital marketplaces and resource banks to support circular construction and dealing particularly effectively with excavated soil through innovative “soil-dating” applications (Williams, 2021). The Queen Elizabeth Olympic Park exemplifies how circular construction and adaptive infrastructure can be embedded from the outset so that buildings, products and materials continue to generate high value beyond the initial mega-event, as seen in modular cabins from the Athletes’ Village being repurposed as a community hub through an Asset Disposal scheme that promotes reuse and charitable gifting. Brixton presents circular urbanism in an existing neighborhood, where municipally released sites and temporary planning permissions have enabled community-led projects such as urban farming, local food reuse and repair spaces that reduce resource consumption while creating employment and reinforcing a circular local economy (Williams, 2021).

The Circularity construction criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that exhibits presence of spaces for temporary use, resource banks, adaptive infrastructure, urban farming, and repair spaces. No is assigned to the WBUPP example case that doesn’t. The Yes is marked with a Dot sign. The No is not marked.

6.5.1.8 Implement Tourist Activity

Strategic tourism activation transforms urban public space into destination attractions that generate revenue, create employment and increase international and regional visitor flows. Complex urban environment mixes soft and hard activities. It can act on increasing the population’s life quality and have a positive impact on tourism (Mrak et al., 2022). Iconic architecture, public art installations and heritage interpretation create experiences that generate visibility and promotion. Fusco Girard and Nijkamp (2009) name tourism as one of the

Diversity of use components in criteria for sustainable development, in the context of adaptive heritage reuse. Mrak et.al. (2022) state that tourism based on local culture and products should be incentivized.

The Implement Tourist Activity criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that exhibits presence of amenities and facilities that stimulate tourist activity, within its program. No is assigned to the WBUPP example case that doesn't. The Yes is marked with a Dot sign. The No is not marked.

6.5.2 Environmental

6.5.2.1 Size

This criterion's theoretical background was explained in Chapter 6.4. WBUPP Screening criteria set, criterion named **Park size**.

The Size criterion in this research, for the purpose of WBUPP representative example cases analysis, has four categories: 1. S small, up to 5 hectares, 2. M medium 5-20 hectares, 3. L big 20-100 hectares, and 4. XL extra big for WBUPP whose size exceeds 100 hectares. The WBUPP example case is classified in a certain category according to its area. The category is written in the corresponding table cell as the analysis result.

6.5.2.2 Position within National Territory

The spatial positioning of urban public spaces within national administrative hierarchies and territorial networks influences their strategic importance, funding eligibility and regional development impact. Projects located within nationally designated growth poles or regional development corridors gain priority access to infrastructure investment, policy support and integrated planning frameworks. Territorial position relative to national transportation networks—highways, rail corridors, shipping channels—determines accessibility for visitors and goods. Matković and Jakovčić (2019b) establish the Position within national territory criterion for brownfield regeneration. They propose four categories: brownfields with a dominant central location and good transport connectivity, peripherally located brownfields with good transport connection and development potential,

peripherally located brownfields in areas of highly attractive landscape and built environment, and peripherally located brownfields with poor transport connectivity and weak development indicators and potentials.

The Position Within National Territory criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that has a centrally located position and good transport connectivity, within national territory. No is assigned to the WBUPP example case that doesn't. The Yes is marked with a Dot sign. The No is not marked.

6.5.2.3 Position within Urban/Rural Structure

This criterion's theoretical background was explained in Chapter 6.4. WBUPP Screening criteria set, criteria named **Park/City relationship, Park/Neighborhood relationship,** and **Park/Infrastructure relationship.**

The Position Within Urban/Rural Structure criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case with a central position in urban/rural structure. No is assigned to the WBUPP example case that is not positioned centrally. The Yes is marked with a Dot sign. The No is not marked.

6.5.2.4 Previous Use

This criterion's theoretical background was explained in Chapter 6.4. WBUPP Screening criteria set, criterion named **Previous land use**.

The Previous Use criterion in this research, for the purpose of WBUPP representative example cases analysis, has seven categories: 1. Port infrastructure, 2. Port infrastructure/ Industrial, 3. Industrial, 4. Infrastructure, 5. Landfill, 6. Reclaimed land, and 7. Mixed use. The WBUPP example case is classified in a certain category according to its previous land usage found in scientific or other relevant literature. The category is written in the corresponding table cell as the analysis result.

6.5.2.5 Space Management

Space surrounds us. It is a formless but tangible substance, experienced through movement, sight, sound, touch, and smell. Its characteristics rely on our perception of spatial boundaries, defined by elements of form (Ching, 1979). Carmona et al. (2003) discuss the concept that well-defined boundaries demarcating a specific territory render functional and social interactions and foster a sense of community and identification with the place. They argue that positive outdoor space is distinct by shape and has definite boundaries. Lynch (1960), within the five key physical elements he derived from his research, distinguishes Districts as parts of the city in which users can “enter”, that have the character of physically identifiable “thematic continuities”. Districts can have rigid and clearly defined, or soft and indistinct boundaries (Lynch, 1960).

The Space management criterion in this research, for the purpose of WBUPP representative example cases analysis, involves boundaries as the way the WBUPP area is confined. The categories evolved during the analysis; they are finally set after the analysis is performed and the results are revised accordingly. It has four categories: 1. Open boundary, 2. Closed boundary, 3. Permeable boundary, and 4. Water boundary. The analysis result shows which categories are present in WBUPP example case. The categories are written in the corresponding table cell as the analysis result.

6.5.2.6 Historical and Cultural Value

The preservation and activation of historical and cultural value distinguish waterfront brownfield parks from other spatial zones, anchoring community identity, tourist appeal and place meaning. Matković and Jakovčić (2019b) establish the Historical and cultural value criterion for brownfield regeneration. They propose three categories: brownfield wholly or partially designated as a cultural property, brownfield with historical and cultural value and potential for cultural protection, but without formal protection, and brownfield without structure or value in terms of history or culture. Fusco Girard and Nijkamp (2009) name Historical – artistic conservation criteria for sustainable development, in the context of adaptive heritage reuse. Throsby (2001) in his analysis of the relationship between economic theory and cultural sectors highlights Historical

value as the representation of the living conditions of the historical period, giving it a sense of continuity.

The Historical And Cultural Value criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that holds or presents any historical and cultural value, according to the available literature and the spatial analysis. No is assigned to the WBUPP example case that does not present it. The Yes is marked with a Dot sign. The No is not marked.

6.5.2.7 Spatial Morphology

This criterion's theoretical background was explained in Chapter 6.4. WBUPP Screening criteria set, criterion named **Park shape**.

The Spatial Morphology criterion in this research, for the purpose of WBUPP representative example cases analysis, involves the WBUPP area shape. It has four categories: 1. Central, 2. Irregular, 3. Linear, and 4. Longitudinal. The WBUPP example case is classified in a certain category according to its shape. The category is written in the corresponding table cell as the analysis result.

6.5.2.8 Accessibility

Accessibility is a fundamental prerequisite for regenerated waterfronts, which should be physically and visually open to locals and tourists of all ages and income groups, and built to a quality that supports intensive use (Giovinazzi and Moretti, 2010). It is crucial to prioritize simple and comprehensive access for pedestrians, cyclists, and people with impairments, ensuring that routes, gradients, and surfaces accommodate different mobility needs. Guaranteeing accessibility for all age groups and abilities also involves incorporating sustainable design elements such as green roofs, permeable surfaces, and energy-efficient lighting, which simultaneously improve environmental performance and user comfort (Üzümcüoğlu, 2023). Background assessments recommended by UN-Habitat emphasize measuring public space per capita, distance to the nearest accessible public open space, and the presence of potential spaces on undeveloped or derelict sites zoned for public use, thereby linking accessibility to a citywide network of public spaces. Additional evaluation of how well public space meets community needs– considering size, type, quality,

use, distance, and physical barriers such as fencing– helps determine whether accessibility is equitable rather than merely nominal (UN-Habitat, 2020). Historically, the accessibility of green open spaces has been associated with positive human health outcomes, from Garden City ideas through contemporary discourses on urban sustainability and medical evidence on the benefits of nearby parks (Stanley et al., 2012). Equitable access to parks and public spaces is increasingly framed as an environmental justice issue (Howard, 1898; de Vries et al., 2003; Stanley et al., 2012). Mrak et al. (2022), in their criterion C6, distinguish the condition of safe access to all accessible areas.

The Accessibility criterion in this research, for the purpose of WBUPP representative example case analysis, has two categories: 1. Yes, and 2. No. "Yes" is assigned to a WBUPP example case that has at least one entrance point for every 200 m of its land boundary, has more than 40% of its boundaries open, or if the average entrance points exceed one every 200 m along the closed boundary. "No" is assigned to a WBUPP example case that does not fulfill the requirements for the Yes category. The Yes is marked with a dot sign. The No is not marked.

6.5.2.9 Nature-Based Solutions Implementation

Nature-based solutions (NBS) offer a comprehensive approach to improving urban areas where natural systems are already disturbed, polluted, or degraded by introducing measures inspired by and working with ecological processes. NBS often focus on enhancing blue infrastructure such as streams, stormwater drains, irrigation channels, wetlands, and other water bodies, along with public spaces that can temporarily accommodate water overflow during extreme events. They also strengthen green infrastructure, including street trees, recreation zones, playgrounds, parks, forests, greenways, and riparian strips (Zaman et al., 2024). The NBS framework was developed to implement the ecosystem services approach in spatial planning, merging ecological and social aspects. It evolves from conventional "protect and preserve" tactics to focus on enhancement, restoration, and the creation of interconnected multifunctional green networks. Within this framework, NBS integrate concepts of green and blue infrastructure, ecosystem services, and biomimicry into an urban design tool for ecologically

sensitive development (Dushkova and Haase, 2020). The European Commission defines NBS as “actions and solutions to societal challenges that are inspired by, supported by, or copied from nature,” delivering multiple environmental, social, and economic co-benefits such as improved attractiveness, health, quality of life, and green jobs (Dushkova and Haase, 2020). A rising volume of research recognizes NBS as a key instrument for addressing climate change impacts and their mitigation, with aims of urban sustainability enhancement, ecosystems rejuvenation, hybrid infrastructures innovation, and improving resilience via integrated designs. NBS establishes secure areas for recreation, varied social interactions, and strengthens community ties. In financial terms, they improve the desirability of housing areas, secure funding for upgrades, offer green employment opportunities, and expand touristic infrastructure and networks. Through the use of NBS, we can enhance our capacity for climate adaptation, enrich the variety of species, lessen environmental waste, and support ways of living that are sustainable (Dushkova and Haase, 2020). Nature-based solutions rely on three key criteria: addressing societal challenges through landscape design; drawing inspiration from local ecosystems for planning; and delivering environmental, social, and economic benefits (Ignatieva et al., 2020).

The Nature-based Solutions Implementation criterion in this research, for the purpose of WBUPP representative example case analysis, has two categories: 1. Yes, and 2. No. Yes is assigned to a WBUPP example case that presents evidence of NBS implementation, such as multi-layer tree groves, native meadows, living shorelines, natural playgrounds, or similar features. No is assigned to a WBUPP example case that does not present such evidence. Yes is marked with a dot, while No is not marked.

6.5.2.10 Water-Sensitive Urban Design (WSUD) Integration

Many concepts have emerged to design blue-green networks that enhance urban resilience and reduce multiple risks, with water sensitive urban design (WSUD) occupying a central position alongside sustainable urban drainage systems, sponge city approaches, and water sensitive cities. The WSUD concept promotes integrated management of the three core urban water systems– potable water, wastewater, and stormwater. It uses a holistic approach that addresses technical,

social, economic, and environmental factors at their respective scales. WSUD aims to improve urban environmental quality by reducing stormwater runoff volumes and the hydrological impacts of urbanization, enhancing water quality through the integration of ecological systems with human needs, and optimizing landscape amenities, aesthetics, biodiversity, and microclimates. WSUD implementation requires comprehensive integration of stormwater management, water supply, reuse, recycling, and sewage systems into a unified technical-ecological framework (Zaman et al., 2024). For seaside residential developments along waterfronts, WSUD principles translate into sustainable practices such as rainfall harvesting, energy conservation, and waste minimization strategies that capitalize on scenic views while protecting water resources (Üzümcüoğlu, 2023).

The Water-Sensitive Urban Design (WSUD) Integration criterion in this research, for the purpose of WBUPP representative example case analysis, has two categories: 1.Yes, and 2.No. Yes, is assigned to a WBUPP example case that presents evidence of WSUD integration, such as rain gardens, bioswales, permeable pavements, constructed wetlands, or similar features. No is assigned to a WBUPP example case that does not present such evidence. Yes is marked with a dot, while No is not marked.

6.5.2.11 Climate Change Adaptation And Mitigation Interventions

Public spaces play a crucial role in public life and local identity, with growing interest in how climate change specifically affects their functionality and accessibility (Marsia Marino and Mariano, 2019; Mrak et al., 2022). The dynamics of climate-related systems remain inadequately understood, complicating the comprehensive modeling of climate effects in spatial planning, where numerous factors interact across various temporal and spatial dimensions (Mrak et al., 2022; Sen Li et al., 2017). Climate change brings about rising risks such as sea and river level increases, river desiccation, and severe weather occurrences, exacerbated by pre-existing infrastructure that is either poorly maintained or based on outdated climate information. Conventional risk management that relies exclusively on physical infrastructure and economic assessments is now seen as insufficient, leading to a preference for hybrid strategies that blend hard

infrastructure with more flexible measures, such as establishing acceptable flooding thresholds and preserving functionality in critical areas through regular low-level interventions (Mrak et al., 2022; Jing Ran, 2016). Cities are increasingly recognizing their contribution to climate change and are concurrently addressing irreversible climate impacts while moving toward sustainable urban development (Iturriza et al., 2020; Pietrapertosa et al., 2018). Effective city response depends on integrated factors including governance structures, social systems, economic conditions, natural resources and infrastructure robustness (Iturriza et al., 2020; Gian Delgado and Guibrunet, 2017; Nathan L. Engle et al., 2013).

The Climate Change Adaptation and Mitigation Interventions criterion in this research, for the purpose of the WBUPP representative example case analysis, has two categories: 1.Yes, and 2.No. Yes is assigned to a WBUPP example case that presents evidence of relevant elements, such as floodable terraces, elevated program nodes or paths, shaded structures, cooling refuges, windbreak belts, or similar features. No is assigned to a WBUPP example case that does not present such evidence. Yes is marked with a dot, while No is not marked.

6.5.2.12 Pedestrian and Cycling Path Network

Pedestrian and cycling infrastructure form the functional non-motorized path network. Doick et al. (2009) performed interviews during their research about defining “sustainability objectives of brownfield regeneration to greenspace” and found that some stakeholders defined sustainability as possessing an effective public transportation system along with a well-connected network of cycling paths and walkways. Mrak et.al. (2022) point out the importance of planning and designing sea waterfronts with pedestrian paths that allow contact with water, respecting as well as integrating resilience factors. Both author's articles promote healthy living and well-being, so it can be stated how enhancing movement through an elaborate and efficient path network benefits WBUPP users.

The Pedestrian and Cycling Path Network criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that has a well-balanced path network density that reaches its program nodes, containing pedestrian and cycling paths. No is assigned to the WBUPP example case whose

pedestrian or cycling network is scarce. The Yes is marked with a Dot sign. The No is not marked.

6.5.2.13 Urban Design (Well-Being Offered By Urban Design)

Elements of urban design can be a tool that allows users to feel the way an open space offers functional adaptability. Universal design that implements comfortable and healthy structures enhances well-being in public spaces. This criterion is aligned with SDG 9 Goal that promotes quality infrastructure, and technological innovation, among others (Mrak et al., 2022).

The Urban Design (Well-Being Offered By Urban Design) criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case whose urban design elements are created according to the high-level contemporary standards. No is assigned to the WBUPP example case that does not match urban design elements standard. The Yes is marked with a Dot sign. The No is not marked.

6.5.2.14 Public Restrooms

Provision of accessible, well-maintained public restrooms constitutes essential infrastructure for park usability and public health. Mrak et.al. (2022) align with SDG's Goal 6 (United Nations, 2026b; United Nations Human Settlements Programme UN-Habitat, 2020) by highlighting the process of introducing and revitalizing sanitary services as criterion. It encompasses both private initiatives—facilitated through various financial and administrative frameworks—and public amenities, including essential facilities like toilets and showers. Public restroom implementation also aims to enhance the efficient utilization of water resources while simultaneously promoting recycling practices to ensure sustainability.

The Public Restrooms criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case with evident public restroom presence. No is assigned to the WBUPP example case that does not have public restrooms. The Yes is marked with a Dot sign. The No is not marked.

6.5.2.15 Drinking Water Fountains (Access To Drinking Water)

Access to drinking water fountains supports public health, enables extended public space and park visits and demonstrates municipal commitment to equitable provision of essential services. Mrak et.al. (2022) align with SDG's Goal 6 (United Nations, 2026b) by highlighting the implementation of drinking water points that are easily accessible. Public spaces drinking fountains should be planned and designed integrating resilience features (Mrak et al., 2022).

The Drinking Water Fountains (Access To Drinking Water) criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case with drinking water fountains installed. No is assigned to the WBUPP example case that does not offer access to drinking water. The Yes is marked with a Dot sign. The No is not marked.

6.5.2.16 Renewable Energy Sources

Integration of renewable energy sources into public spaces infrastructure reduces operational emissions, demonstrates climate commitment and creates resilience to energy price volatility and supply disruptions. Mrak et.al. (2022) align with SDG's Goal 7 (United Nations, 2026b; United Nations Human Settlements Programme UN-Habitat, 2020) by proposing the implementation of renewable energy sources as criterion for Strategic Sustainable Development. They promote prioritizing renewable energy usage over traditional resources, and improving energy efficiency by doubling it (Mrak et al., 2025; Mrak et al., 2022).

The Renewable Energy Sources criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case with renewable energy sources installed. No is assigned to the WBUPP example case that does not have it. The Yes is marked with a Dot sign. The No is not marked.

6.5.2.17 Adaptable Spaces

Adaptable spaces enable public spaces to respond to changing user needs, climate conditions, programming priorities and community preferences without requiring capital-intensive redesign or physical reconstruction. Mrak et al. (2022); Evans (2001); Frey (1999); Haughton and Hunter (1994); Bentley (1990); Hough

(1984); URBED (1997)} write about adaptability, flexibility, ability to adapt and change, and adaptable spaces, in the context of sustainability development or regeneration of public spaces. Carmona et al (2003) identified Adaptability as one of the seven objectives of urban design, assigning to the place a possibility of changing easily. They refer to Lynch (1960) who claimed that environments unable to adapt lead to their own failure.

The Adaptable Spaces criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case whose program or green surfaces contain adaptable spaces. No is assigned to the WBUPP example case that does not contain it. The Yes is marked with a Dot sign. The No is not marked.

6.5.2.18 Public Transport - Resting Places Every 300m

Accessible public transport with frequent resting places ensures that public spaces are easily reachable, without the need for personal motorized vehicle usage, which consequently reduces pollution. It also serves to render community destinations inclusive rather than destinations only for mobile, fit users. Mrak et.al. (2022) align with SDG's Goal 11 (Nations, 2026; United Nations Human Settlements Programme UN-Habitat, 2020) by proposing the Public Transport - Resting Places Every 300m criterion for Strategic Sustainable Development. Goal 11, Target 11.2 is based on the benefits of functional public transport network that contribute "in terms of economic activity, quality of life, the environment, and the overall success of a networked city" (Nations, 2026; United Nations Human Settlements Programme UN-Habitat, 2020).

The Public Transport - Resting Places Every 300m criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case where public transport system offers resting places every 300m. Named presence must exist within or in proximity of WBUPP's perimeter functioning as an open or permeable boundary. No is assigned to the WBUPP example case that does not meet the criterion. The Yes is marked with a Dot sign. The No is not marked.

6.5.2.19 Wayfinding

The ability to navigate through a public space is essential for effectively accomplishing one's objectives (Jamshidi et al., 2020; Weisman, 1981). The act of identifying a path from one place to another and successfully traversing that path is referred to as "wayfinding" (Chen et al., 2009). While wayfinding and navigation are often used interchangeably, navigation more precisely encompasses both wayfinding (the cognitive decision-making process of route determination) and locomotion (the physical movement along the chosen path) (Jamshidi et al., 2020; T.P. McNamara, 2008; Montello, 2005). In this context, wayfinding is understood as a problem-solving process of determining and navigating a route to a destination while recognizing that destination as one approaching it. Wayfinding therefore emerges from the interaction of cognitive functions such as problem-solving and decision-making with behavioral execution including navigation and decision implementation (Chen et al., 2009; Paul Arthur and Passini, 1992). Wayfinding is, amongst pattern language, mobility, universal design and others, a factor which shapes urban design (Mrak et al., 2022). Signage systems should provide consistent directional logic, redundant navigational cues and cultural-historical interpretation that converts functional guidance into place-making opportunities (Jamshidi et al., 2020). Successful wayfinding reduces user anxiety, increases place exploration and fundamentally shapes positive perceptions of park quality and usability (Jamshidi et al., 2020).

The Wayfinding criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that implements set of elements whose repetitive presence positively meets the criterion. The element’s number, nature, or physical appearance is not strictly defined, but the process of implementing consistent directional logic translated into physical elements that aid WBUPP users must be performed, according to the available literature and the spatial analysis. No is assigned to the WBUPP example case that does not present named characteristic. The Yes is marked with a Dot sign. The No is not marked.

6.5.2.20 Visual Impact

The assessment and selection of visual impact are fundamental considerations throughout both urban design and building design stages for public urban spaces (Mrak et al., 2022). In epidemiological research from the United Kingdom, environmental beauty has been shown to influence public health positively through large-scale analysis of landscape images using multiple regression techniques. Both landscape beauty and greening levels are confirmed to contribute to public health outcomes, with pleasant urban park scenery providing visual enjoyment that gradually reduces negative emotions and increases positive affect (Zhang et al., 2023). Puspitasari and Kwon (2019) also explore visual impact of waterfront skyline.

The Visual Impact criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that presents evidence of quality viewpoints within its boundaries, according to the available literature and the spatial analysis. No is assigned to the WBUPP example case that does not contain it. The Yes is marked with a Dot sign. The No is not marked.

6.5.2.21 Sustainable Waste Management

Sustainable waste management in urban public spaces requires visible recycling infrastructure integrated into key locations such as entry points and activity nodes, alongside organic waste composting systems that process vegetation maintenance waste alongside user-generated organics. Mrak et.al. (2022) recommend implementing design that facilitates efficient waste management (in a straightforward and effective manner, taking into account vulnerable populations) along with the designation of suitable spaces and technologies. Heritage monuments, explanatory signage and public art celebrating the site's unique history and character can anchor user engagement and stewardship, correlating with higher waste-management compliance rates (Üzümcüoğlu, 2023). The circular construction practices discussed earlier—material passports, resource banks and adaptive reuse—extend into operational waste management, ensuring that construction waste reduction principles are implemented (Williams, 2021).

The Sustainable Waste Management criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that contains recycling points or recycling bins. No is assigned to the WBUPP example case that does not contain it. The Yes is marked with a Dot sign. The No is not marked.

6.5.2.22 Green Areas Heterogeneity

This criterion's theoretical background was explained in Chapter 6.4. WBUPP Screening criteria set, criterion named **Park green spaces**.

The Green Areas Heterogeneity, Open Space, Urban Greening criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that contains heterogeneous green areas, holding at least three out of the four named categories. Green areas categories: 1. protective green areas, 2. trees disperse, 3. garden, 4. grassland. No is assigned to the WBUPP example case that does not have heterogeneous green areas. The Yes is marked with a Dot sign. The No is not marked.

6.5.2.23 Sports/Recreation Areas Heterogeneity

Sports and recreation program nodes accommodate varied interests, ages and abilities while maximizing park activation and public health benefits. Mrak et.al. (2022) recommend designing safe and universal sport and recreation areas, and define the minimum limit of 15% interventions that include activities, sports, and festivals based on characteristics such as cultural and natural heritage. Fusco Girard and Nijkamp (2009) write about one of the sustainable development aspect through exploitation of the city by integrating leisure and public services.

The Sports/Recreation Areas Heterogeneity criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that contains heterogeneous sports and recreation areas, holding at least three out of the five named categories. Sports and recreation areas categories: 1. sports pitch, 2. sports facility, 3. recreation picnic or rest area, 4. recreation grassland area, 5. playground. No is assigned to the WBUPP example case that does not have

heterogeneous sports and recreation areas. The Yes is marked with a Dot sign. The No is not marked.

6.5.2.24 Other Public Areas Heterogeneity

Diverse public spaces beyond designated recreation areas—plazas, gathering zones, quiet areas, and water-edge spaces—serve varied social functions and activity types. Mrak et.al. (2022) recommend designing safe and universal areas, other than sports, recreation, or green areas, and define the minimum limit of 10% interventions that include open public spaces.

The Other Public Areas Heterogeneity criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that contains heterogeneous Other public areas, such as plaza, waterfront promenade, or boardwalk on the water. No is assigned to the WBUPP example case that does not have heterogeneous Other public areas. The Yes is marked with a Dot sign. The No is not marked.

6.5.2.25 Reduce Marine and Coast Pollution

Waterfront park design should actively reduce marine and coastal pollution through stormwater management, waste containment, and habitat restoration to improve water quality and aquatic ecosystem health. Goal 14 of United Nations SDGs is called “Life Below Water” (The International Institute for Sustainable Development IISD, 2025), and its objective is to “conserve and sustainably use the oceans, seas and marine resources”. The stated includes responsible ocean management that integrates effective fisheries oversight, ecosystem-centered strategies, innovative financial solutions, and bold, targeted conservation efforts. Named ocean management requires increased investment, worldwide collaboration, and creative partnerships at every societal level (The International Institute for Sustainable Development IISD, 2025).

Mrak et.al. (2022) discuss interventions to reduce pollution in marine and coastal environments, such as ecosystem regeneration using multi-perspective approaches to enhance resilience, considering location-based conservation efforts.

The Reduce Marine and Coast Pollution criterion in this research, for the analysis of WBUPP representative example cases, has two categories: 1. Yes, and 2. No. "Yes, is assigned to a WBUPP example case whose regeneration resulted in reduced marine and coastal pollution, according to the available literature. "No" is assigned to a WBUPP example case whose regeneration did not result in pollution reduction. "Yes" is marked with a dot. "No" is not marked.

6.5.2.26 Ecosystem Preservation/Restoration

Doick et al. (2009) name Protect biodiversity and the natural environment as one of the objectives for sustainable brownfield greening projects, within the Environmental pillar objectives group. The strategies for planning, assessing, and choosing alternatives must emphasize the conservation and rehabilitation of terrestrial ecosystems and habitats, linking isolated areas into cohesive ecological networks at suitable scales. Measures that improve ecosystems and bolster resilience to climate change in the region as well as potentially in adjacent regions, need to be implemented. Revitalization of marine and coastal ecosystems with the goal of fully enhancing their resilience is done through a combination of hard and soft measures (Mrak et al., 2022). Research on urban parks reveals six evolutionary stages in public health connections: from preventing infectious diseases, solving environmental problems, enabling leisure sports, to social integration, mental health promotion, healthy lifestyles and integrated socio ecosystem health (Zhang et al., 2023).

The Ecosystem Preservation/Restoration criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that presents evidence of ecosystem preservation or restoration, according to the available literature and the spatial analysis. No is assigned to the WBUPP example case that does not present it. The Yes is marked with a Dot sign. The No is not marked.

6.5.2.27 Mixed Use, Functional Diversity

This criterion's theoretical background was explained in Chapter 6.4. WBUPP Screening criteria set, criterion named **Park content type**.

The Mixed Use, Functional Diversity criterion in this research, for the purpose of WBUPP representative cases analysis, has two categories: 1. Yes, and 2. No.

Yes, is assigned to the WBUPP example case that presents evidence of mixed development found within and in proximity around the WBUPP, or evidence of functional diversity found in the WBUPP. No is assigned to the WBUPP example case that does not present it. The Yes is marked with a Dot sign. The No is not marked.

6.5.2.28 Resilience

Over the past decade, the city resilience concept has evolved to strengthen urban capacities for responding to, recovering from and adapting to climate change impacts across multiple timescales. The Smart Mature Resilience (2026) project defines resilience holistically as a city's “ability to resist, absorb, adapt to and recover from acute shocks and chronic stresses” while maintaining critical services, learning through collaboration and anticipating future challenges via strengthened preparedness. Resilience-building encompasses four core dimensions: leadership and governance through stakeholder engagement and multi-level collaboration; preparedness via hazard anticipation, flexibility enhancement and education; infrastructure robustness ensuring critical service reliability; and cooperation spanning local to international partnerships. Ten essential processes include organizing for resilience, understanding risk scenarios, strengthening financial capacity, pursuing resilient urban design, safeguarding natural buffers, building institutional capacity, enhancing societal resilience, increasing infrastructure durability, ensuring effective response and building back better after events. Monitoring, learning mechanisms and targeted support for vulnerable populations complete the framework, extending resilience beyond physical assets to governance, social and economic transformation (Iturriza et al., 2020).

Wang and Foley (2021) study presents an assessment approach that established an evaluation methodology to assess the effectiveness of urban open spaces regarding ecosystem services and spatial arrangement, both of which are considered compounding resilience characteristics of urban settings. Water regulation, Climate regulation, Carbon sequestration, Habitat for biodiversity, Cultural heritage, Sense of place, Education, Health, Landscape diversity,

Typology and topography, Color and texture, Influence on adjacency, are some the main indicators evaluated in the study (Wang and Foley, 2021).

The Resilience criterion in this research, for the purpose of the WBUPP representative example case analysis, has two categories: 1.Yes, and 2.No. Yes is assigned to a WBUPP example case that presents evidence of relevant elements, such as diversified access nodes, smart monitoring systems, embedded service facilities, elevated utilities, redundant path networks, or similar features. No is assigned to a WBUPP example case that does not present such evidence. Yes is marked with a dot, while No is not marked.

6.5.3 Social

6.5.3.1 Program / Function

This criterion's theoretical background was explained in Chapter 6.4. WBUPP Screening criteria set, criterion named **Park content type**.

The Program / Function criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Homogeneous, and 2. Heterogeneous. The WBUPP example case is classified in a certain category according to its diversity of use, functional mix of cultural, environmental, and social assets. If more than 5 assets are present, it is classified in the Heterogeneous category. If five or less assets are present, it is classified in the Homogeneous category. The category is written in the corresponding table cell as the analysis result.

6.5.3.2 Proximity of Social Facilities (School Facilities, Home For Elderly, Health Facilities)

Proximity to social infrastructure– such as schools, senior care facilities, and health services– ensures that vulnerable populations can access essential services while also benefiting from park amenities and community connections. Rey et. al. (2022) include the proximity of school facilities in their sociocultural impact group within the Context criteria and indicators. They consider the average distance to a nursery, kindergarten, elementary school, junior high or middle school, and high school to assess values and determine best practice standards.

In this research, the Proximity of Social Facilities (School Facilities, Home for Elderly, Health Facilities) criterion, used for analyzing WBUPP representative example cases, has two categories: 1. Yes, and 2. No. "Yes, is assigned to a WBUPP example case that has school facilities, a home for the elderly, or health facilities within or within 200 meters of the WBUPP area. "No" is assigned to a WBUPP example case that does not have these facilities. "Yes" is marked with a dot, while "No" is not marked.

6.5.3.3 Proximity of Commercial Facilities

Commercial facility proximity creates convenient access to goods and services while generating activity that supports park vitality and user safety. Rey et. al. (2022) include the proximity of commercial facilities in their sociocultural impact group within the Context criteria and indicators. They consider the average distance to a commercial zone to assess values and determine best practice standards.

The Proximity Of Commercial Facilities criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that has commercial facilities within or in 200 m proximity around the WBUPP area. No is assigned to the WBUPP example case that does not have that. The Yes is marked with a Dot sign. The No is not marked.

6.5.3.4 Well-Being

The interaction between urban park planning design and public health has evolved through six stages: enabling leisure sports, seeking social integration and mental health, as well as cultivating healthy lifestyles, among others (Zhang et al., 2023).

Criterion is found in (Rey, 2022), listed as outdoor and indoor well-being criterion within the „quality of life" objective, related to the sociocultural sustainability pillar, in the context of urban projects. It is a part of a holistic approach in implementing the four pillars of sustainability. Questions of quality of life and user comfort occupy a central place in designing built and unbuilt spaces, with green spaces and quality public places emerging as particularly important for neighborhood attractiveness and conviviality. Criterion Well-being: Quality of outdoor spaces

specifically evaluates quality of outdoor spaces accessible to the public with multiple amenities for user well-being including seating, vegetation, play areas and sensory elements (Reiter, 2007). Design guidelines should prioritize car free public spaces connected by landscaped pedestrian and cyclist paths circling central green alleys, with sober and optimized treatments that maintain liveliness through community managed features (Rey, 2022). Psychological benefits encompass stress reduction, attention restoration and mood improvement; social dimensions include community gathering and cultural expression; physical outcomes feature activity promotion and disease prevention (Zhang et al., 2023).

The Well-being criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. The Yes is assigned to the WBUPP example case that presents many (more than five) outdoor spaces accessible to the public, with multiple amenities that contribute to the user's well-being (seating, vegetation, play area, etc.). The No is assigned to the WBUPP example case that presents few (less than five) outdoor spaces accessible to the public. The Yes is marked with a Dot sign. The No is not marked.

6.5.3.5 Security

Uzumcuoglu (2023) cites the necessity of ensuring safety measures such as lighting, access to emergency services, and clear path marking. This criterion is found in (Rey, 2022), listed as Security, and relates to the degree of security as a sociocultural quality in the context of urban projects. It refers to promoting the safety of outdoor public spaces through passive measures, such as separating vehicles from cycling and pedestrian paths, mixing functions to ensure a lively neighborhood, and standard measures like lighting and surveillance cameras. The safety criterion in scientific literature also refers to security in public transportation systems (Mrak et al., 2022).

The Security criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that presents generalized security measures in addition to the regulatory aspects, according to the available literature and the spatial analysis. No is assigned to the WBUPP example case whose handling of

security issues is limited to compliance with regulatory aspects, or not even that. The Yes is marked with a Dot sign. The No is not marked.

6.5.3.6 Heritage

Redeveloping brownfield sites serves as a powerful tool to valorize abandoned cultural heritage, generating positive impacts on neighboring property values while reviving specific site histories (Rey et al., 2022). Criterion is found in (Rey et al., 2022), listed within the sociocultural quality objectives related to the sociocultural sustainability pillar, in the context of urban projects. It is a part of a holistic approach in implementing the four pillars of sustainability. Evaluation criteria determine intervention levels based on heritage value, with minimal approaches focusing on protected structures and best practices on maintaining original substance. Prioritizing the recycling of existing infrastructures enhances public perception and economic potential through notable architectural projects. Societal recognition of conservation-worthy sites enhances brownfield perceptions and revives histories. Modern brownfield regeneration views heritage as a dynamic resource that fosters resilience, economic vitality, and collective meaning-making (Rey, 2022). Integrating heritage monuments, informative signage, and public art that acknowledges the unique regional history is important for enhancing place identity and community involvement (Üzümcüoğlu, 2023). Ashworth (1999), Mrak et.al. (2022), Mrak (2013; 2014), Bilušić M. (2024), Andrew Blowers(1993), and Doick et al. (2009) consider heritage preservation very valuable.

The Heritage criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that presents evidence of heritage elements implemented. No is assigned to the WBUPP example case that does not have that. The Yes is marked with a Dot sign. The No is not marked.

6.5.3.7 Diversity / Social Inclusion

Public places must ensure a diversity of functions and equitable access for people of all ages and abilities to support social inclusion. Rey et. al. (2022) include Diversity in their Sociocultural quality section within the Project criteria and indicators, using the degree of functional mix as their indicator. Fusco Girard and

Nijkamp (2009) highlight the importance of diversity in the context of local identity, representing values and maintaining continuity over time. Doick et al. (2009) state that encouraging social inclusion and cohesion is among their Social pillar objectives. Mrak et.al. (2022) propose characterizing gentrification limits, reviewing alternatives, and implementing strategies for equal space usage within their guidelines for sustainable development.

The Diversity / Social Inclusion criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. The Yes is assigned to the WBUPP example case that presents implementation of diversity or social inclusion, found in literature. The No is assigned to the WBUPP example case that doesn't present it. The Yes is marked with a Dot sign. The No is not marked.

6.5.3.8 Participation

Community participation in park planning, design, management, and programming ensures that development reflects actual user needs and preferences while building local ownership and social capital. Rey et. al. (2022) include Participation in their Process impact group within the Governance criteria and indicators. They consider the level of population participation, such as public consultation and information exchange with public entities or planning and design professionals, to assess and determine best practice standards. Bonney et al., (2023); Green (2023); Hoyle (2000); Zakirzianova (2021); Moore (2016); Üzümcüoğlu (2023) write about engaging the local community in planning and designing phase to ensure their accordance with true requirements.

In this research, the Participation criterion for the analysis of WBUPP representative example cases has two categories: 1. Yes, and 2. No. "Yes" is assigned to a WBUPP example case that presents evidence of participation in the WBUPP planning and design process found in the literature. "No" is assigned to a WBUPP example case that does not present such evidence. "Yes" is marked with a dot, while "No" is not marked.

6.5.3.9 Educative (Cultural) Facilities/Services

Educational and cultural facilities integrated into public scape provide programming that enriches community life, supports lifelong learning and

celebrates local heritage. Burinskiene (2017) name Access to educational institutions among their Social criteria. Doick et al. (2009) build their Social pillar objectives and present “Facilitate education” as one of them.

The Educative (Cultural) Facilities/Services criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. The Yes is assigned to the WBUPP example case that offers educative facilities or services. The No is assigned to the WBUPP example case that doesn’t offer it. The Yes is marked with a Dot sign. The No is not marked.

6.5.3.10 Accessibility (Public Transportation) / Mobility

Brownfields often occupy valuable central urban locations, close to existing transport routes. Rey et. al. (2022) include the Mobility criterion in their Environmental Impact section within the Context criteria and indicators. They identify quality of public transport service, number of parking spaces, connection to 'soft' mobility networks, and the presence of a company mobility plan as indicators. Indicator development includes the number of public transport modes, ranging from low to high levels of service, public transport frequency, and distances to public transport stops (from a limit value of about a 15-minute walk to a best practice value of about a 5-minute walk for bus, subway, and tram modes). Interventions should enhance safety and accessibility in public transport while ensuring transportation access for all users, including vulnerable populations. Suitable infrastructure should be provided for all transport modes, incorporating safety measures (Mrak et al., 2022).

The Accessibility (Public Transportation) / Mobility criterion in this research, for the purpose of WBUPP representative example case analysis, has two categories: 1. Yes, and 2. No. "Yes" is assigned to a WBUPP example case that shows evidence of a public transportation network in the vicinity. "No" is assigned to a WBUPP example case that is not served by public transportation. "Yes" is marked with a dot sign; "No" is not marked.

6.5.3.11 Interventions that define Waterfront

Distinctive interventions that create a recognizable waterfront character through artistic, architectural, or landscape elements can influence the establishment of place identity and foster community attachment while attracting visitors and

investment. Mrak et.al. (2022) discuss the importance of proposing interventions that define the waterfront with solutions based on existing resources and by creating characteristic spatial elements that support year-round use. Highlighting the value already present at the site can enhance waterfront design (Mrak et al., 2022). The Interventions That Define Waterfront criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. The Yes is assigned to the WBUPP example case whose acclaimed transformation is found in available scientific or other literature. The No is assigned to the WBUPP example case that doesn't prove that its intervention had a significant influence on the waterfront. The Yes is marked with a Dot sign. The No is not marked.

6.5.3.12 Shelter Areas

Shelter provision– including weather protection, wind buffering, and thermal comfort – significantly extends park usability across seasons and weather conditions. Pavilions and covered gathering spaces allow events, markets, and social gatherings to continue during rain, snow, or excessive heat. Wind barriers such as vegetation screens, walls, and topographic modifications reduce wind stress, which is especially important on exposed waterfront sites. Sunshade structures– including trees, pergolas, and retractable systems – offer relief during extreme heat while maintaining visual openness. Bus and transit shelters located within or adjacent to parks provide waiting areas that enhance transit accessibility and park connectivity. Mrak et.al. (2022) discuss the creation of equipped shelters to provide safe spaces during emergency situations.

The Shelter Areas criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. The Yes is assigned to the WBUPP example that offers shelters within the area. The No is assigned to the WBUPP example case that doesn't offer it. The Yes is marked with a Dot sign. The No is not marked.

6.5.3.13 Vitality/ Concentration

This criterion's theoretical background was explained in Chapter 6.4. WBUPP Screening criteria set, criterion named **Park content type**.

The Vitality/ Concentration criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that presents density of amenities and facilities, at least two per hectare on average. No is assigned to the WBUPP example case whose amenities and facilities presence is scarce. The Yes is marked with a Dot sign. The No is not marked.

6.5.3.14 Sense of Place

The "sense of place" criterion implies the meaning of urban spaces within the broader city fabric, identifying cultural and historical identity layers and their degree of expressiveness (Krmpotić Romić, 2025). As Giovinazzi (2010) argues, the collective heritage of water, city events, landmarks, and nature should be utilized to give waterfront redevelopments character and meaning, with the preservation of industrial pasts serving as an integral element of sustainable development. Authors like Kevin Lynch (1960) and Jane Jacobs (1961) studied the importance of understanding how communities inhabit spaces (Carmona et al., 2003). Relph (1976) distinguished places as centers of meaning constructed from lived experience, where individuals and societies imbue spaces with significance through emotional attachment and a sense of belonging. He termed "rootedness," representing an unconscious but profound people-place tie. Alexander (1977) further developed this thinking through pattern languages that base spatial design in observed human behaviors and activities rather than predetermined aesthetic formulas (Carmona et al., 2003). Buchanan's (1988) assertion that urban design is "essentially about place making, where places are not just a specific space, but all the activities and events that make it possible" captures the criterion's holistic nature (as cited in Carmona et al. (2003)). Blowers (1993); Commission of the European Communities (1990); Evans (2001); Frey (1999); Haughton and Hunter (1994); URBED (1997) also write about this topic.

The Sense Of Place criterion in this research, for the purpose of WBUPP representative example cases analysis, has two categories: 1. Yes, and 2. No. Yes, is assigned to the WBUPP example case that presents evidence of spaces adapted to human scale perception and usage. No is assigned to the WBUPP

example case that does not present it. The Yes is marked with a Dot sign. The No is not marked.

6.6 Concluding Remarks on Urban-Planning Criteria

Urban-planning criteria relevant to WBUPPs are integrated and organized to illustrate the depth and fragmentation of existing frameworks across the domains of brownfields, waterfronts, public spaces and parks, cultural heritage, and sustainability discourse. The chapter examines the distinction between criteria and indicators, emphasizing that criteria are value-based standards reflecting stakeholder interests and planning objectives, while indicators are operational tools that translate these standards into quantifiable variables. This distinction underscores ongoing terminological inconsistencies and hierarchical ambiguities in literature. Building on this clarification, the chapter highlights the prominence and practical utility of the triple sphere sustainability framework, demonstrating how ecological resilience, governance, and cultural and spatial dimensions increasingly complement the traditional environmental, social, and economic pillars. This supports adopting these three dimensions as the main organizing framework, while explicitly acknowledging the overlaps and ambiguities in assigning individual criteria to a single pillar. Using systematic review and consolidation methodology, diverse criteria from interdisciplinary and multi-scalar sources are compiled into an inventory and reorganized according to sustainability dimensions. This process reveals both similarities in themes such as access, environmental quality, heritage preservation, participation, and mixed use, and differences in the framing, terminology, and measurement of these themes.

Criteria systematization performed on all 375 criteria found in scientific literature partially confirms Hypothesis 2, organizing them hierarchically according to economic, environmental, and social dimensions.

The resulting outcome is not a fully unified taxonomy; instead, it is a transparent and adaptable framework that highlights the diversity and cross-cutting nature of criteria, establishes a link between sustainability principles, specific planning

criteria, and related indicators, and provides a methodological basis for evaluating WBUPP projects and developing the case study assessment matrix in subsequent chapters. A set of 50 criteria for WBUPP representative example cases analysis derived from literature review fields. These criteria's distribution by domain of origin is shown in Table 13 and Figure 8.

Table 13 WBUPP urban-planning criteria for planning and design: 50 criteria distribution according to their literature review domain origin, presented numerically M. Gudac Cvelic

BROWNFIELDS	22	27%	**13**
URBAN WATERFRONT	6	7%	**4**
PUBLIC SPACE / PUBLIC PARK	31	38%	**19**
SUSTAINABILITY	23	28%	**14**
number of segments	82		
total number of WBUPP crit	50		50

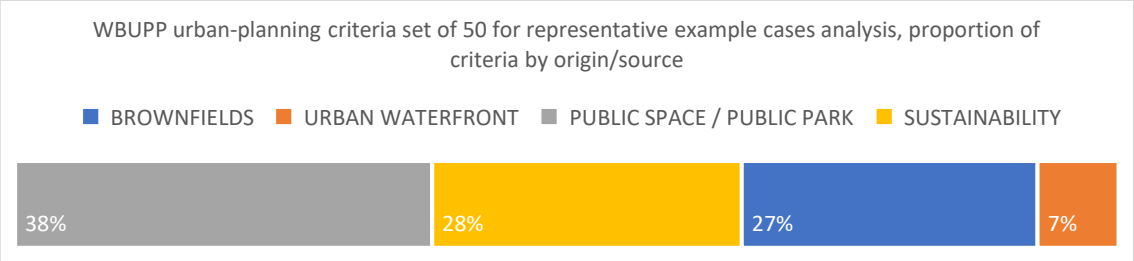


Figure 8 WBUPP urban-planning criteria for planning and design: 50 criteria distribution according to their literature review domain origin, presented graphically, M. Gudac Cvelic

7 WBUPP EXAMPLE CASES DATABASE

7.1 WBUPP Example Cases Database: Introduction, Methodology, Preliminary Research

WBUPPs are open spaces adjacent to a water body, publicly accessible, situated within the urban tissue, and redeveloped on a brownfield area.

The database containing WBUPPs does not exist, so the search for examples of WBUPP is done through scientific literature, internet sources, applying general knowledge and inquiring about information gathered through other sources, personal or academic interaction. Scientific literature is researched using WoS and Scopus databases. Internet sources and their versions used for inquiry over the course of two years (2025 and 2026) are Google, Gemini 1.0, Gemini 1.5, Gemini 2.5, Perplexity pro Sonar Model and Deep Research Integration, ChatGPT-4, ChatGPT-4.1, ChatGPT-4.5, ChatGPT-5. Keywords Waterfront, Public Park, Brownfield, Urban are applied during the search.

The WBUPP relevant cases selection method is deduced citing Flyvbjerg (2006), choosing **Random selection** type instead of the Information-oriented selection because it aims to avoid systematic biases in the sample. The sample's size is decisive for generalization. The method includes Random sampling to achieve a representative sample that allows for generalization for the entire population, or Stratified sampling to generalize for specially selected subgroups within the population. **Random sampling** is chosen for the WBUPP example cases database selection to obtain the most extensive sample available at the time, to achieve objectivity.

WBUPP example cases database is created and modified using Identification, Screening and Selection methodology, graphically represented in Figure 9 based

on the PRISMA flow diagram[4] (Matthew J Page et al., 2021; Alessandro Liberati et al., 2009).

The PRISMA 2020-based diagram presented in Figure 9 presents the Identification, Screening, and Selection phases. The Identification phase includes the search for example cases (Table 14**Error! Reference source not found.**) and removing the ones that do not meet initial elimination criteria (Table 15). WBUPP example cases are identified from three source groups: scientific literature, internet sources, and other sources. The Screening phase includes the process of examining WBUPP example cases data to identify their qualities (Table 16, Table 18, Table 19). The Selection phase includes purging WBUPP example cases, after screening analysis, that do not meet selection criteria (Table 17, Table 20).

Cases identified through named sources (151) are checked for initial search characteristics (**Error! Reference source not found.**, Table 16) and removed before screening if one or more of the listed criteria could be applied (Table 15): example cases excluded because of repetitiveness in one city (6); example cases excluded because of repetitiveness in one country (4); example cases excluded because the intervention is evidently a big waterfront brownfield neighborhood regeneration, not a park (2); example cases excluded because the intervention is evidently not completed (3); example cases excluded because they didn't seem like best examples (11).

Table 14 WBUPP initial search characteristics, M. Gudac Cvelic

WBUPP initial search characteristics
○ open space
○ urban setting (located within a city/urban tissue)
○ positioned by water body
○ built on a brownfield site

[4] PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) Statement, the original Guideline published in 2009. and the updated PRISMA 2020 statement published in 2021., is developed by an international group that included experienced authors and methodologists, as an evolution of the original QUOROM guideline for systematic reviews and meta-analyses of evaluations of health care interventions. The PRISMA Statement consists of a 27-item checklist and a four-phase flow diagram. The checklist includes items deemed essential for transparent reporting of a systematic review.

Table 15 WBUPP initial elimination criteria list, M. Gudac Cvelic

WBUPP INITIAL ELIMINATION CRITERIA LIST
○ repetitiveness within one city
○ repetitiveness within one country
○ intervention cannot be defined as a park, but encompasses a big waterfront neighborhood
○ is not completed
○ does not seem like the best example

Purged example cases (125) are analyzed by WBUPP initial examples characteristics list (Table 16) and screened using WBUPP analysis and classification criteria list (Table 18), forming an extensive multicriterial and multilevel features table in Excel spreadsheet. WBUPP example case's locations are shown on Figure 1 in Appendix, 1, chapter 1.1.1. Maps. They are pinned on a world map using Google My Maps (Google, 2026b). Screening results present a final number of WBUPP example cases database (99). The excess cases are removed if elimination criteria (Table 20) are met: example cases excluded because they were not completed (5); example cases excluded because it was hard to find documents that prove their actual state (1); example cases excluded because they were not adjacent to a water body (10); example cases excluded because their location is not real park area (2); example cases excluded because they do not meet the previous land use criteria (1); example cases excluded because their adjacent water body does not meet the criteria (1); example cases excluded because they do not meet Timeframe completion criteria (1); example cases excluded because there is no waterfront park area, the whole island is a tourist resort (1); example cases excluded because of combination of listed criteria (4).

WBUPPs are classified, and a comparative analysis is performed, with results presented in the following chapter.

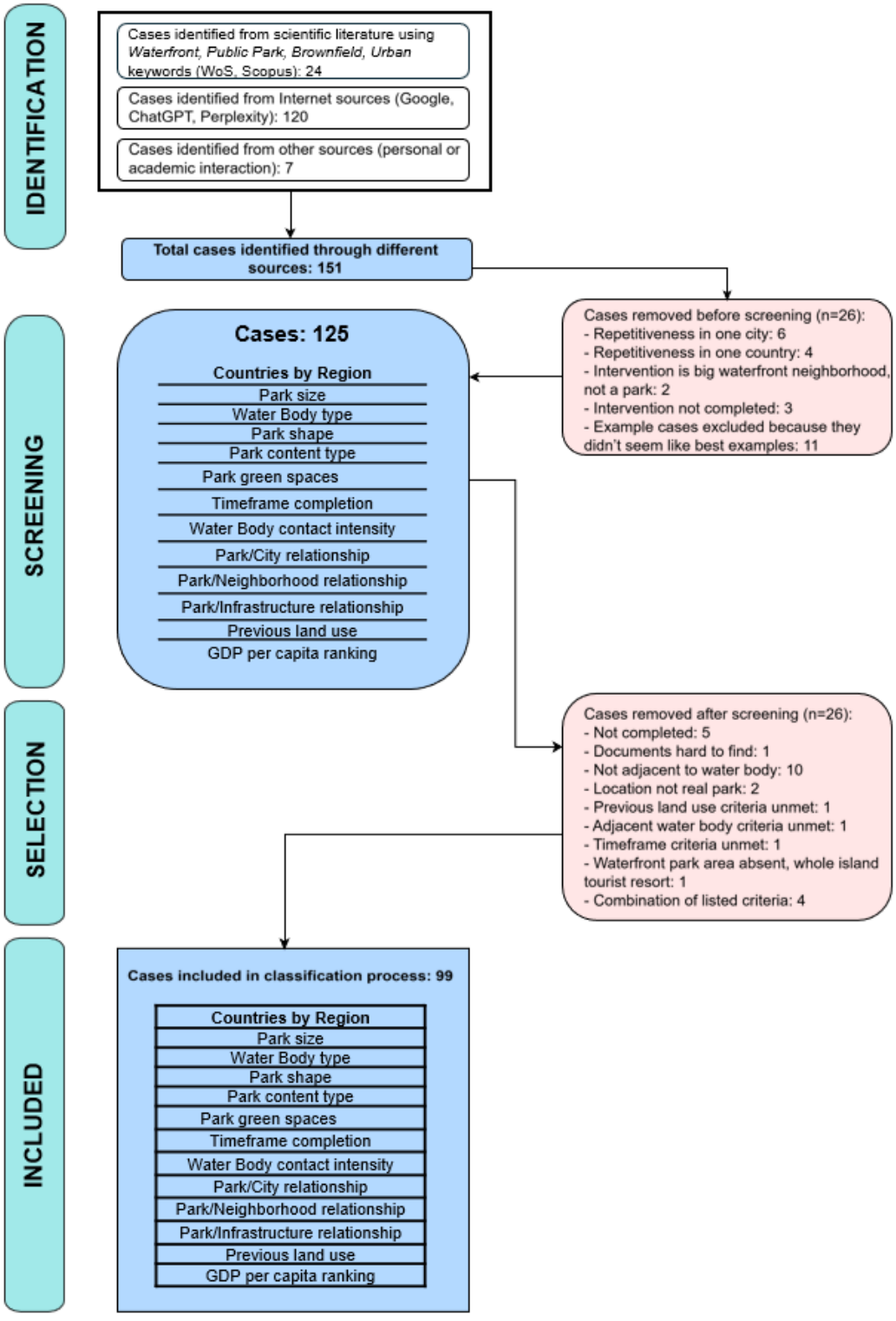


Figure 9 Diagram of the flowchart for the WBUPP example cases database identification, screening (WBUPP analysis according to the screening criteria) and selection process, based on PRISMA 2020

(Yefferson Llonto Caicedo et al., 2024; Dan He et al., 2024; Matthew J Page et al., 2021)[5] , M. Gudac Cvelic

WBUPP examples are found using the characteristics listed in Table 14**Error! Reference source not found.**. It was important to characterize an open space in an urban setting, located within a city tissue, adjacent to a water body. The site had to be a brownfield redevelopment.

The process produced a WBUPP database that consists of 125 locations, each listed and analyzed to the point that a set of respective characteristics can be identified for further comparison. WBUPP examples list contains information about each member, listed in Table 16 WBUPP initial examples characteristics list. Characteristics were found and verified by scientific and other internet sources, listed in Appendix, 1, chapter 1.2.3. WBUPP example cases database bibliography. The analysis result with 125 WBUPP example cases is presented in Table 1, Appendix, 1, chapter 1.2.

Table 16 WBUPP initial examples characteristics list, M. Gudac Cvelic

WBUPP initial examples characteristics list
o Country
o Location
o Park / Project Name
o Transformation Description
o Size (ha)
o Completion Year
o Water Body
o Photo (aerial satellite, source: (Google, 2026a; Google, 2026b)
o World Bank Rank (Wikipedia, 2025c)

7.2 WBUPP Screening, Selection Criteria and Classification

7.2.1 WBUPP Screening and Selection Criteria

The 125 WBUPP example cases, selected using Random selection method, Random sampling subtype (Flyvbjerg, 2006), are submitted to the process of screening: data examination to identify WBUPP qualities. WBUPP examples are analyzed and (later) classified using thirteen criteria, whose theoretical sources,

[5] WBUPP selection process using the PRISMA 2020 scheme

elements, and factors are described in Chapter 6.4, WBUPP SCREENING CRITERIA SET. Each criterion origin derives from a scientific source, listed alongside criteria set, in Table 18 WBUPP analysis and classification criteria list, with scientific sources criterion origin. A list of selection criteria is formed, and each criterion was given a range that contains its certain characteristics, alternatively distinguishing it quantitatively or qualitatively. The list was slightly modified with progression of the examples analysis. The range and characteristics of the selection criteria were adjusted multiple times, given the found information about WBUPP example cases, adjusting to the majority or all WBUPP characteristics results. The initial and the final selection criteria are presented in Table 17 WBUPP initial selection criteria list and Table 20 WBUPP elimination criteria list.

Table 17 WBUPP initial selection criteria list, M. Gudac Cvelic

WBUPP INITIAL SELECTION CRITERIA LIST
○ adjacent to a water body
○ substantially completed
○ it meets the Previous land use criteria (port infrastructure, infrastructure, industrial, landfill, reclaimed land, mixed use
○ is completed within the past 75 years
○ possesses data available for analysis

The final criteria characteristics cleanup was made after completing all example cases analysis and after elimination of the example cases not meeting the criteria, whose ultimate extent somewhat differed from the initial supposition. They are listed in Table 18 WBUPP analysis and classification criteria list, and used for WBUPP classification as well. To illustrate the way the characteristics were adjusted, the Previous land use criteria was first expanded with all previous land uses of all example cases, just to be reduced (by eliminating example cases characteristics of the ones that were eliminated because they did not meet selection criteria) and have the Previous land use grouped into six main usage types: port infrastructure (port infrastructure, industrial), industrial (military), infrastructure (airport, parking lot, railway, other), landfill, reclaimed land (reclaimed land: drained river, underutilized agricultural and wetland land,

undeveloped land), mixed use (cultural, military, and political event site; industrial, infrastructure; industrial, landfill), with respective subdivisions.

1.1.1 WBUPP Classification Criteria

WBUPP examples are analyzed and classified using thirteen criteria, whose theoretical sources, elements, and factors are described in Chapter 6.4, WBUPP SCREENING CRITERIA SET. Each criterion origin derives from a scientific source, listed alongside criteria set, in *Table 18 WBUPP analysis and classification criteria list, with scientific sources criterion origin*. WBUPP analysis and classification are conducted by applying the analysis and classification criteria listed in Table 18 WBUPP analysis and classification criteria list, to each example. This is performed within a screening process of data examination to identify WBUPP qualities.

Table 18 WBUPP analysis and classification criteria list, with scientific sources criterion origin, M. Gudac Cvelic

WBUPP ANALYSIS AND CLASSIFICATION CRITERIA LIST	CRITERION ORIGIN, SCIENTIFIC SOURCES
Countries by Region	Communities (1990); Matthew Carmona et al. (2003); Mrak et al. (2022); Britannica (2025)
WBUPP size	Matković and Jakovčić (2019)
Water Body type	Mrak et al. (2022); Zaman et al. (2024)
WBUPP shape	Bilušić (2024); Matthew Carmona et al. (2003); Frey (1999)
WBUPP content type	Rey et al. (2022); Hauri (2011); Fusco Girard and Nijkamp (1997); Hough (1984); Randall and Baetz (2015); Bentley (1990); Breheny (1992); Frey (1999); Mrak et al. (2022); URBED (1997); Evans et al. (2001)
WBUPP green spaces	Rey et al. (2022); Mrak et al. (2022); Denis Michalina (2021); Teller et al. (2014); Gómez-Villarino et al. (2021); Kostrenčić and Jukić (2020)
Timeframe completion	Bilušić (2024)
Water Body contact intensity	Coss and Keller (2022); Sarai Pouso et al. (2021); Nutsford et al. (2016); Garrett et al. (2019); White et al. (2019); Dempsey et al. (2018)
WBUPP /City relationship	Matković and Jakovčić (2019)
WBUPP /Neighborhood relationship	Mrak et al. (2022); UN SDG Goal 11.7

WBUPP /Infrastructure relationship	Carmona et al. (2001/2003); Frey (1999); Carmona (2010a); Burinskienė et al. (2017)
Previous land use	Matković and Jakovčić (2019); Perović and Kurtović Folić (2012); Kranjčević (2016)
GDP per capita ranking	Rey et al. (2022); Mrak et al. (2022); Carmona et al. (2001/2003); Hough (1984); Haughton and Hunter (1994, 2003, 2004, 2016)

Each criterion is elaborated through categories. The range and characteristics of the criteria categories were adjusted multiple times, given the found information about WBUPP example cases, adjusting to the majority or all WBUPP characteristics results. The final list is presented in Table 19 List of criteria categories for WBUPP analysis and classification.

World regions are determined mostly by continents (Britannica, 2025a) which WBUPP examples belong to. Australia and Oceania is listed as a continent although its territory is often called Australia. Antarctica was not included for obvious reasons: there are no example cases found there.

WBUPP size criteria total range was determined by WBUPP example case's sizes and divided into four area categories: Small (S) WBUPP up to five hectares, Medium (M) WBUPP sized five to twenty hectares, Big (L) WBUPP with area spanning from twenty to a hundred hectares, Extra big (XL) WBUPP whose surface exceeds one hundred hectares.

Example cases completion year spans from 1935 – 2030. The earliest example completed in 1935. is qualified as not meeting the criteria since at that time many sustainability and other principles considered in this research barely existed. The examples that were not built by 2025 are eliminated as Incomplete. Timeframe completion criterion includes example cases completed from 1975 to the year 2025, the period divided into the following intervals: second half of the twentieth century (1975-1999), early twenty-first century (2000-2014) and the last decade (2015-2025).

Water body type criterion contains lakes, seas and rivers. In cases when WBUPP is located on a bank belonging to a river mouth or within an estuary, or when a water channel is linked to the sea, the sea was considered as an adjacent water body. Example cases initially qualified as waterfront public parks, that turned out

to be retention basins, rain gardens or stormwater ponds after further analysis, are eliminated due to being adjacent to something that in this research does not meet water body criteria. Named water types are eliminated from this criteria composition, adjusting to the final screening results.

Table 19 List of criteria categories for WBUPP analysis and classification, M. Gudac Cvelic

WBUPP ANALYSIS AND CLASSIFICATION CRITERIA CATEGORIES LIST	
Countries by Region criterion	Africa
	Asia
	Australia and Oceania
	North America
	South America
	Europe
WBUPP size criterion	S small 0-5ha
	M medium 5-20ha
	L big 20-100ha
	XL extra big 100+ha
Timeframe completion criterion	2nd half of the 20th century
	early 21st century
	the last decade
Water Body type criterion	lake
	river
	sea
Water Body contact intensity criterion	full immersion +60%
	intense 40-60%
	medium 25-40%
	minimal 0-25%
WBUPP shape criterion	central
	irregular
	linear
	longitudinal
WBUPP content type criterion	mostly heterogeneous
	mostly homogeneous
WBUPP /City relationship criterion	within the urban tissue
	outside the urban tissue
WBUPP /Neighborhood relationship criterion	contact
	distant
	integrated
WBUPP /Infrastructure relationship criterion	Contact (relevant)
	contact
	contact (tangent)
	distant
	intersecting
Previous land use criterion	port infrastructure
	port infrastructure/industrial
	industrial
	infrastructure
	landfill
	reclaimed land
	mixed use
WBUPP green spaces	minimal (0-10%)
	medium (10-30%)
	significant (31-100%)
GDP per capita ranking criterion	first 25
	26-50
	51-75
	75+

Water body contact intensity criterion reflects on how much WBUPP interacts with water and the length of its edge that meets the adjacent water surface. Having more than 60% of its border on the water is regarded as Full immersion, between 40% and 60% Intense, 25%-40% Medium, and from 0% to 25% Minimal.

WBUPP shape criterion consists of generalized forms derived from initial 125 example cases, simplified to create a recognizable category a reader can relate to. Compact WBUPPs are essentially divided into Central and Longitudinal. Riverfront WBUPPs with lengths much greater than their width are mostly categorized as Linear. The rest of example cases whose shape is complex, or it cannot be determined because they are dispersed into a neighborhood are referred to as Irregular.

WBUPP content type criterion sorts example cases as Mostly heterogeneous and Mostly homogeneous, which reflects the program (facilities, amenities, services) variety the WBUPP contains.

WBUPP/City relationship criterion provides information about the example case location, Within the urban tissue or Outside the urban tissue. This segment has evolved from having a center-periphery-distant categories, all related to the position within the City the WBUPP belongs to, to simplifying into the final two components based on screening analysis results.

WBUPP/Neighborhood relationship criterion organizes example cases into having Contact with the surrounding blocks (applies mostly to compact WBUPPs), being Distant from the district or being Integrated into a neighborhood (Irregular WBUPPs that are merged within the surrounding urban tissue).

WBUPP/Infrastructure relationship criterion considers nearby road, railway, cyclist, pedestrian, water and other related infrastructure whether it’s public or private transportation. It determines its rapport as Contact, Distant or Intersecting, using auxiliary spatial analysis tools. Contact characteristics has three different grades: relevant (WBUPP is visibly very well connected or has a multitude of infrastructure nearby), limited (WBUPP is not connected well) and tangent (WBUPP has a major infrastructure line along one of its boundaries marked significant).

Previous land use criterion initial presumption had three types: industrial, port infrastructure, landfill. Those evolved into a more elaborated list due to the screening analysis results, later reduced based on the example cases elimination method and structured according to appropriate correspondence to the selected example cases. Port infrastructure includes both standalone activity areas and also the ones where they are combined with industrial activities. Industrial sites include both standalone activity areas and military facilities. Infrastructure includes various infrastructure types such as airports (military/civil), parking lots, railways, and other uses (e.g., schools, neighborhood infrastructure). Additional categories encompass landfills, reclaimed land and mixed-use. Reclaimed land includes drained river areas, underutilized agricultural/wetland land, and undeveloped land. Mixed-use sites are locations whose use couldn't be characterized by previous categories, such as areas that combine cultural, military, and political event venues, as well as industrial/infrastructure combinations, and industrial/landfill overlaps.

WBUPP green spaces criterion assigns Minimal, Medium or Significant characteristic to an example case based on visible presence of green areas in relation to the entirety of the WBUPP's surface. Range spans start from the small percentage 0-10%, medium from 10 to 30%, to having significant green surface presence if it's over 30%.

GDP per capita ranking criterion qualifies WBUPPs located in belonging countries into one of four categories of economic development index, related to a country's income per person (Wikipedia, 2025c)[6]. First twenty-five, twenty-six to fifty, fifty-one to seventy-five, and countries ranked lower than seventy-five in the world list.

[6] List of countries by nominal GDP per capita. GDP per capita is the total value of a country's finished goods and services (gross domestic product) divided by its total population (per capita).

7.3 WBUPP Screening RESULTS

Screening results include the analysis that led to the elimination of WBUPP example cases that did not meet the selection criteria, as well as the classification of the included WBUPP example cases according to the same criteria used in the analysis. The WBUPP elimination criteria list, presented in Table 20, is based on the initial selection criteria list, which was supplemented, updated, and refined according to characteristics found in the analyzed WBUPP cases.

Table 20 WBUPP elimination criteria list, M. Gudac Cvelic

WBUPP ELIMINATION CRITERIA LIST
not completed
hard to find documents that prove their actual state
not adjacent to a water body
location is not real WBUPP area
it does not meet the previous land use criteria
the adjacent water body does not meet the criteria
does not meet Timeframe completion criteria
no waterfront park area, the whole island is a tourist resort
combination of listed criteria

The process produced a WBUPP database that consists of 125 locations, verified or dismissed for categorization and further analysis:

- Amsterdam; NDSM Wharf
- Lagos; Eko Atlantic
- Porto; Campanhã

were eliminated because they are not completed, and it's hard to find documents that prove their actual state

- Atlanta; Historic Fourth Ward Park
- Atlanta; Rodney Cook Sr. Park
- Eindhoven; Green Urban Axis Torenallee, Strijp-S
- Graz; Reininghaus
- Houston; Discovery Green
- Milan; Biblioteca degli Alberi park, Porta Nuova
- Mississauga; Saigon Park
- Saint Paul, Minnesota; Midway Peace Park
- Tel Aviv; Hiriya Park (Ariel Sharon Park)
- Zurich; Josefwiese park, Züri-West

were eliminated because it is not adjacent to a water body

- Basel; Dreispitz
- Geneva; Sécheron

were eliminated because their location is not real park area, and they are not adjacent to a water body

- Chennai; Marina Beach Restoration was eliminated because it does not meet the previous land use criteria (previous land use: port infrastructure, infrastructure, industrial, landfill, reclaimed land, mixed use)
- Clarksville, Indiana; Origin Park
- Düsseldorf; MedienHafen, Pier One waterfront park
- Haifa; Haifa Port waterfront park
- Naples; Parco urbano di Bagnoli
- Vienna; Seestadt Aspern park

were eliminated because they haven't been completed

- Incheon; Songdo Central Park, Songdo International City was eliminated because the adjacent water body does not meet the criteria (water body: sea, lake, river)
- Kitchener, Ontario; RBJ Schlegel Park was eliminated because it is not completed, it is not adjacent to a water body and it's hard to find documents that prove actual state
- Montevideo; Rambla Sur was eliminated because it was built in the early 20th century, does not meet Timeframe completion criteria (2nd half of the 20th century, early 21st century, the last decade)
- Singapore; Sentosa Island was eliminated because there's no waterfront park area, the whole island is a tourist resort
- Stockholm; Hammarby Sjöstad was eliminated because it is hard to find documents that prove actual state

This phase refined the list according to the aforementioned criteria. Ninety-nine (99) WBUPP examples resulted from the process at the end of the Selection phase. They are identified for further analysis.

7.3.1 Screening WBUPP, Results by Individual Criteria

Selected WBUPP example cases (99) are classified according to the criteria listed in Table 18 WBUPP analysis and classification criteria list, using the criteria categories listed in Table 19 List of criteria categories for WBUPP analysis and classification. The classification results obtained using descriptive statistics are presented in Tables 2-14, Appendix, 1, Chapter 1.2.1. The classification results

summary is presented using tables and graphical charts, with corresponding descriptions in the following sub-chapters.

7.3.1.1 Screening WBUPP Results, by Region Criteria

WBUPPs are ordered by Countries they are in, and by Region or Continent their country belongs. Certain Continents are grouped in one Region because there are not a lot of examples from there, they are adjacent geographically and often considered as mentioned territory. Region criteria consist of Africa, Asia, Australia and Oceania, North America, South America, Europe.

Result shows that most of the 99 WBUPP examples are in Europe (almost half, 47%), while North America (20%) and Asia (17%) make a big part of the second half. The remaining 16% (16 examples) are found in Africa, Australia and Oceania, and South America. The results are presented in Table 21 Number of WBUPPs by location region, and graphically in Figure 10.

Table 21 Number of WBUPPs by location region, M. Gudac Cvelic

WBUPP location Region (Continent)	No. Of WBUPP
Africa	2
Asia	17
Australia and Oceania	8
North America	20
South America	6
Europe	46
total	**99**

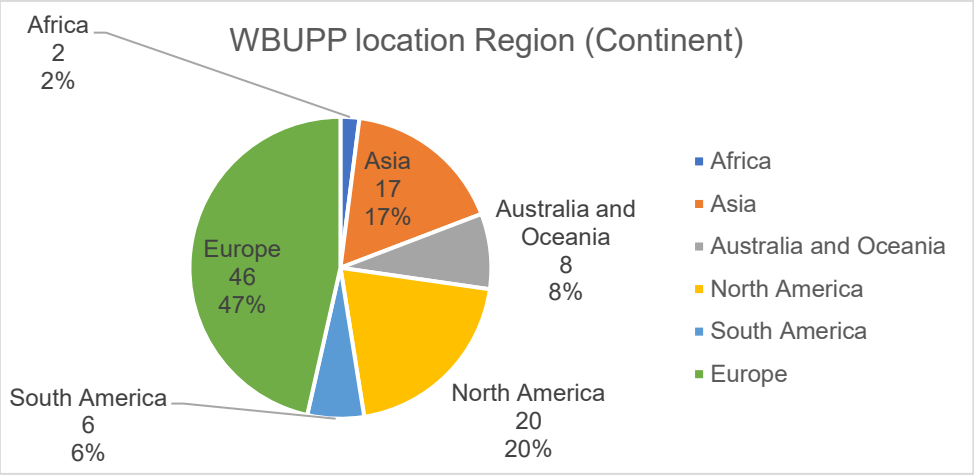


Figure 10 Number of WBUPPs by location region, M. Gudac Cvelic

7.3.1.2 Screening WBUPP Results, by WBUPP Size Criteria

WBUPPs are ordered by Size, measured by the surface they take up, in hectares. Four sizes, determined to simplify the inquiry, range from Small (0-5 ha), Medium (5-20 ha), Large (20-100 ha), to Extra-large (bigger than 100 ha).

Result shows that Medium and Large sized WBUPPs make one approximately one third each, out of the total example number. Small and Extra-large WBUPPs are not so common, as it is presented, making less than one fifth each. The results are presented in Table 22, and graphically in Figure 11.

Table 22 Number of WBUPPs by size, M. Gudac Cvelic

WBUPP size criteria	No. Of WBUPP
S small 0-5ha	19
M medium 5-20ha	37
L big 20-100ha	31
XL extra big 100+ha	12
total	**99**

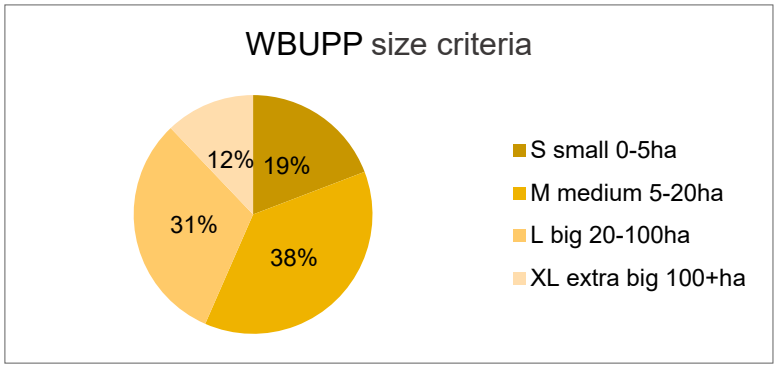


Figure 11 Number of WBUPPs by size, M. Gudac Cvelic

7.3.1.3 Screening WBUPP Results, by Timeframe Completion Criteria

WBUPPs are organized by completion date. Three timeframes cover the period of approximately 50 years: second half of the twentieth century (1975.-1999.), early twenty-first century (2000.-2014.) and the last decade (2015.-2025.).

Result shows that almost 90% of the example cases are completed in the twenty-first century. Roughly stated, equal distribution is presented between the early 21st century (15 years span) and the last decade (10 years span), with the conclusion that the realization of WBUPPs is drastically increasing. The results are presented in Table 23 and graphically in Figure 12.

Table 23 Number of WBUPPs by completion criteria, M. Gudac Cvelic

Timeframe completion criteria	No. Of WBUPP
2nd half of the 20th century	10
early 21st century	45
the last decade	44
total	**99**

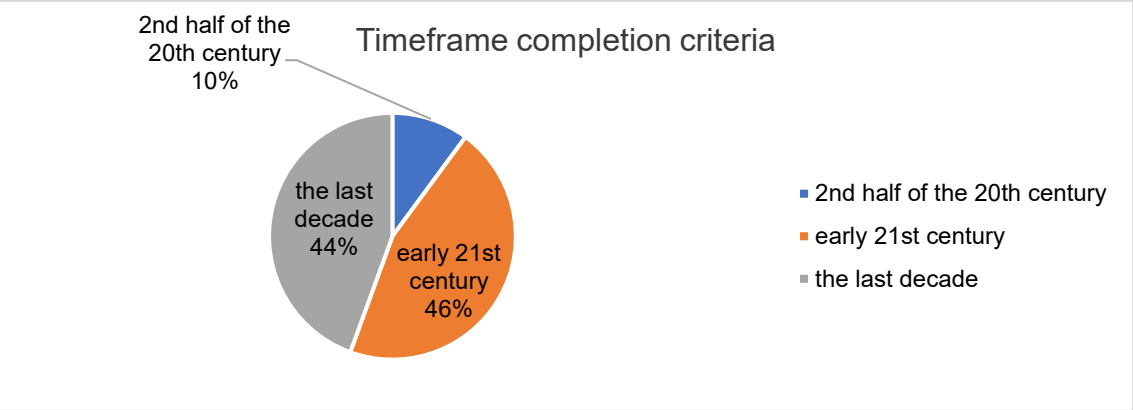


Figure 12 Number of WBUPPs by completion criteria, M. Gudac Cvelic

7.3.1.4 Screening WBUPP Results, by Water Body Type Criteria

WBUPPs are categorized by adjacent water body type. Three types of main water bodies are considered: lake, sea, river.

Result shows that only 6% of example cases are situated on a lake. More than half are built on riverbanks, and the remaining 38% lay by the sea. The results are presented in Table 24 and graphically in Figure 13.

Table 24 Number of WBUPPs by water body type, M. Gudac Cvelic

Water Body type criteria	No. Of WBUPP
lake	6
river	55
sea	38
total	**99**

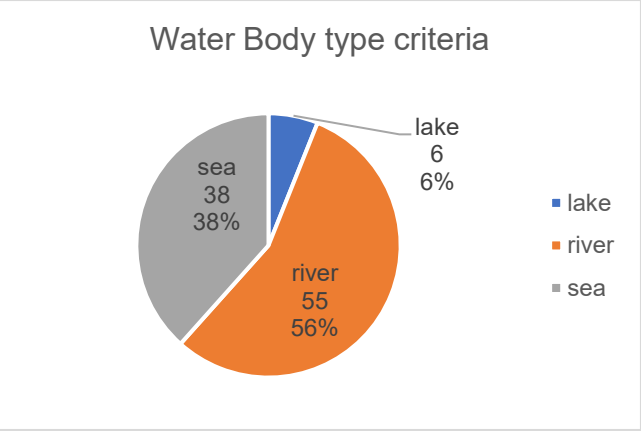


Figure 13 Number of WBUPPs by water body type, M. Gudac Cvelic

7.3.1.5 Screening WBUPP Results, by Water Body Contact Intensity Criteria

WBUPPs are indexed by the intensity with the adjacent water body. Four types of contact are distinguished: Full immersion, Intense, Medium, Minimal.

Result shows that the majority of example cases interact with water significantly (over 80%), while only a small percentage has minimal water contact (7%). This means that the considered WBUPPs justify the classification of being Waterfront with their disposition and are spatially realized in accordance to their qualitative concept. The results are presented in Table 25 and graphically in Figure 14.

Table 25 Number of WBUPPs by water body contact intensity criteria, M. Gudac Cvelic

Water Body contact intensity criteria	No. Of WBUPP
full immersion +60%	17
intense 40-60%	65
medium 25-40%	10
minimal 0-25%	7
total	**99**

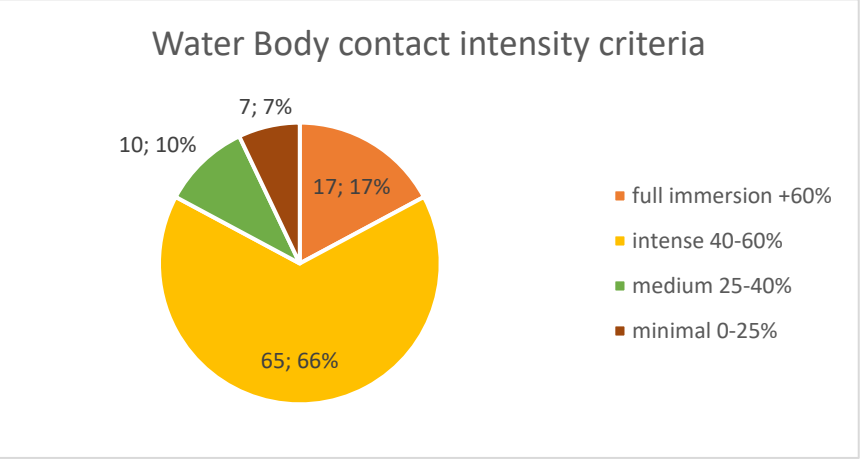


Figure 14 Number of WBUPPs by water body contact intensity criteria, M. Gudac Cvelic

7.3.1.6 Screening WBUPP Results, by WBUPP Shape Criteria

WBUPPs are indexed by the WBUPP's surface shape. Compact shape distinguishes Central and Longitudinal. Linear shape is named after a very long area that spreads, mostly along riverbanks, significantly more in length than widthwise. Fourth type is called Irregular because its shape cannot be or is very difficult to identify.

Result shows that all the four shape types are represented quite evenly. The conclusion is there's no preferred or regularly chosen WBUPP shape. The results are presented in Table 26 and graphically in Figure 15.**Error! Reference source not found.**

Table 26 Number of WBUPPs by shape criteria, M. Gudac Cvelic

WBUPP shape criteria	No. Of WBUPP
central	26
irregular	21
linear	24
longitudinal	28
total	**99**

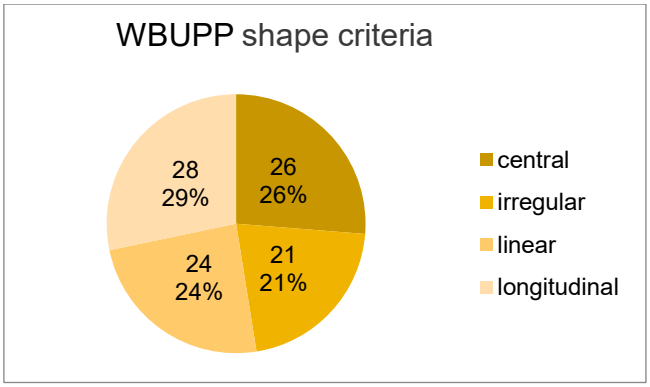


Figure 15 Number of WBUPPs by shape criteria, M. Gudac Cvelic

7.3.1.7 Screening WBUPP Results, by WBUPP Content Type Criteria

WBUPPs are sorted by the variety of the program they contain: Mostly homogeneous and Mostly heterogeneous. An absolute statement of homogeneity and heterogeneity is difficult to obtain because every WBUPP has

a certain mixture of walkable paths, landscaped surfaces and some amenities or facilities, however little the ratio is.

Result shows that mostly heterogeneous example cases prevail over the others. The results are presented in Table 27 and graphically in Figure 16.

Table 27 Number of WBUPPs by content type criteria, M. Gudac Cvelic

WBUPP content type criteria	No. Of WBUPP
mostly heterogeneus	59
mostly homogeneus	40
total	**99**

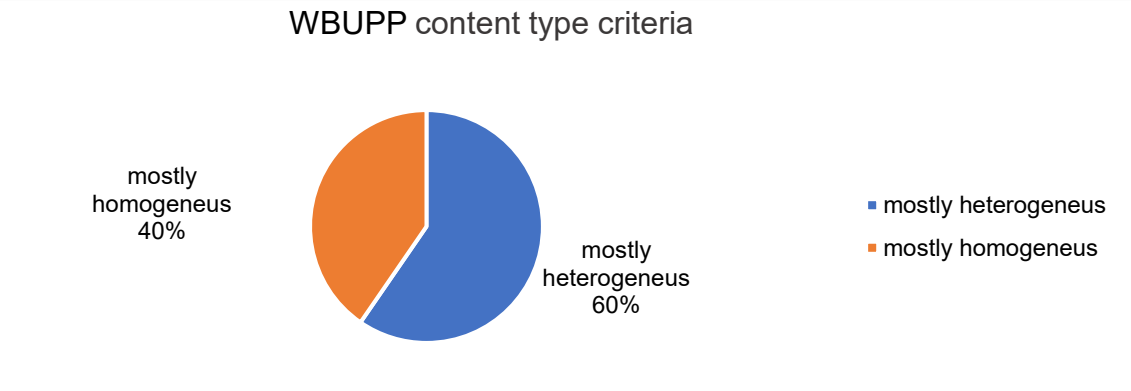


Figure 16 Number of WBUPPs by content type criteria, M. Gudac Cvelic

7.3.1.8 Screening WBUPP Results, by WBUPP/City Relationship Criteria

WBUPPs are distributed by the relationship between WBUPP and the City it belongs to, whether they are located Within the urban tissue or Outside the urban tissue.

Result shows that more than 80% of the example cases are placed within the urban tissue, as expected, considering the initial research criterion (urban) and the fact that most brownfield locations are disused city areas that are regenerated creating, among other uses, public parks. The results are presented in Table 28 and graphically in Figure 17.

Table 28 Number of WBUPPs by WBUPP/city relationship criteria, M. Gudac Cvelic

WBUPP/City relationship criteria	No. Of WBUPP
within the urban tissue	82
outside the urban tissue	17
total	**99**

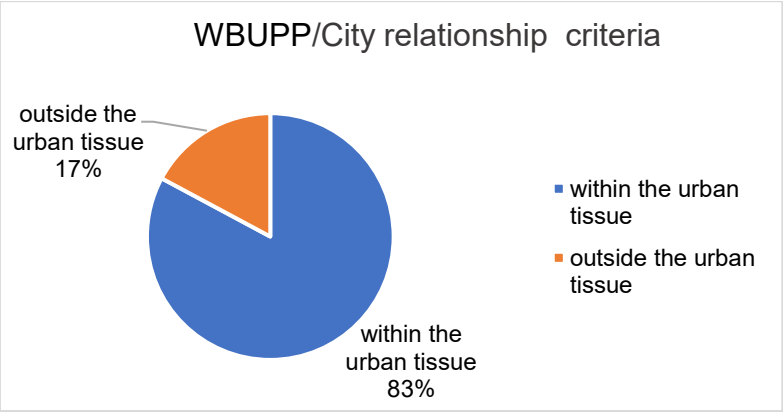


Figure 17 Number of WBUPPs by WBUPP/city relationship criteria, M. Gudac Cvelic

7.3.1.9 Screening WBUPP Results, by WBUPP/Neighborhood Relationship Criteria

WBUPPs are allocated by their rapport with the adjacent neighborhood. Three types are distinguished: Contact, Distant or Integrated.

Result shows that almost all example cases are in contact or integrated within the urban tissue, while only 1 out of 99 is distant. A preferable characteristic their proximity to users, enabling a Public Park to effectively fulfill one of its principal purposes. The results are presented in Table 29 and graphically in Figure 18.

Table 29 Number of WBUPPs by WBUPP/neighborhood relationship criteria, M. Gudac Cvelic

WBUPP/Neighborhood relationship criteria	No. Of WBUPP
contact	58
integrated	40
distant	1
total	**99**

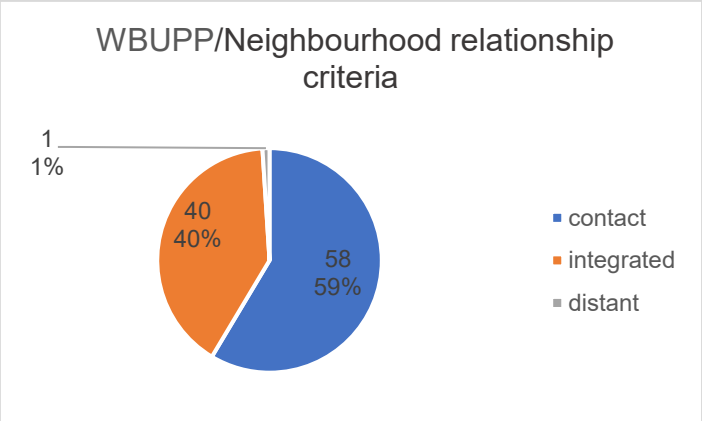


Figure 18 Number of WBUPPs by WBUPP/neighborhood relationship criteria, M. Gudac Cvelic

7.3.1.10 Screening WBUPP Results, by WBUPP/Infrastructure Relationship Criteria

WBUPPs are arranged by their rapport with infrastructure, defined as Contact, Distant or Intersecting.

Result shows that all except five example cases have either contact or are intersected with different types of infrastructure. This attribute renders the WBUPP accessible to the citizens and other visitors. The results are presented in Table 30 and graphically in Figure 19.

Table 30 Number of WBUPPs by WBUPP/infrastructure relationship criteria, M. Gudac Cvelic

WBUPP/Infrastructure relationship criteria	No. Of WBUPP
contact (relevant)	28
contact	3
contact (tangent)	32
distant	5
intersecting	31
total	**99**

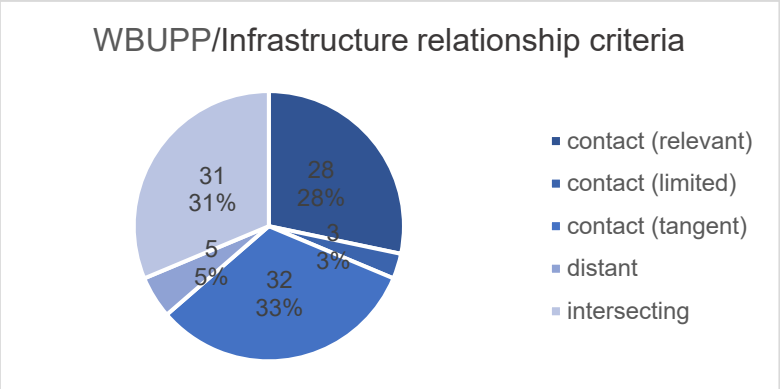


Figure 19 Number of WBUPPs by WBUPP/infrastructure relationship criteria, M. Gudac Cvelicv

7.3.1.11 Screening WBUPP Results, by Previous Land Use Criteria

WBUPPs are distinguished by their previous land use, organized in six different categories with subcategories: Port infrastructure (port infrastructure, industrial), Industrial (military), Infrastructure (airport, railway, other), Landfill, Reclaimed land (drained river, underutilized agricultural and wetland land, undeveloped land) and Mixed use (cultural, military, and political event site; industrial, infrastructure; industrial, landfill).

Result shows that majority of example cases were used for industrial use, infrastructure and different necessities of port operations (more than 85%). The rest are mixed-use or cases on newly formed land taken created on an adjacent water surface. The results are presented in Table 31 and graphically in Figure 20.

Table 31 Number of WBUPPs by previous land use criteria, M. Gudac Cvelic

Previous land use criteria	No. Of WBUPP
port infrastructure	40
port infra.structure_ industrial	2
_industrial	40
infra_structure	3
landfill	4
reclaimed land	8
mixed use	2
total	**99**

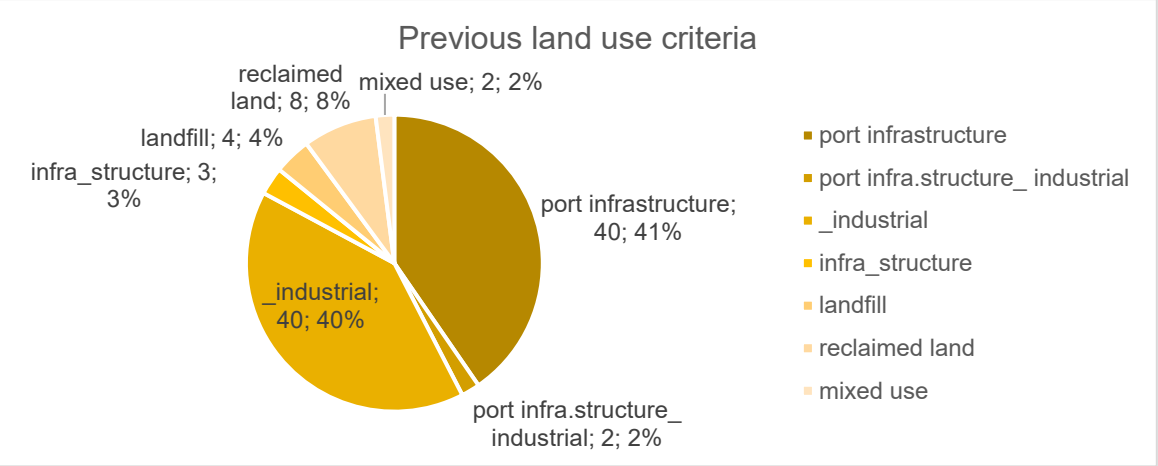


Figure 20 Number of WBUPPs by previous land use criteria, M. Gudac Cvelic

7.3.1.12 Screening WBUPP Results, by WBUPP Green Spaces Quantity Criteria

WBUPPs are ranked based on visible presence of their green areas. Three types are distinguished: Minimal, Medium or Significant.

Result shows that more than half of the example cases have significant amount of landscaped areas and 26% have medium. Notable 22 out of 99 WBUPPs have minimal presence of natural surfaces. The results are presented in Table 32 and graphically in Figure 21.

Table 32 Number of WBUPPs by green spaces quantity criteria, M. Gudac Cvelic

WBUPP green spaces quantity criteria	No. Of WBUPP
medium	26
minimal	22
significant	51
total	**99**

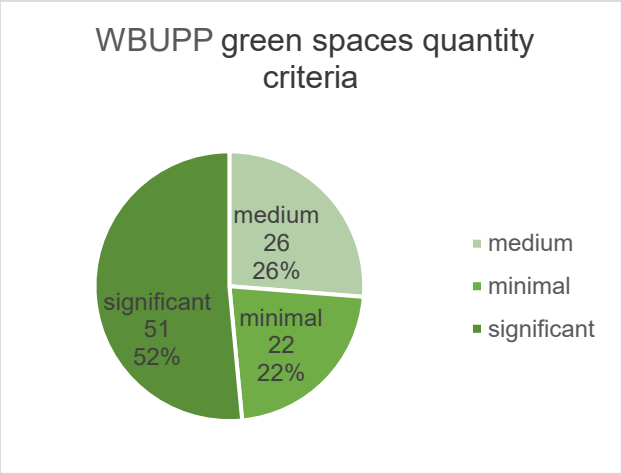


Figure 21 Number of WBUPPs by green spaces quantity criteria, M. Gudac Cvelic

7.3.1.13 Screening WBUPP Results, by GDP Per Capita Ranking Criteria

WBUPPs are indexed by the country's GDP per capita ranking they belong to. Five categories are distinguished: First twenty-five, twenty-six to fifty, fifty-one to seventy-five, and countries ranked lower than seventy-five in the world list.

Result shows that most example cases are in countries whose ranking is in the first 50 (85%), while only a small percentage can be found in countries whose GDP per capita level puts them on positions higher than 50 (17%). Conclusion is that richer countries develop more WBUPPs. The results are presented in Table 33 and graphically in Figure 22.

Table 33 Number of WBUPPs by GDP per capita ranking criteria, M. Gudac Cvelic

GDP per capita ranking criteria	No. Of WBUPP
first 25	61
26-50	23
51-75	6
75+	9
total	**99**

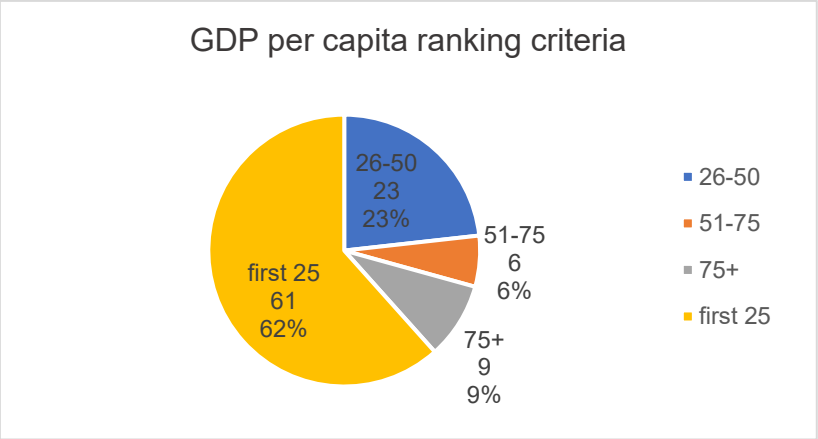


Figure 22 Number of WBUPPs by GDP per capita ranking criteria, M. Gudac Cvelic

7.3.2 Screening WBUPP Results, Comparative Analysis

Comparative analysis was performed with excel tools to test and compare inserted data, previously cleaned from eliminated WBUPP example cases information. Analysis was executed on 99 WBUPP example cases using descriptive statistics. Only significative results are shown, illustrating relationships between stated criteria using graphic charts. Insignificant results, that are coherent to the results given by individual criteria analysis which are presented in the previous chapter, are omitted from the comparative analysis.

7.3.2.1 Screening WBUPP Results, Water Body Type in relation to Previous Land Use Criteria

Comparison between the Water body type and the Previous land use showed that most industrial brownfield sites are situated on rivers, while port infrastructure brownfields take up river and sea sites, prevalently sea locations. The result is presented graphically in Figure 23.

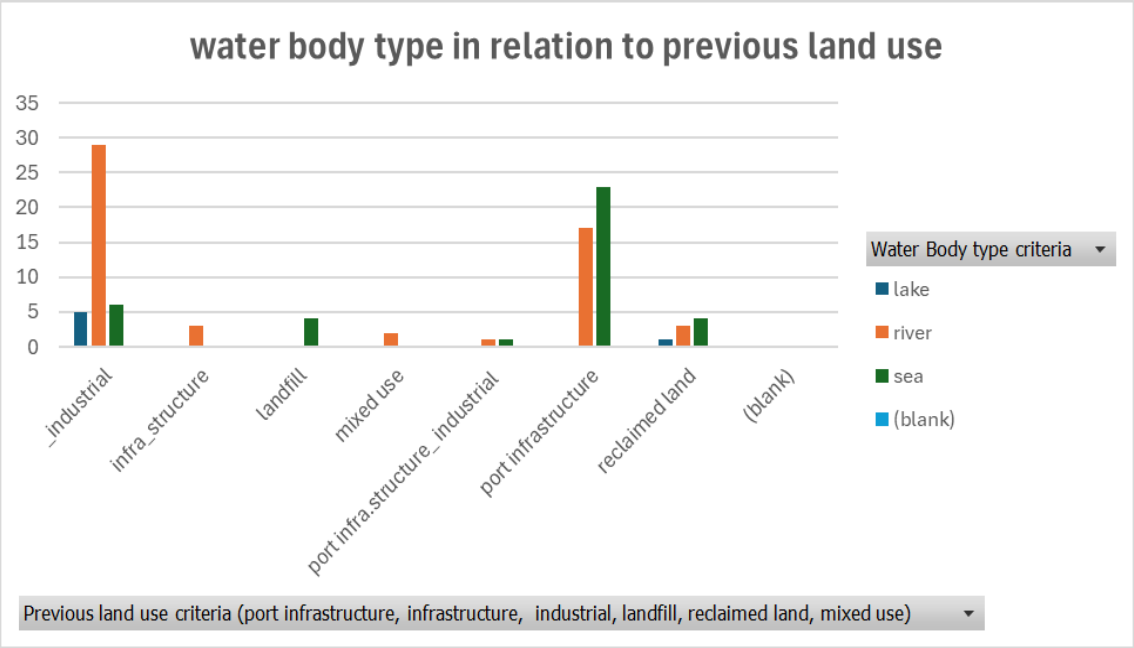


Figure 23 Comparison between the Water body type and the Previous land use, M. Gudac Cvelic

7.3.2.2 Screening WBUPP Results, Water Body Type in relation to GDP Per Capita Country Ranking Criteria

Comparison between the Water body type and the GDP per capita country ranking showed that the percentage of WBUPP example cases on rivers grows with the growing number of cases in the more financially successful countries, based on GDP per capita data. The result is presented graphically in Figure 24.

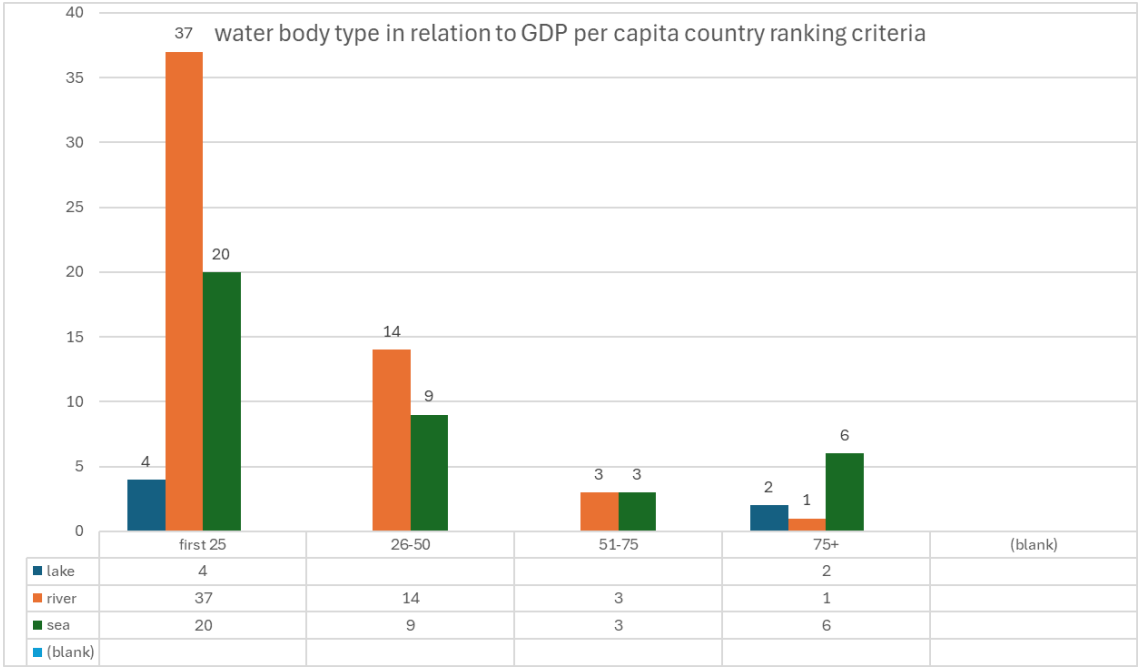


Figure 24 Comparison between the Water body type and the GDP per capita country ranking, M. Gudac Cvelic

7.3.2.3 Screening WBUPP Results, Water Body Type in relation to Timeframe Completion Criteria

Comparison between the Water body type and the Timeframe completion showed that the overall number of cases completed in the 21st century is growing rapidly. The number of river adjacent in relation to the sea adjacent drops in the last decade, while the other slightly increases. The result is presented graphically in Figure 25.

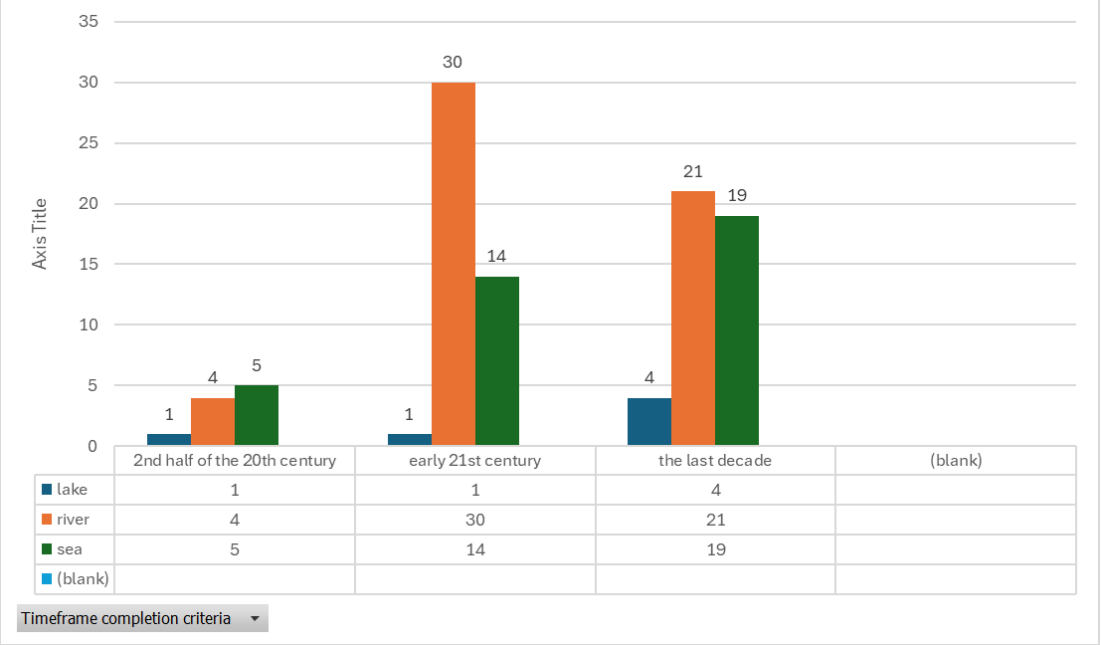


Figure 25 Comparison between the Water body type and the Timeframe completion, M. Gudac Cvelic

7.3.2.4 Screening WBUPP Results, Water Body Type in relation to WBUPP Size Criteria

Comparison between the Water body type and the WBUPP size criteria presents that most Medium size WBUPPs are adjacent to rivers. The greatest portion of the screened extra big example cases are sited on the rivers. Majority lake WBUPPs within the analyzed cases are big. The result is presented graphically in Figure 26.

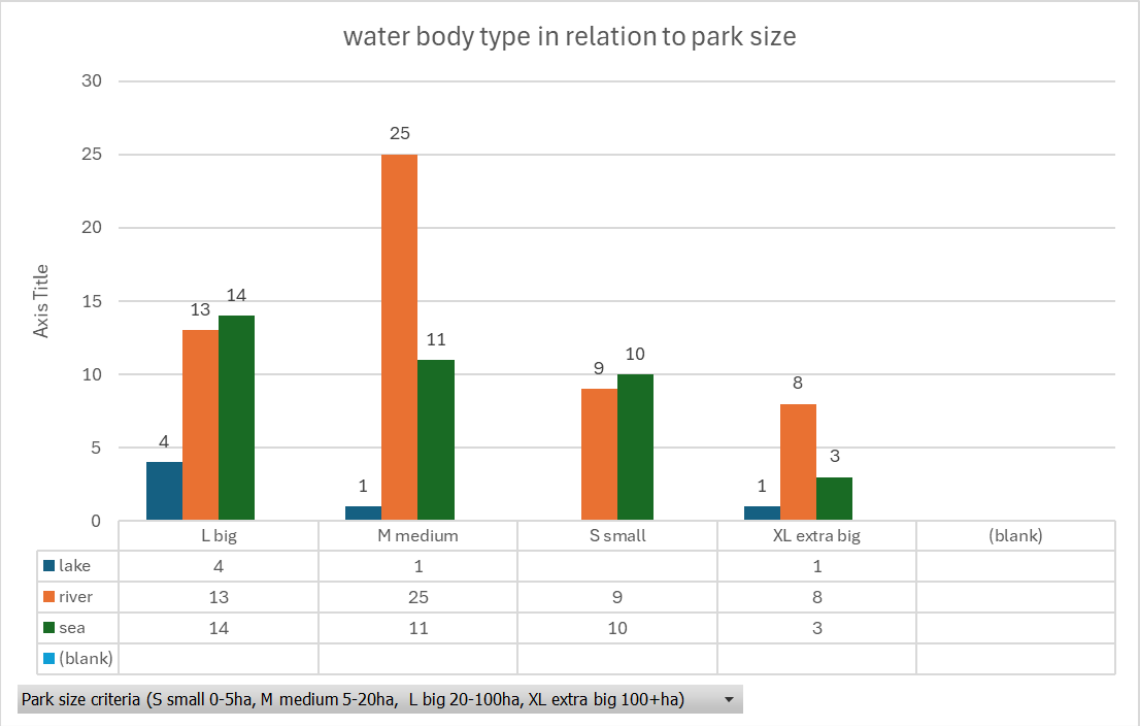


Figure 26 Comparison between the Water body type and the WBUPP size criteria, M. Gudac Cvelic

7.3.2.5 Screening WBUPP Results, WBUPP Shape in relation to WBUPP Size Criteria

Correlation between WBUPP shapes and WBUPP size demonstrates a relatively even result. The minimal number of irregularly shaped WBUPPs are small and extra big. The result is presented graphically in Figure 27.

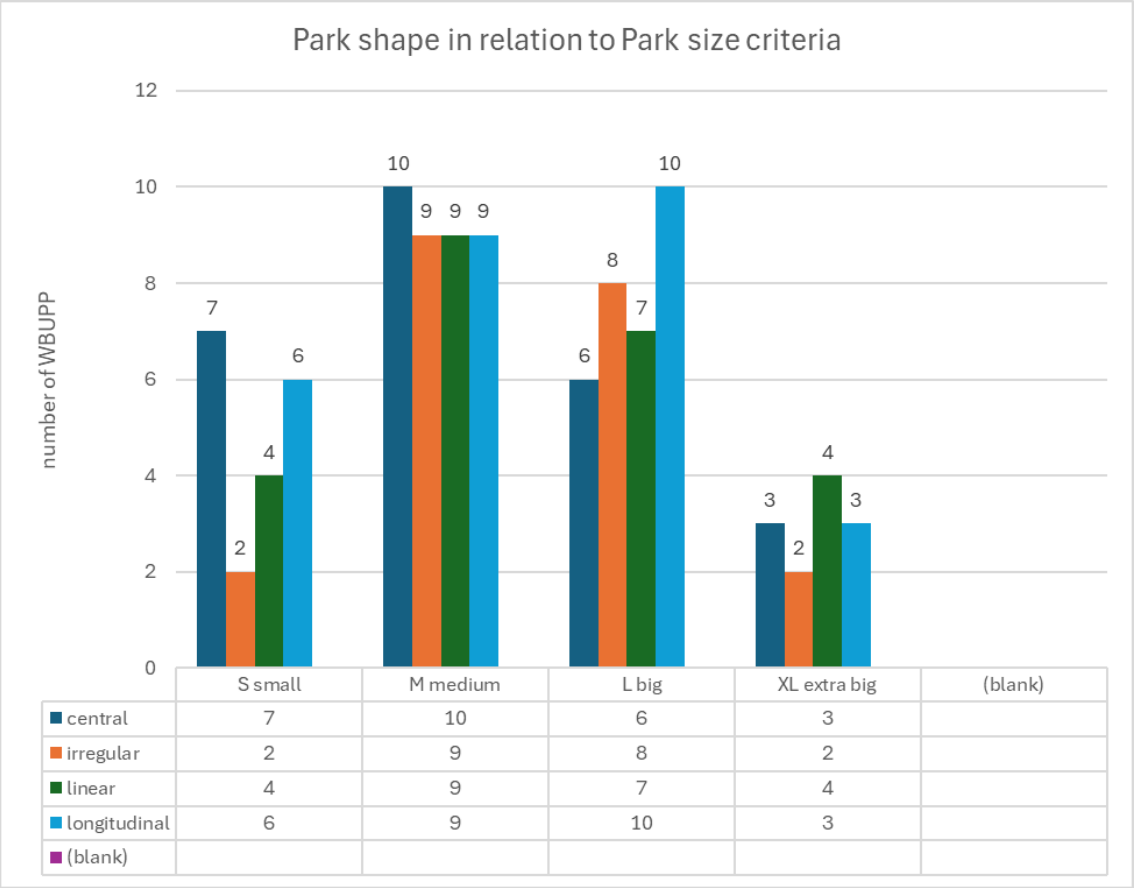


Figure 27 Correlation between WBUPP shapes and WBUPP size, M. Gudac Cvelic

7.3.2.6 Screening WBUPP Results, WBUPP Shape in relation to WBUPP/Infrastructure Relationship Criteria

Observing the rapport among the WBUPP shape and WBUPP/infrastructure relationship criteria, the result of having the biggest number of irregular cases with intersecting infrastructure leaps out. At the same time, the portion of irregularly shaped WBUPPs with contact infrastructure is the smallest. The result is presented graphically in Figure 28.

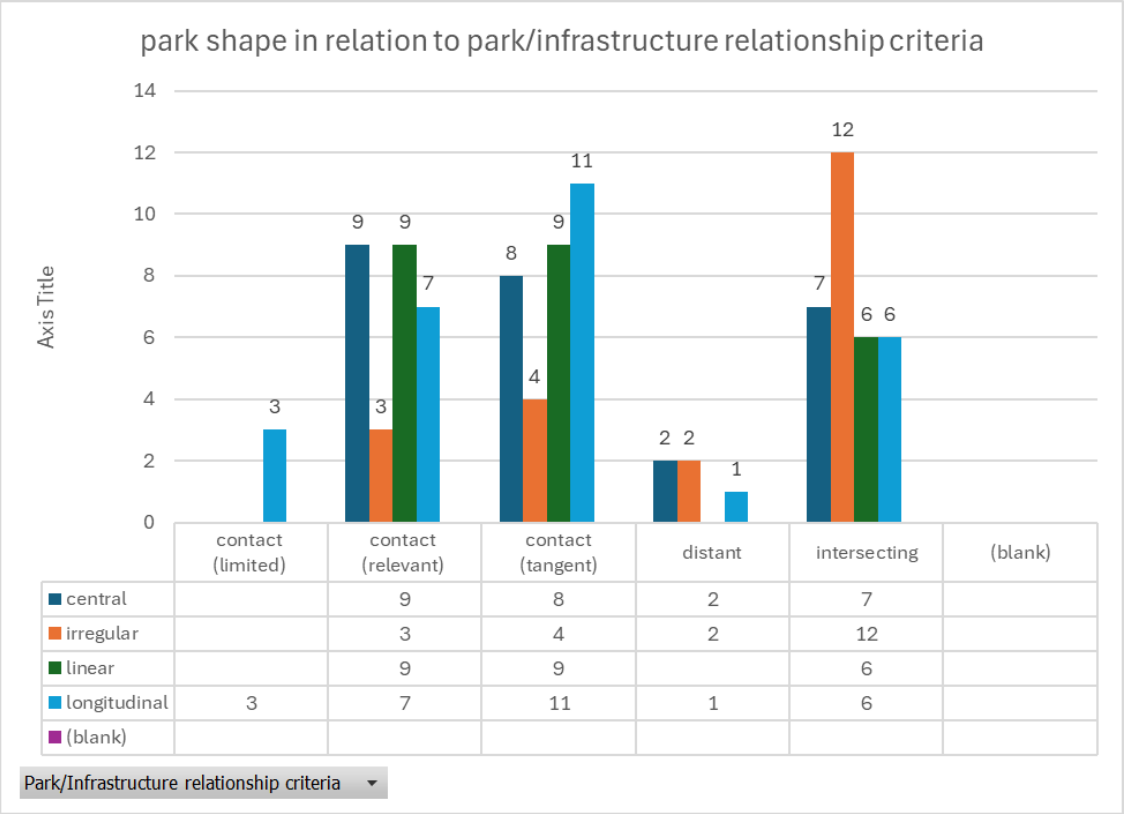


Figure 28 Correlation between WBUPP shapes and WBUPP/infrastructure relationship criteria, M. Gudac Cvelic

7.3.2.7 Screening WBUPP Results, WBUPP Content Type in relation to WBUPP Shape Criteria

Comparison between the WBUPP content type in relation to WBUPP shape highlights the fact that almost every irregularly shaped example case that takes part in the screening is mostly heterogeneous. Central shaped, linear and longitudinal WBUPPs do not present severe deviations and are mostly equally represented in both mostly homogeneous and mostly heterogeneous category. The result is presented graphically in Figure 29.

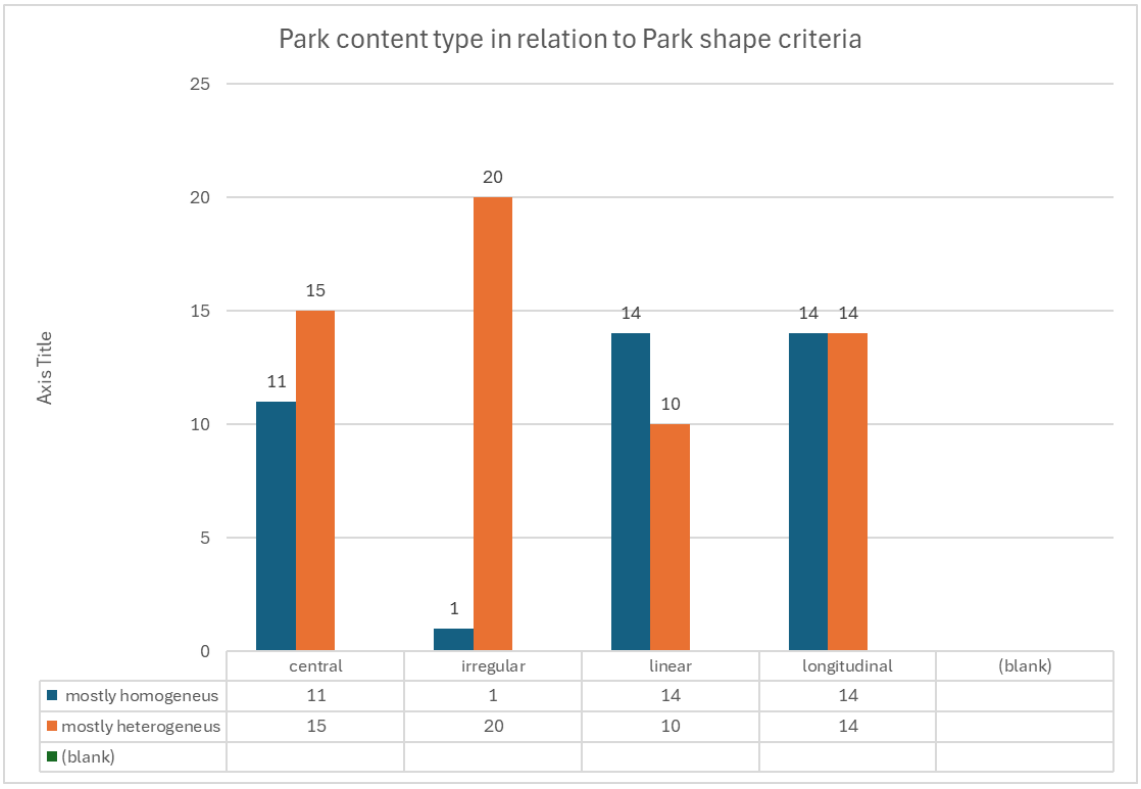


Figure 29 Comparison between the WBUPP content type in relation to WBUPP shape, M. Gudac Cvelic

7.3.2.8 Screening WBUPP Results, WBUPP Content Type Criteria in relation to WBUPP/Infrastructure Relationship Criteria

Correlation between the WBUPP content type and the WBUPP/infrastructure relationship criteria confirms that cases with intersecting infrastructure prevale on being mostly heterogeneous. Mostly homogeneous WBUPPs' infrastructure is contact, either tangent or relevant but with strong reciprocal relationship. The result is presented graphically in Figure 30.

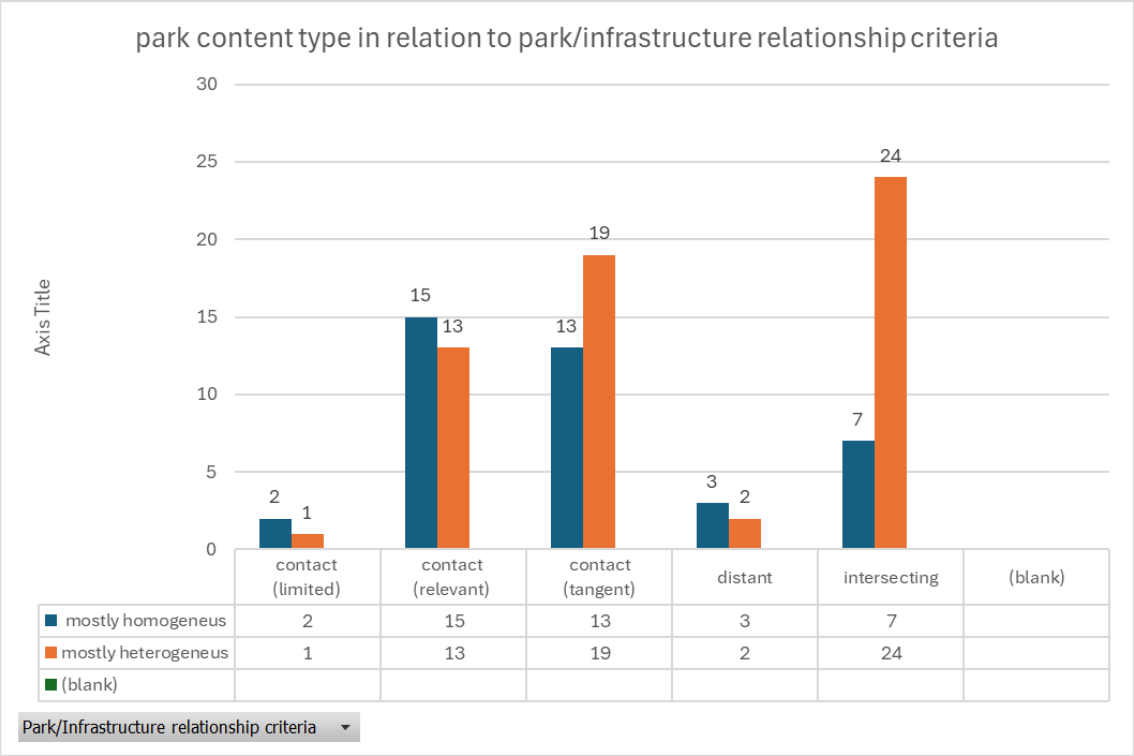


Figure 30 Correlation between the WBUPP content type and the WBUPP/infrastructure relationship criteria, M. Gudac Cvelic

7.3.2.9 Screening WBUPP Results, WBUPP Region Location Criteria in relation to WBUPP/Infrastructure Relationship Criteria

Comparison between the WBUPP region location criteria in relation to WBUPP/Infrastructure relationship criteria presents that majority of European WBUPPs have relevant contact or intersecting infrastructure, while North America's cases proportionately take up contact (tangent and relevant) and intersecting category. Asian's example cases prevail in tangential contact with adjacent infrastructure. The result is presented graphically in Figure 31.

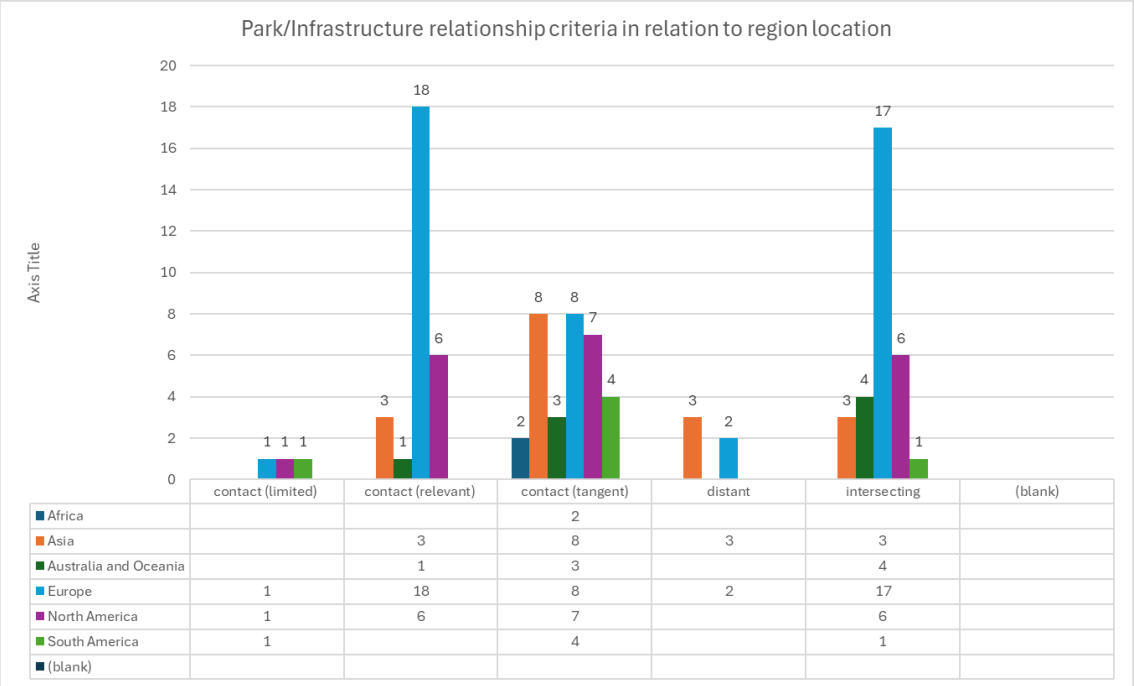


Figure 31 Comparison between the WBUPP region location criteria in relation to WBUPP/Infrastructure relationship criteria, M. Gudac Cvelic

7.3.2.10 Screening WBUPP Results, WBUPP Region Location Criteria in relation to WBUPP Size Criteria

Comparison between the WBUPP region location criteria and WBUPP size criteria showed that extra big cases are sitting only in Europe, Asia and South America. Almost 20% of European WBUPPs is small sized. More than 50% of North American WBUPPs are medium sized. More than 50% of Asian example cases are big. The result is presented graphically in Figure 32.

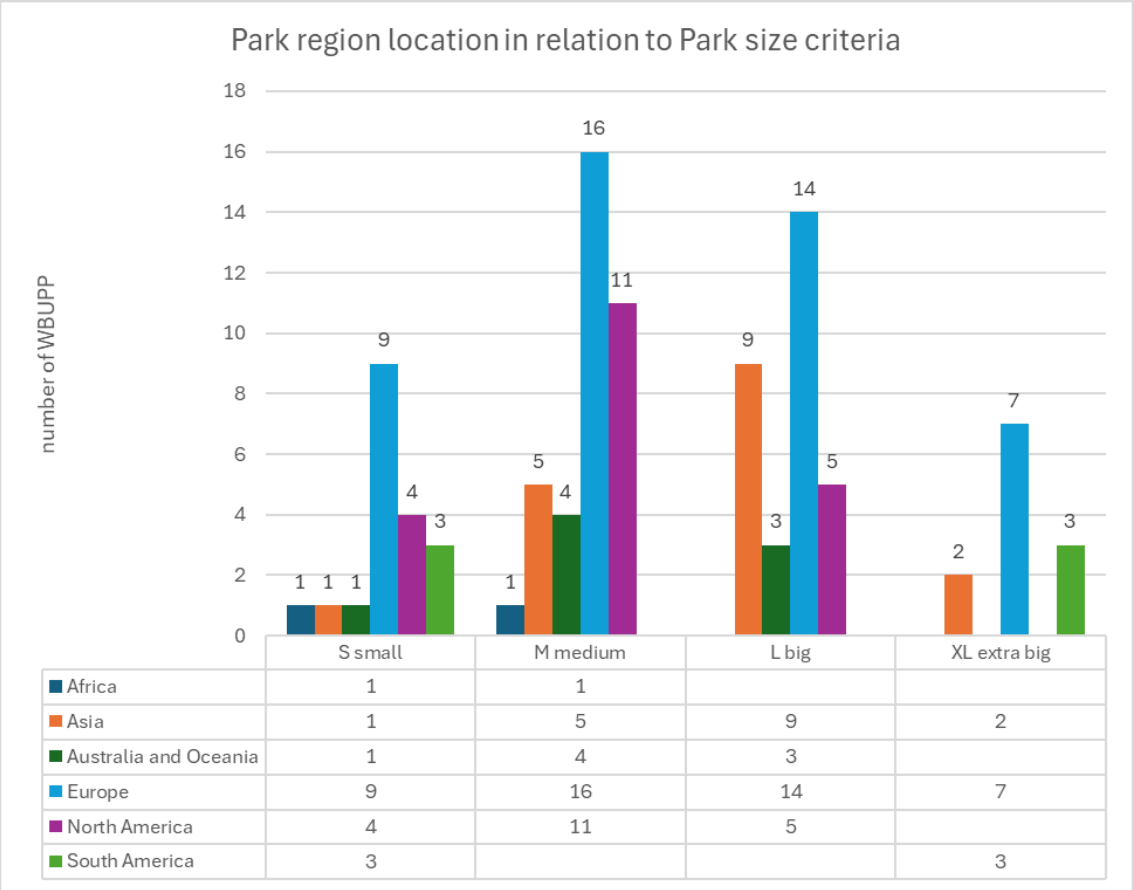


Figure 32 Comparison between the WBUPP region location criteria and WBUPP size criteria, M. Gudac Cvelic

7.3.2.11 Screening WBUPP Results, WBUPP Region Location in relation to Water Body Type Criteria

Comparison between the Water body type and the WBUPP region location showed that almost 70% of European WBUPPs are adjacent to rivers. Lake adjacent cases can only be found in Asia and North America. 65% of North American WBUPPs reside on rivers. More than 50% of Asian example cases are places by the sea. The result is presented graphically in Figure 33.

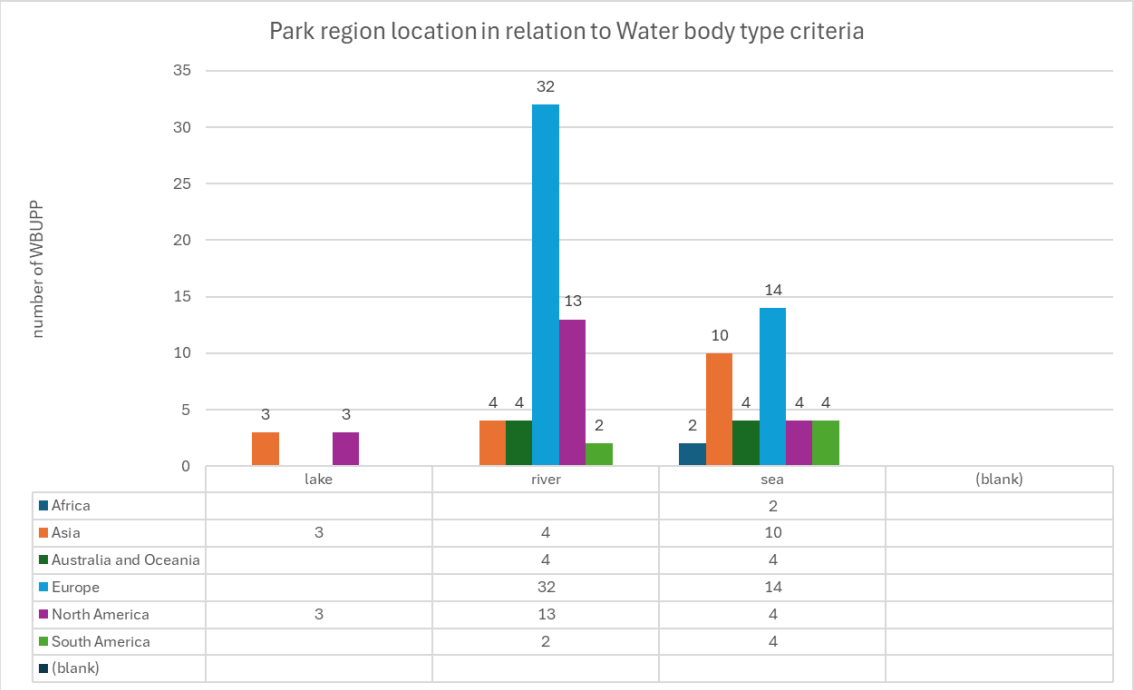


Figure 33 Comparison between the Water body type and the WBUPP region location, M. Gudac Cvelic

7.3.2.12 Screening WBUPP Results, WBUPP Region Location in relation to WBUPP Shape Criteria

Correlation between the WBUPP region location and WBUPP shape criteria presents European linear WBUPPs headlining these criteria relationships quantity. Asian WBUPPs prevale as central shaped. South America's cases, though the overall ratio within the total cases number is small, are mostly longitudinal. The result is presented graphically in Figure 34.

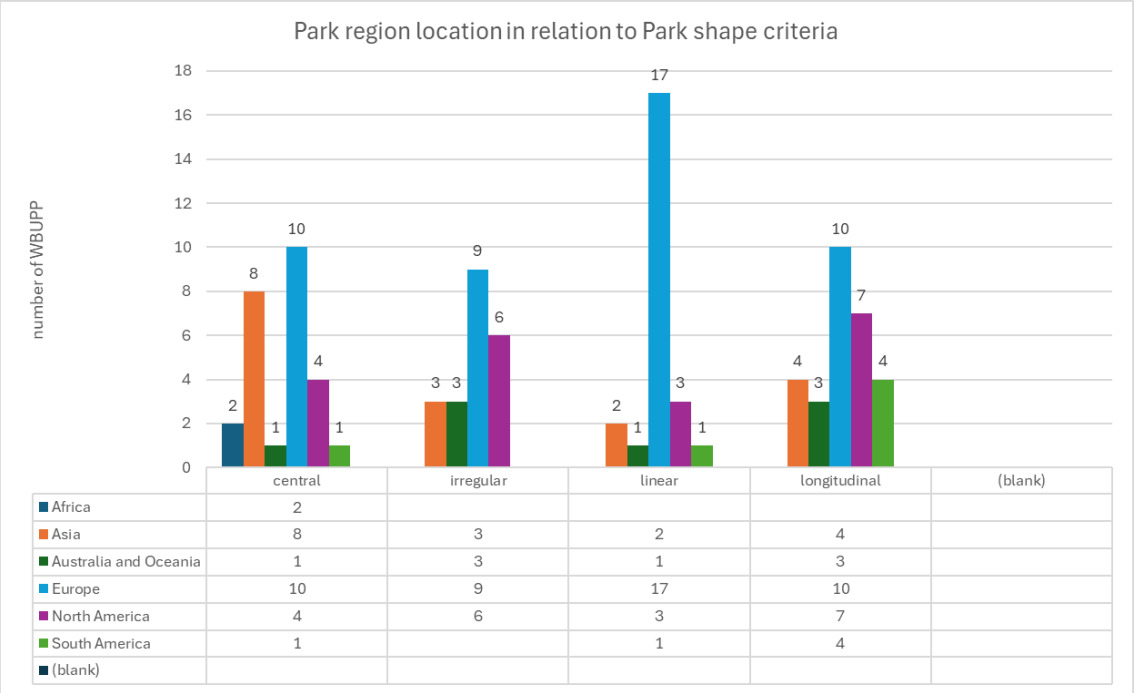


Figure 34 Correlation between the WBUPP region location and WBUPP shape criteria, M. Gudac Cvelic

7.3.2.13 Screening WBUPP Results, WBUPP Region Location in relation to Previous Land Use Criteria

Comparing WBUPP region location in relation to Previous land use criteria resulted in a relatively unified distribution. The WBUPP's number by previous land use criteria reflects the single criteria proportion result, but shows that most North American cases were of industrial use previously. The result is presented graphically in Figure 35.

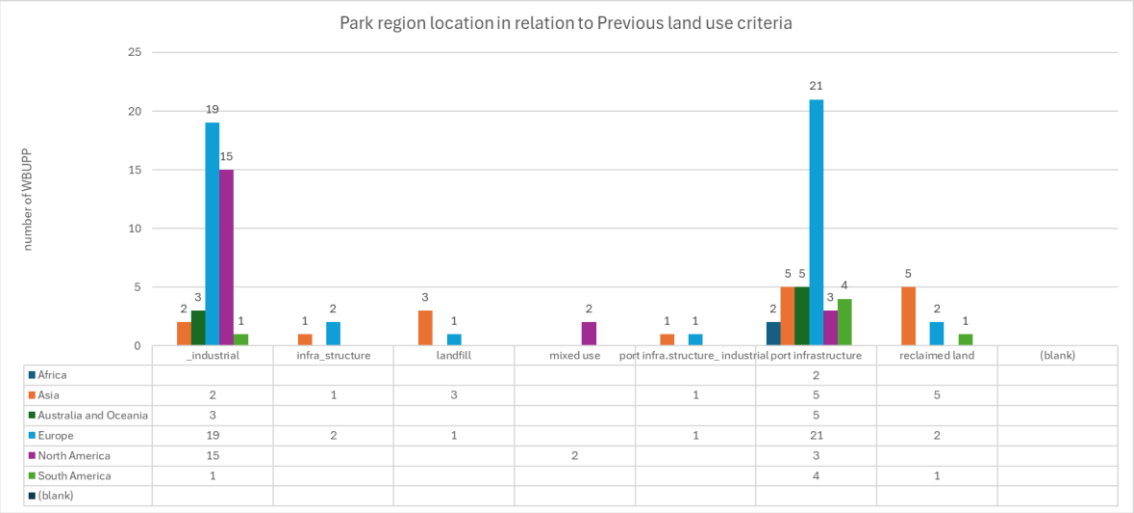


Figure 35 Comparison between WBUPP region location and Previous land use criteria, M. Gudac Cvelic

7.3.2.14 Screening WBUPP Results, WBUPP Region Location in relation to WBUPP Green Spaces Criteria

A comparison of the WBUPP region location with WBUPP green space criteria showed that there is no example case with minimal green space area in North America. The greatest number of WBUPPs with significant landscape surface areas are found in Europe and North America. Among the European WBUPP example cases, the largest portion has a significant ratio of natural areas. The result is presented graphically in Figure 36.

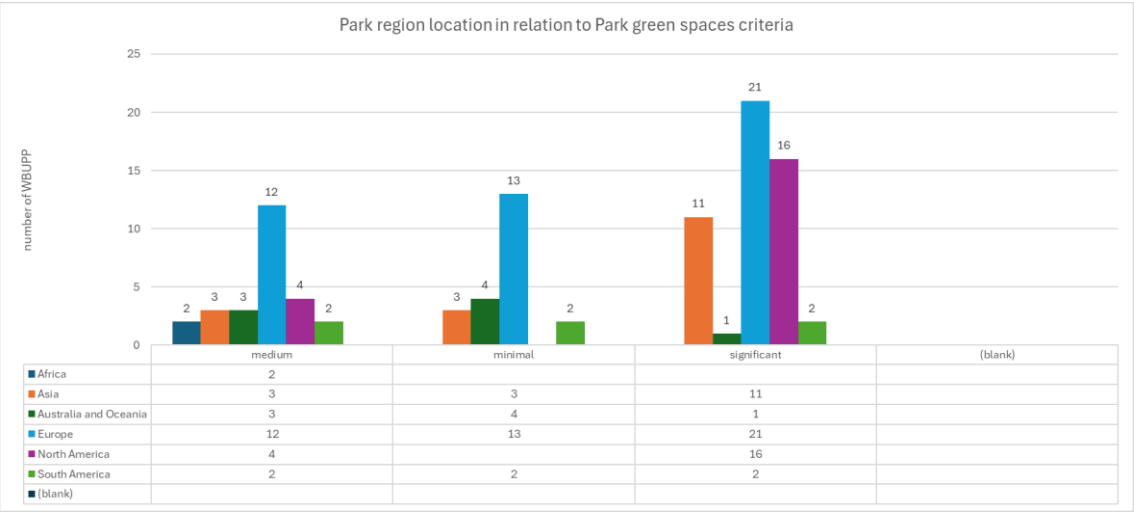


Figure 36 Comparison between the WBUPP region location in relation to WBUPP green spaces criteria, M. Gudac Cvelic

Another 14 comparison results are shown in Figures 2–28, Appendix 1, Chapter 1.2.2. Each comparative analysis is presented with two figures, where two characteristics switch their positions between primary and secondary factors, resulting in graphic charts that represent their mutual relationship.

The comparative screening of WBUPPs shown in Figures 2–28, Appendix 1, Chapter 1.2.2, reveals several clear spatial and programmatic patterns. Lakefront WBUPPs in the sample are predominantly located on previously industrial sites (around 83%), whereas about half of all industrial brownfields are situated on rivers. Former port infrastructure is mainly found along the sea but accounts for over 30% of riverfront cases. All infrastructure/mixed-use brownfields in the database are on rivers, while all landfill sites are on the sea. In lower-income countries, WBUPPs are mainly sea-adjacent, whereas in higher-income countries, riverfront WBUPPs are comparatively more common. Lakefront examples were mostly completed in the last decade.

In terms of size, about two-thirds of lakefront WBUPPs are large, and large WBUPPs are also the most frequent type on the sea (37%); in contrast, nearly half of riverfront WBUPPs are medium-sized (5–20 ha). Medium and large WBUPPs more generally tend to be irregularly shaped, and lakefront sites in particular are typically both large and irregular. Around 38% of central and linear WBUPPs fall into the medium-size category. WBUPPs with only limited (tangent) infrastructure contact are all linear or longitudinal, whereas WBUPPs where infrastructure crosses or strongly intersects the site are predominantly irregular, reflecting a relationship between spatial configuration and how heavily the site is cut by transport or built elements.

Programmatically, almost all irregular sites have mostly heterogeneous (mixed, diverse) programs, while linear and longitudinal WBUPPs are relatively more frequent among the mostly homogeneous category. Heterogeneous programs are also concentrated in WBUPPs where infrastructure intersects or closely contacts the WBUPP. Regionally, tangent (contact) infrastructure is the dominant pattern in Africa, Asia, and South America, whereas intersecting and strongly contacting infrastructure is more typical in Europe. Around half of the WBUPPs

in Australia & Oceania, Africa, and North America are medium-sized, while in Asia, large WBUPPs prevail and small or extra-large ones are rare.

Riverfront sites dominate in Europe, sea-adjacent WBUPPs in Africa, Asia, and South America, and lakefront WBUPPs (within this dataset) occur only in Asia and North America. Linear WBUPPs are especially common in Europe, while irregular and longitudinal forms predominate in Australia & Oceania and North America; central-type WBUPPs are relatively most frequent in Africa and Asia. In terms of previous land use, WBUPPs located on reclaimed land and on landfills are concentrated in Asia, former port-infrastructure sites dominate in Africa, Australia & Oceania, and South America, and about 75% of North American WBUPPs are on regenerated industrial land. WBUPPs with a lot of green space are most common in Asia, Europe, and North America, while in South America the shares of minimal, medium, and significant greenery are roughly balanced. In Australia & Oceania, half of the selected WBUPPs have minimal green surfaces, and North American cases in the sample include none with minimal greenery.

7.3.3 Screening WBUPP Results, MCA and LCA Analysis

Since the initial WBUPP screening section, which used descriptive statistics to analyze the example cases, did not yield statistically significant results that would clearly indicate an optimal set of representative WBUPP selection criteria, the analysis proceeds with more advanced methods. Multiple Correspondence Analysis (Hunter et al., 2021) and Latent Class Analysis (LCA) are conducted using jamovi software (Love et al., 2025) to discover underlying patterns and typologies among the cases. jamovi is a free, open-source statistical software designed as a user-friendly tool. It provides a spreadsheet-like graphical interface, supports a wide range of analyses with automatic updates, publication-ready output, and extensibility via community modules (Wikipedia, 2026d). MCA is a descriptive multivariate technique designed for nominal categorical data; it projects individuals and categories as points in a multidimensional Euclidean space, allowing the detection and visualization of hidden structures without assuming ordinality (Costa et al., 2013). LCA, on the other hand, identifies

unobserved (latent) subgroups within a population based on patterns across multiple categorical indicators, a widely used approach in psychology, social sciences, and medicine to explore heterogeneity in complex datasets (Weller et al., 2020; Sinha et al., 2021).

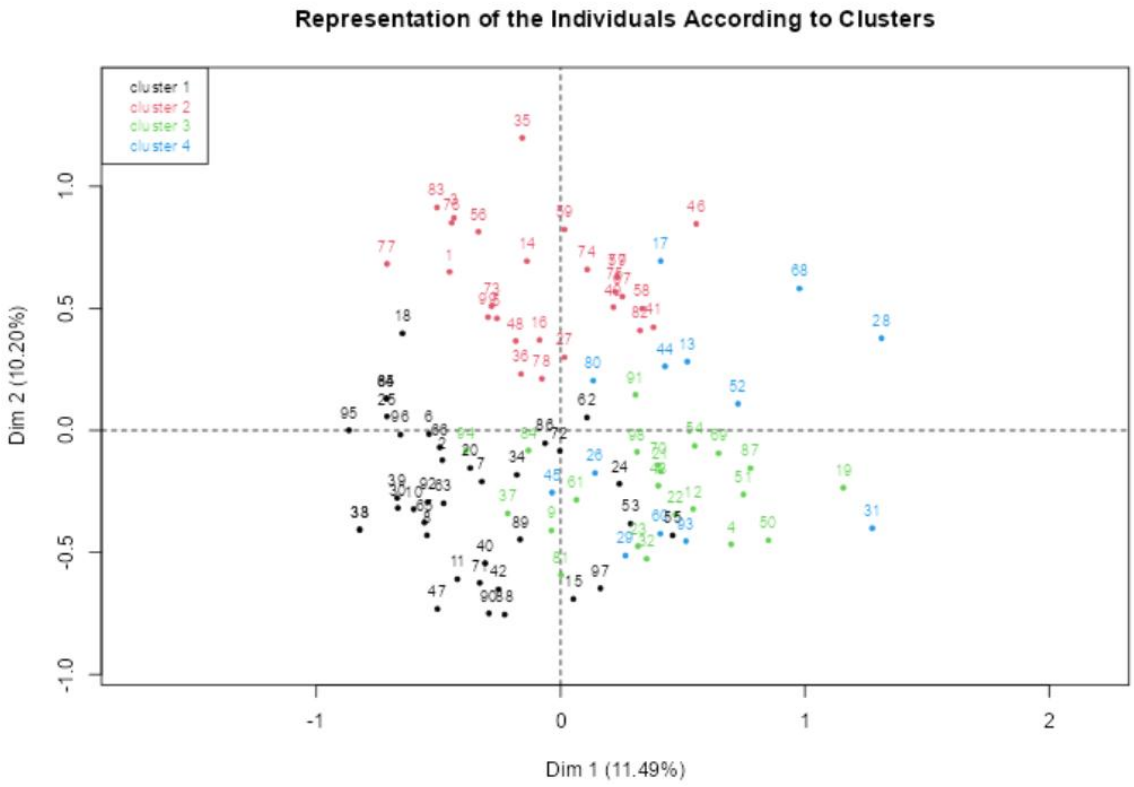


Figure 37 WBUPP example cases screening, MCA analysis result, produced using jamovi software tool, M. Gudac Cvelic

The MCA results, presented in Figure 37, reveal a four-cluster structure. Cluster 1 (black, bottom-left) consists of riverfront, linear-shaped WBUPPs with homogeneous content and intersecting infrastructure. Cluster 2 (red, top-left) includes riverfront but irregular, heterogeneous WBUPPs, also with intersecting infrastructure, reflecting a more complex, mixed-use pattern along rivers. Cluster 3 (green/turquoise, bottom-right) comprises more distant, “immersion”-type seafront WBUPPs with central shapes and homogeneous programs, suggesting a more contained, single-core character. Cluster 4 (orange/red/pink, top-right) groups seafront WBUPPs with heterogeneous, irregular layouts and intersecting

infrastructure, indicating more fragmented, multifunctional waterfront schemes. The LCA confirms that a two-class model best fits the data, but the three-class solution, with nearly equivalent fit indices, yields more interpretable profiles. Class 1 (“Riverine Contact & Central Shape,” 36.1% of cases) is dominated by riverfront sites, limited to medium immersion, central shapes, and strong neighborhood contact. Class 2 (“Natural Orientation & Distance,” 33.1%) emphasizes lake/sea environments, high immersion, irregular forms, and distance from infrastructure. Class 3 (“Urban Port Legacy,” 30.8%) is defined by lake/sea sites, low to medium immersion, linear geometries, and former port infrastructure, aligning with the MCA’s sea-oriented, port-related cluster. Although the two-class model is statistically cleaner, the three-class structure offers finer typological distinctions that is more useful for planning-oriented interpretation. Random Forest validation shows moderate predictive performance, confirming that the classes are only partially separable but still capture consistent, non-random patterns in the data. LCA results show that the proportion of distinctive potential cluster portions increases with the number of participating factors. The distinguished classes cannot be meaningfully tied to other significant WBUPP characteristics.

Since this analysis did not produce a concrete and usable result, representative WBUPP example case selection is performed with an alternative method.

7.4 Concluding Remarks on WBUPP Representative Example Cases Database

The database for WBUPPs does not exist, so examples are sought through literature, internet sources, and personal inquiries. Scientific literature is accessed via WoS and Scopus. Various internet sources have been utilized over two years, including Google and different versions of Gemini and ChatGPT, while searching with keywords like Waterfront, Public Park, Brownfield, and Urban.

The WBUPP case selection method follows Flyvbjerg (2006), opting for Random selection to prevent biases. Sample size is crucial for generalization. Random sampling is used for WBUPP case selection to represent the whole population.

The WBUPP example cases identification methodology is illustrated with a PRISMA flow diagram. Initially identified cases (151) are purged, screened (125), resulting in exclusions according to multiple criteria sets, leading to a total of 99 valid cases.

WBUPPs are classified, and a comparative analysis is made.

The analysis of 99 WBUPPs uncovers unique patterns in their distribution and development. Findings are based on thirteen screening criteria and key indicator correlations.

Geographical Distribution and Scale: Almost half of WBUPPs (47%) are in Europe, with North America (20%) and Asia (17%) forming the next largest groups. Medium (5–20 ha) and large (20–100 ha) WBUPPs make up about one-third each, while small and extra-large WBUPPs are less common.

Temporal Development: About 90% of WBUPPs were completed in the 21st century, showing increased waterfront regeneration efforts. The last decade (2015–2025) has seen almost as many WBUPP completions as the previous 2000–2014 period.

Water Context and Spatial Form: The majority of WBUPPs are along rivers (55%), with fewer by the sea (38%) or lakes (6%). Over 80% of WBUPPs have strong water integration, and WBUPP shapes are varied, with no single dominant form.

Urban Integration and Land Use Background: Most WBUPPs (83%) are integrated into urban areas, often adjacent to residential neighborhoods. Nearly all (95%) have infrastructural connections, ensuring high accessibility, and over 85% were previously industrial or port-related sites.

Landscape Quantity and Socio-Economic Context: More than half of the WBUPPs feature substantial green spaces, highlighting landscape design's importance. Additionally, 85% of WBUPPs are in countries among the top 50 by GDP per capita, suggesting wealthier nations more easily implement these projects.

Comparative Findings: Correlative analyses support these trends, showing industrial brownfields are mainly riverfront, while port redevelopments are

coastal. Medium and extra-large WBUPPs often occupy river sites, with irregular shapes integrating diverse programs, and European WBUPPs typically have linear forms and rich green spaces.

Overall, the analysis indicates that contemporary WBUPPs are primarily medium to large, water-integrated, and located in economically developed areas.

Additional analyses were conducted because descriptive statistics did not yield a concrete or usable result for selecting representative WBUPP example cases. Multiple Correspondence Analysis (Hunter et al., 2021) and Latent Class Analysis (LCA) also did not yield concrete or usable results.

The analysis of 99 WBUPP example cases, grounded in a scientific literature review encompassing the four interrelated WBUPP domains, confirms Hypothesis 1: WBUPPs are a specific typology characterized by unique characteristics that emerge from the intersection of its factor's domains: brownfields, urban waterfront, public park, and sustainability principles. Empirical analysis of 99 global cases partially confirms Hypothesis 3: The identified criteria framework can be validated through analysis of WBUPP example cases using the developed content and spatial analysis methodology.

8 WBUPP REPRESENTATIVE EXAMPLE CASES

WBUPP representative example cases are WBUPPs with specific characteristics, chosen to represent the typology in further research. They are subjected to a detailed analysis aiming to validate the established WBUPP urban-planning criteria set and potentially supplement it with additional criteria that could result from WBUPP representative example cases detailed analysis.

8.1 WBUPP Representative Example Cases Selection Methodology

The WBUPP representative example cases selection method is deduced citing Flyvbjerg (2006), choosing Information-oriented selection type instead of the Random selection. The latter aims to avoid systematic biases in the sample and can include Random sampling to achieve a representative sample that allows for generalization for the entire population, or Stratified sampling to generalize for specially selected subgroups within the population. **Information-oriented selection type** is used to maximize the utility of information from small samples and single cases. Cases are selected based on expectations about their information content. Specifically, the type can have four variants: 1. *Extreme/deviant cases* to obtain information on unusual cases, which can be especially problematic or especially good in a more closely defined sense; 2. *Maximum variation cases* to obtain information about the significance of various circumstances for case process and outcome (e.g., three to four cases that are very different on one dimension: size, form of organization, location, budget); 3. *Critical cases* to achieve information that permits logical deductions of the type, “If this is (not) valid for this case, then it applies to all (no) cases.”; and the fourth which is chosen for the WBUPP representative cases selection, **Paradigmatic cases** to develop a metaphor or establish a school for the domain that the case concerns (Flyvbjerg, 2006).

WBUPP representative example cases had to have enough information available to be able to conduct the detailed analysis. That was considered to be a prerequisite, even though no actual exclusion was based on that general criterion. WBUPP example cases starting number (99) is the result from the previous research phase: WBUPP example cases database screening. WBUPP representative example cases are selected in three phases by eliminating cases that do not fit the criteria presented in **Error! Reference source not found.**. WBUPP representative example cases selection process with phase-by-phase number reduction of example cases is presented graphically in Figure 38 and Figure 39.

Table 34 WBUPP representative example cases selection criteria, M. Gudac Cvelic

WBUPP representative example cases selection criteria	
GENERAL	WBUPP example case with available material (WBUPP screening result)
PHASE 1	WBUPP example case is completed within the 21st century, meaning a more recent timeframe completion criterion (early 21st century, the last decade)
	WBUPP example cases are in close proximity to infrastructure (contact, intersecting)
	WBUPP example case has at least an intense water body contact intensity criteria met (intense, full immersion)
	WBUPP example case's program is mostly heterogeneous
	WBUPP example cases were previously used as industrial or port infrastructure sites (industrial, port infrastructure)
PHASE 2	WBUPP example case meets the WBUPP green spaces categories, at least medium (medium, significant)
	WBUPP example case is in country within top 50 GDP per capita criteria range (first 25, 26-50)
	WBUPP example cases are professionally acclaimed and cited in scientific literature
PHASE 3	WBUPP example cases medium and big sizes covered (medium, big)
	WBUPP example case is located in regions with majority number of cases covered (Europe, North America, Asia)
	WBUPP example case implements sustainability characteristics
	WBUPP example case all adjacent water body type covered (sea, river, lake)

THE WBUPP REPRESENTATIVE CASES SELECTION, PHASE 1

- WBUPP example case is completed within the 21st century, meaning a more recent timeframe completion criterion (early 21st century, the last decade included, 2nd half of the 20th century excluded)
- WBUPP example cases are in close proximity to infrastructure (contact, intersecting included, distant excluded)
- WBUPP example case has at least an intense water body contact intensity criterion met (intense, full immersion included, medium, minimal excluded)
- WBUPP example case's program is mostly heterogeneous (mostly heterogeneous included, mostly homogeneous excluded)
- WBUPP example cases were previously used as industrial or port infrastructure sites (industrial, port infrastructure included, mixed use, landfill, reclaimed land excluded)

The result obtained 35 representative example cases. By eliminating cases that are completed in the 20th century the overall number of example cases was reduced to 88. By eliminating cases that are categorized as distant, in the WBUPP/Infrastructure relationship criterion, the overall number of example cases was reduced to 86. By eliminating cases whose water body contact is categorized as minimal (0-25% of the area's boundary is water) or medium (25-40% of the area's boundary is water), the overall number of example cases was reduced to 69. By eliminating cases whose program is homogeneous the overall number of example cases was reduced to 44. By eliminating cases that were previously used for mixed use, that are landfill or have reclaimed land, the overall number of example cases was reduced to 35.

THE WBUPP REPRESENTATIVE CASES SELECTION, PHASE 2

- WBUPP example cases have met the medium category of WBUPP green spaces criterion, at least (medium, significant included, minimal excluded)
- WBUPP example cases are in countries with top 50 GDP per capita income ranking (first 25, 26-50 included, 51-75, 75+ excluded)

The result obtained 20 representative example cases. By eliminating cases whose green spaces make up less than fifteen percent of WBUPP area (category minimal), the overall number of example cases was reduced to 25. By eliminating cases that are in countries ranked lower than the top 50 according to GDP income per capita, the overall number of example cases was reduced to 20.

- WBUPP example cases are professionally acclaimed and cited in scientific literature

The result obtained 12 representative example cases.

Asia's case Singapore, Jurong Lake Gardens meets the professional recognition and scientific literature citation credit criterion. It has won Landezine award in 2021. (Landezine International Landscape Award LILA, 2019), 2021 ULI Asia Pacific Awards for Excellence (Urban Land Institute Asia Pacific, 2021), and Green Space (International) Award in 2020 (National Parks Board, 2020). Scientific articles that studied urban green spaces (Srikanth and Schroepfer, 2023), (Hwang and Jain, 2021) and biodiversity (Altoaimi et al., 2025).

European cases (Austria, Linz, Donaupark; Ireland, Cork, Marina Park Waterfront; Spain, Bilbao, Abandoibarra; Netherlands, Rotterdam, Kop van Zuid; Sweden, Gothenburg, Jubileumsparken; Sweden, Malmö, Western Harbor; Denmark, Copenhagen, Havnestad Havnepark; United Kingdom, London, Queen Elizabeth Olympic Park) are mutually compared analyzing professional recognition and scientific literature citation credit criterion. Donaupark in Linz and Marina Park Waterfront in Cork do not meet the criterion.

Donaupark or Donaulande in Linz is not found in scientific articles and is not mentioned as being awarded professionally (Linz Tourist Information, 2025). Marina Park Waterfront in Cork does not appear in scientific literature, is present on curated professional platforms (Landezine International Landscape Award LILA, 2023), and has been awarded by Cork City Council (World Landscape Architecture WLA, 2025).

Abandoibarra in Bilbao was studied extensively in scientific literature, as a part of the famous Bilbao-effect (Rodríguez and Martinez, 2003), (Gonzalez, 2011), and

as the transformation in the post-industrial city (Gospodini, 2006). It has received many awards and has been acknowledged worldwide for planning, regeneration and design excellence. It won the Biennial Special Jury Award for the Regeneration of the banks of the Estuary “Industrial Banks – Urban Banks” at Venice Architecture Biennale in 2004., the European Council of Town Planners Award for the OAVS operation (Abandoibarra, Ametzola, Variante Sur ferroviaria) in the Local Urban Regeneration Plans section, award for excellence from the International Society Of City And Regional Planners IsoCaRP in 2005., and others (Bilbao Ría 2000, 2025). The city of Bilbao has been named the inaugural Lee Kuan Yew World City Prize Laureate of 2010, in recognition of its integrated and holistic approach in urban transformation, especially interventions of rejuvenating the waterfront, with Abandoibarra being highlighted among the 25 projects over 25 years (Lee Kuan Yew World City Prize, 2025b).

Kop van Zuid in Rotterdam is widely cited in scientific literature as an exemplary urban transformation, studied by McCarthy (1998), Doucet (2013); Doucet et al. (2011), Lee (2020), Harteveld (2021), Daniëls (1991); Dehaene and Vervloesem (2011). It received recognition by Lord Richard Rogers' Urban Task Force (2003) in the publication Towards an Urban Renaissance.

Jubileumsparken in Gothenburg is cited in scientific literature (Dahl, 2016), (Allik, 2021). The park had early prototypes developed as part of the *Jubileumsparken 0.5 / Bathing Culture*: the public sauna and harbor bath at Frihamnen (Landezine International Landscape Award LILA, 2024), which won the Siena Prize[7] Swedish architecture award in 2018 (The Swedish Association of Architects, 2019).

Western Harbor in Malmö is cited in scientific literature (Anderson, 2014), (Urfels, 2019), (Anderberg, 2015). It was awarded with Grandesign Etico award in 2015, together with Hammarby quarter in Stockholm, by the city of Milan, the Lombardy region and the Plana Cultural Association committee (City of Malmo, 2015). The city of Malmo, together with the city of Copenhagen, received a Special Mention award at the Lee Kuan Yew World City Prize 2012 in recognition of its good work at Västra hamnen (Western Harbor) (Lee Kuan Yew World City Prize, 2025a).

[7] Prize replaced by Swedish architecture award in 2019.

Havnestad Havnepark in Copenhagen is cited in scientific literature (Al Khani, 2001; Simon Bell et al., 2021). The WBUPP comprises Islands Brygge Harbour Bath (Badeanstalt) designed by Bjarke Ingels Group (BIG) after 2003. competition win. It received Honourable Mention for Best Public Recreational Facility from International Olympic Committee in 2007., and European Prize for Urban Public Space in 2004 (BIG LEAP: Bjarke Ingels Group of Landscape, 2002).

Queen Elizabeth Olympic Park in London, United Kingdom is cited in scientific literature (Pinto; and Santos, 2022) and was awarded with Excellence in Landscape and Parks Management by the Landscape Institute in 2020 (The Landscape Institute LI, 2025), the Rosa Barba international landscape prize at the 9th Barcelona International Landscape Biennial (Biennal Internacional de Paisatge de Barcelona, 2016), and others (Green Flag Award, 2026); (London Legacy Development Corporation LLDC, 2023). The Park Management Plan (PMP) is a document that describes, among other topics, the vision and management strategy for Queen Elizabeth Olympic Park, and the governance and park management structures and relationships with partner organizations and stakeholders. PMP won a Landscape Institute Award for excellence in 2016 (Green Flag Award, 2026).

North American cases (Canada's Toronto, Biidaasige Park, Port Lands Waterfront Park; Mississauga, Port Credit Waterfront; Montreal, Lachine Canal Park; Vancouver, Olympic Village; and United States of America's New York City, Brooklyn Bridge Park; Columbus, Scioto Audubon Metro Park; Philadelphia, Spruce Street Harbor Park; Newark, Newark Riverfront Park; San Francisco, India Basin Waterfront Parks; Long Island City, Hunters Point South Waterfront Park; Nashville, Cumberland Park) are mutually compared analyzing professional recognition and scientific literature citation credit criterion. Port Credit Waterfront in Mississauga, Lachine Canal Park in Montreal, Olympic Village in Vancouver, Scioto Audubon Metro Park in Columbus, Newark Riverfront Park in Newark and India Basin Waterfront in San Francisco do not meet the criterion.

Biidaasige Park, part of the Port Lands Waterfront Park in Toronto, is a newly opened park so it is not yet cited in scientific literature, but the City of Toronto

through Waterfront Toronto Corporation is regenerating its waterfront for decades. It is widely cited as an example worth learning from De Sousa (2002); De Sousa (2003);Gordon, 2001;White (2016); Ute Lehrer and Laidley (2008). Toronto's WBUPP was awarded Best Overall Project at the 2025 Brownie awards (Environment Journal, 2025). The project commission was won in 2007 thanks to a small competition, invited by Waterfront Toronto organization. Other cited awards include 2022 Waterfront Toronto Design Review Panel Award for Excellence in Public Landscape Design, 2011 Excellence in Planning Award from the Ontario Professional Planners Institute (Lehtovuori and Ruoppila, 2012), 2010 Institute of Transportation Engineers Transportation Achievement Award, 2009 BEX International Award for Best Futuristic Design, 2008 Royal Architectural Institute of Canada (RAIC) Special Jury Award for Sustainable Development, 2008 ASLA Analysis and Planning Honor Award, 2007 Toronto Urban Design Award (Michael Van Valkenburgh Associates Inc, 2026b).

Port Credit Waterfront in Mississauga is not cited in scientific literature and was not acclaimed professionally.

Lachine Canal Park in Montreal is not cited in scientific literature and was not acclaimed professionally.

Olympic Village in Vancouver is cited in scientific literature (Kear, 2007). Professional acclamation evidence was not found.

Brooklyn Bridge Park in New York City is cited in scientific literature (Simon Bell et al., 2021), (Rembeza and Sas-Bojarska, 2022), and was awarded with 2021 Rosa Barba International Landscape Prize, 2014 The American Planning Association's National Planning Excellence Award for Urban Design, 2014 ASLA New York Design Merit Award, Brooklyn Bridge Park Pier 5, 2013 ASLA New York Honor Award, Brooklyn Bridge Park Pier 1, 2011 Municipal Art Society of New York Brendan Gill Prize, Brooklyn Bridge Park Master Plan, 2011 AIANY Urban Design Honor Award, Brooklyn Bridge Park Master Plan, 2011 Rudy Bruner Award Silver Medal, Brooklyn Bridge Park Master Plan, 2010 National Park Service "Designing the Parks" Honor Award, 2009 ASLA Analysis and Planning Honor Award, Brooklyn Bridge Park Master Plan, 2009 Waterfront Plan Honor Award, the Waterfront Center's Excellence on the Waterfront Awards

(Michael Van Valkenburgh Associates Inc, 2026a), 2018 ASLA General Design Award of Excellence, 2014 Municipal Art Society of New York MASterworks Award for the Best Urban Landscape (AKRF, 2025). It is named as a case study, specific example of reuse and repurpose of the city's industrial waterfront into a dynamic and sustainable park, contributing to New York City being awarded The Lee Kuan Yew World City Prize Laureate in 2012 (The Lee Kuan Yew World City Prize, 2025a; The Lee Kuan Yew World City Prize, 2025b).

Scioto Audubon Metro Park in Columbus' citation in scientific literature was not found. It was awarded 2016 APA National Planning Excellence Award for Implementation by the American Planning Association, 2014 Ohio EPA Outstanding Achievement in Brownfield Redevelopment, 2010 Ohio Chapter ASLA Award of Excellence (MKSK Landscape Architecture, 2025).

Spruce Street Harbor Park in Philadelphia is cited in scientific literature (Simon Bell et al., 2021). WRT, the firm behind the adjacent Delaware River Waterfront Corporation master plan that incorporates Spruce Street Harbor Park, received the 2018 ULI Rouse Award for Excellence for the overall Penn's Landing waterfront strategy (LLC, 2018).

Newark Riverfront Park in Newark's scientific literature citation was not found. It is a case studied through academic research (Rutgers University Libraries, 2025). Professional acclamation evidence was not found.

India Basin Waterfront Park in San Francisco's citation is not found in scientific literature, but was awarded in 2025 from World Urban Parks with Neighborhood Park Award (Global Award for Excellence and Innovation) (World Urban Parks, 2025).

Hunters Point South Waterfront Park in Long Island City, New York, is cited in scientific literature (Nur Simais and Korgavus, 2024), (Domlesky, 2023) and was awarded ULI Americas Awards for Excellence Winner in 2025 (SWA/Balsley, 2023), 2019 ASLA General Design Award Of Honor for Phase II (gooood, 2020), AIA National Award, Honor Award – ASLA NY, Honor Award – National ASLA, The Municipal Art Society of New York, MASterworks Award, Urban Design, and others (Weiss/Manfredi, 2025).

Cumberland Park in Nashville is cited in scientific literature (Olson, 2021) and was awarded with LEED Gold-certified status from the U.S. Green Building Council (The National Recreation and Park Association NRPA, 2016).

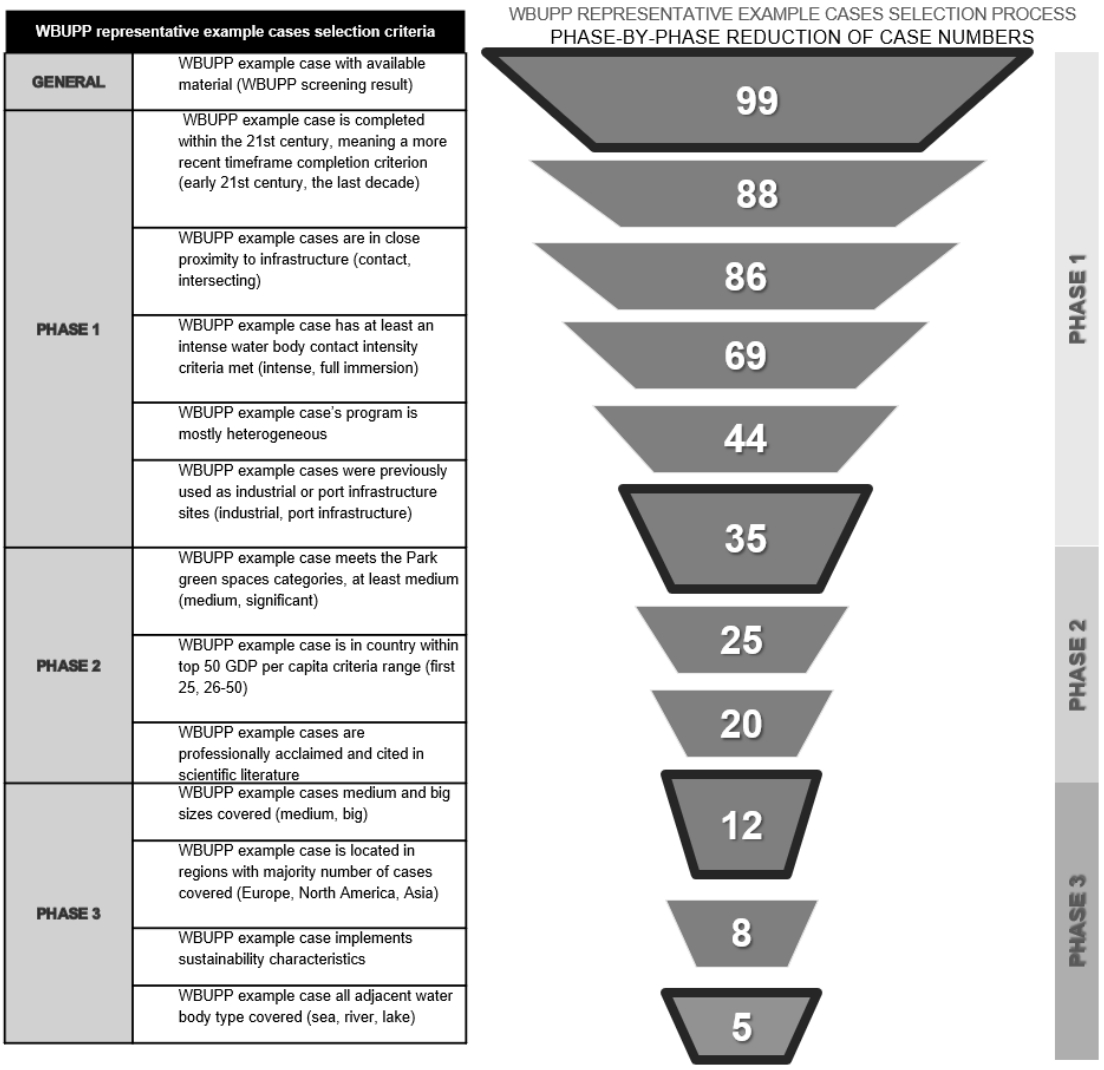


Figure 38 WBUPP representative example cases selection process, presenting phase-by-phase number reduction of example cases, M. Gudac Cvelic

THE WBUPP REPRESENTATIVE CASES SELECTION, PHASE 3

- WBUPP example cases sized S and XL are eliminated due to substantial deviation in size

- WBUPP example cases represent the exemplary cases of the regions where majority of example cases included in the screening are located (Europe, North America, Asia)
- WBUPP example cases have sustainability characteristics implemented
- WBUPP example cases represent different water body types

Information-oriented selection type is used to maximize the utility of information from small samples and single cases. Cases are selected based on expectations about their information content (Flyvbjerg, 2006). **Paradigmatic cases** develop a metaphor or establish a school for the domain that the case concerns (Flyvbjerg, 2006), is chosen for the WBUPP representative cases selection.

The phase 3 result obtained 5 representative example cases. Phase 2 results consist of 12 example cases that comprise 1 WBUPP's in Asia, 5 in North America and 6 in Europe. Asia's case Singapore, Jurong Lake Gardens is the only one so it met the region's exemplary case criterion.

European cases (Spain, Bilbao, Abandoibarra; Netherlands, Rotterdam, Kop van Zuid; Sweden, Gothenburg, Jubileumsparken; Sweden, Malmö, Western Harbor; Denmark, Copenhagen, Havnestad Havnepark; United Kingdom, London, Queen Elizabeth Olympic Park) are mutually compared analyzing scientific literature citation credit, professional recognition and sustainability characteristics implementation. Havnestad Havnepark in Copenhagen is eliminated for being S small. Queen Elizabeth Olympic Park in London is eliminated for being XL extra big. Abandoibarra, Bilbao is selected as a **big** (L) category representative WBUPP **river** example case . Jubileumsparken in Gothenburg is selected as a **medium** (M) category representative WBUPP **sea** example case. North American cases (Canada's Toronto, Biidaasige Park, Port Lands Waterfront Park; and United States of America's New York City, Brooklyn Bridge Park; Philadelphia, Spruce Street Harbor Park; Long Island City, Hunters Point South Waterfront Park; Nashville, Cumberland Park) are mutually compared analyzing scientific literature citation credit, professional recognition and sustainability characteristics implementation. Hunters Point South Waterfront Park in Long

Island City, New York and Cumberland Park in Nashville, are eliminated for being S small. Two WBUPPs are selected to represent Canada and United States of America, each individually. Biidaasige Park, Port Lands Waterfront Park in Toronto is selected as the most recently completed, a **big** (L) category representative WBUPP **lake** example case. Brooklyn Bridge Park in New York City is selected as the most recently completed, a **big** (L) category representative WBUPP **sea** example case.

The resulting WBUPP representative example cases list is presented in Table 35**Error! Reference source not found.**.

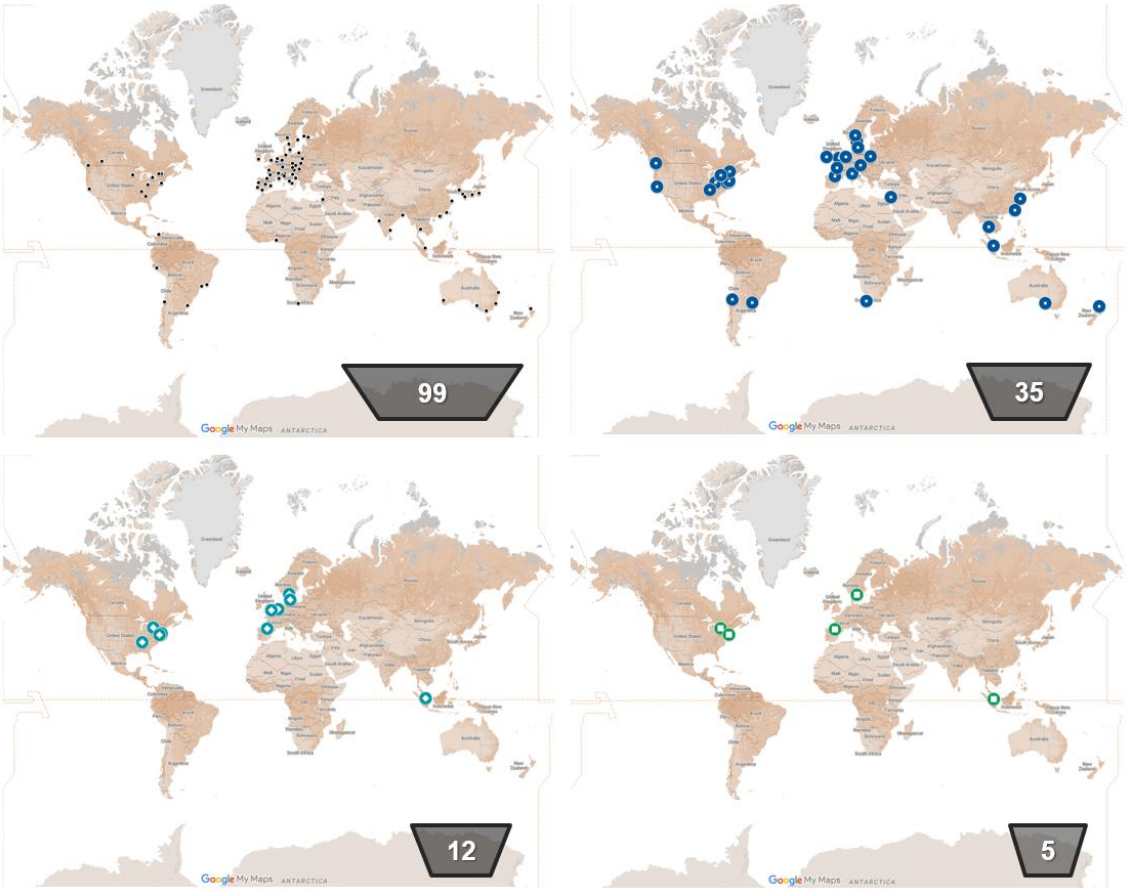


Figure 39 WBUPP representative example cases selection process, graphically representing phase-by-phase number reduction of example cases on a world map, M. Gudac Cvelic in Google My Maps (Maps, 2026)

Table 35 WBUPP representative example cases, M. Gudac Cvelic

No.	Countries by Region criteria (Africa, Asia Australia and Oceania, North America, South America, Europe)	Country	Location	Park / Project Name	Transformation Description	Size (ha)	Park size criteria (S small 0-5ha, M medium 5-20ha, L big 20-100ha, XL extra big 100+ha)	Completion Year	Timeframe completion criteria	Water Body	Water Body type criteria	Water Body contact intensity criteria	Photo	Park shape criteria	Park content type criteria	Park/City relationship criteria (within the urban tissue, outside the urban tissue)	Park/Neighbourhood relationship criteria	Park/Infrastructure relationship criteria	Previous land use criteria (port infrastructure, infrastructure, industrial, landfill, reclaimed land, mixed use)	Park green spaces (minimal (0-10%), medium (15-30%), significant (31-100%))	World Bank Rank (GDP Per Capita, 2025)	GDP per capita ranking criteria
1	North America	USA	**New York City**	**Brooklyn Bridge Park**	Former shipping piers transformed into 85-acre public park with recreational facilities	34,00	L big	2021	the last decade	East River	sea	full immersion +60%		longitudinal	mostly heterogeneus	within the urban tissue	contact	contact (tangent)	port infrastructure	significant	7	first 25
2	North America	Canada	**Toronto**	**Biidaasige Park, Port Lands Waterfront Park**	Massive industrial waterfront revitalization with parks and mixed-use development	40,00	L big	2025	the last decade	Lake Ontario	lake	intense 40-60%		irregular	mostly heterogeneus	outside the urban tissue	contact	contact (tangent)	_industrial	significant	20	first 25
3	Europe	Sweden	**Gothenburg**	**Jubileumsparken**	Industrial harbor converted to park and residential area	8,00	M medium	2023	the last decade	Göta River	river	intense 40-60%		irregular	mostly heterogeneus	within the urban tissue	contact	contact (relevant)	port infrastructure	medium	14	first 25
4	Europe	Spain	**Bilbao**	**Abandoibarra**	Former industrial port transformed into cultural quarter	34,85	L big	2011	early 21st century	Nervión River	river	intense 40-60%		longitudinal	mostly heterogeneus	within the urban tissue	integrated	intersecting	port infrastructure	medium	29	26-50
5	Asia	Singapore	**Singapore**	**Jurong Lake Gardens**	Former industrial area transformed into waterfront botanical gardens	90,00	L big	2019	the last decade	Jurong Lake	lake	full immersion +60%		irregular	mostly heterogeneus	within the urban tissue	integrated	distant	_industrial	significant	4	first 25

8.2 WBUPP Representative Example Cases Analysis Methodology

Basis of the analysis component set is the urban-planning criteria list, categorized in Economic, Social and Environmental sections without a distinct qualitative division. The aim was to specify spatial and non-spatial characteristics that can be analyzed in existing WBUPP representative example cases, and based on the results, used for establishing the urban-planning criteria for the planning and design of urban public parks within waterfront brownfield regeneration.

Sixty-five criteria were singled-out initially, before the detailed analysis was made. During the analysis execution, the need to adjust the list appeared, and ultimately it was performed according to fifty criteria, presented in Table 37.

Indicators have descriptive and spatial characteristics. Different sources were used: scientific literature where possible and internet sources for majority of the quantitative data. QGIS (QGIS Development Team, 2025) is used as a tool for marking, measuring, highlighting spaces, proportions, relations.

WBUPP representative example cases are analyzed in relation to their history, previous land use, the process conducted for their planning, design, and building phase. Their program, broader spatial context, and sustainability features are analyzed through scientific and other available sources. Every aspect that is analyzed helps in the overall understanding of how WBUPPs are developed, how they function, and how they relate to their surroundings. The aim of the multiple aspect analysis is to comprehensively expand and then summarize knowledge about WBUPP representative example cases, so the urban-planning criteria can be validated and, potentially, supplemented with additional urban-planning criteria.

Table 36 WBUPP representative example cases analysis criteria with established categories, based on cited scientific sources, M. Gudac Cvelic

CRITERIA DIMENSION	WBUPP REFERENCE CASES ANALYSIS CRITERIA	CATEGORIES	CRITERIONs SCIENTIFIC SOURCE
ECONOMIC	SELF-SUFFICIENCY	1. Yes 2. No	Doick et al. (2009)
	EMPLOYMENT OPPORTUNITIES	1. Yes 2. No	Doick et al. (2009)
	ALL YEAR USE	1. Yes 2. No	Mrak, I., Ambruš, D., and Marović, I. (2022)
	CIRCULARITY OF CONSTRUCTION	1. Yes 2. No	Mrak, I., Ambruš, D., and Marović, I. (2022); Williams J. (2021)
	IMPLEMENT TOURIST ACTIVITY	1. Yes 2. No	Mrak, I., Ambruš, D., and Marović, I. (2022)
ENVIRONMENTAL	SIZE	1. S small 0-5ha 2. M medium 5-20ha 3. L big 20-100ha 4. XL extra big 100+ha	Matković, I. i Jakovčić, M. (2019)
	POSITION WITHIN NATIONAL TERRITORY	1. Yes 2. No	Matković, I. i Jakovčić, M. (2019)
	POSITION WITHIN URBAN/RURAL STRUCTURE	1. Yes 2. No	Matković, I. i Jakovčić, M. (2019)
	SPACE MANAGEMENT	BOUNDARIES: 1. open 2. closed 3. permeable 4. water	Carmona (2010a); Ching, F.D. (1979)
	HISTORICAL AND CULTURAL VALUE	1. Yes 2. No	Matković, I. i Jakovčić, M. (2019); Throsby D. (2001)
	SPATIAL MORPHOLOGY	1. central 2. irregular 3. linear 4. longitudinal	Sitte (1889); Zucker (1959); Carmona (2014) in Krmpotić Romić, I. (2025)
	ACCESSIBILITY	1. Yes 2. No	Giovinazzi, O. and Moretti, M. (2010); UN-Habitat, (2020)
	NATURE-BASED SOLUTIONS IMPLEMENTATION	1. Yes 2. No	Bin Z. (2024)
	WATER-SENSITIVE URBAN DESIGN (WSUD) INTEGRATION	1. Yes 2. No	Bin Z. (2024); Mrak, I., Ambruš, D., and Marović, I. (2022)
	CLIMATE CHANGE ADAPTATION AND MITIGATION INTERVENTIONS	1. Yes 2. No	Zhang, C., Su, Q., and Zhu, Y. (2023); Nordin, M.N., et al. (2024). Greening the city: criteria and...; Ibes, D.C. (2016). Integrating Ecosystem Services Into Urban…; Mrak, I., Ambruš, D., and Marović, I. (2022); Doick et al. (2009)
	PEDESTRIAN AND CYCLING PATH NETWORK	1. Yes 2. No	Doick et al. (2009); Mrak, I., Ambruš, D., and Marović, I. (2022)

CRITERIA DIMENSION	WBUPP REFERENCE CASES ANALYSIS CRITERIA	CATEGORIES	CRITERIONs SCIENTIFIC SOURCE
	URBAN DESIGN (WELL-BEING OFFERED BY URBAN DESIGN)	1. Yes 2. No	Mrak, I., Ambruš, D., and Marović, I. (2022)
	PUBLIC RESTROOMS	1. Yes 2. No	Mrak, I., Ambruš, D., and Marović, I. (2022)
	DRINKING WATER FOUNTAINS (ACCESS TO DRINKING WATER)	1. Yes 2. No	Mrak, I., Ambruš, D., and Marović, I. (2022)
	ADAPTABLE SPACES	1. Yes 2. No	Mrak, I., Ambruš, D., & Marović, I. (2022); Michael Hough (1984), Ian Bentley (1990), Graham Haughton and Colin Hunter (1994), URBED (1997), Evans et al. (2001), Frey (1999)
	PUBLIC TRANSPORT - resting places every 300m	1. Yes 2. No	Mrak, I., Ambruš, D., and Marović, I. (2022)
	VISUAL IMPACT	1. Yes 2. No	Mrak, I., Ambruš, D., and Marović, I. (2022); Zhang, C., Su, Q., and Zhu, Y. (2023)
	SUSTAINABLE WASTE MANAGEMENT	1. Yes 2. No	Mrak, I., Ambruš, D., and Marović, I. (2022); Üzümcüoğlu, D. (2023) ; Williams J. (2021)
	GREEN AREAS heterogeneity.	1. Yes 2. No	Mrak, I., Ambruš, D., and Marović, I. (2022); Carmona et.al. (2001/2003) (editor?), Commission of the European Community (1990), Michael Breheny (1990), Andrew Blowers (1993), Hugh Barton (1996), Evans et al. (2001), Frey (1999)
	SPORTS and RECREATION AREAS heterogeneity	1. Yes 2. No	Mrak, I., Ambruš, D., and Marović, I. (2022); Fusco Girard, L. and Nijkamp, P. (1997)
	OTHER PUBLIC AREAS heterogeneity	1. Yes 2. No	Mrak, I., Ambruš, D., and Marović, I. (2022)
	ECOSYSTEM PRESERVATION/RESTORATION	1. Yes 2. No	Mrak, I., Ambruš, D., and Marović, I. (2022); Doick et al. (2009);); Zhang, C., Su, Q., and Zhu, Y. (2023);
	MIXED USE, FUNCTIONAL DIVERSITY	1. Yes 2. No	Girard and Nijkamp (1997); Mrak, I., Ambruš, D., and Marović, I. (2022); Rey et al. (2022) Hauri (2011) Fusco Girard and Nijkamp (1997) , and Michael Hough (1984), Michael Hough (1984) . Randall & Baetz (2015) Bentley (1990) Breheny (1992) Frey (1999) Mrak, Ambruš and Marović (2022) URBED (1997), Evans et al. (2001), Şenik, B., and Uzun, O. (2022)

CRITERIA DIMENSION	WBUPP REFERENCE CASES ANALYSIS CRITERIA	CATEGORIES	CRITERIONs SCIENTIFIC SOURCE
	RESILIENCE	1. Yes 2. No	Mrak, I., Ambruš, D., and Marović, I. (2022); Carmona et.al. (2001/2003) (editor?), Michael Hough (1984), Ian Bentley (1990), Graham Haughton and Colin Hunter (1994), URBED (1997), Evans et al. (2001); (Iturriza et al., 2020); (Wang and Foley, 2021)
SOCIAL	PROGRAM / FUNCTION	1. homogeneous 2. heterogeneous	Carr et al (1992); Stanley (2010); Gehl, Gemzoe (2001); Carmona (2015) in Krmpotić Romić, I. (2025); Fusco Girard, L. and Nijkamp, P. (1997)
	PROXIMITY OF SOCIAL (SCHOOL FACILITIES, HOME FOR ELDERLY, HEALTH FACILITIES)	1. Yes 2. No	Rey, E., et.al. (2022)
	PROXIMITY OF COMMERCIAL FACILITIES	1. Yes 2. No	Rey, E., et.al. (2022)
	WELL-BEING	1. Yes 2. No	Rey, E., et.al. (2022); Zhang, C., Su, Q., and Zhu, Y. (2023);
	HERITAGE	1. Yes 2. No	Rey, E., et.al. (2022) ; *Giovinazzi, O. and Moretti, M. (2010);* Üzümcüoğlu, D. (2023); Ashworth (1999), Mrak, I., Ambruš, D., and Marović, I. (2022), Bilušić M. (2024), Andrew Blowers (1993), and Doick et al. (2009)
	EDUCATIVE FACILITIES/SERVICES	1. Yes 2. No	Doick et al. (2009); Burinskienė, M., et al. (2017)
	ACCESSIBILITY (PUBLIC TRANSPORTATION) / MOBILITY	1. Yes 2. No	Rey, E., et.al. (2022); Mrak, I., Ambruš, D., and Marović, I. (2022)
	SHELTER AREAS	1. Yes 2. No	Mrak, I., Ambruš, D., and Marović, I. (2022)
	VITALITY/ CONCENTRATION	1. Yes 2. No	Carmona et.al. (2001/2003) (editor), Ian Bentley (1990), Commission of the European Community (1990), Michael Breheny (1990), Graham Haughton and Colin Hunter (1994), Barton (1996), URBED (1997), Rogers (1997), Evans et al. (2001), Frey (1999)
	SENSE OF PLACE	1. Yes 2. No	Carmona et.al. (2001/2003) (editor), Commission of the European Community (1990), Blowers (1993), Haughton and Hunter (1994), URBED (1997), Evans et al. (2001), Frey (1999); *Giovinazzi, O. and Moretti, M. (2010)*

8.2.1 WBUPP Classified Thematic Maps

Spatial analysis is conducted by integrating graphic and text analysis, using both scientific and non-scientific literature sources. The graphic component is based

on combining stratified data layers in the QGIS program (QGIS Development Team, 2025). OpenStreetMap (2025) and Google Satellite (Google, 2026b) that serve as base maps, which are juxtaposed and combined with data imported from the OpenStreetMap (OSM) physical features catalog (OpenStreetMap Wiki, 2025). Imported OSM data was transformed. Transformation results related to keys, values and assigned categories are presented in Table 37. Additional specific local open data system information is incorporated when necessary and available. Supplementary tools, such as Google Maps (Google, 2026b), Google Street View (Google, 2025), and Google Earth Pro (Google, 2026a), are used for verification and to check whether the information provided by OSM is correct, whether the scientific and non-scientific literature sources are accurate, or to double-check similar information from different sources. Corrections for map deficiencies, inaccuracies, and errors are made directly in QGIS using editing tools. Thematic maps for corresponding WBUPP representative example cases are shown in Figures 29-89, in Appendix, 3, chapters 3.1-3.5.

Table 37. OSM data transformation results related to keys, values and assigned categories, M. Gudac Cvelic

Original OSM Key	Grouped Category	Original Values
Highway	Major roads	Motorway, Trunk, Primary, Secondary, Tertiary, Motorway link, Trunk link, Primary link, Secondary link, Tertiary link
	Minor roads	Road, Residential, Living street, Service
	Cycleway	Track, Cycleway
	Footway	Footpath, Pedestrian, Path
	Steps	Steps
Cycleway	Cycleway	Track, Lane
Bridge	Bridge	different values (Yes, Viaduct, Movable, Covered...)
Man-made		Bridge
	Breakwater (rocky material)	Breakwater
	Waterfront structures	Pier, Tower
Public transport	Public transport	Stop position, Platform, Station, Stop area
Highway		Bus stop, Elevator, Platform
Railway		Platform, Station, Stop, Tram stop

Original OSM Key	Grouped Category	Original Values
Amenity		Bus station
	Bicycle parking	Bicycle parking
	City bike	Bicycle rental
	Parking facilities	Parking, Parking entrance, Parking space, Motorcycle parking
	Bench	Bench
	Drinking water	Drinking water
	Commercial/Services/Catering/Educational	Atm, Bank, Social facility, Theatre, Pub, Bar, Cafe, Restaurant, Fast food, Ice cream, Residential, Educational, Religious, Commercial, University, Library
	Waste facilities	Recycling, Waste basket, Waste disposal
	Shelter	Shelter
	Information	Information
	Toilets	Toilets
Building		Toilets
	Parking facilities	Parking
	Built area	different values of buildings (unified), Apartments, Commercial, Office, Public, Retail, University, Museum, Residential, Church, House, Roof, School, Service, Conference center, Yes, Tower, Pier
	(waterfront structures)	(included in pier/tower/boardwalk/monument grouping)
Tourism	Viewpoint	Viewpoint
	Artwork/Memorials	Artwork
Leisure	Picnic area, Outdoor seating area	Picnic site
		Picnic table
	Dog park	Dog park
	Garden	Garden
	Playground	Playground
	Amusement arcade	Amusement arcade
	Sports facilities	Pitch
	Fishing	Fishing
	Slipway	Slipway
	Park/Green areas	Park
Natural		Grassland, Wetland
	Breakwater (rocky material)	Shingle, Gravel
	Wood/Forest	Wood

Original OSM Key	Grouped Category	Original Values
	Tree, Trees disperse, Trees avenue (protective)	Tree, Tree row
	Single tree	Tree
	Beach	Beach
Surface		Gravel
Landuse	Park/Green areas	Grass, Greenery
	Sports facilities	Recreation ground
Sport		Basketball, Table tennis, Fitness station, other specific sports
Barrier	Tree, Trees disperse, Trees avenue (protective)	Hedge
Historic	(waterfront structures)	Monument
	Artwork/Memorials	Memorial, Monument
Memorial		Plaque

The WBUPP screening process described in the previous chapter identified 99 example cases that met the established selection criteria. These cases were subsequently analyzed using the initial nine-part data collection framework and 13 criteria derived from the literature review. Where necessary, additional criteria were introduced to better capture the broader characteristics of the WBUPP cases.

The same criteria were also applied to classify the parks. This approach was intended from the outset and was considered essential when defining the selection criteria, as it ensured consistency between the processes of case selection and classification.

Parallel to the WBUPP example case screening, criteria research was conducted through a literature review, as described in Chapter 6: Urban–Planning Criteria. The sets of criteria are heterogeneous, consisting of measures defined in different units that are not always compatible and interpreted from non-uniform perspectives. Combining all identified criteria found in scientific literature and classifying them into three groups related to the three pillars of sustainability resulted in a list of Economic, Environmental, and Social criteria, which was considered when creating the WBUPP representative example case analysis criteria list. The focus is on determining, dissecting, and comparing the properties

of examples, which can, individually or in correlation, provide results that help establish an urban-planning criteria set for planning and designing WBUPPs that implement sustainability principles in the future.

Sustainability characteristics are examined in Chapter 5, but this perspective is also present in additional criteria sets identified in the literature review, which involve brownfields, urban waterfronts, public space, public parks, and urban-planning criteria. The most observed groups are named Objectives, Qualities, Sections (Rey et al., 2022), Dimensions (Denis Michalina et al., 2021), Categories, Thematic Categories (Denis Michalina et al., 2021), Impact, Aspect (Sabri and Ponrahono, 2024), and similar terms. In Dan He et al. (2024) systematic literature review of brownfield sustainability, they are jointly considered and compared as Economic, Social, Environmental, Cultural, Ecosystem, and Governance Dimensions. The three dimensions that refer to the basic sustainability pillars – Economic, Social, and Environmental – are the most common and are therefore chosen as the groups on which the WBUPP representative case analysis methodology is based.

Fifty criteria from a list of nearly four hundred classified criteria are identified, emphasizing the importance of spatial elements and the most significant WBUPP characteristics and properties that could contribute to the final research goal. The graphic map set is designed to show both the broader and more detailed spatial layout within context, presenting the WBUPP representative example case elements through imagery linked to each of the three selected sustainability dimensions. The process of organizing the maps was conducted in parallel with the research analysis, and the criteria set presented by each map was adapted according to the results and information availability. Criteria categories and ranges were also modified multiple times to achieve a clearer and more understandable presentation. Graphic presentation imagery evolved throughout the research until the final version, which is presented in this dissertation, was adopted. The urban-planning criteria selection process for WBUPP spatial analysis with results is presented schematically in **Error! Reference source not found.**Figure 40.

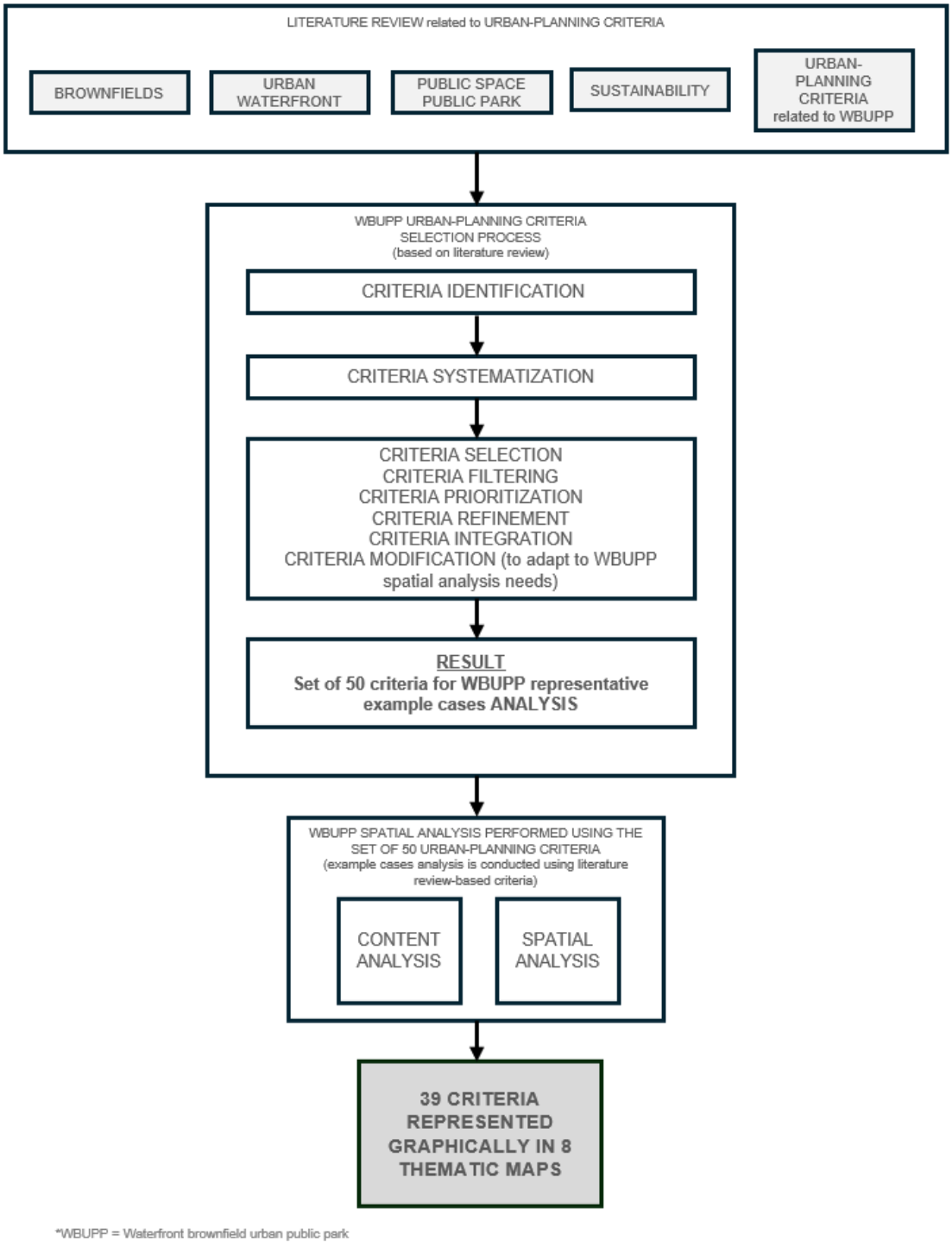


Figure 40 Urban-planning criteria selection process for WBUPP example cases spatial analysis, with results showing that the number of criteria that can be represented graphically within the 8 thematic maps is 39 out of 50, M. Gudac Cvelic

Spatial data is processed and organized into eight thematic maps listed in Table 38. Thematic maps for corresponding WBUPP representative example cases are

shown in Figures 29-89, in Appendix, 3, chapters 3.1-3.5. Each map represents more than one WBUPP factor, which is summarized in Table 39. Maps are created in the GIS software tool (QGIS Development Team, 2025) using iterative process of by extracting elements for analysis and visualization and processing them through organizing group denominations, labels, and graphics. The WBUPP thematic maps creation process is graphically represented in Figure 41**Error! Reference source not found.**. Elements are highlighted to ensure they are easily readable graphically. Table 40 presents which WBUPP analysis criteria are represented graphically in thematic maps, showing the criteria list adjoined with categories, source, and the representing map number. Table 41 presents which WBUPP analysis criteria are represented graphically in thematic maps, showing the distribution by maps.

Table 38. WBUPP thematic maps list, maps are shown in Figures 29-89, in Appendix, 3, chapters 3.1-3.5, M. Gudac Cvelic

No.	Thematic map
1	WBUPP Position within national territory
2	WBUPP Position within urban structure
3	WBUPP area
4	WBUPP accessibility, mobility
5	WBUPP environmental, health
6	WBUPP social, well being
7	WBUPP self-sufficiency, mixed use, educative, land/building use context
8	WBUPP brownfield remnants

8.2.1.1 WBUPP Position within National Territory

Map 1 shows the position of the WBUPP representative example cases within the national territory. It displays the region on a modified Open Street Maps background, which is more saturated and lightened than its original appearance. The country’s borders are marked with a solid red line, and the WBUPP location is highlighted with a green diamond marker.

The criterion " Position within national territory" from Matković and Jakovčić (2019a) proposes possible brownfield categories: brownfield with a centrally located position and good transport connectivity; connected brownfield with good

transport connectivity and development potential; isolated brownfield in areas of high landscape value; and peripheral brownfield with poor transport connectivity and weak development indicators and potential (Matković and Jakovčić, 2019a). Since one of the basic conditions of this research was location within an urban settlement, all WBUPP example cases have a central position and good transport connectivity from the national perspective.

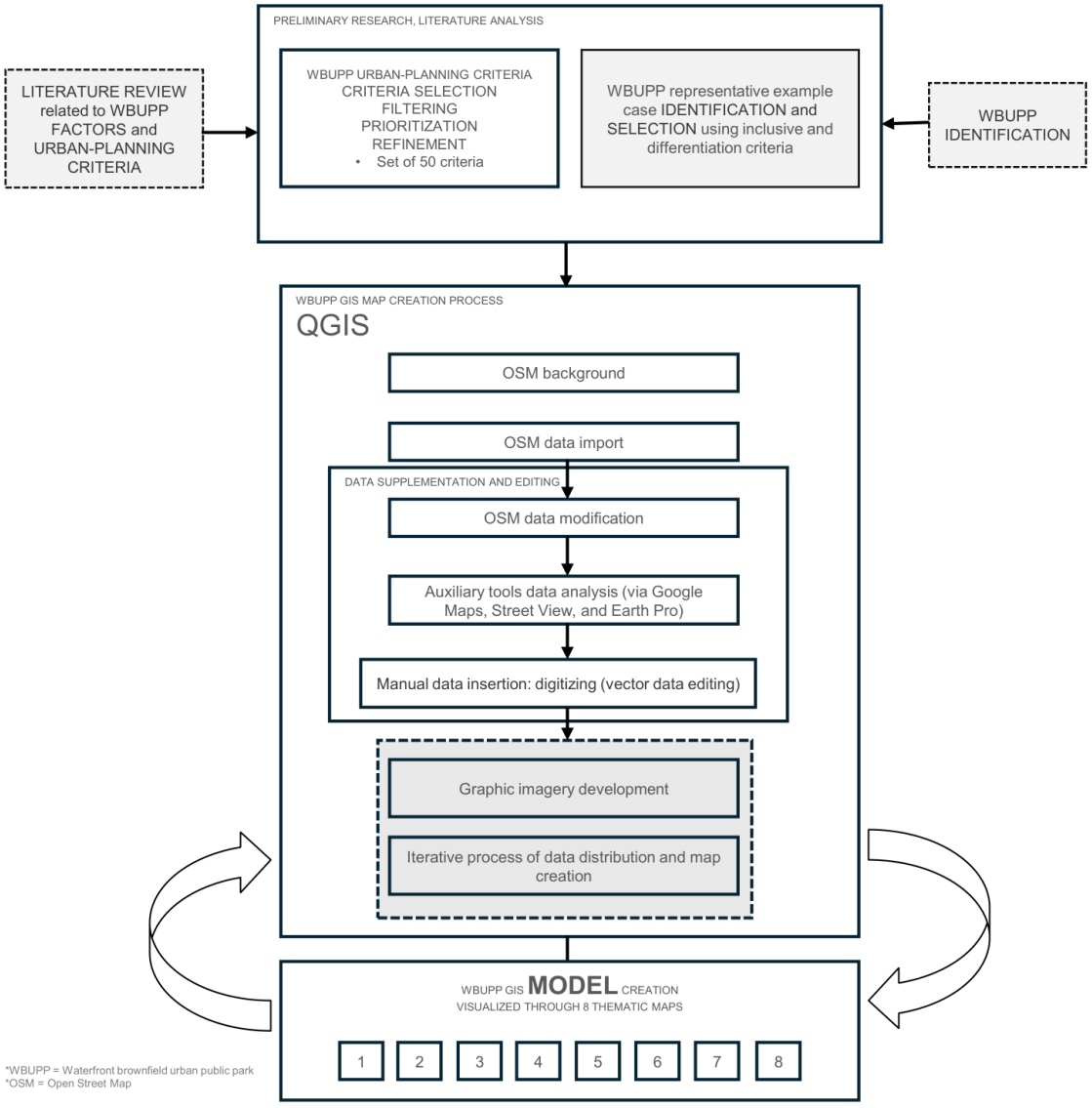


Figure 41 WBUPP thematic maps creation process in GIS-based tool (QGIS Development Team, 2025) , M. Gudac Cvelic

8.2.1.2 WBUPP Position within Urban Structure

Map 2 shows the position of the WBUPP representative example cases within the urban structure. The graphic illustrates the spatial relationship of the WBUPPs to the historic city center. It displays a portion of the country on a modified Open Street Maps background, which is more saturated and lightened than its original appearance. The city boundaries are marked with a solid blue line, the historic center is highlighted with a red dashed line, and the WBUPP area is highlighted with a solid red line.

The criterion "Spatial relationship with city center," as found in Matković and Jakovčić (2019a), proposes possible brownfield categories: brownfield with a central position in the urban or rural structure; brownfield located in the contact zone between urban and rural structures; and brownfield with a peripheral position in the urban or rural structure (Matković and Jakovčić, 2019a). The location illustrates the WBUPP position in relation to the city limits and the historic center to show centrality within the urban structure.

Table 39. WBUPP thematic maps list with topics, M. Gudac Cvelic

No.	Thematic map	Topics
1	WBUPP Position within national territory	WBUPP position Country borders Water body type (water, ocean) Information on the base map, graphic scale
2	WBUPP Position within urban structure	City limits WBUPP limits Historic center Water body type (water, ocean) Information on the base map, graphic scale
3	WBUPP area	WBUPP area Boundaries (open boundary, water boundary, closed boundary) WBUPP access Water body type (water, ocean) Information on the base map, graphic scale
4	WBUPP accessibility, mobility	Boundaries (open boundary, water boundary, closed boundary)

No.	Thematic map	Topics
		WBUPP access Transportation (major road, minor road, cycleway, footway, steps, waterway, ferry route, bus stop, subway station, ferry terminal, bicycle parking, city bike, parking entrance, parking, parking area, tunnel, pier block) Buildings (buildings within WBUPP) Water body type (water, ocean) Information on the base map, graphic scale
5	WBUPP environmental, health	Viewpoints WBUPP area WBUPP access Transportation (major road, minor road, cycleway, footway, steps) Services, amenities (bench, drinking water, toilets, waste, recycling, shelter) Leisure (playground, dog park, garden, picnic outdoor seating, grassland, sports recreation) Natural elements (sand, rocky materials, grassland, trees disperse)) Buildings (buildings within WBUPP, buildings) Water body type (water, ocean) Information on the base map, graphic scale
6	WBUPP social, well being	Viewpoints Boundaries (open boundary, water boundary, closed boundary) WBUPP access Program spatial enclosure (enclosed, covered, opened) Landmark Transportation (major road, minor road, cycleway, footway, steps, tunnel, bridge, pier) Leisure (artwork, bench, outdoor seating, playground, dog park, sports recreation) Buildings (buildings within WBUPP, buildings) Water body type (water, ocean) Information on the base map, graphic scale
7	WBUPP self-sufficiency, mixed use, educative, land/building use context	Boundaries (open boundary, water boundary, closed boundary) Transportation (major road, minor road, tunnel, pier block, bridge, pier) Land / building use (culture, public services, educational, commercial, service, infrastructure, catering facilities, residential)

No.	Thematic map	Topics
		Buildings (buildings within WBUPP, buildings) Water body type (water, ocean) Information on the base map, graphic scale
8	WBUPP brownfield remnants	WBUPP area Boundaries (open boundary, water boundary, closed boundary) WBUPP access Brownfield elements Water body type (water, ocean) Information on the base map, graphic scale

8.2.1.3 WBUPP Area

Map 3 presents the area of the WBUPP representative example cases at scales of 1:3,000, 1:5,000, 1:10,000, and 1:15,000. It shows the range and the surrounding area within a perimeter of 100 to 200 meters. The map illustrates the criteria of spatial morphology, size, accessibility, and space management.

The map displays a portion of the city on a modified Open Street Maps (2025) background, which is more saturated and lighter than its original appearance. The WBUPP area is highlighted with a solid red line. Water surfaces are shown as a category that includes the water body adjacent to the WBUPP area. WBUPP boundaries are interpreted using Open Street Maps (2025), Google Maps (Google, 2026b), internet sources, and physical features on the ground, classified by categories and components, as well as Google Maps (Google, 2026b), Google Street View (Google, 2025), Google Earth Pro (Google, 2026a), and various internet sources regarding the subject area.

Three categories represent open boundary, water boundary, and closed boundary. Open boundaries refer to boundaries without obstacles, fences, walls, or anything that could prevent users from visiting the area. Road traffic is not considered, as the public park area is primarily intended for non-road vehicle access. Water boundary refers to boundaries with a water body. Closed boundaries refer to boundaries where users cannot access the WBUPP area because a physical obstacle is continuously in place, such as a built structure that cannot be opened even temporarily.

WBUPP access points focus on pedestrians, cyclists, and other users entering the area. Marked WBUPP access points have no gates or temporary barriers and are marked according to existing paths. Paths are analyzed through OSM physical data imported into QGIS and verified, as much as possible, by Google Maps (Google, 2026b), Google Earth Pro (Google, 2026a), and Google Street View (Google, 2025). Access points are marked with yellow arrowheads pointing in the direction where users can enter the WBUPP area.

WBUPP internal edges are readable lines created by the perception of existing physical elements within the park. The built/non-built edge refers to a row of tall buildings or similar structures. District-defining lines refer to major roads that intersect the WBUPP and significantly influence, if not dictate, its spatial organization.

8.2.1.4 WBUPP Accessibility, Mobility

Map 4 presents the WBUPP representative example cases' areas at scales of 1:3,000, 1:8,000, 1:10,500, and 1:11,000. It aims to illustrate criteria such as spatial morphology, size, accessibility, space management, accessibility (public transportation) and mobility, public transport (resting places every 300 m), pedestrian/path/cycling path, and other public areas (heterogeneity).

The map shows a portion of the city on a modified OpenStreetMap background, which is more saturated and lightened compared to its original appearance. The WBUPP area range, water bodies, WBUPP boundaries, and access points are also displayed. Their characteristics and institutional context are explained in Chapter Spatial Analysis, Section 3.

Minor and major roads represent road infrastructure that intersects or borders the WBUPP area. Existing roads of varying importance are grouped into two categories and shown in segments closely related to the researched area. The data is entered into the QGIS (QGIS Development Team, 2025) map using the

OpenStreetMap (2025) tool Quick OSM, selected and processed to reduce and classify the number of different values[8].

The tram line is a two-way railway serving as public transportation.

Cycleways, footways, steps, and waterways are non-driving paths shown within the WBUPP area and their immediate continuations outside it. These categories are derived from OpenStreetMap data[9] (OpenStreetMap contributors, 2025). Data was adapted and supplemented when necessary, using Google Maps (LLC, 2026b), Google Street View (Google, 2025), and Google Earth Pro (LLC, 2026a) as supplemental tools.

Bridges are infrastructure elements shown on WBUPP maps. Data is obtained from OpenStreetMap[10] and processed in QGIS.

Public elevators help overcome differences in ground elevation, improving accessibility for people with reduced mobility and other users. Their locations vary, connecting different overground levels and linking street levels with underground parking garages.

Bus stops and tram stops are public transportation points where users can board or alight. Their markers are modified and presented with the same symbol because they serve the same purpose within the context and relevance of these maps, both being public transportation stops.

City bike stations are public transportation cycling stations.

Parking areas are open overground surfaces dedicated to vehicular traffic, privately owned and available for a fee.

Parking entrances are overground entrances to underground parking lots or fee-charging garages.

[8] The original Highway key contains values Motorway, Trunk, Primary, Secondary, Tertiary, Motorway link, Trunk link, Primary link, Secondary link, Tertiary link that have been grouped in Major roads category. Values Road, Residential, Living street and Service have been grouped in Minor roads category.

[9] The original Highway key contains Track, Cycleway, Footpath, Pedestrian, Path, Steps. The original Cycleway key contains values Track, Lane. Named values have been grouped into Cycleway, Footway and Steps category.

[10] The original Bridge key, within Additional track features or attributes, contains different values marked with Yes. The original Man-made key contains value Bridge.

Bicycle parking is an overground bike parking facility that includes options such as bike stands, bike hangars, and secure bike parks, providing safe and convenient storage for cyclists.

Public elevator, bus stop, tram stop, city bike, parking, parking entrance, and bicycle parking data are obtained from OpenStreetMap[11] and processed in QGIS.

Buildings within the WBUPP area are footprints of all constructed structures located within the WBUPP boundaries. Data is obtained from OpenStreetMap[12] and processed in QGIS.

8.2.1.5 WBUPP Environmental, Health

Map 5 presents the WBUPP representative example cases' areas at scales of 1:3000, 1:5500, 1:6000, 1:10,500, and 1:11,000. It aims to illustrate criteria such as spatial morphology, size, accessibility, nature-based solutions implementation, water-sensitive urban design, climate change adaptation and mitigation, pedestrian/path/cycling path, urban design (well-being offered by urban design), public restrooms, drinking water fountains (access to drinking water), adaptable spaces, visual impact, sustainable waste management, green areas heterogeneity, sports/recreation areas heterogeneity, ecosystem preservation/restoration, resilience, program/function, well-being, accessibility (public transportation)/mobility, shelter areas, and vitality/concentration.

The map shows a portion of the city on a modified OpenStreetMap background, which is more saturated and lightened compared to its original appearance. The WBUPP area is highlighted with a solid red line.

Viewpoints are locations where the WBUPP spatial organization allows users to enjoy views of the water body and contact area, with the range depending on the neighborhoods' spatial configuration. Initial points are obtained from

[11] The original Public transport key contains values Stop position, Platform, Station, Stop area. The original Amenity key contains values Bus station, Bicycle rental, Bicycle parking, Parking, Parking entrance, Parking space, Motorcycle parking. The original Highway key contains values Bus stop, Elevator, Platform, the original Railway key contains values Platform, Station, Stop, Tram stop. The original Building key contains value Parking.

[12] The original Building key contains different values of buildings, in this case unified to represent the built area.

OpenStreetMap[13] and processed in QGIS. Additional points with view directions are added after the WBUPP visual analysis, performed using previously mentioned auxiliary graphic tools.

The WBUPP area range, water body, WBUPP boundaries, and access are also shown on this map. Their characteristics and institutional context are explained in chapter Spatial Analysis, section 3.

Building polygons represent the footprints of all constructed structures within the WBUPP boundaries. Data is obtained from OpenStreetMap[14] and processed in QGIS.

Minor and major roads, tram lines, cycleways, footways, and steps are shown on this map. Their characteristics and institutional context are explained in chapter Spatial Analysis, section 4.

Benches are marked rest points where permanent urban equipment elements such as benches, chairs, and similar objects are placed. Data is obtained from OpenStreetMap[15] and processed in QGIS. OSM data was further adapted and verified using Google Maps, Google Street View, and Google Earth Pro as supplementary tools.

Drinking water points indicate the locations of drinking fountains where WBUPP users have access to potable water. Data is obtained from OpenStreetMap[16] and processed in QGIS. OSM[17] data was verified using Google Maps, Google Street View, and Google Earth Pro as supplementary tools.

Toilet markers highlight public restroom locations. Data is obtained from OpenStreetMap[18] and processed in QGIS. OSM data was verified using Google Maps, Google Street View, and Google Earth Pro as supplementary tools.

Waste recycling is defined as a waste management category that includes urban equipment such as waste bins, disposal units, and recycling stations. Data is

[13] The original Tourism key contains Viewpoint values.
[14] The original Building key contains different values of buildings, in this case unified to represent the built area.
[15] The original Amenity key contains Bench value.
[16] The original Amenity key contains Drinking water value.
[17] OpenStreetMap
[18] The original Amenity key contains Toilets value. The original Building key contains Toilets value.

obtained from OpenStreetMap[19] and processed in QGIS. All identified elements were unified and listed under a single category. OSM data was further adapted and verified using Google Maps, Google Street View, and Google Earth Pro as supplementary tools. Additional data was incorporated in areas where resting places were not mapped but were expected and confirmed using these supporting sources.

Shelter refers to locations on the map that provide covered areas. These spaces offer shelter for playgrounds, sports, recreation, and other programs against adverse weather conditions. Data is obtained from OpenStreetMap[20] and processed in QGIS. OSM data was further adapted and verified using Google Maps, Google Street View, and Google Earth Pro as supplementary tools. Additional data was incorporated for covered playground areas.

Information points indicate locations with structures dedicated to providing information about WBUPP. These include small buildings, kiosks, covered information points, or signage elements such as boards, panels, and similar items. Data is obtained from OpenStreetMap[21] and processed in QGIS.

Playground marks areas designated for children to play. Surfaces are sometimes fenced for safety, paved with appropriate soft material, and equipped with children's play structures. Data is obtained from OpenStreetMap[22] and processed in QGIS. OSM data was further adapted and verified using Google Maps, Google Street View, and Google Earth Pro as supplementary tools. Verification could not be performed for a newly opened playground area in the southwest section of WBUPP because it is marked in OSM but not visible on Google Maps, Google Street View, or Google Earth Pro.

Dog park indicates a designated area, with or without a fenced boundary, where dog owners are permitted to exercise their pets unrestrained (Wikipedia, 2025d). Data is obtained from OpenStreetMap[23] and processed in QGIS. OSM data was further adapted and verified using Google Maps, Google Street View, and Google

[19] The original Amenity key contains values Recycling, Waste basket, Waste disposal.
[20] The original Amenity key contains value Shelter.
[21] The original Amenity key contains value Information.
[22] The original Leisure key contains value Playground.
[23] The original Leisure key contains value Dog park.

Earth Pro as supplementary tools. Verification could not be performed because the dog park is marked in OSM but not visible on Google Maps, Google Street View, or Google Earth Pro.

Garden refers to surfaces where flowers and other plants are grown in a decorative and structured manner or for scientific purposes (OpenStreetMap Wiki, 2025). Data is obtained from OpenStreetMap[24] and processed in QGIS. OSM data was further adapted and verified using Google Maps, Google Street View, and Google Earth Pro as supplementary tools.

Picnic outdoor seating marks a locality suitable for outdoor eating, with facilities such as tables and benches to aid a picnic (OpenStreetMap Wiki, 2025). Data is obtained from OpenStreetMap[25] and processed in QGIS. OSM data was further adapted and verified using Google Maps, Google Street View, and Google Earth Pro as supplementary tools.

Grassland is an area where the vegetation is dominated by grass and other herbaceous (non-woody) plants (OpenStreetMap Wiki, 2025). Data is obtained from OpenStreetMap[26] and processed in QGIS. OSM data was further adapted and verified using Google Maps, Google Street View, and Google Earth Pro as supplementary tools. Different values obtained from OSM are unified in one category named Grassland.

Rocky material refers to surfaces with either shingle, gravel, or those built with rock, stone, or other natural slab elements. Data is obtained from OpenStreetMap[27] and processed in QGIS. OSM data was further adapted and verified using Google Maps, Google Street View, and Google Earth Pro as supplementary tools. Different values obtained from OSM are unified in one category named Rocky Material.

[24] The original Leisure key contains value Garden.
[25] The original Leisure key contains value Picnic table. The original Tourism key contains value Picnic site.
[26] The original Natural key contains value Grassland, Wetland. The original Tourism key contains value Picnic site. The original Landuse key contains values Grass, Greenery. The original Leisure key contains value Park.
[27] The original Natural key contains value Shingle, Gravel. The original Man-made key contains value Breakwater.

Beach areas are surfaces with a recreational purpose, made of sand or gravel. Data is obtained from OpenStreetMap[28] and processed in QGIS. OSM data was further adapted and verified using Google Maps, Google Street View, and Google Earth Pro as supplementary tools. Different values obtained from OSM are unified in one category named Beach.

Sports recreation indicates outdoor areas dedicated to sports and recreation programs, such as sports fields, outdoor gyms, pitches, and other related features. Data is obtained from OpenStreetMap[29] and processed in QGIS. OSM data was further adapted and verified using Google Maps, Google Street View, and Google Earth Pro as supplementary tools. Different values obtained from OSM are unified in one category named Sports Recreation.

Trees avenue (protective) highlights rows of trees planted as a defining spatial configuration element. They protect an area, visually block, or create a guiding perspective element (Ayman Hassaan Mahmouda and Omar, 2015). Data is obtained from OpenStreetMap[30] and processed in QGIS. All found elements were unified and listed in the named category. OSM data was further adapted and verified using Google Maps, Google Street View, and Google Earth Pro as supplementary tools. Additional elements were included in areas where tree avenues were not marked but were identified using supplementary tools.

Trees (disperse) indicate the approximate distribution of trees, providing a general sense of wooded areas within the parkland, as opposed to clearly defined grassland surfaces. Data is obtained from OpenStreetMap[31] and processed in QGIS. All found elements were unified and listed in the named category. OSM data was further adapted and verified using Google Maps, Google Street View, and Google Earth Pro as supplementary tools. Additional elements were included in areas where tree avenues were not marked but were identified using supplementary tools.

[28] The original Natural key contains value Beach. The original Surface key contains value Gravel.
[29] The original Landuse key contains value Recreation ground. The original Leisure key contains value Pitch. The original Sport key contains values Basketball, Table tennis, Fitness station and other specific sports values implemented in OSM in a form of a node o ran area.
[30] The original Barrier key contains value Hedge. The original Natural key contains values Tree, Tree row.
[31]The original Natural key contains value Tree.

Wood areas are marked by surface. Data is obtained from OpenStreetMap[32] and processed in QGIS. These are areas with trees planted in high density.

8.2.1.6 WBUPP Social, Well Being

Map 6 presents the WBUPP representative example cases' areas at scales of 1:3,000, 1:5,800, 1:6,000, 1:10,000, and 1:10,500. It aims to illustrate criteria such as spatial morphology, size, space management, accessibility, implementation of tourist activities, historical and cultural value, climate change adaptation and mitigation, pedestrian/path/cycling path, urban design (well-being offered by urban design), adaptable spaces, sports/recreation areas heterogeneity, other public areas heterogeneity, program/function, well-being, heritage, accessibility (public transportation)/mobility, vitality/concentration, and identity /sense of place/historic identity.

The map shows a portion of the city on a modified OpenStreetMap background, which is more saturated and lightened compared to its original appearance. The WBUPP area range, water bodies, WBUPP boundaries, and access points are shown on this map. Their characteristics and institutional context are explained in chapter Spatial Analysis, section 3.

Buildings within the WBUPP are shown on this map. Their characteristics and institutional context are explained in chapter Spatial Analysis, section 4.

Building use enclosure and coverage is a category defined by the way a space is protected. "Enclosed" refers to program portions contained in a closed space such as a building, kiosk, pavilion, or similar structure. A space protected by a canopy with a structure of steel, wood, concrete, or other durable construction, and covered with plastic, wood, metal, or similar opaque, transparent, waterproof, or semi-protective material is characterized as "Covered." Open spaces are WBUPP public program features without protective overhead. Data was obtained from OpenStreetMap[33] and processed in QGIS. All identified elements were analyzed and classified into these three categories and marked accordingly.

[32] The original Natural key contains value Wood.

[33] The original keys contain different values that are specified through other keys and values within their corresponding categories. Spaces are interpreted according to the described process aiming to characterize spaces as enclosed, covered or open.

OSM data was further adapted and verified using Google Maps, Google Street View, and Google Earth Pro as supplementary tools.

A landmark functions as a point of reference that provides spatial orientation through distinct physical and visual characteristics (Lynch, 1960). The landmark marker highlights significant structures within or around the WBUPP. Data was obtained from OpenStreetMap[34] and processed in QGIS. OSM data was further adapted and verified using Google Maps, Google Street View, and Google Earth Pro as supplementary tools. Landmark data was also obtained from internet sources to validate the structure as a landmark.

Minor and major roads, tram lines, cycleways, footways, steps, and public elevators are shown on this map. Their characteristics and institutional context are explained in chapter Spatial Analysis, section 4.

An amusement arcade is an enclosed leisure area subject to payment. Data was obtained from OpenStreetMap[35] and processed in QGIS. OSM data was verified using Google Maps, Google Street View, and internet sources to validate its existence.

undefined.

Artwork points are locations where public art is placed, contributing to the aesthetic and cultural quality of urban environments (Yue Cheng, 2023). Data is obtained from OpenStreetMap[36] and processed in QGIS. OSM data was further adapted and verified using Google Maps, Google Street View, and Google Earth Pro as supplementary tools.

Benches, playgrounds, dog parks, and sports recreation areas are shown on this map. Their characteristics and establishment are explained in Chapter Spatial Analysis, Section 5.

[34] The original Building key contains different values. The original Man-made key contains value Pier, Tower. The original Bridge key contains value Boardwalk. The original Historic key contains value Monument.
[35] The original Leisure key contains value Amusement arcade.
[36] The original Tourism key contains value Artwork. The original Historic key contains value Memorial, Monument. The original Memorial key contains value Plaque.

Landmark contact area is a symbol marking the three buildings considered landmarks around WBUPP. Data is obtained from OpenStreetMap[37] and processed in QGIS.

A fishing point is a place designated for fishing activity. It is properly marked with signage and equipped with durable materials and space to sit or position fishing equipment. Data is obtained from OpenStreetMap[38] and processed in QGIS. OSM data was verified using Google Maps, Google Street View, and internet sources to validate its existence.

A slipway is a place designated for paddle sports and similar recreational activities. It is properly marked with signage and equipped with durable materials suitable for handling sports and recreation equipment. Data is obtained from OpenStreetMap[39] and processed in QGIS. OSM data was verified using Google Maps, Google Street View, and internet sources, when available, to validate its existence.

8.2.1.7 WBUPP Self-Sufficiency, Mixed Use, Educative, Land/Building Use Context

Map 7 presents the WBUPP representative example cases' areas at scales of 1:3,000, 1:8,000, 1:10,500, and 1:12,000. It aims to illustrate criteria such as spatial morphology, size, space management, self-sufficiency, employment opportunities, implementation of tourist activities, mixed development, program/function, proximity to social facilities (school facilities, homes for the elderly, health facilities), proximity to commercial facilities, educational (cultural) facilities/services, and vitality/concentration.

The map shows a portion of the city on a modified OpenStreetMap background, which is more saturated and lightened compared to its original appearance. WBUPP boundaries and water bodies are displayed on the map. Their characteristics and institutional context are explained in Chapter Spatial Analysis, Section 3.

[37] The original Building key contains different values of buildings, in this case unified to represent the built area.
[38] The original Leisure key contains value Fishing.
[39] The original Leisure key contains value Slipway.

Building use indicates the built environment within the WBUPP area and around its perimeter. The criteria for selecting surrounding structures were a 100-meter offset and visually exposed parts of the urban fabric, where exposure originates from within WBUPP. Categories were established by analyzing and grouping complementary uses. ATM and bank are combined under Financial; theater and library are grouped together; pub, bar, cafe, restaurant, fast food, and ice cream are unified as Catering Facilities; apartments, residential, and house are classified as Residential; university and school are unified as Educational; church is renamed Religious; and Commercial includes commercial, retail, office, conference center, and tower. Public use appears in the Educational and Library OSM building classification data, but it has not been reused as a category because all public use structures have been specifically classified by closely associated functions. Data was obtained from OpenStreetMap[40] and processed in QGIS. All identified elements were analyzed and classified into eight categories and marked accordingly. OSM data was further adapted and verified using Google Maps, Google Street View, and Google Earth Pro as supplementary tools.

Tourism, along with galleries, hotels, and museums, is shown on this map. Their characteristics and institutional context are explained in Chapter Spatial Analysis, Section 6.

Buildings within WBUPP are shown on this map. Their characteristics and institutional context are explained in Chapter Spatial Analysis, Section 4.

The building's contact area refers to the physical footprints of the urban structures within the 100-meter perimeter around WBUPP, together with the visually exposed buildings from the designated research area.

8.2.1.8 WBUPP Brownfield

Map 8 shows the WBUPP representative example cases' areas at scales of 1:3,000, 1:5,000, 1:6,000, 1:10,000, and 1:10,500. It aims to illustrate criteria

[40] The original Amenity key contains values Atm, Bank, Social facility, Theatre, Pub, Bar, Cafe, Restaurant, Fast food, Ice cream, Residential, Educational, Religious, Commercial, University, Theatre, Library. The original Building key contains values Apartments, Commercial, Office, Public, Retail, University, All other values, Museum, Residential, Church, House, Roof, School, Service, Conference center, Yes, Tower.

such as spatial morphology, size, accessibility, historical and cultural value, heritage, and identity /sense of place.

The map displays a portion of the city on a modified OpenStreetMap background, which is more saturated and lighter than the original. The WBUPP area is highlighted with a solid red line.

The map also shows the WBUPP area range, water bodies, WBUPP boundaries, and access points. Their characteristics and institutional context are explained in Chapter Spatial Analysis, Section 3.

Brownfield points indicate locations where physical evidence of previous land use can be found. These mark a building or structure, a part of a previously existing building or structure (such as a roof, wall, or frame), or an element from a previous building or structure (such as a pillar, pavement section, or track section). The available data is sourced from OpenStreetMap[41] and processed in QGIS. Additional data was added following WBUPP information research and visual analysis using the auxiliary graphic tools mentioned earlier.

Table 40. WBUPP analysis criteria represented graphically in thematic maps, criteria list adjoined with categories, source, and the representing map number M. Gudac Cvelic

CRITERIA DIMENSION	WBUPP REFERENCE CASES ANALYSIS CRITERIA	CATEGORIES	CRITERIONs SCIENTIFIC SOURCE	MAP NUMBER THAT GRAPHICALLY REPRESENTS THE CRITERION
ECONOMIC	SELF-SUFFICIENCY	1. Yes 2. No	(Doick et al.)	**7**
	EMPLOYMENT OPPORTUNITIES	1. Yes 2. No	(Doick et al.)	**7**
	ALL YEAR USE	1. Yes 2. No	(Mrak et al., 2022)	**5, 6, 7**
	CIRCULARITY OF CONSTRUCTION	1. Yes 2. No	(Mrak et al., 2022),(Williams, 2021)	**4, 5, 6**
	IMPLEMENT TOURIST ACTIVITY	1. Yes 2. No	(Mrak et al., 2022)	**6, 7**
ENVIRONMENTAL	SIZE	1. S small 0-5ha 2. M medium 5-20ha 3. L big 20-	(Matković and Jakovčić, 2019a)	**3,4,5,6,7,8**

[41] The original Building key contains different values of buildings, in this case unified to represent the built area.

CRITERIA DIMENSION	WBUPP REFERENCE CASES ANALYSIS CRITERIA	CATEGORIES	CRITERIONs SCIENTIFIC SOURCE	MAP NUMBER THAT GRAPHICALLY REPRESENTS THE CRITERION
		100ha 4. XL extra big 100+ha		
	POSITION WITHIN NATIONAL TERRITORY	1. Yes 2. No	(Matković and Jakovčić, 2019a)	**1**
	POSITION WITHIN URBAN/RURAL STRUCTURE	1. Yes 2. No	(Matković and Jakovčić, 2019a)	**2**
	SPACE MANAGEMENT	BOUNDARIES: 1. open 2. closed 3. permeable 4. water	(Carmona, 2010), (Ching, 1979)	**3,4,6,7,8**
	HISTORICAL AND CULTURAL VALUE	1. Yes 2. No	(Matković and Jakovčić, 2019a),(Throsby, 2001)	**6,8**
	SPATIAL MORPHOLOGY	1. central 2. irregular 3. linear 4. longitudinal	(Sitte, 1889),(Zucker, 1959),(Carmona, 2010) in (Krmpotić Romić, 2025)	**3,4,5,6,7,8**
	ACCESSIBILITY	1. Yes 2. No	(Giovinazzi and Moretti, 2010),(United Nations Human Settlements Programme UN-Habitat, 2020)	**3,4,5,6,8**
	NATURE-BASED SOLUTIONS IMPLEMENTATION	1. Yes 2. No	(Zaman et al., 2024)	**5**
	WATER-SENSITIVE URBAN DESIGN (WSUD) INTEGRATION	1. Yes 2. No	(Zaman et al., 2024),(Mrak et al., 2022)	**5**
	CLIMATE CHANGE ADAPTATION AND MITIGATION INTERVENTIONS	1. Yes 2. No	(Zhang et al., 2023),(Sabri and Ponrahono, 2024),(Ibes, 2016),(Mrak et al., 2022),(Doick et al., 2009)	**5,6**
	PEDESTRIAN AND CYCLING PATH NETWORK	1. Yes 2. No	(Doick et al., 2009),(Mrak et al., 2022)	**4,5,6**
	URBAN DESIGN (WELL-BEING OFFERED BY URBAN DESIGN)	1. Yes 2. No	(Mrak et al., 2022)	**5,6**
	PUBLIC RESTROOMS	1. Yes 2. No	(Mrak et al., 2022)	**5**

CRITERIA DIMENSION	WBUPP REFERENCE CASES ANALYSIS CRITERIA	CATEGORIES	CRITERIONs SCIENTIFIC SOURCE	MAP NUMBER THAT GRAPHICALLY REPRESENTS THE CRITERION
	DRINKING WATER FOUNTAINS (ACCESS TO DRINKING WATER)	1. Yes 2. No	(Mrak et al., 2022)	**5**
	ADAPTABLE SPACES	1. Yes 2. No	(Mrak et al., 2022),(Hough, 1984),(Bentley, 1985),(Haughton and Hunter, 1994),(Evans, 2001; Falk and Johnson, 1997) in (Carmona et al., 2003), (Frey, 1999)	**5,6**
	PUBLIC TRANSPORT - resting places every 300m	1. Yes 2. No	(Mrak et al., 2022)	**4**
	VISUAL IMPACT	1. Yes 2. No	(Mrak et al., 2022); (Zhang et al., 2023)	**6**
	SUSTAINABLE WASTE MANAGEMENT	1. Yes 2. No	(Mrak et al., 2022),(Üzümcüoğlu, 2023),(Williams, 2021)	**5**
	GREEN AREAS heterogeneity.	1. Yes 2. No	(Mrak et al., 2022),(Carmona et al., 2003),(Commission of the European Communities, 1990) in (Carmona et al., 2003),(Breheny, 1992b),(Blowers, 1993) in (Carmona et al., 2003), (Barton, 1996),(Evans, 2001) in (Carmona et al., 2003),(Frey, 1999)	**5**
	SPORTS and RECREATION AREAS heterogeneity	1. Yes 2. No	(Mrak et al., 2022),(Girard and Nijkamp, 2009)	**5,6**
	OTHER PUBLIC AREAS heterogeneity	1. Yes 2. No	(Mrak et al., 2022)	**4,6**
	ECOSYSTEM PRESERVATION/RESTORATION	1. Yes 2. No	(Mrak et al., 2022); (Doick et al., 2009);); (Zhang et al., 2023);	**5**

CRITERIA DIMENSION	WBUPP REFERENCE CASES ANALYSIS CRITERIA	CATEGORIES	CRITERIONs SCIENTIFIC SOURCE	MAP NUMBER THAT GRAPHICALLY REPRESENTS THE CRITERION
	MIXED USE, FUNCTIONAL DIVERSITY	1. Yes 2. No	(Girard and Nijkamp, 2009),(Mrak et al., 2022); (Rey et al., 2022) Hauri (2011) (Hough, 1984),(Randall and Baetz, 2015),(Bentley, 1985) ,(Breheny, 1992c) (Frey, 1999) (Mrak et al., 2022), (Falk and Johnson, 1997; Evans, 2001) in (Carmona et al., 2003),(Şenik and Uzun, 2022)	**7**
	RESILIENCE	1. Yes 2. No	(Mrak et al., 2022), (Carmona et al., 2003) ,(Hough, 1984), (Haughton and Hunter, 1994), (Falk and Johnson, 1997; Evans, 2001) in (Carmona et al., 2003), (Iturriza et al., 2020); (Wang and Foley, 2021)	**5**
SOCIAL	PROGRAM / FUNCTION	1. homogeneous 2. heterogeneous	(Carr et al., 1992); (Stanley et al., 2012);(Gehl and Gemzøe, 2008); (Carmona, 2015) in (Krmpotić Romić, 2025),(Girard and Nijkamp, 2009)	**5,6,7**
	PROXIMITY OF SOCIAL (SCHOOL FACILITIES, HOME FOR ELDERLY, HEALTH FACILITIES)	1. Yes 2. No	(Rey et al., 2022)	**7**
	PROXIMITY OF COMMERCIAL FACILITIES	1. Yes 2. No	(Rey et al., 2022)	**7**
	WELL-BEING	1. Yes 2. No	(Rey et al., 2022); (Zhang et al., 2023);	**5,6**
	HERITAGE	1. Yes 2. No	(Rey et al., 2022) *(Giovinazzi and Moretti, 2010);* (Üzümcüoğlu, 2023); (Howard and Ashworth, 1999), (Mrak et al., 2022), (Bilušić, 2024), (Blowers, 1993) (Doick et al., 2009)	**6,8**

CRITERIA DIMENSION	WBUPP REFERENCE CASES ANALYSIS CRITERIA	CATEGORIES	CRITERIONs SCIENTIFIC SOURCE	MAP NUMBER THAT GRAPHICALLY REPRESENTS THE CRITERION
	EDUCATIVE FACILITIES/SERVICES	1. Yes 2. No	(Doick et al., 2009),(Burinskienė et al.)	**7**
	ACCESSIBILITY (PUBLIC TRANSPORTATION) / MOBILITY	1. Yes 2. No	(Rey et al., 2022); (Mrak et al., 2022)	**4,5,6**
	SHELTER AREAS	1. Yes 2. No	(Mrak et al., 2022)	**5**
	VITALITY/ CONCENTRATION	1. Yes 2. No	(Carmona et al., 2003) (Bentley, 1990), (Commission of the European Communities, 1990),(Breheny, 1992b), (Haughton and Hunter, 1994), (Barton, 1996),(Rogers, 1997), (Falk and Johnson, 1997; Evans, 2001) (Frey, 1999)	**5,6,7**
	SENSE OF PLACE	1. Yes 2. No	(Carmona et al., 2003) (Commission of the European Communities, 1990), (Blowers, 1993) (Haughton and Hunter, 1994),(Falk and Johnson, 1997; Evans, 2001) (Frey, 1999), *(Giovinazzi and Moretti, 2010)*	**6,8**

Table 41. WBUPP analysis criteria represented graphically in thematic maps, distribution by maps, M. Gudac Cvelic

Map 1			
Dimension	Criterion	Categories / Scale	Scientific source
Environmental	Position within national territory	1. Yes 2. No	(Matković and Jakovčić, 2019a)
Map 2			
Dimension	Criterion	Categories / Scale	Scientific source
Environmental	Position within urban/rural structure	1. Yes 2. No	(Matković and Jakovčić, 2019a)
Map 3			
Dimension	Criterion	Categories / Scale	Scientific source
Environmental	Size	1. S small 0–5 ha 2. M 5–20 ha 3. L 20–100 ha 4. XL 100+ ha	(Matković and Jakovčić, 2019a)
Environmental	Space management (boundaries)	1. open 2. closed 3. permeable 4. water	(Carmona), (Ching)
Environmental	Spatial morphology	1. central 2. irregular 3. linear 4. longitudinal	(Sitte, 1889), (Zucker, 1959), (Carmona) in (Krmpotić Romić, 2025)
Environmental	Accessibility	1. Yes 2. No	(Giovinazzi and Moretti, 2010), (UN-Habitat)
Map 4			
Dimension	Criterion	Categories / Scale	Scientific source
Environmental	Size	1. S small 0–5 ha 2. M 5–20 ha 3. L 20–100 ha 4. XL 100+ ha	(Matković and Jakovčić, 2019a)
Environmental	Space management (boundaries)	1. open 2. closed 3. permeable 4. water	(Carmona), (Ching)
Environmental	Spatial morphology	1. central 2. irregular 3. linear 4. longitudinal	(Sitte, 1889), (Zucker, 1959), (Carmona) in (Krmpotić Romić, 2025)
Environmental	Accessibility	1. Yes 2. No	(Giovinazzi and Moretti, 2010), (UN-Habitat)
Environmental	Pedestrian and cycling path network	1. Yes 2. No	(Kieron J. Doick), (Iva Mrak)
Environmental	Public transport – resting places every 300 m	1. Yes 2. No	(Iva Mrak)
Environmental	Other public areas heterogeneity	1. Yes 2. No	(Iva Mrak)
Economic	Circularity of construction	1. Yes 2. No	(Iva Mrak), (Williams)
Social	Accessibility (public transportation) / mobility	1. Yes 2. No	(Emmanuel Rey), (Iva Mrak)
Map 5			
Dimension	Criterion	Categories / Scale	Scientific source
Economic	All year use	1. Yes 2. No	(Iva Mrak, 2022)
Economic	Circularity of construction	1. Yes 2. No	(Iva Mrak), (Williams)
Environmental	Size	1. S small 0–5 ha 2. M 5–20 ha 3. L 20–100 ha 4. XL 100+ ha	(Matković and Jakovčić, 2019a)

Environmental	Spatial morphology	1. central 2. irregular 3. linear 4. longitudinal	(Sitte, 1889), (Zucker, 1959), (Carmona) in (Krmpotić Romić, 2025)
Environmental	Accessibility	1. Yes 2. No	(Giovinazzi and Moretti, 2010), (UN-Habitat)
Environmental	Nature-based solutions implementation	1. Yes 2. No	(Zaman et al., 2024)
Environmental	WSUD (water-sensitive urban design) integration	1. Yes 2. No	(Zaman et al., 2024), (Iva Mrak)
Environmental	Climate change adaptation and mitigation interventions	1. Yes 2. No	(Zhang et al., 2023), (Sabri and Ponrahono, 2024), (Ibes), (Iva Mrak), (Kieron J. Doick)
Environmental	Pedestrian and cycling path network	1. Yes 2. No	(Kieron J. Doick), (Iva Mrak)
Environmental	Urban design (well-being offered by urban design)	1. Yes 2. No	(Iva Mrak)
Environmental	Public restrooms	1. Yes 2. No	(Iva Mrak)
Environmental	Drinking water fountains (access to drinking water)	1. Yes 2. No	(Iva Mrak)
Environmental	Adaptable spaces	1. Yes 2. No	(Iva Mrak), (Hough, 1984), (Bentley, 1985), (Haughton and Hunter, 1994), (Evans, 2001; Falk and Johnson, 1997) in (Carmona et al., 2003), (Frey, 1999)
Environmental	Sustainable waste management	1. Yes 2. No	(Iva Mrak), (Üzümcüoğlu, 2023), (Williams)
Environmental	Green areas heterogeneity	1. Yes 2. No	(Iva Mrak), (Carmona et al., 2003), (Commission of the European Communities, 1990) in (Carmona et al., 2003), Michael Breheny (1990), (Blowers, 1993) in (Carmona et al., 2003), (Barton), (Evans, 2001) in (Carmona et al., 2003), (Frey, 1999)
Environmental	Sports and recreation areas heterogeneity	1. Yes 2. No	(Iva Mrak), (Girard and Nijkamp, 2009)
Environmental	Ecosystem preservation / restoration	1. Yes 2. No	(Iva Mrak), (Kieron J. Doick), (Zhang et al., 2023)
Resilience	Resilience	1. Yes 2. No	(Iva Mrak), (Carmona et al., 2003), (Hough, 1984), (Haughton and Hunter, 1994), (Falk and Johnson, 1997; Evans, 2001) in (Carmona et al., 2003), (Iturriza et al., 2020), (Wang and Foley, 2021)
Social	Program / function	1. homogeneous 2. heterogeneous	(Carr et al.), (Stanley et al.), (Gehl and Gemzøe, 2008), (Carmona) in (Krmpotić Romić, 2025), (Girard and Nijkamp, 2009)
Social	Well-being	1. Yes 2. No	(Emmanuel Rey), (Zhang et al., 2023)
Social	Accessibility (public transportation) / mobility	1. Yes 2. No	(Emmanuel Rey), (Iva Mrak)
Social	Shelter areas	1. Yes 2. No	(Iva Mrak)
Social	Vitality / concentration	1. Yes 2. No	(Carmona et al., 2003), Ian Bentley (1990), (Commission of the European Communities, 1990), Michael Breheny

			(1990), (Haughton and Hunter, 1994), (Barton), Richard Rogers (1997), (Falk and Johnson, 1997; Evans, 2001), (Frey, 1999)
Map 6			
Dimension	Criterion	Categories / Scale	Scientific source
Economic	All year use	1. Yes 2. No	(Iva Mrak, 2022)
Economic	Circularity of construction	1. Yes 2. No	(Iva Mrak), (Williams)
Economic	Implement tourist activity	1. Yes 2. No	(Iva Mrak)
Environmental	Size	1. S small 0–5 ha 2. M 5–20 ha 3. L 20–100 ha 4. XL 100+ ha	(Matković and Jakovčić, 2019a)
Environmental	Space management (boundaries)	1. open 2. closed 3. permeable 4. water	(Carmona), (Ching)
Environmental	Historical and cultural value	1. Yes 2. No	(Matković and Jakovčić, 2019a), (Throsby, 2001)
Environmental	Spatial morphology	1. central 2. irregular 3. linear 4. longitudinal	(Sitte, 1889), (Zucker, 1959), (Carmona) in (Krmpotić Romić, 2025)
Environmental	Accessibility	1. Yes 2. No	(Giovinazzi and Moretti, 2010), (UN-Habitat)
Environmental	Climate change adaptation and mitigation interventions	1. Yes 2. No	(Zhang et al., 2023), (Sabri and Ponrahono), (Ibes), (Iva Mrak), (Kieron J. Doick)
Environmental	Pedestrian and cycling path network	1. Yes 2. No	(Kieron J. Doick), (Iva Mrak)
Environmental	Urban design (well-being offered by urban design)	1. Yes 2. No	(Iva Mrak)
Environmental	Adaptable spaces	1. Yes 2. No	(Iva Mrak), (Hough, 1984), (Bentley, 1985), (Haughton and Hunter, 1994), (Evans, 2001; Falk and Johnson, 1997) in (Carmona et al., 2003), (Frey, 1999)
Environmental	Visual impact	1. Yes 2. No	(Iva Mrak), (Zhang et al., 2023)
Environmental	Sports and recreation areas heterogeneity	1. Yes 2. No	(Iva Mrak), (Girard and Nijkamp, 2009)
Environmental	Other public areas heterogeneity	1. Yes 2. No	(Iva Mrak)
Social	Program / function	1. homogeneous 2. heterogeneous	(Carr et al.), (Stanley et al.), (Gehl and Gemzøe, 2008), (Carmona) in (Krmpotić Romić, 2025), (Girard and Nijkamp, 2009)
Social	Well-being	1. Yes 2. No	(Emmanuel Rey), (Zhang et al., 2023)
Social	Heritage	1. Yes 2. No	(Emmanuel Rey), (Giovinazzi and Moretti, 2010), (Üzümcüoğlu, 2023), (Howard and Ashworth), (Iva Mrak), (Bilušić, 2024), (Blowers, 1993), (Kieron J. Doick)
Social	Accessibility (public transportation) / mobility	1. Yes 2. No	(Emmanuel Rey), (Iva Mrak)
Social	Vitality / concentration	1. Yes 2. No	(Carmona et al., 2003), Ian Bentley (1990), (Commission of the European Communities, 1990), Michael Breheny (1990), (Haughton and Hunter, 1994),

			(Barton), Richard Rogers (1997), (Falk and Johnson, 1997; Evans, 2001), (Frey, 1999)
Social	Sense of place	1. Yes 2. No	(Carmona et al., 2003), (Commission of the European Communities, 1990), (Blowers, 1993), (Haughton and Hunter, 1994), (Falk and Johnson, 1997; Evans, 2001), (Frey, 1999), (Giovinazzi and Moretti, 2010)
Map 7			
Dimension	Criterion	Categories / Scale	Scientific source
Economic	Self-sufficiency	1. Yes 2. No	(Kieron J. Doick)
Economic	Employment opportunities	1. Yes 2. No	(Kieron J. Doick)
Economic	All year use	1. Yes 2. No	(Iva Mrak, 2022)
Economic	Implement tourist activity	1. Yes 2. No	(Iva Mrak)
Environmental	Size	1. S small 0–5 ha 2. M 5–20 ha 3. L 20–100 ha 4. XL 100+ ha	(Matković and Jakovčić, 2019a)
Environmental	Space management (boundaries)	1. open 2. closed 3. permeable 4. water	(Carmona), (Ching)
Environmental	Spatial morphology	1. central 2. irregular 3. linear 4. longitudinal	(Sitte, 1889), (Zucker, 1959), (Carmona) in (Krmpotić Romić, 2025)
Environmental	Accessibility	1. Yes 2. No	(Giovinazzi and Moretti, 2010), (UN-Habitat)
Environmental	Mixed use, functional diversity	1. Yes 2. No	(Girard and Nijkamp, 2009), (Iva Mrak), (Emmanuel Rey), Hauri (2011), (Hough, 1984), (Randall and Baetz), (Bentley, 1985), (Frey, 1999), (Falk and Johnson, 1997; Evans, 2001) in (Carmona et al., 2003), (Şenik and Uzun, 2022)
Social	Program / function	1. homogeneous 2. heterogeneous	(Carr et al.), (Stanley et al.), (Gehl and Gemzøe, 2008), (Carmona) in (Krmpotić Romić, 2025), (Girard and Nijkamp, 2009)
Social	Proximity of social facilities (schools, elderly homes, health facilities)	1. Yes 2. No	(Emmanuel Rey)
Social	Proximity of commercial facilities	1. Yes 2. No	(Emmanuel Rey)
Social	Educative facilities / services	1. Yes 2. No	(Kieron J. Doick), (Burinskienė et al., 2017)
Social	Vitality / concentration	1. Yes 2. No	(Carmona et al., 2003), Ian Bentley (1990), (Commission of the European Communities, 1990), Michael Breheny (1990), (Haughton and Hunter, 1994), (Barton), Richard Rogers (1997), (Falk and Johnson, 1997; Evans, 2001), (Frey, 1999)
Map 8			
Dimension	Criterion	Categories / Scale	Scientific source
Environmental	Size	1. S small 0–5 ha 2. M 5–20 ha 3. L 20–100 ha 4. XL 100+ ha	(Matković and Jakovčić, 2019a)

Environmental	Space management (boundaries)	1. open 2. closed 3. permeable 4. water	(Carmona), (Ching)
Environmental	Historical and cultural value	1. Yes 2. No	(Matković and Jakovčić, 2019a), (Throsby, 2001)
Environmental	Spatial morphology	1. central 2. irregular 3. linear 4. longitudinal	(Sitte, 1889), (Zucker, 1959), (Carmona) in (Krmpotić Romić, 2025)
Environmental	Accessibility	1. Yes 2. No	(Giovinazzi and Moretti, 2010), (UN-Habitat)
Social	Heritage	1. Yes 2. No	(Emmanuel Rey), (Giovinazzi and Moretti, 2010), (Üzümcüoğlu, 2023), (Howard and Ashworth), (Iva Mrak), (Bilušić, 2024), (Blowers, 1993), (Kieron J. Doick)
Social	Sense of place	1. Yes 2. No	(Carmona et al., 2003), (Commission of the European Communities, 1990), (Blowers, 1993), (Haughton and Hunter, 1994), (Falk and Johnson, 1997; Evans, 2001), (Frey, 1999), (Giovinazzi and Moretti, 2010)

8.2.1.9 Conclusions - Conceptual Schematic Diagrams

Kevin Lynch (1960) was a professor at the MIT Center for Urban and Regional Studies whose study explored the form of three American cities: Boston, Jersey City, and Los Angeles. This five-year research resulted in the publication of The Image of the City, which examines the imageability of urban environments. Lynch argues that a beautiful city environment exists when its various parts can be easily recognized by inhabitants and organized into a coherent pattern (Lynch, 1960).

Urban environments generate collective mental images formed through the overlap of individual perceptions, which Lynch contends are necessary for residents to navigate effectively and cooperate within shared spaces. While acknowledging that social meaning, function, history, and nomenclature influence imageability, Lynch focuses specifically on the role of physical form in structuring these cognitive maps. He systematizes urban imagery into five interdependent elements: paths, edges, districts, nodes, and landmarks.

Paths are movement channels that structure the observer's experience. Along these paths – such as streets, walkways, transit lines, canals, and railroads – the other environmental elements are arranged and related. Edges are linear boundaries that define districts and continuity. They are elements not considered as paths by the observer, serving as lateral references rather than coordinate axes and representing linear breaks in continuity interpreted as boundaries

between two phases. Edges can be more or less penetrable barriers or seams that join two regions together and are important organizing features that hold generalized areas together. For example, the outline of a city can be defined by water or a wall. The edge element can physically manifest as a shore, railroad cut, wall, or development edge.

Districts are sections of the city that the observer can enter, recognizable as two-dimensional areas with a common, identifying character. Districts are the structuring city elements for most people, depending on the dominance of the district or path elements. Nodes are defined as enterable strategic locations within the urban fabric where activity, movement, or attention is concentrated. They serve as gathering or attention points in a town (Zhin Yang Lau et al., 2021; Lynch, 1960). Nodes can manifest as junctions, transportation breaks, path convergences, street-corner hangouts, enclosed squares, or any concentration node acting as the epitome and focus of a district, called cores. Nodal points can be found in almost every city image, but they are not always dominant features. Cores are typically the intensive focal points of districts, their polarizing centers.

Landmarks are external points of reference in a city. They can be distant, within the city, or local. Landmarks are frequently used as clues of identity, relied upon when navigating the urban environment. Physical manifestations include buildings, signs, stores, mountains, isolated towers, golden domes, great hills, and, on a local level, signs, trees, and storefronts.

These five elements are neither isolated nor static; they interpenetrate and reintegrate into holistic urban images, with their dominance varying by individual and city context. Lynch contends that successful urban design must reinforce meaning through form, recognizing that districts are structured with nodes, defined by edges, penetrated by paths, and marked by landmarks, creating coherent environmental legibility essential for both psychological satisfaction and functional urban operation (Lynch, 1960).

Lynch’s elements are used, as he himself suggests, for more general application (Lynch, 1960) in analyzing and understanding WBUPP spatial organization. The five elements are identified within the observed urban area, and their interrelation is interpreted and presented in a simplified abstract diagram. The definition of

these elements is not uniform; it depends on the specific perspective and the objective that the particular juxtaposition and relationship aim to present.

8.3 WBUPP REPRESENTATIVE EXAMPLE CASE # 1 ABANDOIBARRA, BILBAO, SPAIN

8.3.1 Overview

During the 1970s and 1980s, Bilbao experienced a social crisis driven by global industrial shifts, which resulted in the elimination of approximately forty percent of the region's industrial employment within a single decade. Following this period of decline, the city initiated a comprehensive revitalization program aimed at repositioning Bilbao as a contemporary, competitive metropolis able to meet the challenges of the twenty-first century (del Cerro Santamaría, 2013), (Bilbao Metro´ poli-30, 2001).

The program adopted strategies common to contemporary European urban regeneration, focusing on converting the former industrial waterfront into a mixed-use service, business, and cultural district. The key components included cultural anchors (the development of the Guggenheim Museum Bilbao as a primary catalyst for tourism and international visibility); infrastructure modernization (expansion of port and airport capacities, construction of a new metropolitan subway system, and the development of an intermodal transit station); commercial and technological hubs (creation of a new downtown business district, a convention center, and a technology park housing the European Software Institute); connectivity (implementation of new highway networks and railroad corridors to integrate the city with the broader metropolitan region) (del Cerro Santamaría, 2013).

Four distinct characteristics defined Bilbao's planning approach during this period:

1. State-Led Investment: The revitalization was primarily a public sector initiative, funded almost entirely by Basque and Spanish institutions. The estimated budget of two billion dollars represented a substantial portion of

the Basque Country's GDP, underscoring the strategic importance of the metropolitan region. Although it occupies only 5.7% of the land area, the region accommodates nearly 45% of the population.

2. Long-Term Temporal Scale: Given the magnitude of the intervention, the program was conceived as a long-term effort spanning approximately 15 years.
3. Economic Diversification: The strategy aimed to balance production and consumption. The industrial base was selectively regenerated through investments in steel and shipbuilding, while at the same time fostering the development of a high-tech sector and a consumption-oriented service economy. This dual approach sought to attract both large and small firms while enhancing the city’s attractiveness as a place to live and as a tourist destination.
4. Internationalization: Particular emphasis was placed on integrating Bilbao into global networks, fostering foreign trade, and attracting cultural tourism in order to diversify the local economy beyond its traditional industrial base (del Cerro Santamaría, 2013).

As noted by Roberts and Sykes (2008), this approach exemplifies a comprehensive model of urban regeneration, defined as a vision and action which leads to the resolution of urban problems and which seeks to bring about a lasting improvement in the economic, physical, social and environmental condition of an area that has been subject to change.

Central to this transformation was the redevelopment of the Abandoibarra waterfront (Figure 42), a site widely regarded as the "jewel of the crown" (Rodríguez and Martinez, 2003) in the city's revitalization plan. Located on the city's northwest border between the Nervión River and the Ensanche (a late-19th-century industrial expansion area), and in close proximity to the Guggenheim Museum, the site covers approximately 35 hectares in an elongated half-moon configuration (del Cerro Santamaría, 2013).

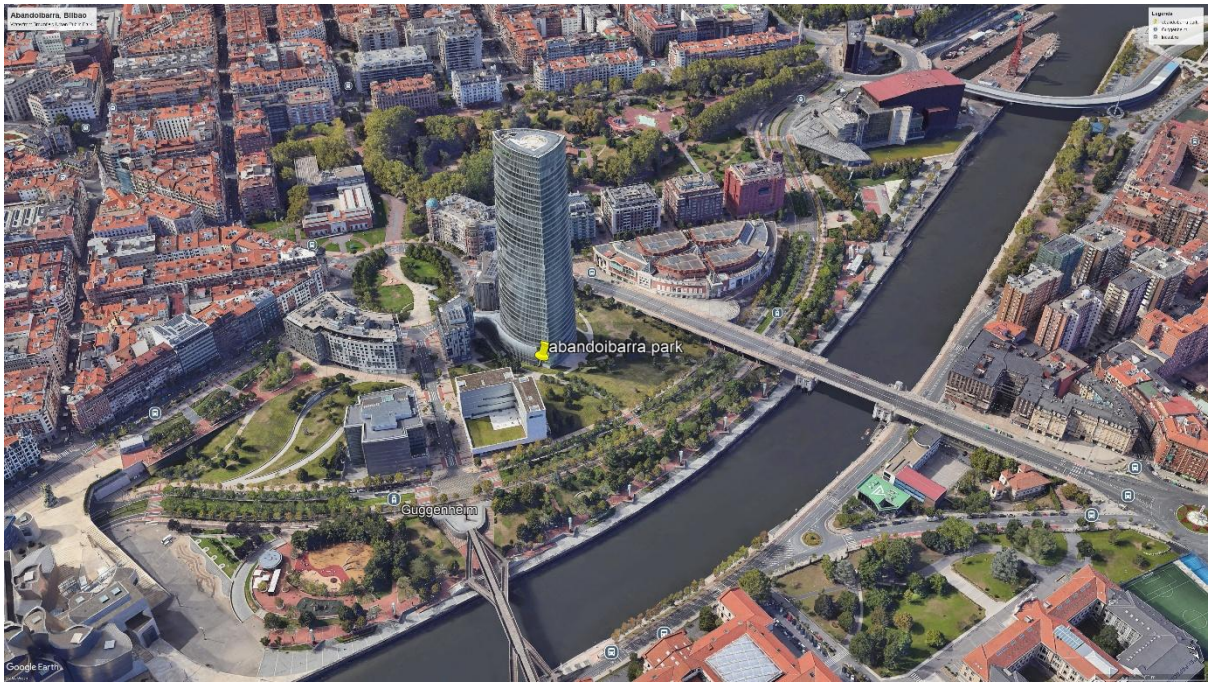


Figure 42 Abandoibarra, 2025., Google Earth Pro (Google, 2026a)

8.3.2 History/Previous Land Use

Bilbao's waterfront transformation (Figure 43, Figure 44, Figure 45, Figure 46, Figure 47, and Figure 48) was initiated following the industrial decline of the 1970s, major flood disaster in 1983, and the strategic decision to relocate port from city center (Lee Kuan Yew World City Prize, 2025b).

The Abandoibarra site has been previously occupied by sparsely used port facilities, by the TECO (container) station of the national railroad company (RENFE, Red Nacional de Ferrocarriles Españoles, Spanish National Railroad Network), and by the Euskalduna shipyards – a public sector firm that closed in the early 1990s (Abalos and Herreros, 1999) in (del Cerro Santamaría, 2013). The centerpiece of this zone was the *Compañía Euskalduna de Construcción y Reparación de Buques*, founded in 1900 by shipping magnates Ramón de la Sota and Eduardo Aznar. Occupying approximately 90,000 m² of the riverbank, the Euskalduna shipyards became a major employer, with a workforce exceeding 4,000 people at its peak (Odriozola Oyarbide et al., 2025) (Areso, 2017).



Figure 43 Abandoibarra, 1991., Google Earth Pro (historical imagery) (Google, 2026a)



Figure 44 Abandoibarra, 2001., Google Earth Pro (historical imagery) (Google, 2026a)



Figure 45 Abandoibarra, 2002., Google Earth Pro (historical imagery) (Google, 2026a)



Figure 46 Abandoibarra, 2004., Google Earth Pro (historical imagery) (Google, 2026a)



Figure 47 Abandoibarra, 2009., Google Earth Pro (historical imagery) (Google, 2026a)

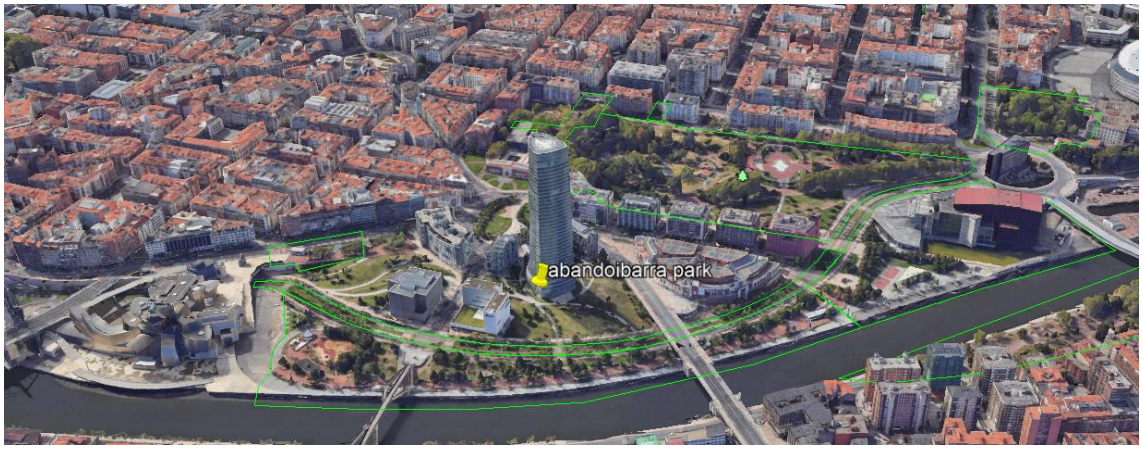


Figure 48 Abandoibarra, 2025., Google Earth Pro (historical imagery) (Google, 2026a)

8.3.3 Planning/Design/Building Process

The regeneration of the Ría Nervión waterfront in Bilbao exemplifies a long-term, integrated approach to urban-planning. Over more than 25 years, former industrial brownfield sites have been transformed into sustainable public parks and mixed-use districts. Coordinated by Bilbao Ría 2000 since 1992, the strategy responds to post-industrial decline, the floods of 1983, and emerging climate projections through phased interventions that prioritize green space, flood resilience, and pedestrian connectivity (Centre for Liveable Cities Singapore, 2025).

Bilbao Ría 2000 is a public limited company established in 1992. Its ownership is shared equally between the Spanish State Administration—through affiliated entities such as SEPES (Public Business Land Entity), the Port Authority of Bilbao, and ADIF—and the Basque public administrations, including the Basque

Government, the Provincial Council of Bizkaia, Bilbao City Council, and Barakaldo Town Council. The organization's mission is to recover degraded and declining industrial areas within metropolitan Bilbao, thereby promoting balanced urban development and improved territorial cohesion. To achieve this objective, Bilbao Ría 2000 coordinates and implements actions that integrate urban-planning, transportation, and environmental considerations (Bilbao Ria 2000, 2025b). Over the past twenty-five years, the agency has successfully delivered a series of projects based on a comprehensive and integrated urban vision (Lee Kuan Yew World City Prize, 2025b).

Bilbao's waterfront regeneration is conducted in multiple phases.

Phase 1: Abandoibarra (1998–2012)

Abandoibarra project reclaimed 35 hectares of former port and rail land into a cultural-green axis designed by Pelli Clarke Pelli Architects and Balmori Associates, with Eugenio Aguinaga from Aguinaga y Asociados Arquitectos as the local architect of record (Architects, 2026). Key features include the 93,000 m² Ribera Park, a 3 km two-level promenade, and 66% green dedication supporting 800 housing units, offices, and the Guggenheim Museum hub. Light rail integrates cultural access, while land-value capture finances ongoing works via developer plot sales (de la Vía, 2025; Centre for Liveable Cities Singapore, 2025; Lee Kuan Yew World City Prize, 2025b; Balmori Associates, 2012a; Pelli Clarke & Partners, 2025).

Phase 2: Zorrozaurre Peninsula (2004–Ongoing)

Zaha Hadid Architects' master plan converts 60 hectares of industrial peninsula into a flood-resilient island via Deusto Channel opening. Highlights encompass a 40,000 m² central linear park, waterfront promenades, and zoned districts for 15,000 residents plus 6,000 jobs in knowledge, leisure, and integration areas. Sustainability aspects integrate zero - emission buildings, EV infrastructure, 75,000 m³ stormwater tanks, and 1m river height reduction against projected 10% rainfall increases by 2050 (Centre for Liveable Cities Singapore, 2025; Landezine, 2020; Fairs, 2007).

Phase 3 Metropolitan Green Ring (Ongoing)

The 99.3 km Metropolitan Green Ring links urban-forest parks for wellbeing, complemented by metro expansion, buried roads, rail relocation, river sanitation, and historic core rehabilitation. Governance via Bilbao Ría 2000 ensures consensus-driven financing and avoids administrative fragmentation (Centre for Liveable Cities Singapore, 2025).

The transformation of Abandoibarra was conceived as a strategic restructuring intervention designed to reposition Bilbao within the European urban hierarchy, prioritizing international visibility from the outset. While the General Urban Organization Plan (PGOUB) established broad regulatory outlines, the specific spatial articulation was defined through the "Special Plan of Interior Reform" (PERI) (Ayuntamiento de Bilbao, 1999). This plan was grounded in a two-phase international competition held in 1992, organized by the City Council and Bilbao Metropoli-30. Bilbao Metropoli-30 is a public–private strategic planning association founded in 1991 that promotes the long-term economic, urban, and social development of the Bilbao metropolitan area by coordinating collaboration among government institutions, businesses, and civil society (Bilbao Metro´ poli-30, 2001). The process, which progressed from a local open call (48 entries) to an invited international stage (three foreign teams), culminated in the 1993 selection of architect César Pelli, whose proposal was deemed the most responsive to the site’s complex challenges (Bilbao Metro´ poli-30, 1999).

Pelli’s master plan adhered to the PGOUB’s mixed-use mandate while introducing significant flexibility to minimize financial risk, a strategy drawing on his experience with New York's Battery Park City. The proposal structured the area into distinct functional zones, notably reducing the permitted office space from 20 to 8 hectares in favor of a more balanced program. This included a 3-hectare shopping mall, a hotel, 800 residential units, and dedicated sites for cultural anchors. A defining feature was the extensive provision of open public space, totaling over 12,2 hectares along the riverfront. Key interventions included the new Parque de la Ribera and the extension of Parque de Doña Casilda, ensuring a continuous green network. The plan allocated specific sites for "prestige projects" that served as the district's anchors, including the Guggenheim Museum, the Music and Conference Auditorium, and the University

of Deusto Library. In total, the approved PERI proposed over 19,5 hectares of green and open areas, slightly exceeding the 18,6 hectares designated for built structures (Bilbao Metro´ poli-30, 1999), (Ayuntamiento de Bilbao, 1999).

By presenting Abandoibarra as the flagship project of metropolitan restructuring, city leaders used this targeted physical renewal to promote an “image reconstruction,” repositioning Bilbao as a city associated with creativity and success and thereby strengthening its competitiveness in the global economy (del Cerro Santamaría, 2013).

8.3.4 Program

Amenities

The Abandoibarra park system provides a range of amenities that support diverse recreational activities and social interaction. Campa de los Ingleses includes a café integrated beneath sculpted earth forms, offering dining and leisure facilities within the landscape. Seating infrastructure consists of fixed benches distributed throughout the parks, complemented by varied seating typologies, including ottoman-style elements made from recycled rubber in selected plaza pockets.

Shaded areas created through topographic design and tree-lined perimeter paths provide relief from weather extremes, particularly during Bilbao’s hot summer months. A circular tree-lined path encourages walking and informal seating while creating secondary circulation routes distinct from primary movement corridors. Water features and jets, including those at Campa de los Ingleses, provide cooling amenities during summer. Picnic areas with tables and benches enable informal outdoor dining and group gatherings, while wide, flat pathways ensure accessibility for strollers and wheeled mobility devices (Balmori Associates, 2012b; Landezine, 2012; Balmori, 2012).

Facilities

Recreation facilities within Abandoibarra are suitable for diverse user groups and activities. The area adjacent to the Guggenheim Museum, Euskalduna Conference and Concert Hall, and Dona Casilda park extension, contain a comprehensive children's play area with partially covered playground structures

and safety surfaces. Water jets and spray features provide summer recreation for children, integrated into the broader park program. The Campa de los Ingleses park incorporates ramps, stairs, and terraces that sculpt the landscape while serving as seating and gathering spaces, creating multipurpose infrastructure. The Ribiera del Nervión Park on the riverfront, includes an extensive sculptural collection along the "Paseo de la Memoria" (Memory Promenade), featuring works by prominent Basque and international artists that commemorate the area's industrial heritage while providing cultural and educational amenities. The three-kilometer pedestrian promenade running along the Nervión River serves as the primary recreational circulation corridor, with connections facilitated through major infrastructure such as the Pedro Arrupe Walkway and Zubizuri Footbridge. The promenade infrastructure supports continuous leisure movement and social activity along the waterfront (Bilbao Ria 2000, 2025b; Lee Kuan Yew World City Prize, 2025b; Landezine, 2012).

Services

The Abandoibarra parks system is integrated within a broader urban district providing diverse support services. Nearby institutional facilities including the University of Deusto Library and the UPV/EHU Auditorium (Bizkaia Aretoa or Paraninfo de la Universidad del País Vasco) offer educational and cultural programming in proximity to the parks. The Guggenheim Museum and Euskalduna Conference and Concert Hall provide cultural and entertainment services accessible from park areas. Commercial and retail services through nearby shopping facilities, hotels, restaurants, and cafés support visitors and park users. Emergency and maintenance services are provided through the comprehensive management infrastructure coordinated by Bilbao Ría 2000 and municipal authorities. Parking is available in adjacent structures supporting day-use and longer-term visits to the parks and cultural institutions (Lee Kuan Yew World City Prize, 2025b; Bilbao Ria 2000, 2025a). Public restrooms, drinking water fountains, waste and recycling bins are distributed within the park area. Best equipped areas include the children's playground and sports facilities vicinity, Plaza Euskadi, culture and information point surroundings.

Green areas

The Abandoibarra system comprises distinct but interconnected green spaces serving different functional and ecological purposes (Balmori, 2012). The Ribiera del Nervión Park functions as the primary waterfront promenade, bordering the riverfront between Euskalduna Conference and Concert Hall and Guggenheim Museum for approximately 800 meters. This linear park integrates sculptural infrastructure, viewing areas, and the Memory Promenade, establishing a cultural and ecological transition between the urban district and the river (Bilbao Ria 2000, 2025a). The Campa de los Ingleses park, located between the Guggenheim Museum and Deusto Bridge, serves as the landscape heart of Abandoibarra with undulating topographic features mediating elevation differences. Its design emphasizes recreation and walking, with "Freedom Lawn" planted with diverse grass species, clovers, and wildflowers that reduce maintenance and pesticide requirements. The sustainable paving incorporates GeoSilex®, an additive that absorbs CO2, manufactured entirely from industrial waste in collaboration with the University of Granada (Landezine, 2012). The Plaza Euskadi functions as a transitional green space connecting the established Doña Casilda park in the Ensanche district with the newer Campa de los Ingleses, serving as both movement corridor and recreation zone. Its design comprises three distinct public "pockets," each with different characters: a reflective seating section with water features, an ottoman-style seating area using recycled materials, and a garden pocket featuring a 100-year-old Laegostremia tree. The plaza's perimeter path and dominant central circulation corridor accommodate both leisurely walking and direct movement between districts (Balmori Associates, 2012b).

Together, these spatially and functionally differentiated green areas create a comprehensive ecosystem of public recreation spaces that connects the waterfront with the neighboring center (Land8: Landscape Architects Network, 2016) while supporting diverse recreational, cultural, and ecological functions.

8.3.5 Context

Park/city relationship

The Abandoibarra district, covering almost 35 hectares, represents the natural continuation and extension of Bilbao's Ensanche (19th-century expansion district) toward the Nervión River, reshaping the city's spatial organization and functional structure. The district accommodates a comprehensive mix of urban functions including the iconic Guggenheim Museum, the Euskalduna Conference and Concert Hall, Maritime museum facilities, approximately 600 luxury housing units, offices, shopping centers, university facilities, hotels, and extensive green spaces featuring a three-kilometer pedestrian promenade. This functional diversity positions Abandoibarra as a new urban center for Bilbao, transitioning the city from an industrial base toward services and culture. The Campa de los Ingleses park connects the Abandoibarra area with the Nervión River through undulating topographic design that mediates elevation differences (Lee Kuan Yew World City Prize, 2025b; Landezine, 2012).

Access

The Abandoibarra area benefits from a highly integrated multimodal transportation network, making it readily accessible from Bilbao's city center and beyond. The Moyua and Abando metro station (underground railway stations located 500 and 900 meters from WBUPP, respectively), function as key urban hubs, directly connecting multiple transport systems and serving as a gateway to Abandoibarra. The Bilbao tram (Tranbia) provides direct access to Abandoibarra WBUPP. Stations serving the Guggenheim Museum, Abandoibarra, Euskalduna Conference and Concert Hall, connect the district with the Old Town, making this the most convenient access method for visitors and residents. Walking distances are relatively short, with routes from Abando railway station to the Guggenheim taking approximately 15–25 minutes. Pedestrian connectivity is further enhanced by bridges such as the Pedro Arrupe footbridge, which links key institutions including the Guggenheim Museum and the University of Deusto. More broadly, the waterfront promenade and park design promote walkability, encouraging urban movement and public engagement with both the park and the river landscape (Landezine, 2012; Wikipedia, 2025a; TourismAttractions, 2025).

Public transportation

Abandoibarra is served by Bilbao's public transport system, providing multiple transit options. The Bilbao Metro, with lines 1 and 2 converging through the central area, connects Moyua and Abando stations to surrounding neighborhoods with frequent service. The tram (Tranbia) operates a single line with 16 stops along the river through the city center, directly serving the Guggenheim and Abandoibarra areas. Regional train services (Renfe Cercanias) provide four commuter lines (C1-C4) from Abando Station, connecting the area to surrounding municipalities. City buses (Bilbobus) complement the rail network, serving areas not covered by metro or tram systems, with a single metro/tram journey. In addition to public transport, the area is supported by underground parking facilities and nearby parking garages, ensuring accessibility for private vehicles while minimizing surface traffic. The unified Barik card system facilitates multimodal transit, allowing seamless transfers between these interconnected systems (Bilbao Insider, 2025).

Land and building use

The surrounding urban fabric of Abandoibarra comprises a strategically programmed mix of cultural, residential, commercial, and institutional uses. The Guggenheim Museum anchors the cultural district, complemented by the Euskalduna Conference and Concert Hall. Residential development includes approximately 600 high-end housing units designed by prominent architects, alongside hotels such as the Meliá Bilbao, contributing to a stable residential presence. Commercial and retail activities are concentrated in facilities such as the Zubiarte Shopping Center, supporting both everyday urban life and tourism. Institutional functions are represented by the University of Deusto Library (Rafael Moneo) and the UPV/EHU Auditorium (Bizkaia Aretoa, Álvaro Siza), positioning Abandoibarra as a center of education and knowledge production. Office uses are also present, most prominently the Iberdrola Tower (César Pelli), reinforcing the district’s economic role. This heterogeneous land-use composition establishes Abandoibarra as a polycentric mixed-use district that integrates recreation, commerce, residential, and institutional functions within a waterfront

setting. Green spaces and multimodal transport infrastructure connect these elements, creating both visual and functional continuity across elevation changes and linking previously fragmented urban areas into a cohesive whole (Lee Kuan Yew World City Prize, 2025b; Land8: Landscape Architects Network, 2016; Josu san Pedro Villalba, 2020; Bilbao Ria 2000, 2025a). Abandoibarra is surrounded by historic urban tissue, prevalently of residential use. It is officially considered as part of Abando district, bordering the Indautchu and Abando neighborhoods.

8.3.6 Sustainability

Abandoibarra represents a comprehensive waterfront regeneration initiative that transformed a heavily industrialized and environmentally degraded estuary into a multifunctional urban district explicitly aligned with sustainable development principles. The project, spanning 14 years, was managed by Bilbao Ría 2000, a public entity who oversaw the recovery of degraded industrial areas through coordinated town planning, transportation, and environmental restoration (Centre for Liveable Cities Singapore, 2025; Lee Kuan Yew World City Prize, 2025b). The transformation responded to centuries of industrial pollution and port deterioration through an integrated approach combining environmental remediation with sustainable urban design, directly supporting SDG 11 (Sustainable Cities and Communities), SDG 6 (Clean Water and Sanitation), and SDG 8 (Decent Work and Economic Growth) (United Nations, 2025).

Water sanitation infrastructure investments of €1 billion achieved dramatic pollution reductions between 1993 and 2003: biochemical oxygen demand decreased 51.8%, ammonia nitrogen 70.9%, and fecal coliforms 81.9%. (García-Barcina et al., 2006) These improvements directly addressed SDG Target 6.3 (reduce water pollution) and SDG 14.1 (prevent marine pollution) (García-Barcina et al., 2006) (United Nations, 2025). Scientific monitoring from 1997–2006 documented benthic recovery, with heavy metal concentrations decreasing up to 85% following wastewater treatment plant implementation in 2001–2002. Zooplankton studies (1999–2001) (Leorri et al., 2008), confirmed establishment of previously absent copepod species, indicating ecosystem convergence toward healthier baselines and supporting SDG Target 14.2 (protect and restore

ecosystems). Dissolved oxygen saturation improved, enabling marine biodiversity recovery (Albaina et al., 2009).

The project created 6 kilometers of waterfront leisure corridors and an 800-meter Bank Park promenade connected by pedestrian infrastructure (three-kilometer promenade, multiple bridges including Zubizuri and Pedro Arrupe). Underground positioning of arterial roads and railway rerouting eliminated vehicular barriers and reclaimed riverside land, directly supporting SDG Target 11.7 (safe, inclusive green and public spaces) and SDG 11.2 (sustainable transport) (Centre for Liveable Cities Singapore, 2025; Lee Kuan Yew World City Prize, 2025b).

Bilbao Ría 2000's governance model represents an institutional innovation, structured as a public–public partnership between regional and national administrations, through which development revenues were systematically reinvested in environmental restoration and public realm enhancement, advancing SDG Target 17.17 (effective public-private-civil society partnerships) (Centre for Liveable Cities Singapore, 2025; United Nations, 2025). By extending commitment beyond conventional project cycles, the model facilitated sustained ecological recovery while also contributing to SDG 8 through employment generation and economic diversification (United Nations, 2025).

Abandoibarra demonstrates simultaneous achievement of multiple SDGs through integrated interventions, including water quality improvements, biological recovery, sediment remediation, green infrastructure, pedestrian-oriented design, and broader economic transformation from an industrial to a service-based economy (Centre for Liveable Cities Singapore, 2025; Lee Kuan Yew World City Prize, 2025b; United Nations, 2025)(García-Barcina et al., 2006) (Albaina et al., 2009) (Leorri et al., 2008) .

8.3.7 Spatial Analysis

Thematic maps created within the process of spatial analysis are shown on Figures 29-40, in Appendix, 3, chapter 3.1.

1. WBUPP Position within national territory

Map 1 presents the WBUPP representative example cases' Position within national territory.

WBUPP is placed in the north of Spain, in one of the smallest regions called the Basque country. Basque country lies on the Bay of Biscay, part of the Atlantic Ocean.

2. WBUPP Position within urban structure

Map 2 presents the WBUPP representative example cases' Position within urban structure. The graphics aim to illustrate the Spatial relationship with city center.

Bilbao is the largest city in the Basque country, situated inland but well connected with the Biscay bay through Estuary of Bilbao and the Nervion river. WBUPP is adjacent to the Nervion river, central considering the citys' urban tissue concentration, and close to the historic city center.

3. WBUPP area

Map 3 presents the WBUPP representative example cases' area in the scale of 1:5000. It aims to illustrate criteria named Spatial morphology, Size, Accessibility, and Space management.

WBUPP range is determined by analysis of the historical development of Abandoibarra district within the city of Bilbao. Documents explaining its evolution since the industrial and port infrastructure activities seized to exist were the basis for setting the WBUPP boundaries. Google Earth Pro Historical imagery tool[42] (Google, 2026a) helped in connecting the written timeline with spatial context and show how the surrounding area co-existed with the redeveloped land. César Pelli's masterplan (2025) defined the spatial components of the WBUPP range as a longitudinally shaped cultural-green axis spanning approximately 35 hectares along the Nervión River. The plan integrates the Campa de los Ingleses park — serving as the central green spine with promenades and plazas — alongside waterfront promenades along the Ribera del Nervión, and a series of key attractors and boundary elements: the Guggenheim Museum (cultural anchor

[42] Google Earth Pro app, 7.3.6.10441 (64-bit) version, Historical imagery since December, 1991. till today

and eastern boundary), the Euskalduna Conference Hall (occupying the former shipyard site to the west), and the Iberdrola Tower (defining the northern skyline). Urban edges are further articulated by Parque Dona Casilda Iturrizar park and road infrastructure such as Paseo Estitxu and Euskalduna Zubia, with the overall precinct delimited by Mazarredo Zumarkalea, dense built fabric — including the residential blocks — and topographic conditions. These elements delineate WBUPP Abandoibarra, composing a cohesive park system that mediates between cultural attractors and contemporary urban uses. Water surface is shown through a category that encompasses the water body adjacent to the WBUPP area, Nervion river, and **water** that marks smaller, still contained water features such as fountains, decorative water pools, ponds, reservoirs and similar features.

WBUPP boundaries represent Open boundaries, Water boundaries and Closed boundaries. Water boundary is with Nervion river. WBUPP Abandoibarras' closed boundary takes up only a small portion and consists of a wall that prevents visitors from falling because of the substantial height difference.

WBUPP internal edges present readable lines created by the perception of existing physical elements within the Park. The built/non-built edge refers to the tall buildings row along the Paseo de Eduardo Victoria de Lecea. The district defining lines refer to major roads that intersect WBUPP and greatly influence, if not dictate, its spatial organization: the road around Plaza Euskadi, Deustuko Zubia, and Calle de Ramon Rubial.

WBUPP access points prevale on the land side of the Park, appearing often since there are almost none closed boundaries. Access points are related to existing pathways readable using auxiliary graphic tools named earlier. Two access points from Nervion river side are limited to two bridges, concluding that the water boundary does not facilitate access to the WBUPP using any kind of water transportation.

4. WBUPP accessibility, mobility

Map 4 presents the WBUPP representative example cases' area in the scale of 1:8000. It aims to illustrate criteria named Spatial morphology, Size, Accessibility,

Space management, Accessibility (Public Transportation) / Mobility, Public transport (resting places every 300m), Pedestrian/Path/Cycling Path, and Other public areas (heterogeneity).

Tram line is a two-way railway line, serving citizens as public transportation Euskotren tranbia. It was opened in 2002. as the first modern tramway in Bilbao, operating under the name of EuskoTran (Trenbideak, 2025).

Cycleway, Footway and Steps are non-driving paths, shown within the WBUPP area with their immediate outside continuation. The network is complex, dense, but not overly dense since it serves the purpose of connecting a very heterogeneous use and program. Cycleways are mostly concentrated along major roads and the tram line. Footways follow cycleways but are placed additionally along the waterfront and in major landscaped areas, presenting both linear and intersecting spatial disposition.

Public elevators at the marked locations are mixed, connecting different overground levels but also street levels with underground parking garage.

Bus stops and tram stops are located on major roads proximity and along the tram line.

City bike are public transportation stations of municipal bicycle sharing service in Bilbao, called Bilbaobizi, provided by the Bilbao City Council (Bilbao Council, 2025). Two are located within the Park, on major roads, and another two are near WBUPP boundaries, in the south.

Parking areas are placed outside of WBUPP boundaries, distributed on the north, east and west side. Parking entrances are related to commercial building content (Zubiarte Mall, hotel) , and public underground garage (Plaza Euskadi).

Bicycle parking points are placed along major roads within WBUPP area.

There is a significant number of Buildings within WBUPP area that make its constructed percentage area considerable, comparing to a standard urban public park. Their disposition interrelated with major roads within WBUPP. Five small structures related to the Parks' program contain amenities and services like catering (restaurant, bar), information point and playground shelter.

5. WBUPP environmental, health

Map 5 presents the WBUPP representative example cases' area in the scale of 1:5500. It aims to illustrate criteria named Spatial morphology, Size, Accessibility, Nature – based solutions implementation, Water-sensitive urban design, Climate change adaptation and mitigation, Pedestrian / Path / Cycling path, Urban design (Well-being offered by urban design), Public restrooms, Drinking water fountains (access to drinking water), Adaptable spaces, Visual impact, Sustainable waste management, Green Areas Heterogeneity, Sports/Recreation Areas Heterogeneity, Ecosystem Preservation/Restoration, Resilience, Program / Function, Well-being, Accessibility (Public Transportation) / Mobility, Shelter Areas, Vitality/ Concentration.

Viewpoints are mostly observed in the waterfront area, along Nervion river and around the Guggenheim and Euskalduna building. Pedro Arrupe Zubia pedestrian bridge offers elevated areas where the viewpoint range extends. Another two viewpoints are in Plaza Euskadi, towards the pedestrian bridge, and next the Guggenheim building, on an elevated platform that offers views on the WBUPP Abandoibarra.

Benches are placed along the waterfront, and major roads that are in contact with a green area or lined with trees. There are other, not marked, dispersed urban elements (benches or chairs) within WBUPP.

Drinking water points are dispersed within WBUPP, placed in the program vicinity (playgrounds, sports pitch) as well as in bigger grassland areas and gardens.

Toilets are placed inside commercial buildings (Zubiarte), and next to certain program focal points. Not all are provided with this service: the playground and sports pitch in the north-west, close to Euskalduna, does not offer that service.

Waste, recycling points are marked within WBUPP, although their positions are rare. It is possible that some positions are not marked or visible through auxiliary graphic tools.

Shelter is a space protected by a canopy whose structure is steel, wood, concrete or other durable construction, and covered with plastic, wood, metal or similar opaque, transparent, waterproof or semi-protective material. The space provides

shelter to the southern playground, as well as to sports and recreation program in the west, close to Euskalduna building.

Playgrounds, Sports and recreation outdoor areas are concentrated in three areas. Two are in the waterfront zone, each placed next to a landmark building with strong cultural character. The third area combines a playground and a Dog park, is in the south, within the Dona Casilda de Iturrizar Park extension.

Garden areas are mostly put next to the Guggenheim plaza public square. The rest is dispersed along the waterfront coastal belt in the form of small longitudinal surfaces.

Picnic outdoor seating can be found in two places, next to the Guggenheim playground and between the other two program concentrated areas in the west and south, respectively.

Grassland areas are found all over WBUPP, since the green surfaces are substantially proportioned. They circle the program features, the buildings in the central and east spatial zones, and spread along the waterfront longitudinal area. Tree avenues protect the Bizkaia Aretoa building and create a guiding perspective element on the tram line. They also form a protective and guiding perspective element along Mazzaredo zumarkalea and Leizaola lehendakariaren street.

Trees are dispersed all over WBUPP without obvious order, providing shaded areas for most of the Parks' surfaces.

6. WBUPP social, well being

Map 6 presents the WBUPP representative example cases' area in the scale of 1:6000. It aims to illustrate criteria named Spatial morphology, Size, Space management, Accessibility, Implement tourist activity, Historical and cultural value, Climate change adaptation and mitigation, Pedestrian / Path / Cycling path, Urban design (Well-being offered by urban design), Adaptable spaces, Sports/Recreation Areas Heterogeneity, Other Public Areas Heterogeneity, Program / Function, Well-being, Heritage, Accessibility (Public Transportation) / Mobility, Vitality/ Concentration, Identity / Sense of Place / Historic (Local)(The Smart Local) Identity.

Building use enclosure and coverage graphic symbols show enclosed, covered, and opened spaces within WBUPP. In Abandoibarra, enclosed are all the buildings within WBUPP, as well as two catering facilities located close to the waterfront area playgrounds, and the information point in the east close to the Guggenheim Museum. Covered are the two program features: sports and recreation pitch on the waterfront, close to Euskalduna building, and the children's playground in the south of WBUPP. Those spaces are protected by a canopy whose structure is steel covered with plastic, metal or similar material. Open spaces are sports and recreation pitches and outdoor seating area in the west close to Euskalduna, dog park in the south, and playgrounds in the east close to Guggenheim Museum.

Landmark marker within WBUPP highlights the skyscraper Torre Iberdrola. The building is the tallest in the city of Bilbao and acts as a prominent, distinctive urban reference point (Council on Vertical Urbanism, 2025; Torre Iberdrola A.I.E., 2025). The building data was obtained from internet sources to validate the Torre Iberdrola as a landmark. WBUPP contact area marks three buildings that are considered landmarks around WBUPP and hold great influence on the Parks' area spatial organization. Their main character is culture, even though one's use is mixed: culture and commercial. Euskalduna is a conference center and a theatre, on the west side of WBUPP (Palacio Euskalduna, 2026). Museum of Fine Arts of Bilbao is a museum, in the south of WBUPP, NEXT TO Plaza Euskadi (Museo de Bellas Artes de Bilbao, 2026). Guggenheim Bilbao is a museum, situated in the east of the WBUPP, on the waterfront (Guggenheim Bilbao Museoa, 2026).

Amusement arcade is an enclosed leisure area located in Zubiarte shopping mall, subject to payment. The space is a family entertainment center that provides arcade and redemption machines, along with a birthday party venue (Ilusiona, 2025).

Artwork locations are dispersed around the WBUPP, but the majority stand in the waterfront area and around Paseo de Eduardo Victoria de Lecea.

Bench, Playground, Dog park and Sports recreation are shown on this map. Their characteristics and their institution are explained in chapter Spatial analysis, section 5.

Landmark contact area is a symbol that marks the three buildings that are considered landmarks around WBUPP.

7. WBUPP self-sufficiency, mixed use, educative, land/building use context

Map 7 presents the WBUPP representative example cases' area on the scale range of 1:8000. It aims to illustrate criteria named Spatial morphology, Size, Space management, Self-sufficiency, Employment opportunities, Implement tourist activity, Mixed development, Program / Function, Proximity of social facilities (school facilities, home for elderly, health facilities), Proximity of commercial facilities, Educative (cultural) facilities / services, Vitality/ Concentration.

Buildings within WBUPP

Building use shows the built environment within WBUPP area and around its perimeter. The buildings within WBUPP create a relatively dense urban tissue, concentrated around major roads. They create some sort of usage clusters without defined shape. The prevalent cultural use[43] is situated in the northeast area. An extensive dimensioned commercial building and landmark tower are positioned centrally. The prevalently residential buildings with commercial and catering facilities on the ground floor are concentrated around Plaza Euskadi and along Paseo de Eduardo Victoria de Lecea.

Buildings outside WBUPP are mostly residential, culture, and educational. The contact zone presents an urban, mixed-use character.

8. WBUPP brownfield

Map 8 presents the WBUPP representative example cases' area in the scale of 1:5000. It aims to illustrate criteria named Spatial morphology, Size, Accessibility,

[43] Building use categories creation and definitions are described in Chapter 10.2.

Historical and Cultural Value, Heritage, Identity / Sence of Place / Historic Identity.

No heritage or other elements associated to brownfield regeneration are found in WBUPP that can be marked as Brownfield points.

9. Conclusions - Conceptual schematic diagrams

a. THE TWO-ZONES SCHEME

Figure 49 shows how the two zones are divided by a multimodal transportation semicircular line. The waterfront zone (Zone 1) is characterized by the more natural, non-built area with high program components concentration. The central zone (Zone 2) is developed with mixed use multifunctional buildings and a skyscraper, the tallest in the city, acting as a city landmark. Following Lynch (1960), district characteristics are interpreted as discrete visual identities emerging from urban design components such as materiality, texture, and building form. Modern and contemporary design features prevail. The construction size is significant; structures accommodate minimum od 10.000m2 of usable space each.

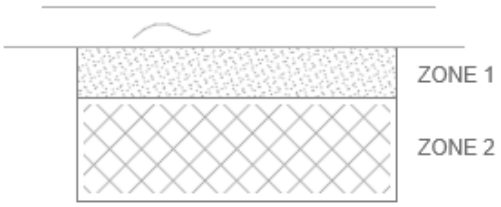


Figure 49. WBUPP Abandoibarra spatial relation, schematic diagram ZONES, M. Gudac Cvelic

b. THE URBAN STRUCTURE AND ATTRACTION SCHEME (nodes/district)

Figure 50 shows how zone 1 is a continuation of a non-built waterfront zone, connecting two nodes, important attractions. Zone 2 is a moderate density built district, situated within a high density urban structure.

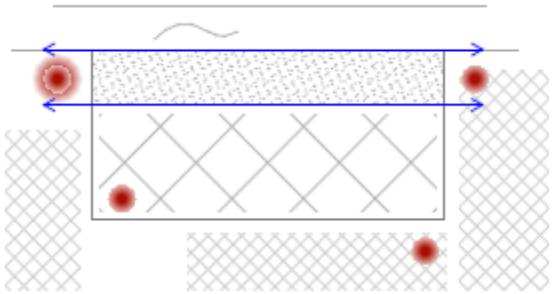


Figure 50. WBUPP Abandoibarra spatial relation, schematic diagram URBAN STRUCTURE AND ATTRACTION, M. Gudac Cvelic

c. THE RADIAL DISPOSITION SCHEME (path/district)

Error! Reference source not found. shows how WBUPP spatial structure is formed in a radial form and defined by the main radial multimodal path (rail/road/cycle/footway). It is limited by the river's edge, but faces a dense urban structure at the opposite river bank. The two major roads and two footway/cycleway transportation lines intersect the area spreading into the urban tissue, highlighting its radial character.

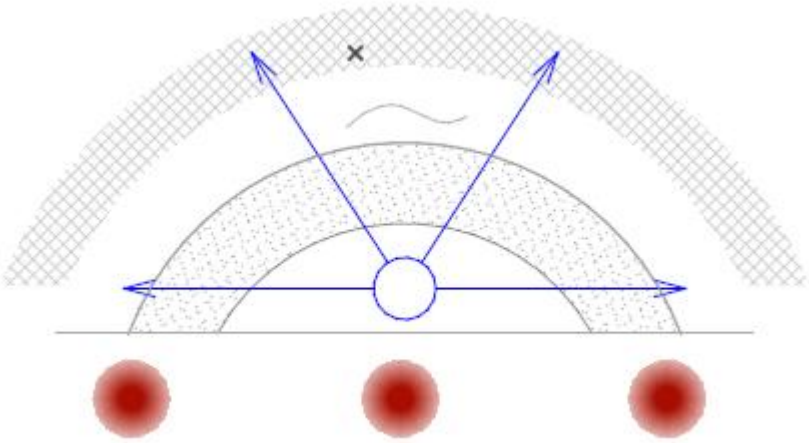


Figure 51. WBUPP Abandoibarra spatial relation, schematic diagram DISPOSITION, M. Gudac Cvelic

d. THE WBUPP AREA SCHEME (edge)

Logic should place views, services, facilities by the WBUPP edges.

Logical conclusion: most program components (amenities/facilities/services) are placed within the non-built zone by a water body. Built zone diversity is limited,

with buildings which contain enclosed space content, and substantial grassland surface (green district) between. **Error! Reference source not found.** presents the conclusion graphically.

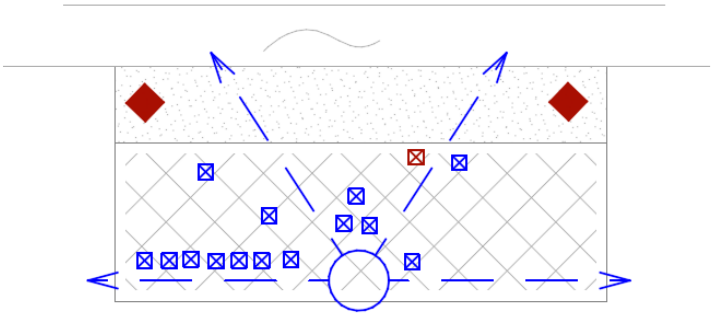


Figure 52. WBUPP Abandoibarra spatial relation, schematic diagram AREA, M. Gudac Cvelic

e. THE NODES SCHEME (nodes-non nodes, no classic Lynch nodes on the zones intersections)

In Lynch's framework, nodes are significant points within the urban structure where paths intersect or where spatial concentrations, such as plazas, occur. These locations function as focal points for gathering and attention within the city (Hassan, 2010). As shown in **Error! Reference source not found.**, there are no classic nodes according to Lynch, if we simplify the two zones into a scheme, with the path intersections or zone division point being non-nodes. Nodes lay outside, close to Zone 1 edges (public buildings), and in the Zone 2 center whose physical form of a big round-about crossing unites four multilevel transportation paths.

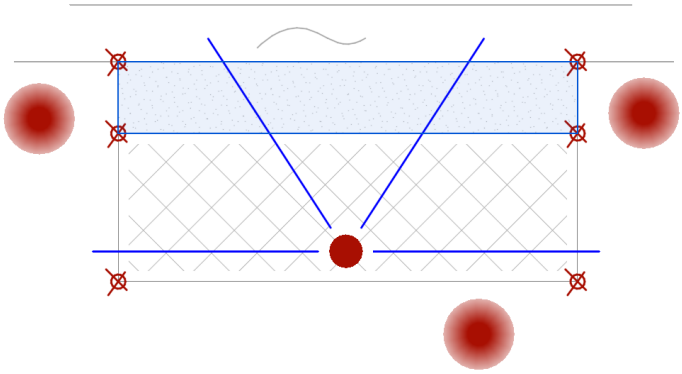


Figure 53. WBUPP Abandoibarra spatial relation, schematic diagram NODES, M. Gudac Cvelic

f. THE LANDMARK SCHEME

Landmark as a point for reference with physical elements guidance has outstanding visual features (Foltz, 1998; Lynch, 1960). WBUPP Abandoibarra's skyscraper holds characteristics of dominance, importance and potent location. As shown schematically in **Error! Reference source not found.**, Torre Iberdrola acts as prominent, distinctive reference point capturing the essential landmark cue in the wayfinding method in the city's legibility. It holds the ability to strengthen the sense of place, elements of the location, and emphasizes the importance of WBUPP Abandoibarra.

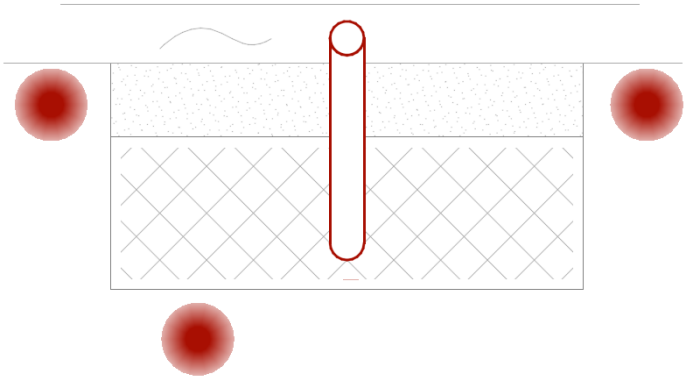


Figure 54. WBUPP Abandoibarra spatial relation, schematic diagram LANDMARK, M. Gudac Cvelic

g. THE BUILT /NON-BUILT SCHEME

Buildability of the zone follows the major transportation lines. Buildings are situated between those paths, and their alignment follows the path direction, as shown schematically in **Error! Reference source not found.**.

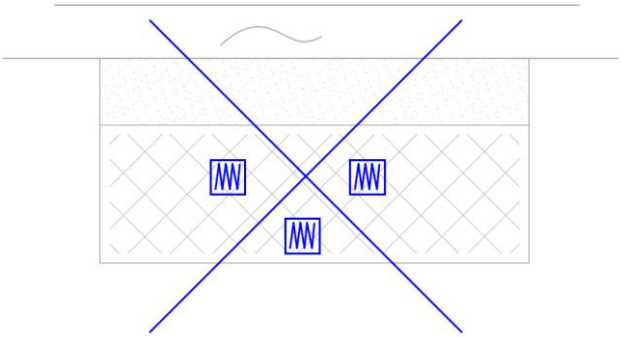


Figure 55. WBUPP Abandoibarra spatial relation, schematic diagram BUILT/NON.BUILT, M. Gudac Cvelic

h. THE PROGRAM SCHEME

Error! Reference source not found. shows schematically how the program concentration revolves around the public buildings, acting as important nodes of attraction. The paths connect the nodes. Nodes locations and effect on the environment and the area's usage is enhanced by supplementing with content. Sports field, playgrounds, catering facilities are compacted close to the external edges of the WBUPP Abandoibarra, close to the Guggenheim museum and Palacio Euskalduna.

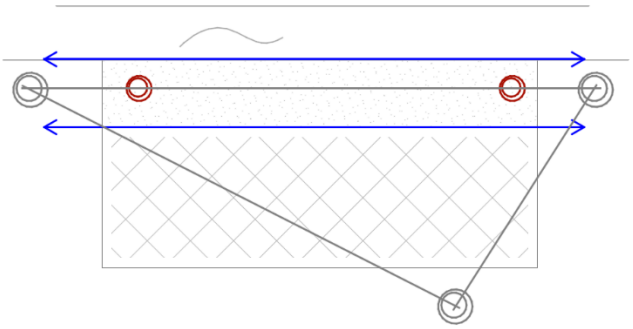


Figure 56. WBUPP Abandoibarra spatial relation, schematic diagram PROGRAM, M. Gudac Cvelic

i. THE NODES SCHEME (attractions/paths/nodes)

Error! Reference source not found. shows schematically how the nodes connect the paths from the outside. Nodes are public buildings (social functions): the two museums and a theatre/conference center. Program content is concentrated close to the nodes, inside the waterfront park zone.

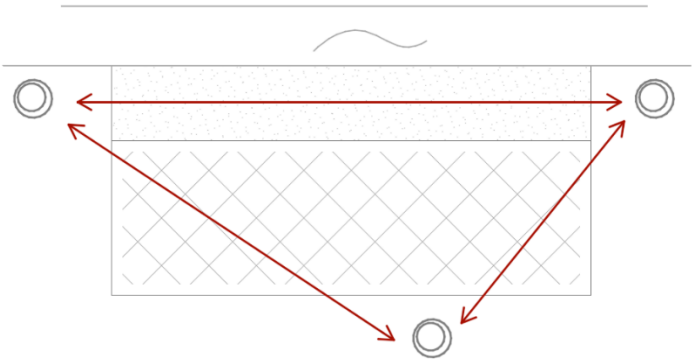


Figure 57. WBUPP Abandoibarra spatial relation, schematic diagram NODES 2, M. Gudac Cvelic

j. THE NON-PLACE SCHEME, SPATIAL CONFLICT (not resolved)

Error! Reference source not found. shows schematically that while Abandoibarra area is characterized by a high-quality pedestrian environment, adjacent transport infrastructure creates localized residual non-spaces beneath elevated road elements, which can function as underused or weakly integrated areas within the urban fabric.

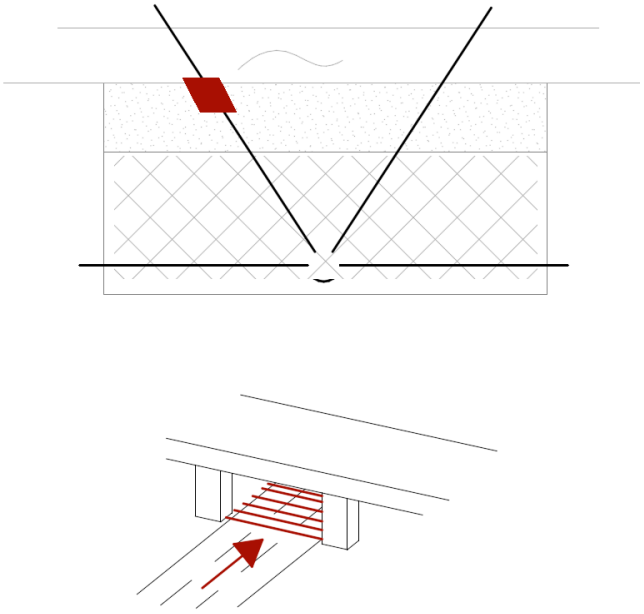


Figure 58. WBUPP Abandoibarra spatial relation, schematic diagram SPATIAL CONFLICT, M. Gudac Cvelic

8.3.8 Additional Criteria

The WBUPP representative example was analyzed using fifty criteria derived from scientific literature, with additional criteria identified after the performed analysis. Abandoibarra demonstrates a distinctive form of cultural activity characterized by its spatial reach and transformative role. Rather than relying on heritage or historical continuity, cultural presence in this context is deliberately designed to shape the neighborhood, the city, and, in Bilbao's case, the wider region. These cultural nodes are even more highlighted through their spatial clustering, their connection with attractive waterfront paths, and their role as focal points for visual and experiential engagement.

Abandoibarra is organized with multi-zoned spatial distribution. Zones hold different types of character and the relationship between them increases the neighborhoods' dynamic and vitality. Zones are, in this case, divided clearly with the strong multimodal transportation path, physically enhanced by multiple lines of trees acting both as protective and defining spatial elements.

Additional criteria proposed based on Abandoibarra WBUPP example case analysis are Water Related Program, Multi-Zoned Spatial Organization, Program Spatial Organization, Landmark Presence, Program Concentration, Circular Communication Network, Waterfront Communication Network, Spatial Enclosure Diversity, Water Contact Intensity.

8.4 WBUPP REPRESENTATIVE EXAMPLE CASE # 2 JUBILEUMSPARKEN, GOTHENBURG, SWEDEN

8.4.1 Overview

Jubileumsparken in Gothenburg, Sweden, represents an urban park development in the Frihamnen harbor district (Figure 59), created on former industrial brownfield land as part of the Älvstaden (RiverCity Gothenburg) redevelopment strategy. The park was conceived as a central initiative along the

Göta River creation for the Gothenburg's 400th anniversary programme (Utveckling, 2019). The wider RiverCity project covers more than 100 hectares of riverfront redevelopment, with the municipal eco-city vision to "Connect the city, Embrace the water, Reinforce the centre". It was developed through a participatory process that involved thousands of people with different backgrounds (Mossfeldt, 2020; 21stCenturyDevelopment, 2026).

The Jubileumsparken area initiated its regeneration in 2013 as "Jubileumsparken 0.5", a temporary experimental park on a former port infrastructure area. Over time, this evolved into a permanent 8-hectare park completed in 2023. The development of Jubileumsparken demonstrates how disused industrial and harbour sites can be converted into urban green spaces through iterative, participatory processes (Dahl, 2016; Allik, 2021).



Figure 59 Jubileumsparken, 2025., Google Earth Pro (Google, 2026a)

8.4.2 History/Previous Land Use

Frihamnen was established in the 1920s as a public harbor, crucial for Gothenburg's economy. It played a vital role in Sweden's maritime trade until its decline in the late twentieth century, leaving behind underutilized land. The abandoned harbor featured tarmac, concrete remnants, and typical vegetation of derelict industrial sites (Dahl, 2016).

In 2013, the city initiated Jubileumsparken 0.5 as a temporary placemaking project while planning for Frihamnen. Various design teams created temporary prototypes like a sauna and beach to test ideas for a future park. These initiatives, as shown in Figure 60, Figure 61, Figure 62, Figure 63, Figure 64, and Figure 65, transformed the vacant area into a meaningful social space for residents (Sandström, 2019) (Dahl, 2016).

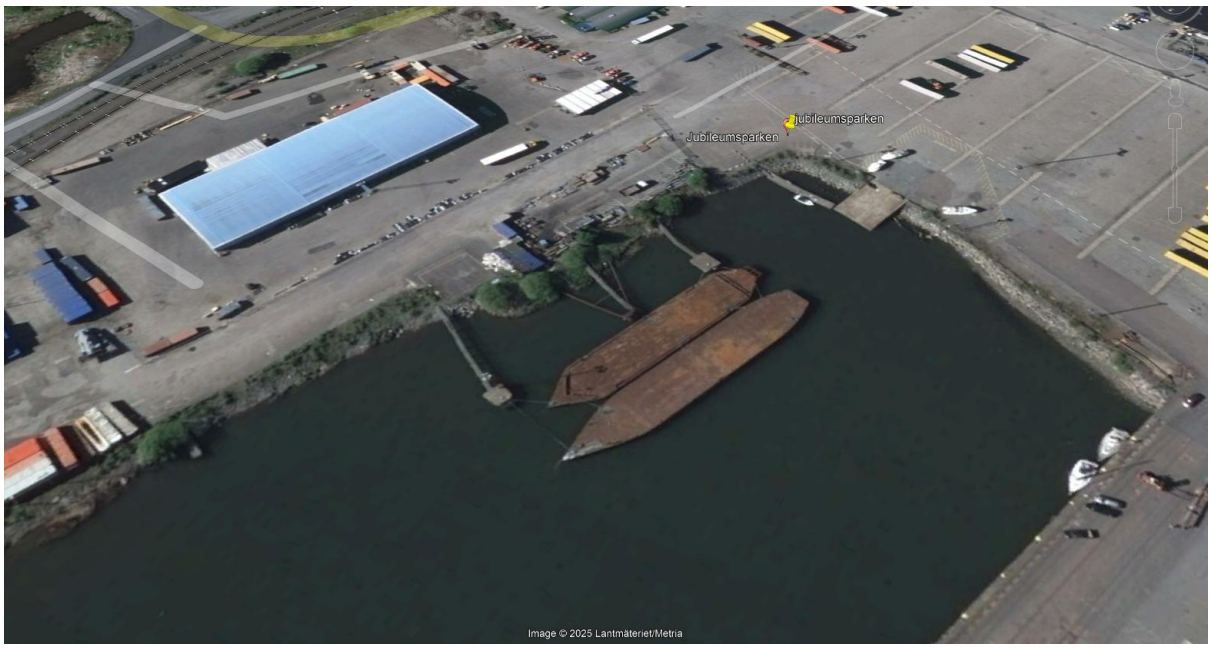


Figure 60 Jubileumsparken, 2008., Google Earth Pro (historical imagery) (Google, 2026a)



Figure 61 Jubileumsparken, 2015., Google Earth Pro (historical imagery) (Google, 2026a)

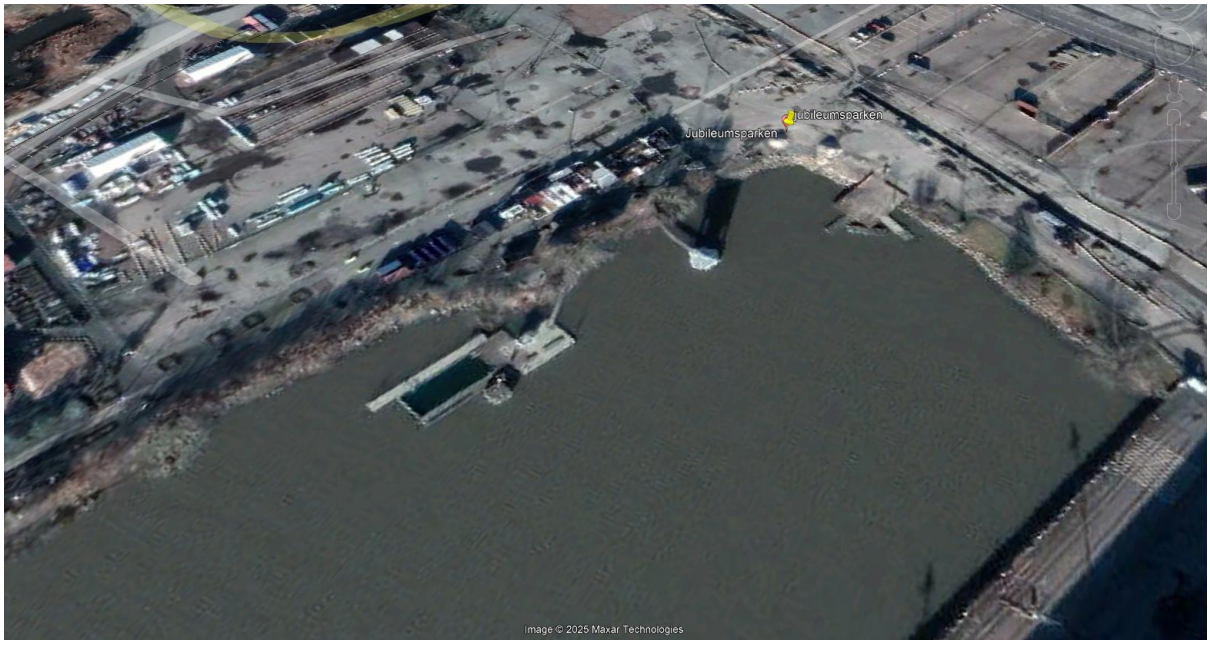


Figure 62 Jubileumsparken, 2020., Google Earth Pro (historical imagery) (Google, 2026a)



Figure 63 Jubileumsparken, 2021., Google Earth Pro (historical imagery) (Google, 2026a)



Figure 64 Jubileumsparken, 2022., Google Earth Pro (historical imagery) (Google, 2026a)



Figure 65 Jubileumsparken, 2024., Google Earth Pro (historical imagery) (Google, 2026a)

8.4.3 Planning/Design/Building Process

In 2014, a preparatory plan for Frihamnen and Ringön was created, focusing on eco-city principles and initially placing the future Jubilee Park in the southwest (Dahl, 2016) (GGAU Gothenburg Green and Active Urban Planning, 2015). A later detailed development plan for Frihamnen (phase 1) modified this layout, expanding the park northward and incorporating existing features like the sauna and pool (Dahl, 2016).

Simultaneously, the Jubileumsparken 0.5 process, starte din 2013, explored DIY construction and workshops to envision the site's future before finalizing regulatory plans. Raumlabor's prototypes—sauna, pool, and urban farming—utilized existing landscape elements creatively instead of treating them as a blank slate (Sandström, 2019) (Dahl, 2016). A 2015 workshop produced "potential maps" that reimagined the site, transforming concrete slabs into stages and roofs into platforms. This approach to repurposing industrial elements aligns with Braae's vision of landscape architects working with existing resources (Dahl, 2016).

A mediating organization within the city administration facilitated collaboration across departments and legitimized DIY efforts This blend of top-down and

bottom-up strategies fostered a planning culture that moved beyond generic eco-city models (Dahl, 2016).

The permanent park design by Mareld Landskapsarkitekter built on experimental prototypes, incorporating landscape strategies for ecology and accessibility (Mareld Landskapsarkitekter, 2025) (Landezine International Landscape Award LILA, 2024).

The park opened in phases beginning in 2021, with full completion in 2023 (Wikipedia, 2026c). This phased development allowed for adjustments based on user feedback and ecological insights, maintaining the experimental ethos of the prototypes. The construction emphasized material reuse, aligning with circular economy principles (Chowdhury et al., 2023; Dahl, 2016).

8.4.4 Program

The park includes an Olympic-length floating pool installation in the harbour, with different basins for swimming and bathing (Landezine International Landscape Award LILA, 2024).

The public sauna, constructed from reused shipping containers and timber, has become a widely recognized icon of Gothenburg's harbor transformation (Dahl, 2016).

Playful and experimental playgrounds support "Play & Learn" outcomes, including a water playground with "rain" features, climbing structures, and informal sand/shore play areas (Aroundus, 2025; Landezine International Landscape Award LILA, 2024). These experimental programs are direct descendants of the prototyping phase described by Dahl, where bathing culture, playgrounds, and informal arenas were deliberately tested as elements of a 21st-century park .

The park also offers a skate ramp, mini-golf, picnic lawns, and seating areas with river views (Aroundus, 2025).

The park is equipped with permanent service buildings hosting toilets, showers, changing rooms, and lockers to support swimming and sauna use (Landezine International Landscape Award LILA, 2024).

Outdoor classrooms and educational installations provide space for school groups and environmental learning activities (Landezine International Landscape Award LILA, 2024).

A sailing school and associated pontoons support small-boat training and youth-oriented maritime education (Landezine International Landscape Award LILA, 2024). This facility connects the park to Gothenburg's maritime heritage while providing accessible water sports programming for young people. The spatial layout integrates ramps, piers, and boardwalks ensuring barrier-free access to water and key facilities.

The timber boardwalks that wind through wetland zones and along the water's edge serve both circulation and ecological education functions, enabling close contact with aquatic vegetation and wildlife while protecting sensitive habitats (Landezine International Landscape Award LILA, 2024).

Jubileumsparken offers a range of free-of-charge activities throughout the year, such as supervised swimming, sailing lessons, yoga, and cultural events, organized in cooperation with municipal departments and local associations.

Educational programming includes guided walks focused on the site's industrial history, ecological restoration, and biodiversity, as well as workshops on sustainable urban development and nature-based solutions. The park serves as an outdoor classroom for Gothenburg schools, supporting environmental education curricula through direct engagement with restored ecosystems and sustainable infrastructure.

Cultural programming includes concerts, film screenings, and community festivals that activate the park throughout the year. The retained industrial structures—warehouse walls, concrete platforms, pier infrastructure—provide distinctive settings for cultural events that connect contemporary programming with the site's harbour heritage.

Emergency and maintenance services are coordinated through Gothenburg's municipal parks and nature department, with ongoing involvement from Platsbyggnad Älvstaden to maintain the participatory governance model established during the park's development (Dahl, 2016).

Species-rich grasslands with scattered trees and shrubs are designed to support pollinators and create seasonal color variation (Mareld Landskapsarkitekter, 2025; Landezine International Landscape Award LILA, 2024).

Native coastal and riparian species create habitat for birds and contribute structural diversity and wind protection (Landezine International Landscape Award LILA, 2024).

Emergent vegetation along the water's edge, accessed via timber boardwalks, encourages contact with aquatic ecologies while protecting sensitive zones.

8.4.5 Context

Gothenburg's RiverCity Vision positions Frihamnen as one of nine strategic waterfront transformation areas and identifies a major Jubilee Park as a key instrument to connect the city to the river, embrace water, and reinforce the centre (GGAU Gothenburg Green and Active Urban Planning, 2015).

Frihamnen sits opposite the historic city centre and is surrounded by infrastructure such as bridges, motorways, and rail lines, making it both highly visible and historically difficult to access (Dahl, 2016). The location of Jubileumsparken at the water's edge turns a previously fenced-off harbour apron into a public interface where residents from the north and south banks can meet (Dahl, 2016).

UN Academic Impact highlights RiverCity Gothenburg as an example of "a city built on inclusion," emphasizing participation and accessibility as central values in the waterfront projects (United Nations, 2026a).

The park serves multiple scales of use: as a neighborhood amenity for emerging residential districts in Frihamnen and adjacent areas; as a city-scale destination attracting visitors from throughout Gothenburg's metropolitan region; and as a regional and international reference project for brownfield transformation and participatory planning.

Prior to transformation, Frihamnen was dominated by port fences and heavy vehicle circulation, with few pedestrian connections The harbour district was effectively sealed off from the surrounding city, accessible only to port workers

and authorized vehicles. As part of RiverCity, new pedestrian and cycling routes have been developed along the waterfront and through Frihamnen, improving non-motorized access to Jubileumsparken (Dahl, 2016).

The city's tourism and neighbourhood guides present the park as easily reached on foot or by bicycle from central Gothenburg, reinforcing its role as an everyday destination rather than a peripheral recreational enclave (City of Gothenburg, 2026a).

The comprehensive pathway system within the park, including wide accessible promenades and timber boardwalks, ensures barrier-free circulation for visitors with mobility devices, strollers, and wheelchairs (Landezine International Landscape Award LILA, 2024).

Jubileumsparken is linked to Gothenburg's public transport network by tram and bus. Official city information identifies tram connections (via Frihamnen and adjacent stops) and local bus routes as primary modes to reach the park in about 10–15 minutes from the central station (City of Gothenburg, 2026b). This public transport connectivity is a core part of RiverCity's emphasis on sustainable mobility and reduced car-dependency in waterfront redevelopment (Buro Happold, 2025).

WBUPP at Frihamnen is embedded within a rapidly transforming urban context. Around the harbour basins, plans foresee a dense mixed-use district with housing, workplaces, services, and community facilities (GGAU Gothenburg Green and Active Urban Planning, 2015). The detailed development plan for Frihamnen phase 1 envisions approximately 1,000 new housing units in the immediate vicinity of the park, along with offices, retail, and cultural facilities (Dahl, 2016).

Adjacent areas such as Lindholmen and Karlastaden, on the opposite side of the river or nearby, host major residential and knowledge-economy developments, including tall residential towers and the Lindholmen Science Park cluster (Buro Happold, 2025).

The broader RiverCity framework seeks to balance these high-value real estate interventions with accessible public space, of which Jubileumsparken is a

flagship example (Buro Happold, 2025; GGAU Gothenburg Green and Active Urban Planning, 2015).

8.4.6 Sustainability

Jubileumsparken is a good example of brownfield transformation using nature-based solutions (Chowdhury et al., 2023). Converting harbour brownfield land into a public park supports compact city objectives by providing greenspace without expanding the urban footprint. Brownfield research emphasizes that reusing such sites avoids additional land take at the urban fringe and supports EU "no net land take by 2050" objectives (Chowdhury et al., 2023).

The reuse of existing industrial structures and materials—such as retaining piers, reinterpreting asphalt surfaces, and reusing shipping containers—aligns with circular economy principles for both land and materials (Chowdhury et al., 2023; Dahl, 2016).

The introduction of multi-layered vegetation, bioswales, and wetland margins enhances biodiversity and ecological connectivity along the Göta River (Tampere Urban Research Perspectives, 2025).

Several guiding principles can be distilled from the Jubileumsparken process, reflecting both explicit design intentions and emergent governance innovations: Prototyping and Experimentation

The "0.5" park was used to test programs, materials, and governance configurations before locking in long-term designs, corresponding to the "mini-laboratories" concept in transformation literature (Dahl, 2016).

Building-together workshops and open calls involved residents and visitors as co-creators, which Dahl interprets as unlocking planning processes and generating a new aesthetic of participation (Dahl, 2016).

Rather than treating Frihamnen as a blank slate, the design process cultivated the specific physical, dynamic, and immaterial qualities of the harbour landscape, following transformation frameworks that prioritize existing atmospheres and relationships (Dahl, 2016).

Recent scholarship on care-centric planning argues for governance models that recognize mutual dependencies between human and non-human actors in urban transformation, an orientation that is evident in RiverCity's inclusive and ecological focus (21stCenturyDevelopment, 2026).

These principles align with broader calls in brownfield literature for integrated, stakeholder-centred processes that map interests, resources, and challenges over time to support realisable greenspaces (Chowdhury et al., 2023).

Park management

Management of Jubileumsparken operates at the intersection of municipal responsibility and community involvement. City departments—parks and nature, real estate, water and environment—retain formal responsibilities for operation, maintenance, and safety, as documented in Gothenburg's planning and RiverCity materials (GGAU Gothenburg Green and Active Urban Planning, 2015; Buro Happold, 2025).

At the same time, Platsbyggnad Älvstaden and collaborator practices have deliberately cultivated expectations of shared care through workshops, open calls, and public programmes, which Dahl identifies as fostering a sense of ownership and belonging (Dahl, 2016). This corresponds to evidence from stakeholder studies indicating that public involvement in urban greenspace development and management increases legitimacy, sense of ownership, and willingness to maintain spaces (Dahl, 2016; Chowdhury et al., 2023).

Converting harbour brownfield land into a public park supports compact city objectives by providing greenspace without expanding the urban footprint (Chowdhury et al., 2023). The park's location and transit accessibility encourage low-carbon access modes and integrate with Gothenburg's climate goals (Buro Happold, 2025). Ecologically, the introduction of multi-layered vegetation, bioswales, and wetland margins enhances biodiversity and ecological connectivity along the Göta River (Chowdhury et al., 2023; Tampere Urban Research Perspectives, 2025).

Socially, the co-creation process and free programming advance agendas of inclusion and equitable access to high-quality public space, consistent with the city's self-presentation as a "city built on inclusion" (United Nations, 2026a).

Economically, the presence of a distinctive public waterfront park is positioned as a quality-of-life asset supporting innovation districts and residential attractiveness, yet anchored in a public-good rather than purely market-driven logic (Buro Happold, 2025; Chowdhury et al., 2023).

The governance innovations pioneered through Jubileumsparken's development—the mediating role of Platsbyggnad Älvstaden, the integration of prototyping with regulatory planning, the cultivation of ongoing community stewardship—represent institutional learning that can inform future brownfield transformations and participatory planning processes (Dahl, 2016).

Jubileumsparken combination of DIY prototyping, mediating governance structures, and integration into a citywide eco-city framework makes it a significant European reference for brownfield urban public parks and sustainable waterfront regeneration (Dahl, 2016; Buro Happold, 2025; Chowdhury et al., 2023).

8.4.7 Spatial Analysis

Thematic maps created within the process of spatial analysis are shown on Figures 41-52, in Appendix, 3, chapter 3.2.

1. WBUPP Position within national territory

Map 1 presents the position of WBUPP within the belonging country national territory.

WBUPP is placed in the southwest of Sweden. The area sits on the North Sea.

2. WBUPP Position within urban structure

Map 2 presents the WBUPP representative example cases' Position within urban structure. The graphics aim to illustrate the Spatial relationship with city center.

Gothenburg is the second-largest city in Sweden (Wikipedia, 2026c). WBUPP has a central position in relation to historic city center. Its position within the city limits is central.

3. WBUPP area

Map 3 presents the WBUPP representative example cases' area on the scale of 1:3000. It aims to illustrate criteria named Spatial morphology, Size, Accessibility, and Space management.

WBUPP range is determined by OSM data. OSM Data was further adapted and verified using multiple internet sources (Landezine International Landscape Award LILA, 2024), as well as Google Earth Pro tool (Google, 2026a) as supplementary tools. WBUPP area includes the floating pools and the surrounding water surface that serves them directly.

Water surface is shown as the water body adjacent to the WBUPP area: Gota River estuary that merges into Kattegat sea, part of the North Sea in the Atlantic Ocean.

WBUPP boundaries represent Open boundaries and Water boundaries. There are no Closed boundaries. Water boundary is the river in the south. Open boundaries are all land borders of the Park.

4. WBUPP accessibility, mobility

Map 4 presents the WBUPP representative example cases' area in the scale of 1:3000. It aims to illustrate criteria named Spatial morphology, Size, Accessibility, Space management, Accessibility (Public Transportation) / Mobility, Public transport (resting places every 300m), Pedestrian/Path/Cycling Path, and Other public areas (heterogeneity).

Minor road network and Footway network inside WBUPP is dense and dispersed. The accentuated L-shaped wider multimodal path intersects the Park area and acts as a spatial organization generator. It integrates minor roads, pathways, and pedestrian plazas. The floating pools are accessed by two footway bridges. Floating pools complex has a multilevel footway and wide decking area integrated in the structure's design. The path network in Zone 3 around the playground and

sports and recreation program features is dense, marked in OSM as a generic “path”. Additional visual analysis using auxiliary tools established that not all paths are footways nor are they all minor roads. Their paving differs. Certain path type and material is hard to decipher because of lacking public information on available sources.

There is only one two-way bus stop west of WBUPP. Two large open, uncovered parking areas are placed outside of WBUPP boundaries, one north and the other south of WBUPP.

One bicycle parking point is situated on the north Park boundary, next to the big playground.

Pedestrian plazas are distributed throughout WBUPP, mostly concentrated around the L-shaped communication Path. The floating pools complex is a pier, marked as a Man-made structure.

5. WBUPP environmental, health

Map 5 presents the WBUPP representative example cases’ area in the scale of 1:3000. It aims to illustrate criteria named Spatial morphology, Size, Accessibility, Nature – based solutions implementation, Water-sensitive urban design, Climate change adaptation and mitigation, Pedestrian / Path / Cycling path, Urban design (Well-being offered by urban design), Public restrooms, Drinking water fountains (access to drinking water), Adaptable spaces, Visual impact, Sustainable waste management, Green Areas Heterogeneity, Sports/Recreation Areas Heterogeneity, Ecosystem Preservation/Restoration, Resilience, Program / Function, Well-being, Accessibility (Public Transportation) / Mobility, Shelter Areas, Vitality/ Concentration.

Benches are dispersed all over WBUPP. They are related to program nodes, connection path, and grassland areas. Toilets and showers are found inside the two buildings with public services.

There is no sheltered space in the WBUPP Jubileumsparken. Outdoor seating areas are places next to playgrounds. Three playgrounds circle the connection path, placed within Zone 3. The biggest playground in the north is equipped with sculptural children’s play elements (City of Gothenburg, 2026a). Sauna is

situated on the water surface; it holds a central position in WBUPP. Sports and recreation areas include the mini golf course in the north, within Zone 3, and the pool complex on the water, in Zone 1.

Grassland areas are mostly in Zone 3, west of connection path. Garden surfaces circle the big playground in Zone 3, in the north. There is a small sandy surface in the south of buildings with public services, between the two pedestrian plaza areas that provide access to floating pools.

Trees are not found in OSM. Their points are added and graphically represented according to analyzed aerial views, using auxiliary tools named earlier, as well as the graphic imagery related to the WBUPP project (City of Gothenburg, 2026b). Their position is mostly limited to grassland and garden surfaces. The number and location of the trees is estimated, since the newly planted trees are not easily noticed.

6. WBUPP social, well being

Map 6 presents the WBUPP representative example cases' area in the scale of 1:3000. It aims to illustrate criteria named Spatial morphology, Size, Space management, Accessibility, Implement tourist activity, Historical and cultural value, Climate change adaptation and mitigation, Pedestrian / Path / Cycling path, Urban design (Well-being offered by urban design), Adaptable spaces, Sports/Recreation Areas Heterogeneity, Other Public Areas Heterogeneity, Program / Function, Well-being, Heritage, Accessibility (Public Transportation) / Mobility, Vitality/ Concentration, Identity / Sense of Place / Historic (Local) Identity.

Building use, enclosure and coverage are represented through graphic symbols indicating enclosed, covered, and opened spaces within WBUPP. In Jubileumsparken, enclosed are all the buildings within WBUPP. There are no covered spaces. Open spaces are sports and recreation areas, outdoor seating area, and playgrounds.

Landmark marker within WBUPP highlights the floating pools complex. The structure is not visually highlighted by its height, but acts as a prominent,

distinctive urban reference point (City of Gothenburg, 2026b). The building data was obtained from internet sources to validate the location as a landmark.

Artwork locations are marked inside the northern playground that holds artistic structures meant for children's play, created in collaboration with a known artist (City of Gothenburg, 2026a).

Bench, Playground, Dog park and Sports recreation are shown on this map. Their disposition and characteristics are explained in chapter Spatial analysis, section 5.

7. WBUPP self-sufficiency, mixed use, educative, land/building use context

Map 7 presents the WBUPP representative example cases' area on the scale of 1:3000. It aims to illustrate criteria named Spatial morphology, Size, Space management, Self-sufficiency, Employment opportunities, Implement tourist activity, Mixed development, Program / Function, Proximity of social facilities (school facilities, home for elderly, health facilities), Proximity of commercial facilities, Educative (cultural) facilities / services, Vitality/ Concentration.

Building use shows the built environment within WBUPP area and around its perimeter. The buildings within WBUPP provide public services for the Park, and one catering facility. Two longitudinal buildings situated on the L-shaped communication Path are public buildings. They contain showers, toilets, and changing rooms for WBUPP users. A Building on the water is a sauna. A small Building next to the sports area, a golf course, is a catering facility containing an ice cream café (City of Gothenburg, 2026b). The area around WBUPP is mostly vacant, characterized by two big open parking lots. One dominant building on the east is a mixed-use adapted industrial structure. smaller buildings on the south create a catering facilities zone hosting Waterfront Cabins, affordable lodging for students and tourists and related services.

The contact zone presents an industrial character that underwent the process of regeneration. It is surrounded by a major road (Landezine International Landscape Award LILA, 2024; City of Gothenburg, 2026b; Dahl, 2016).

8. WBUPP brownfield

Map 8 presents the WBUPP representative example cases' area in the scale of 1:3000. It aims to illustrate criteria named Spatial morphology, Size, Accessibility, Historical and Cultural Value, Heritage, Identity / Sence of Place / Historic Identity.

No heritage or other elements associated to brownfield regeneration are found in WBUPP that can be marked as Brownfield points.

9. Conclusions - Conceptual schematic diagrams

a. THE THREE-ZONES SCHEME

The three zones are distinguished by the WBUPP spatial organization, as shown in **Error! Reference source not found.**. Zone 1 is central, with emblematic floating structures that make the most attractive portion of the park. Zone 1 is composed entirely of water surface with the sauna building and the pools with their walkable adjoining area. Zone 2 contains the waterfront area with contemporary designed pedestrian plazas and pathways. Two public service buildings oriented towards the pools and sauna, are located between two key circulation axes. Zone 3 holds most of the park's landscaped surfaces, as well as the sports and recreation program (playgrounds, outdoor seating, sports field). The three zones present distinct visual entities characterized by urban design components. Contemporary design features prevail. The construction size is medium; structures accommodate about 6.000 - 10.000 m2 of usable space each.

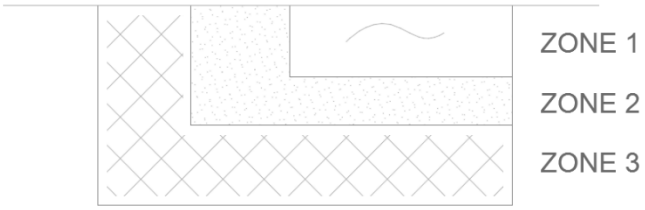


Figure 66. WBUPP Jubileumsparken spatial relation, schematic diagram ZONES, M. Gudac Cvelic

b. THE URBAN STRUCTURE SCHEME

As shown in **Error! Reference source not found.**, WBUPP spatial structure is dominated by the L-shaped pathway, mostly pedestrian. The element associated to Lynch (1960)'s Path definition element, simultaneously connects and separates the two distinct zones: maritime (ZONE 1) and program filled (ZONE 3).

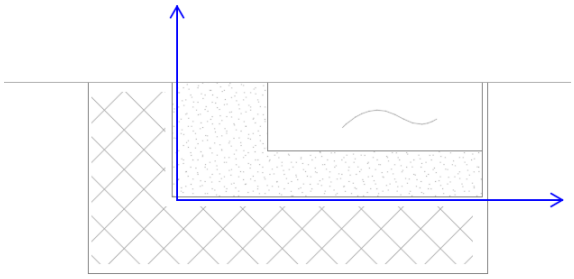


Figure 67. WBUPP Jubileumsparken spatial relation, schematic diagram STRUCTURE, M. Gudac Cvelic

c. THE INTERNAL PATH DISPOSITION SCHEME

As shown in **Error! Reference source not found.**, WBUPP internal communication network is irregular, except the L-shaped path structure that forms Zone 2. The internal connection's types are mixed. Pedestrian bridges are found in Zone 1. Footways and pedestrian plazas intertwine in Zone 2. Minor roads with multimodal transport cut between program nodes, and footways allow movement within program nodes in Zone 3.

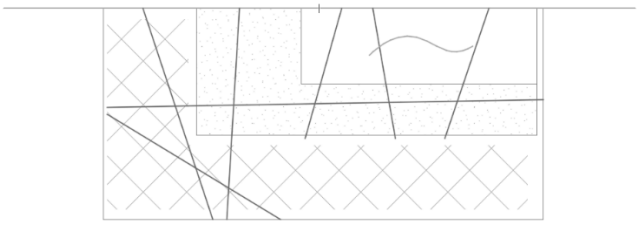


Figure 68. WBUPP Jubileumsparken spatial relation, schematic diagram PATH DISPOSITION, M. Gudac Cvelic

d. THE LANDMARK SCHEME

Landmark acts as a point of reference with physical elements guidance. It has outstanding visual features (Lynch, 1960). As shown schematically in **Error! Reference source not found.**, WBUPP floating structure with pools holds characteristics of dominance, importance and potent location. Although it is not physically dominant in terms of long-distance visibility, it functions as a distinctive and prominent reference point, reinforcing the sense of place within the WBUPP Jubileumsparken.

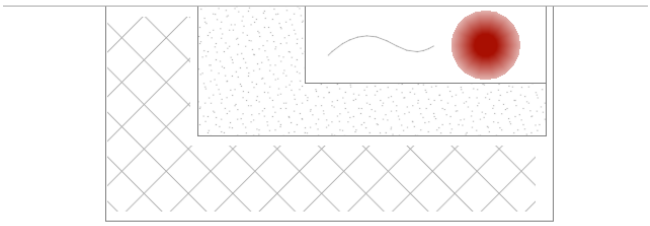


Figure 69. WBUPP Jubileumsparken spatial relation, schematic diagram LANDMARK, M. Gudac Cvelic

e. THE NODES SCHEME

As shown schematically in **Error! Reference source not found.**, nodes are recognized as significant spots within the city where planned focal points are situated. They identify as the gathering point or attention point in a town (Zhin Yang Lau et al., 2021). Within the WBUPP Jubileumsparken context, nodes are program concentration points or areas. They are perceived as dispersed entities with no obvious placement order.

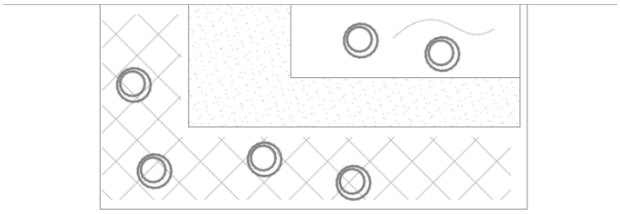


Figure 70. WBUPP Jubileumsparken spatial relation, schematic diagram NODES, M. Gudac Cvelic

8.4.8 Additional Criteria

The WBUPP representative example was analyzed using fifty criteria that originated from scientific literature sources. Additional criteria emerged after the performed analysis. Jubileumsparken has the on-the-water program that is the focal point of the whole WBUPP. Floating pools complex with the open public surfaces surrounding them, and a floating sauna, are unique set of programmatic nodes that create strong attraction in an area that is not yet regenerated after former port infrastructure activity. The pools are a strong design element, marked as landmark based on an alternative, qualitative characteristics (instead of quantitative, such as height, with vertical physical domination).

Multi-zoned spatial organization, as evidenced through analysis, creates a distinct order and brings quality. Connection path that consists of multimodal surfaces and gathers programming and service nodes around it, introduces an element that regulates the WBUPP spatial narrative.

Additional criteria proposed based on Jubileumsparken WBUPP example case analysis are On The Water Body Surface/Area Related Program, Program On The Water Body, Program In The Water Body, Water Related Program, Multi-Zoned Spatial Organization, Program Spatial Organization, Program Concentration, Waterfront Communication Network, WBUPP Program Integration, Spatial Enclosure Diversity, Water Contact Intensity.

8.5 WBUPP REPRESENTATIVE EXAMPLE CASE # 3 BROOKLYN BRIDGE PARK, NEW YORK CITY, USA

8.5.1 Overview

Brooklyn Bridge Park is a transformative redevelopment of obsolete port infrastructure into an 85-acre mixed-use public park along Brooklyn's East River waterfront (Figure 71). Spanning 1.3 miles from Atlantic Avenue to Jay Street

through the Brooklyn Heights and DUMBO neighborhoods, the park converted defunct cargo shipping and storage facilities into a vibrant civic landscape while preserving dramatic views of the industrial waterfront and the Lower Manhattan skyline (Mikkelsen, 2017; Wikipedia, 2026a). The transformation is shown through Figure 72, Figure 73, Figure 74, Figure 75, Figure 76, and Figure 77.

Designed by Michael Van Valkenburgh Associates after an intensive public planning process initiated in the 1980s, the park resulted from sustained community advocacy following the Port Authority's 1984 announcement to sell the piers for commercial development (Mehta, 2021). The Friends of Fulton Ferry Landing, established in 1985 and later renamed the Brooklyn Bridge Park Coalition, mobilized public support to transform this environmentally degraded site into accessible public space (Wikipedia, 2026a; Mehta, 2021).

A distinctive feature of the park is its financial self-sufficiency model, mandated by the 2002 Memorandum of Understanding between New York State and New York City (Mikkelsen, 2017; Wikipedia, 2026a). Revenue-generating developments, including hotels and residential buildings at the park's boundaries, provide ongoing operational funding, ensuring sustained maintenance beyond typical public funding cycles (Mikkelsen, 2017).

The design philosophy, guided by the concept of "post-industrial nature," uses deliberately constructed landscapes to establish new site ecologies capable of thriving in heavily used urban settings (Mikkelsen, 2017; Sessarego, 2017). As landscape architect Michael Van Valkenburgh stated, "We realized this park was not about scenery. The nature of this park is the river" (Wikipedia, 2026a). Construction began in 2008 using reclaimed materials, including soil from the World Trade Center site, with sections opening progressively from 2010 through 2021.

Ecological restoration includes seven tidal pools at Pier 4, salt marshes with native plants, and the Bird Island wildlife preserve with Osprey platforms (Padilla, 2012). These habitats have attracted rare species, including the two-spotted lady beetle (Wikipedia, 2026a). Financial self-sufficiency through revenue-generating developments ensures ongoing maintenance (Mikkelsen, 2017).

Brooklyn Bridge Park integrates diverse programming with innovative sustainability practices across eleven sections (Mehta, 2021). Recreation facilities include Pier 2's sports courts, Pier 5's athletic fields hosting Division I soccer, and Pier 6's themed playgrounds. Cultural amenities include Jane's Carousel and the Bargemusic venue (Wikipedia, 2026a).

Sustainability is achieved through "structural economy," coordinating programs with existing structures (Mikkelsen, 2017). The park reuses salvaged materials, including World Trade Center soil and bridge granite (Wikipedia, 2026a), while stormwater recycling meets 70 percent of irrigation needs (Brooklyn Bridge Park Conservancy, 2026). Ecological features such as tidal pools, salt marshes, and the Bird Island wildlife preserve with Osprey platforms (Padilla, 2012) attract rare species like the two-spotted lady beetle (Wikipedia, 2026a).



Figure 71 Brooklyn Bridge Park, 2025, Google Earth Pro (Google, 2026a)

8.5.2 History/Previous Land Use

The history of the Brooklyn waterfront is closely associated with the establishment of ferry transportation and the subsequent evolution of trade and urban development. The first ferry landing, established in 1642 at the site of the present-day Empire Fulton Ferry in what is now Brooklyn Bridge Park, stimulated the growth of a trading economy and led to the formation of the settlement known as *het Veer*. Throughout the seventeenth century, this settlement expanded and acquired strategic importance, most notably serving as the escape route for George Washington and the Continental Army following the Battle of Long Island on 29 August 1776 (Wikipedia, 2026a).

By the late eighteenth century, additional ferry services had been introduced along the Brooklyn waterfront, further strengthening commercial exchange between Brooklyn and Manhattan. A major technological advancement occurred in 1814 with the establishment of Robert Fulton's steam-powered Fulton Ferry Company, which significantly improved the efficiency of passenger and freight transportation. Enhanced accessibility contributed to the residential development of Brooklyn Heights during the nineteenth century, establishing it as one of the earliest suburban communities in the United States. Simultaneously, the construction of waterfront infrastructure, including ferry ramps and bridges, supported continued urban expansion (Wikipedia, 2026a).

The mid-nineteenth century represented a period of intensive industrial and commercial development along the waterfront. Railroad infrastructure was introduced at Fulton Ferry Landing during the 1850s, facilitating the efficient movement of goods between maritime and inland transportation networks. This period also witnessed the construction of numerous large-scale brick warehouses, including the Empire Stores complex, which was built between 1870 and 1885 (Wikipedia, 2026a). The concentration of warehouse buildings along the waterfront earned the district the nickname "the walled city," reflecting its role as one of Brooklyn's principal commercial and storage districts.

The opening of the Brooklyn Bridge in 1883 fundamentally altered the economic geography of the waterfront by providing a permanent connection between

Brooklyn and Manhattan. While the bridge enhanced regional accessibility, it simultaneously reduced dependence on ferry transportation and encouraged commercial and residential development further inland. This transformation accelerated following the opening of the Manhattan Bridge in 1909. Declining ferry patronage ultimately resulted in the closure of the Fulton Ferry Landing in 1924, while subsequent infrastructure projects, including the construction of the Brooklyn Heights Promenade and the Brooklyn–Queens Expressway (BQE) during the 1950s, further disconnected the waterfront from the surrounding urban fabric (Wikipedia, 2026a).

During the 1950s, the Brooklyn waterfront underwent substantial physical restructuring. More than 130 warehouses and 25 smaller piers were demolished, and between 1956 and 1964 the New York Dock Company constructed thirteen modern piers, including the present-day Piers 1–3 and 5–6 within Brooklyn Bridge Park (Wikipedia, 2026a). Despite these investments, broader changes in maritime transportation, including containerization, technological advances in cargo handling, and the relocation of port activities to facilities better suited to accommodate larger vessels, progressively rendered the Brooklyn waterfront economically obsolete. By the 1970s, much of the area had become abandoned and underutilized, culminating in the Port Authority's termination of cargo operations in 1983.

The closure of port activities initiated a transition from an industrial waterfront to a contested post-industrial landscape. In 1984, the Port Authority announced plans to sell the piers for commercial redevelopment, prompting widespread public opposition and a reassessment of the waterfront's potential as a public resource (Mehta, 2021). Community advocacy led to the establishment of the Friends of Fulton Ferry Landing, an organization that later evolved into the Brooklyn Bridge Park Coalition. Throughout the late 1980s and 1990s, the coalition played a central role in advocating for the preservation of the waterfront as public open space and in promoting the creation of a dedicated governing authority to oversee its redevelopment. During this transitional period, portions of the site remained occupied by the New York State Department of Labor until 1996 (Wikipedia, 2026a). These developments laid the institutional and political

foundations for the eventual creation of Brooklyn Bridge Park as a publicly accessible waterfront landscape.

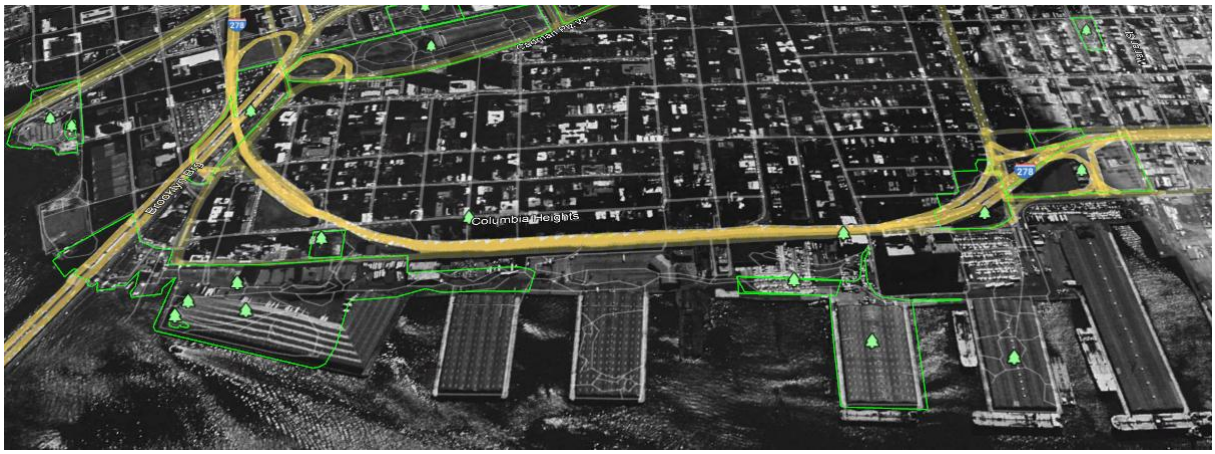


Figure 72 Brooklyn Bridge Park, 1995., Google Earth Pro (historical imagery) (Google, 2026a)

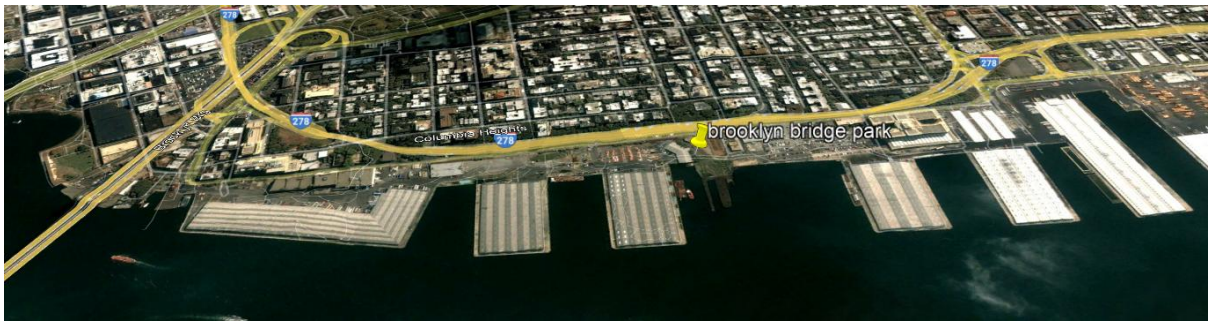


Figure 73 Brooklyn Bridge Park, 2002., Google Earth Pro (historical imagery) (Google, 2026a)



Figure 74 Brooklyn Bridge Park, 2008., Google Earth Pro (historical imagery) (Google, 2026a)

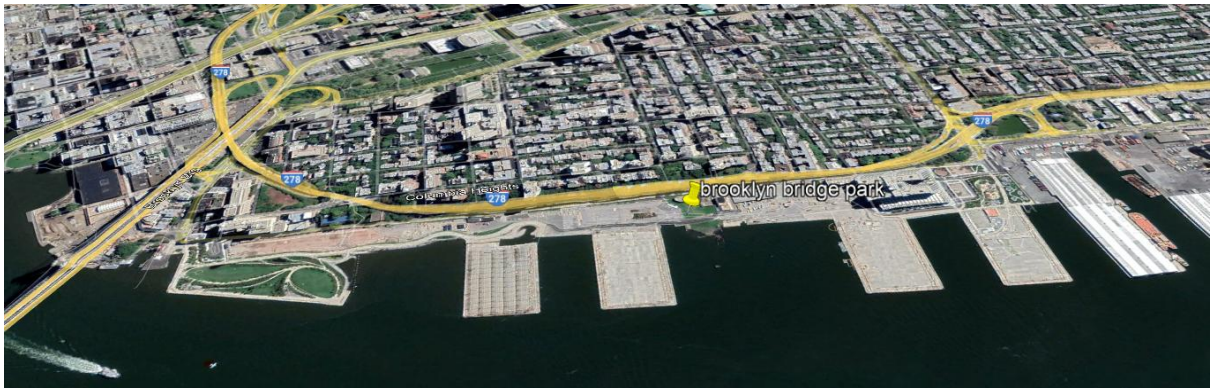


Figure 75 Brooklyn Bridge Park, 2015., Google Earth Pro (historical imagery) (Google, 2026a)



Figure 76 Brooklyn Bridge Park, 2019., Google Earth Pro (historical imagery) (Google, 2026a)



Figure 77 Brooklyn Bridge Park, 2025., Google Earth Pro (historical imagery) (Google, 2026a)

8.5.3 Planning/Design/Building Process

Following the closure of cargo operations in 1983, the Port Authority announced plans in 1984 to sell the waterfront piers for commercial redevelopment. This proposal prompted widespread public opposition and initiated a reconsideration of the site's potential as a public resource. In response, the Friends of Fulton Ferry Landing was established in 1985 to advocate for the creation of a waterfront

park. The organization later became the Brooklyn Bridge Park Coalition (now the Brooklyn Bridge Park Conservancy), which played a central role in mobilizing public support and advancing the vision for Brooklyn Bridge Park (Brooklyn Bridge Park Conservancy, 2026; Wikipedia, 2026a).

Throughout the late 1980s and 1990s, the future of the 55-acre waterfront remained contested. Competing proposals ranged from large-scale residential and commercial development to park-oriented plans emphasizing public open space. In 1989, the coalition successfully advocated for the establishment of a dedicated public authority to oversee the site's redevelopment. By 1998, the Downtown Brooklyn Waterfront Local Development Corporation had been formed to coordinate planning and public consultation, while growing political support gradually shifted the redevelopment strategy toward prioritizing public access and recreation (Wikipedia, 2026a).

By 2000, the Port Authority had agreed to pursue park development rather than commercial redevelopment. The Brooklyn Bridge Park Illustrative Master Plan, released later that year, established the conceptual framework for transforming the former industrial waterfront into a multifunctional public park. In 2001, New York State committed substantial funding for the project, and in 2002 Governor George Pataki and Mayor Michael Bloomberg signed a Memorandum of Understanding establishing the Brooklyn Bridge Park Development Corporation (BBPDC). The agreement required the park to operate as a financially self-sustaining public space, with long-term maintenance supported by revenue-generating development within the park (Wikipedia, 2026a).

Michael Van Valkenburgh Associates was appointed in 2004 to prepare the park's master plan, which integrated ecological restoration, recreational facilities, cultural amenities, and limited mixed-use development. Although proposals for residential development generated public debate and legal challenges, the planning framework was ultimately upheld, allowing implementation to proceed. By 2006, ownership of the former port facilities had been transferred from the Port Authority to the BBPDC, enabling construction to begin (Wikipedia, 2026a).

Construction commenced in 2007 with site clearance and extensive landscape remediation, incorporating reclaimed materials from other New York City

infrastructure projects, including the World Trade Center reconstruction. The park was developed in phases, beginning with the opening of Pier 1 in 2010, followed by additional piers, recreational facilities, restored shoreline habitats, and public spaces between 2010 and 2021. Throughout this period, Brooklyn Bridge Park evolved into a flagship example of post-industrial waterfront regeneration, combining ecological restoration, public recreation, and financially sustainable management. Its success has also contributed to significant residential investment and rising property values in the surrounding neighbourhoods.

8.5.4 Program

Brooklyn Bridge Park integrates a wide range of recreational, ecological, and cultural amenities within its eleven interconnected sections, creating a multifunctional public landscape that supports diverse user groups and activities (Wikipedia, 2026a).

Water plays a central role in the park's design through tidal pools, water-play areas, restored shoreline habitats, and public access points for kayaking and recreational boating. The Brooklyn Bridge Park Boathouse offers seasonal community kayaking programs, while the marina at Pier 5 provides docking facilities for recreational vessels (Wikipedia, 2026a). Ecological restoration is particularly evident at Pier 4, where native vegetation, tidal pools, wetlands, and Bird Island create habitat for local wildlife and contribute to biodiversity and environmental education.

Active recreation is concentrated primarily at Piers 2, 5, and 6, which accommodate sports courts, athletic fields, playgrounds, fitness facilities, dog runs, and other recreational infrastructure. Family-oriented spaces are distributed throughout the park and include themed playgrounds, water-play areas, and expansive lawns designed for informal recreation and community events (Wikipedia, 2026a).

The park also incorporates significant cultural and historic features. Jane's Carousel, housed within a pavilion designed by Jean Nouvel, and Bargemusic at Fulton Ferry Landing provide cultural attractions that complement the site's

industrial heritage. Historic interpretation is integrated throughout the Empire–Fulton Ferry precinct, where the original ferry landing and associated landscape elements commemorate Brooklyn's maritime history (Brooklyn Bridge Park Conservancy, 2026; Wikipedia, 2026a).

Landscape design emphasizes environmental performance as well as visitor experience. Native planting, shaded promenades, stormwater management systems, noise-buffering landforms, and microclimatic design improve environmental quality while creating comfortable public spaces. A continuous waterfront promenade links the park's distinct sections and provides access to lawns, picnic areas, viewpoints, and cultural destinations, reinforcing pedestrian connectivity across the site (Wikipedia, 2026a).

Supporting infrastructure, including restaurants and cafés, picnic facilities, public restrooms, drinking fountains, ferry terminals, bicycle parking, and maintenance services, ensures the park functions as a comprehensive urban public space. Together, these elements demonstrate an integrated approach to waterfront regeneration, combining ecological restoration, active recreation, cultural programming, and sustainable landscape management within a unified park system (Wikipedia, 2026a).

8.5.5 Context

Brooklyn Bridge Park has played a significant role in Brooklyn's transition from an industrial waterfront to a mixed-use district centred on recreation, culture, tourism, and residential development. The surrounding area now accommodates cultural institutions, commercial and hospitality uses, maritime facilities, and high-end residential developments that contribute to the park's long-term financial sustainability (Brooklyn Bridge Park Conservancy, 2026; Wikipedia, 2026a).

Located between the neighbourhoods of Brooklyn Heights and DUMBO, the park is integrated into the surrounding urban fabric through a series of neighbourhood entry points that connect adjacent residential areas with the waterfront. These access nodes incorporate community facilities such as playgrounds, lawns, and dog runs, encouraging everyday use and strengthening the relationship between

the park and its surrounding communities (Brooklyn Bridge Park Conservancy, 2026).

The park is highly accessible by multiple modes of transportation, including pedestrian and cycling networks, subway, bus, and ferry services. It forms part of the Brooklyn Waterfront Greenway, providing continuous connections along the East River, while pedestrian bridges and multiple entrances improve permeability between the waterfront and the surrounding neighbourhoods (Wikipedia, 2026a). Despite the physical barrier created by the Brooklyn–Queens Expressway (BQE), landscape interventions, including vegetated landforms and elevated connections, mitigate noise and enhance accessibility (Wikipedia, 2026a).

The surrounding urban context is predominantly residential, with the historic neighbourhood of Brooklyn Heights to the east and the mixed-use district of DUMBO to the north. Since the park's development, the area has experienced substantial private investment and rising property values, illustrating the park's catalytic role in waterfront regeneration and neighbourhood transformation (Wikipedia, 2026a).

8.5.6 Sustainability

Sustainability at Brooklyn Bridge Park is guided by the principle of *structural economy*, which coordinates new programmatic uses with the site's existing infrastructure while minimizing resource consumption (Brooklyn Bridge Park Conservancy, 2026). Rather than removing former industrial structures, elements of the original pier framework were retained and adapted to provide shelter, define recreational spaces, and support park infrastructure.

The project also demonstrates extensive material reuse through the incorporation of reclaimed soil, salvaged granite, and fill from major New York City infrastructure projects, reducing construction waste and embodied environmental impacts (Brooklyn Bridge Park Conservancy, 2026; Wikipedia, 2026a). A stormwater recycling system supplies approximately 70% of the park's irrigation demand, contributing to reduced potable water consumption and improved stormwater management (Brooklyn Bridge Park Conservancy, 2026).

Ecological restoration forms a central component of the park's sustainability strategy. Salt marshes, tidal pools, native vegetation, and Bird Island create diverse habitats that support local biodiversity while improving the ecological resilience of the East River waterfront. The varied shoreline design—including marshes, beaches, promenades, and boating areas—restores ecological functions while strengthening the relationship between visitors and the waterfront environment (Brooklyn Bridge Park Conservancy, 2026; Wikipedia, 2026a).

Brooklyn Bridge Park demonstrates adaptability as a prime illustration of adaptable design principles. The park's development transformed a formerly industrial waterfront along the East River into a dynamic, multi-use public space that can withstand various urban challenges (Üzümcüoğlu, 2023). The park was developed in phases. Modular design features, such as moveable furniture and flexible event spaces, provide the ability to reconfigure the park for different activities and changing needs (Üzümcüoğlu, 2023).

Elevated landscapes and flood-resistant measures are integrated into the park's design, enhancing its resilience to climate-related challenges (Üzümcüoğlu, 2023). The 20 to 30-foot-high hills between Piers 2–5 serve dual functions: blocking noise from the Brooklyn-Queens Expressway (reducing sound levels from 75 to 68 decibels) while creating elevated landscapes less vulnerable to flooding. The hills were constructed using foam blocks and salvaged fill material, demonstrating lightweight construction techniques (Wikipedia, 2026a).

Brooklyn Bridge Park's most innovative sustainability feature is its mandated financial self-sufficiency. The 2002 Memorandum of Understanding required that all park maintenance and operations be economically self-sufficient, financed through revenues from commercial and residential development within the site (Brooklyn Bridge Park Conservancy, 2026; Wikipedia, 2026a). This model ensures sustained commitment to park maintenance beyond typical project cycles, avoiding the deterioration common to publicly funded parks facing budget constraints.

Revenue-generating developments including hotels, residential buildings, and commercial spaces at park boundaries provide ongoing operational funding, covering maintenance, programming, and capital improvements.

Brooklyn Bridge Park integrates mixed-use approach fosters community engagement and makes the park a destination for people of all ages (Üzümcüoğlu, 2023). Residents and stakeholders were engaged in the planning process, ensuring that the park reflects the desires and needs of the Brooklyn community (Üzümcüoğlu, 2023).

The park incorporates sustainable design features, including green roofs, wetland restoration, and native plantings, which enhance ecological resilience and promote biodiversity along the waterfront (Üzümcüoğlu, 2023). "Urban junctions" at key entry points host programs such as dog runs, civic lawns, and playgrounds that foster community stewardship and the safety that comes with constant occupation (Brooklyn Bridge Park Conservancy, 2026).

8.5.7 Spatial Analysis

Thematic maps created within the process of spatial analysis are shown on Figures 53-65, in Appendix, 3, chapter 3.3.

1. WBUPP Position within national territory

Map 1 presents the position of WBUPP within the belonging country national territory.

WBUPP is placed in the east of United states of America, in New York state. The area sits on the Atlantic Ocean.

2. WBUPP Position within urban structure

Map 2 presents the WBUPP representative example cases' Position within urban structure. The graphics aim to illustrate the Spatial relationship with city center.

New York City is the largest city in New York state. WBUPP is situated within the Brooklyn neighborhood. It has a central position in relation to Downtown Manhattan, historic city center (Wikipedia, 2026e). Its position is close to the city limits to the west, since the Hudson river, adjacent to Manhattan Island, marks the border between New York and New Jersey state.

3. WBUPP area

Map 3 presents the WBUPP representative example cases' area in the scale of 1:10.500. It aims to illustrate criteria named Spatial morphology, Size, Accessibility, and Space management.

WBUPP range is determined by OSM data, and verified by multiple internet sources (Brooklyn Bridge Park Conservancy, 2026), as well as Google Earth Pro tool (Google, 2026a).

Water surface is shown as the water body adjacent to the WBUPP area: East River merging with Upper Bay, belonging to the Atlantic Ocean. Other, additional water surfaces include small ponds and the artificial water surface or channels that make part of the sea.

WBUPP boundaries represent Open boundaries, Water boundaries and Closed boundaries. Water boundary is the sea in the west and north. Open boundaries are prevalent, spanning throughout the land border of the WBUPP. Closed boundaries are marked around infrastructure buildings in the south, and the power plant in the far east.

4. WBUPP accessibility, mobility

Map 4 presents the WBUPP representative example cases' area in the scale of 1:10.500. It aims to illustrate criteria named Spatial morphology, Size, Accessibility, Space management, Accessibility (Public Transportation) / Mobility, Public transport (resting places every 300m), Pedestrian/Path/Cycling Path, and Other public areas (heterogeneity).

Cycleway, Footway and Steps are dispersed within the WBUPP area. The curvilinear network covers densely most of the Park area.

Waterway is marked and highlighted in the middle of East River, because water traffic is dense and almost equally important as road traffic. Ferry route marks the public transportation lines with ferry landings. There are two ferry landings situated within Brooklyn Bridge Park.

Bus stops are concentrated along the major roads, but the ones that are not close to WBUPP. The closest bus stops are under the Brooklyn Bridge, close to DUMBO Ferry terminal (Fulton Ferry landing) near the north portion of the Park,

and in the south, close to Brooklyn Bridge Park Pier 6 / Atlantic Avenue Ferry terminal. Subway stations are little closer to WBUPP access points, but still relatively far. Ferry terminals are positioned within WBUPP, one in the north, next to Pier 1, and another on the south Park border, next to Pier 6.

Open, uncovered parking areas are scarce or scarcely marked, considering available data. Underground parking entrances are marked in the north and in the south, all close to the WBUPP boundary.

Bicycle parking points are concentrated in the north, both within and outside WBUPP boundaries. There are more than twenty locations in the northern area, and just one marked in the southern area.

City bike terminals are situated in wider areas around Brooklyn Bridge, outside WBUPP.

Tunnels are marked on this Map because they, despite being underground, influence the overall traffic volume presented in the graphic document. There are four underground tunnels whose trajectory passes through the WBUPP area.

Piers are marked as man-made structures. Four piers within WBUPP area contain program features, path network, and landscaped areas. Piers 2, 3, 5, and 6 are historical structures built in the 1950s and 1960s, adapted and rehabilitated for today's Parks' use (Michael Van Valkenburgh Associates Inc, 2026a).

Buildings within WBUPP are scarce, considering its overall area. They contain amenities, services, catering, commercial, administrative, and similar activities.

5. WBUPP environmental, health

Map 5 presents the WBUPP representative example cases' area in the scale of 1:10.500. It aims to illustrate criteria named Spatial morphology, Size, Accessibility, Nature – based solutions implementation, Water-sensitive urban design, Climate change adaptation and mitigation, Pedestrian / Path / Cycling path, Urban design (Well-being offered by urban design), Public restrooms, Drinking water fountains (access to drinking water), Adaptable spaces, Visual impact, Sustainable waste management, Green Areas Heterogeneity, Sports/Recreation Areas Heterogeneity, Ecosystem Preservation/Restoration,

Resilience, Program / Function, Well-being, Accessibility (Public Transportation) / Mobility, Shelter Areas, Vitality/ Concentration.

Viewpoints are marked all along the water boundary, in the open promontories: on Piers and peninsula-shaped land areas. They look on the water area in both directions, and wider across on the Manhattan Island. The points are obtained from OpenStreetMap[44] and processed in QGIS. Additional points were added and verified using auxiliary tools named earlier.

Benches are dispersed all over WBUPP Brooklyn Bridge. They are placed in groups or lines, around program nodes and in Viewpoint related positions along the waterfront. There are 261 marked benches.

Drinking water points are found and marked in fourteen points. Their location is attached to playgrounds, sports pitches, and outdoor seating area around Pier 1 Pavillion.

Toilets are situated in five locations, all of them incorporated in Buildings within WBUPP. Their distribution reaches an equal level of service coverage throughout the Park. Three public toilet's location points outside WBUPP are marked on the map because they are found in immediate vicinity to WBUPP boundary.

Waste and recycling points are marked within WBUPP. Their placement is mostly attached to landscaped areas on the waterfront areas, prevalently in the northern part of the Park, and in Zoen 1. There are 44 marked points.

Sheltered spaces are marked only in one, extensive, outdoor seating area on the border between Zone 1 and 2. It is a man-made, pier-like structure built on the water called Picnic Peninsula, designed in irregular, elongated form. The area is situated at the foot of Pier 5 and the adjacent Brooklyn Bridge Marina. Points are organized longitudinally and around the Picnic Peninsula Playground. There are 34 marked points, but there are more actual picnic seating points covered by parasol.

There are five playground locations within WBUPP, dispersed between Pier 6 and the area below Manhattan Bridge. Their position varies between Zone 1 (southern end and northern portion of Brooklyn Bridge Park, below Manhattan

[44] The original Tourism key contains Viewpoint values.

Bridge), Zone 2 (Piers 1 and 2), and the boundary between zones (at the foot of Pier 5). The program node's size varies from 300 m^2 to over 5000 m^2. Playground type is diversified, it ranges from simple children's elements organized on a suitable paved surface, to elaborated thematic recreational surfaces integrated in naturally shaded areas.

One Dog park is located on the foot of Pier 6, outside the WBUPP area. Although it is not formally considered as a part of the Park, its position right next to the boundary (between two high rises), the name (Brooklyn Bridge Park – Pier 6 – Dog Run), and inclusion in the WBUPP program on the official web page (New York City Department of Parks & Recreation, 2025) make it belong.

Garden areas with different vegetation types are concentrated in the northern part of WBUPP, and on Pier 6. Their surface is always smaller than the grassland area they are incorporated in, the biggest Pier 6 Flower Field amounting to around 2000 m^2.

Sports and recreation areas cover Piers 2, 5, and are present on Pier 6 minimally. Brooklyn Bridge Marina is marked as related program node. Most pitches on Pier 2 are covered by the existent roof, the remaining part of the port infrastructure warehouse that served the area until the 1970s (Brooklyn Bridge Park Conservancy, 2026).

Grassland areas are found all over WBUPP, since the green surfaces are substantially proportioned. Piers 2 and 5 make an exclusion, since their surface is dedicated to sports pitches and other related activities.

There are two beaches marked. One on Pier 4 and the other in the north, below Manhattan Bridge.

Rocky material areas are found in the north, below Manhattan Bridge, and on the south side of Pier 1, around Pier 1 Salt Marsh.

Trees are graphically represented according to OSM data. There are 839 tree markers on the map. Trees and tree lines are tied to landscaped areas, mostly placed along the paths and in designated shade areas.

6. WBUPP social, well being

Map 6 presents the WBUPP representative example cases' area in the scale of 1:10.500. It aims to illustrate criteria named Spatial morphology, Size, Space management, Accessibility, Implement tourist activity, Historical and cultural value, Climate change adaptation and mitigation, Pedestrian / Path / Cycling path, Urban design (Well-being offered by urban design), Adaptable spaces, Sports/Recreation Areas Heterogeneity, Other Public Areas Heterogeneity, Program / Function, Well-being, Heritage, Accessibility (Public Transportation) / Mobility, Vitality/ Concentration, Identity / Sense of Place / Historic Identity.

Building use enclosure and coverage graphic symbols show enclosed, covered, and opened spaces within WBUPP. In Brooklyn Bridge Park, enclosed are the three buildings within WBUPP, in the north section, containing commercial facilities, public and infrastructure services. Covered spaces include sports and recreation program areas on Pier 2, and individual outdoor seating sets (benches with a table and a parasol), marked by area, not each separately. Open spaces are children's playgrounds in the north section of the Park, as well as sports, recreation pitches and playgrounds in the south.

Landmark marker outside WBUPP highlights the Downtown Manhattan neighborhood that sits across the river. It is not one element or built structure, but a complex urban tissue with multiple prominent high rises that create a worldwide recognizable skyline. The landmark provides visual features that render Brooklyn Bridge Park more attractive.

Artwork locations are marked within WBUPP. There are three found locations: Walk-in Kaleidoscope and Turning Stone on Pier 3, and Akua, temporary pavilion on Pier 1 (Public Art Fund, 2026). Only the third, Akua is verified using auxiliary tools. A source about public art in WBUPP Brooklyn Bridge Park states that public art displays act as temporary events with yearly rotations (Brooklyn Bridge Park Conservancy, 2026).

Bench, Outdoor seating, Playground, Dog park and Sports recreation are shown on this map. Their characteristics and their institution are explained in chapter Spatial analysis, section 5.

7. WBUPP self-sufficiency, mixed use, educative, land/building use context

Map 7 presents the WBUPP representative example cases' area on the scale range of 1:10.500. It aims to illustrate criteria named Spatial morphology, Size, Space management, Self-sufficiency, Employment opportunities, Implement tourist activity, Mixed development, Program / Function, Proximity of social facilities (school facilities, home for elderly, health facilities), Proximity of commercial facilities, Educative (cultural) facilities / services, Vitality/ Concentration.

Building use shows the built environment within WBUPP area and around its perimeter. The buildings within WBUPP hold a mixed character: culture, public services, commercial, and infrastructure (Brooklyn Bridge Park Conservancy, 2026).

Buildings' outside WBUPP use is mostly residential in the south, with one commercial and mixed-use building exception (One Brooklyn Bridge Park). North section of the WBUPP contact area holds mixed culture, educational, commercial and catering facilities. Exception is the NYPD Police station situated on the ground under the Brooklyn Bridge. The contact zone presents a strong urban, mixed-use character. The high-risers Edge with a multi-level high-volume-traffic major road forms a dominant physical presence in space overlooking the WBUPP from the east, in the south portion of the Park.

8. WBUPP brownfield

Map 8 presents the WBUPP representative example cases' area in the scale of 1:10.500. It aims to illustrate criteria named Spatial morphology, Size, Accessibility, Historical and Cultural Value, Heritage, Identity / Sence of Place / Historic (Local) Identity.

There are several different types of elements found in Brooklyn Bridge WBUPP marked as Brownfield points. Base structures include former cargo piers and pier sheds: Piers 1-6 nowadays integrate the parts of the original structures. Pier 2 holds the original warehouse structural framing whose roof was replaced. Today it covers and protects the sports and recreation fields with related services. Piers

1 – 6 have former warehouses steel structure elements, such as pillars, frames, and signage (Pevzner, 2016; Michael Van Valkenburgh Associates Inc, 2026a; Cooney, 2014).

9. Conclusions - Conceptual schematic diagrams

a. THE TWO-ZONES SCHEME

As shown in **Error! Reference source not found.**, the two zones are distinguished in the WBUPP spatial organization. Zone 1 is longitudinal, acting as an L-shaped area in physical form. It spans throughout the entire WBUPP's area and holds a portion of the program. It is clearly distinguished in the southern part of the park that contains piers, but blends with Zone 2 in the northern part where the land spans toward the water in peninsular forms. Zone 2 is defined as WBUPP's portion that spreads into the river and holds a very strong water body contact intensity. It holds most of the Park's program with sports and recreation amenities, playground, and green landscaped surfaces with multiple viewpoints of Manhattan Island. The construction size is significant; structures accommodate from about 100.000 to over 200.000 m2 of usable space each.

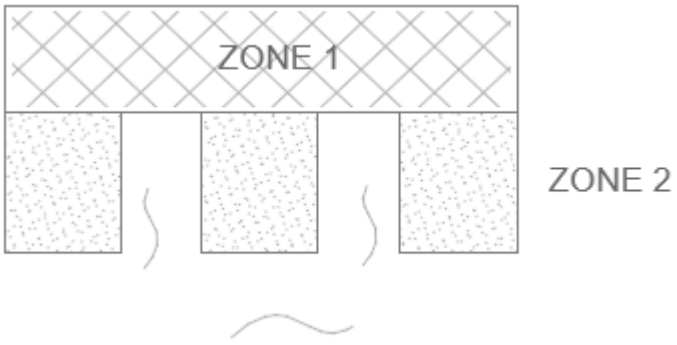


Figure 78. WBUPP Brooklyn Bridge Park spatial relation, schematic diagram ZONES, M. Gudac Cvelic

b. THE LONGITUDINAL DISPOSITION SCHEME (path/edge/district)

As shown in **Error! Reference source not found.**, WBUPPs spatial structure is predominantly longitudinal, forming an overall L-shaped configuration. Its main edge is defined by a strong multilevel highway that is a Path but in this case acts

more as an Edge. Internal Park pathways follow the longitudinal structure in their role of connecting different areas; however, they are not strictly linear. Instead, they adopt fluid, gently curved forms that contrast with and soften the rigidity of the primary infrastructural path.

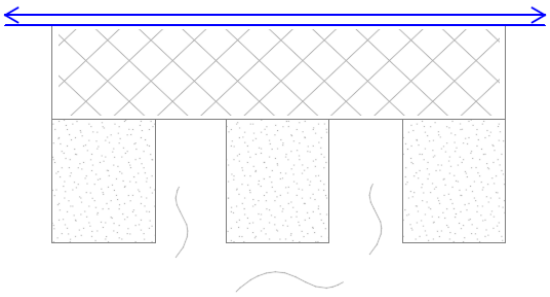


Figure 79. WBUPP Brooklyn Bridge Park spatial relation, schematic diagram PATH DISPOSITION, M. Gudac Cvelic

c. THE INTERNAL PATH SCHEME

As shown in **Error! Reference source not found.**, WBUPPs internal communication network consists of mostly footways and cycleways. Its direction is pronouncedly longitudinal, following the Parks area shape. Internal pathways of the Park follow the longitudinal shape by definition, because of their purpose to connect different parts, but are not linear. In fact, they act as if defying the straight Path, being fluid and playfully curved.

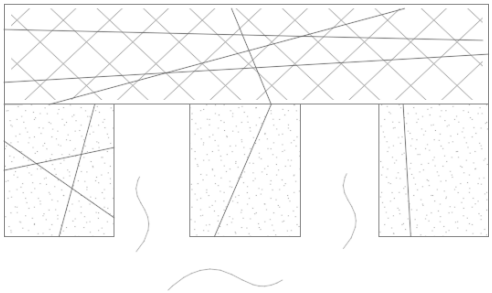


Figure 80. WBUPP Brooklyn Bridge Park spatial relation, schematic diagram INTERNAL PATH, M. Gudac Cvelic

d. THE LONGITUDINAL DISPOSITION SCHEME (edge)

As shown in **Error! Reference source not found.**, WBUPPs spatial structure is clearly defined and highlighted by the contacting dense urban tissue. The buildings are elevated in portions of the neighborhood where the multileveled highway borders the Park. The Edge spatially breaks the WBUPP's longitudinal continuity in areas where the adjacent buildings get closer to the river.

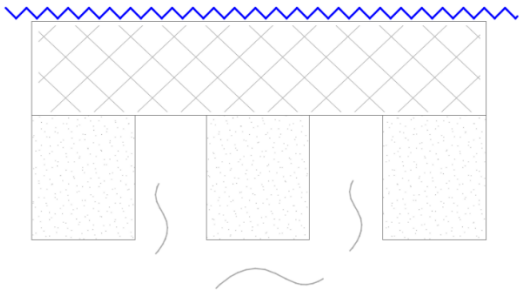


Figure 81. WBUPP Brooklyn Bridge Park spatial relation, schematic diagram EDGE, M. Gudac Cvelic

e. THE LANDMARK SCHEME

As shown in **Error! Reference source not found.**, in this case, a Landmark is not one element or built structure. The adjacent Downtown Manhattan neighborhood provides visual features that render Brooklyn Bridge Park attractive. Located across the river and outside the park's boundaries, this visual relationship intensifies the experiential impact of the water interface.

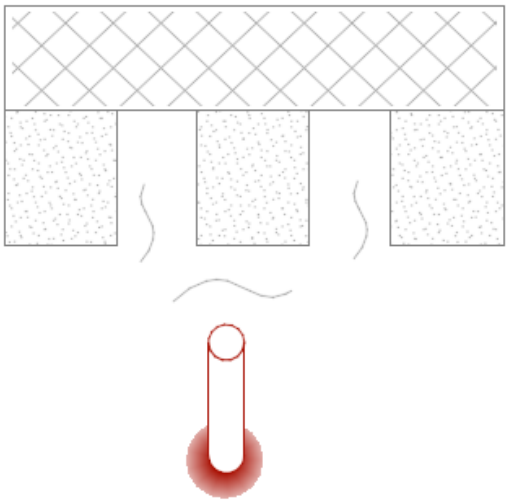


Figure 82. WBUPP Brooklyn Bridge Park spatial relation, schematic diagram LANDMARK, M. Gudac Cvelic

f. THE NODES SCHEME

As shown in **Error! Reference source not found.**, Nodes are program concentration points or areas. They are spatially distinguished in the pier, maritime area in the south, and the ground, land area that spans from south to north longitudinally. Sports and recreation program concentration is in water-adjacent areas. Green and landscaped surfaces fill the area that borders the contact urban tissue, acting as pollution (especially noise) barrier where the high-volume trafficked highway is close to the Park area.

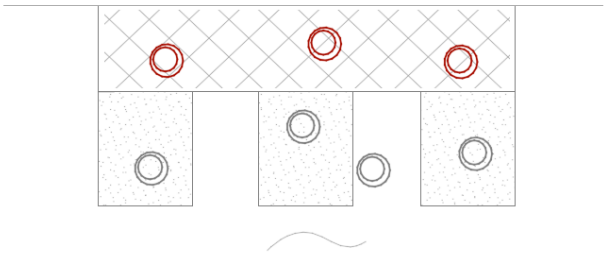


Figure 83. WBUPP Brooklyn Bridge Park spatial relation, schematic diagram NODES, M. Gudac Cvelic

8.5.8 Additional Criteria

The WBUPP representative example was analyzed using fifty criteria that originated from scientific literature sources. Additional criteria emerged after the performed analysis. Brooklyn Bridge Park has an on-the-water program that combines reusing and highlighting heritage structures with maximizing water contact intensity. Downtown Manhattan is a potent landmark located outside of WBUPP but adjacent and highly visible. It acts as a qualitative, multileveled criteria contribution to visual attraction, identity and sense of place.

Multi-zoned spatial organization, as evidenced through analysis, creates a distinct order and brings quality. Zone 1, that is in direct contact with the dense urban tissue and a strong, high volume highway Path, has more natural landscaped surfaces. Zone 2 has a man-made character and seems less natural by the program characteristics but regains natural character by having intense water contact.

Program concentration is high, considering the volume users and high contact neighborhood density, providing many amenities and services to a lot of people. Circular communication network, although the WBUPP area is pronouncedly longitudinal, can be read within smaller Park sections. The pathway's network is playful and curved, contradicting the straight boundaries and the strictly regular contact urban tissue structure.

Anti-pollution measures introduced sound berms, artificial hills located along the high-volume trafficked highway, that act as a sound and air anti-pollution barrier.

Additional criteria, proposed based on Brooklyn Bridge Park WBUPP example case analysis are On The Water Body Surface/Area Related Program, Program On The Water Body, Program In The Water Body, Water Related Program, Anti-Pollution Measures, Multi-Zoned Spatial Organization, Program Spatial Organization, Landmark Presence, Program Concentration, Circular Communication Network, Waterfront Communication Network, WBUPP Program Integration, Spatial Enclosure Diversity, Edge, Water Contact Intensity.

8.6 WBUPP REPRESENTATIVE EXAMPLE CASE # 4 JURONG LAKE, SINGAPORE

8.6.1 Overview

Jurong Lake Gardens is Singapore's third national gardens and stands as a pioneering example of novel habitat restoration within an urban heartland setting (Figure 84). The 90-hectare compound comprises three distinct sections: Lakeside Garden (formerly Jurong Lake Gardens West), Chinese and Japanese Gardens (formerly Jurong Lake Gardens Central), and Garden Promenade (formerly Jurong Lake Gardens East) (Visit Jurong Lake Gardens, 2026). Lakeside Garden, covering 60 hectares, was the first section to be redeveloped, opening in two phases to the public in April 2019 and April 2023, and houses numerous play areas and ecological features for public enjoyment (Wu, 2025).

The vision for Jurong Lake Gardens is to create a biophilic garden where people, animals, and plants can co-exist and bring mutual benefits through the restoration of its landscape heritage as a freshwater swamp forest, serving as a canvas for recreation and community activities (Landezine International Landscape Award LILA, 2019). The design and development of the Gardens took into consideration suggestions from the community through extensive public consultation, establishing it as a true "people's garden" where spaces are landscaped and created for families and the community to come together for leisure and recreation (Chan et al., 2023).

Lakeside Garden's success is evident in the more than 8.2 million visitors since it opened in 2019. The park has emerged as a model for the restoration and landscaping of natural habitats in urban environments, particularly in terms of protecting and promoting flora and fauna (Urban Land Institute Asia Pacific, 2021). The garden plays an important role in advancing the government's plan to decentralize the city by promoting Jurong Lake District as a second Central Business District (CBD). The Gardens as a whole exemplify NParks' "City in Nature" vision and have emerged as a model for the enhancement and landscaping of novel habitats in urban environments (Urban Land Institute Asia Pacific, 2021).



Figure 84 Jurong Lake Gardens 2025-12-30-1, 2025., Google Earth Pro (Google, 2026a)

8.6.2 History/Previous Land Use

Jurong Lake Gardens is closely intertwined with the historical development of Singapore, since the Jurong Lake area evolved through multiple transformations that reflect the nation's rapid modernization over the past six decades (partially shown in Figure 85, Figure 86, Figure 87, Figure 88, and Figure 89). The site has witnessed changes in human-environment relationships, symbolizing the transition from agricultural to industrial civilization (Turenscape, 2023).

Jurong was historically a mangrove swamp, with some plantation farms, fish and prawn ponds, and crocodile-infested rivers (National Parks Board, 2024). The original habitat of the Jurong area consisted of freshwater swamp and mangrove habitats flanking the banks of Sungei Jurong (Chan et al., 2023). The rural land was mostly state-owned, except for plots owned by a small number of residents, with no significant human settlement or development (National Parks Board,

2024). The Jurong Lake area existed in its original state in the 1960s with minimal human traces (Turenscape, 2023).

In 1961, Dutch economist Albert Winsemius initiated Singapore's industrialization programme, with a land area of 69 square kilometers in Jurong chosen as the site for industrial development (National Parks Board, 2024). During the 1970s, the freshwater swamp and mangrove habitats were cleared to give way to factories and urban areas as part of Singapore's industrialization efforts (Chan et al., 2023). Low hills were leveled and the swampland was filled with soil to prepare the land for industrial, residential, and recreational developments (National Parks Board, 2024).

The Jurong Industrial Estate project, Singapore's first industrial estate, was initiated with National Iron & Steel Mills (known today as NatSteel) on September 1, 1962. Industrial activity included handling timber, sawmilling, oil-rig fabrication, shipbuilding, and repair. This period saw extensive land expansion and the establishment of numerous factories (Turenscape, 2023). By 1976, 650 factories were in operation (National Parks Board, 2024).

From the 1970s to 1990s, in order to attract workers and facilitate the expansion of Jurong Industrial Estate, residential and recreational amenities were constructed (National Library Board Singapore, 2025). The estate grew into a self-sufficient town with a comprehensive transportation network consisting of buses and the Mass Rapid Transit (MRT) rail system, along with amenities such as wet markets, food centers, sports complexes, schools, polyclinics, places of worship, shopping centers, a library, community centers, and a country club (National Parks Board, 2024).

The 1990s witnessed rapid real estate development and the emergence of extensive amenities (Turenscape, 2023). By 2000, the estate was experiencing gentrification with private residential developments springing up alongside public housing. In response to the change in residents' profile, plans were made to further enhance existing facilities. On March 25, 2006, the Jurong Town Council launched a five-year masterplan to upgrade Jurong (National Parks Board, 2024).

The conversion to an urban environment in the Jurong area had been very significant, resulting in ecological processes that supported the historical habitat

being largely degraded. When Jurong Lake Gardens was formerly a freshwater mangrove swamp before it was cleared and leveled in the 1960s for industrial developments, the hydrological processes changed beyond the point of being feasibly restored (Chan et al., 2023).



Figure 85 Jurong Lakeside Garden, 2008., Google Earth Pro (historical imagery) (Google, 2026a)



Figure 86 Jurong Lakeside Garden, 2013., Google Earth Pro (historical imagery) (Google, 2026a)



Figure 87 Jurong Lakeside Garden, 2018., Google Earth Pro (historical imagery) (Google, 2026a)



Figure 88 Jurong Lakeside Garden, 2022., Google Earth Pro (historical imagery) (Google, 2026a)



Figure 89 Jurong Lakeside Garden, 2025., Google Earth Pro (historical imagery) (Google, 2026a)

8.6.3 Planning/Design/Building Process

Jurong Lake Gardens was realized in three phases, each developed by different design teams through competitive and collaborative selection methods.

In July 2016, the Urban Redevelopment Authority (URA) issued an open Request for Proposal for the masterplan of the Jurong Lake District. By September 2016, five multidisciplinary teams were shortlisted and given ten weeks to create concept proposals. This was not a traditional design competition but rather a formal government procurement process with rigorous evaluation criteria. In February 2017, KCAP Architects & Planners were chosen to guide the district's extensive development alongside collaborative partners such as SAA Architects, Arup, S333, and Lekker Architects (ArchDaily, 2026c).

The 53-hectare Lakeside Garden, which was finalized in 2019, focused on ecological restoration through an innovative approach. The landscape architecture was directed by Henning Larsen, a Danish firm, in collaboration with Ramboll Studio Dreiseitl, experts in water-sensitive urban design (WSUD). CPG Corporation acted as the local architect, jointly overseeing water engineering with Ramboll Studio Dreiseitl (Landezine, 2025).

The design process gathered over 17,000 public suggestions, contributing to the garden's development as an inclusive space. Specialist teams in arboriculture, biodiversity, and play design worked together throughout the process (Landezine International Landscape Award LILA, 2019).

The second phase, containing the Chinese and Japanese Gardens and Garden Promenade sections, appointed Liu & Wo Architects Pte Ltd as the architect, with SALD Pte Ltd & Landscape Design providing landscape services and AECOM Singapore managing structural, environmental, mechanical and quantity surveying services. This phase demonstrated more conventional procurement through direct appointment of local practices with established Singapore track records (Aecom, 2026).

The new Science Centre underwent a formal two-stage competition from 2018 to 2019, with Zaha Hadid Architects (ZHA) triumphing in May 2019, collaborating with local practice Architects 61 Pte Ltd. The design by ZHA highlighted the

"boldness of scientific endeavour and future-focused STEM aspirations“ (Aecom, 2026).

A central planning objective for Jurong Lake Gardens was the implementation of a garden-wide habitat creation masterplan focused on restoring ecological functions within a highly urbanized landscape. As the site's original hydrological conditions could not be reinstated, the restoration strategy shifted from recreating the historical ecosystem to establishing representative freshwater swamp habitats that support biodiversity under contemporary environmental conditions (Chan et al., 2023).

The masterplan was informed by comprehensive biodiversity assessments that identified existing ecological hotspots and guided the creation of interconnected habitats, including freshwater swamp, woodland, and grassland ecotones. These interventions also addressed urban environmental challenges such as elevated temperatures and reduced humidity resulting from previous land clearing (Chan et al., 2023).

The design was guided by seven biophilic design principles, emphasizing the integration of ecological restoration with community use (Landezine International Landscape Award LILA, 2019). More than 3,000 existing trees were retained, with over 200 successfully transplanted, while close collaboration among landscape architects and contractors enabled the preservation of additional mature trees throughout construction. Wildlife monitoring conducted before, during, and after construction informed mitigation measures to minimize ecological disturbance and evaluate habitat establishment (Landezine, 2025).

Jurong Lake Gardens was opened in phases between 2019 and 2023, reflecting complementary themes of nature, recreation, horticulture, sustainability, and community. Throughout the development process, public exhibitions and community events fostered stakeholder engagement and strengthened public support for the project (Chan et al., 2023; Landezine, 2025).

8.6.4 Program

Jurong Lake Gardens provides a diverse range of recreational, educational, and ecological amenities that promote nature-based recreation while supporting environmental awareness and community engagement across its 90-hectare site.

Water is a defining element of the park. Clusia Cove combines nature-based water play with a closed-loop water recycling system that incorporates biofiltration, aquatic planting, and ultraviolet disinfection, demonstrating sustainable water management in a recreational (Landezine, 2025; ArchDaily, 2026c). Elsewhere, floating wetlands, naturalized streams, and shoreline boardwalks improve water quality through phytoremediation while providing opportunities for environmental education and direct interaction with the lake ecosystem (Chan et al., 2023).

Recreational facilities are integrated with the park's ecological objectives. Forest Ramble, Singapore's largest nature playgarden, uses play equipment inspired by freshwater swamp fauna to encourage environmental learning through play, while inclusive design ensures accessibility for users of different ages and abilities (Chan et al., 2023). Additional amenities include community allotment gardens, therapeutic gardens, waterfront sports facilities, cafés, picnic areas, and extensive seating that support a broad range of recreational and social activities.

The landscape design emphasizes the adaptive reuse of on-site materials and ecological restoration. Existing laterite boulders, salvaged timber, and naturalized waterways were incorporated into the landscape to create distinctive spaces while reducing construction waste. The park is structured around three interconnected habitat zones—freshwater swamp, woodland, and grassland—which support biodiversity, improve ecological connectivity, and provide immersive nature experiences (Landezine, 2025).

Environmental education is embedded throughout the gardens through interpretive landscapes, guided walks, workshops, and community events focusing on biodiversity, horticulture, and sustainable practices. Together, these amenities demonstrate an integrated approach in which recreation, ecological restoration, and environmental learning reinforce one another, supporting the

park's role as both a regional destination and an urban ecological landscape (Chan et al., 2023).

8.6.5 Context

Jurong Lake Gardens is located within the Jurong Lake District, Singapore's designated secondary Central Business District and a key component of the country's urban decentralization strategy (Urban Land Institute Asia Pacific, 2021). Unlike Singapore's destination gardens, it functions primarily as a national garden serving surrounding residential communities. The district comprises a mix of public and private housing supported by a wide range of civic, educational, commercial, and recreational amenities (National Parks Board, 2024).

The gardens are well integrated into Singapore's multimodal transport network, with convenient access by MRT, bus, and private vehicles. They also form part of Singapore's islandwide Park Connector Network, providing continuous pedestrian and cycling links to surrounding neighbourhoods, parks, and natural areas (Tan, 2006; Srikanth and Schroepfer, 2023).

Ecological connectivity extends beyond the park itself through landscaped Nature Ways along adjacent roads, which function as green corridors that facilitate wildlife movement and strengthen links between urban (Chan et al., 2023). Together, these physical and ecological connections reinforce Jurong Lake Gardens' role as an accessible urban green space embedded within Singapore's broader green infrastructure network.

8.6.6 Sustainability

Jurong Lake Gardens demonstrates an innovative approach to habitat restoration in an urban landscape where the original ecological and hydrological conditions could not be fully restored (Chan et al., 2023). Instead, the project focused on establishing resilient freshwater swamp ecosystems informed by comprehensive biodiversity surveys. Ecological hotspots were conserved, buffer woodlands were created to strengthen habitat connectivity, and more than 3,000 existing trees

were retained, with over 200 transplanted to reinforce wildlife corridors (Landezine, 2025).

Water Sensitive Urban Design (WSUD) forms a key component of the park's environmental strategy. Vegetated swales, naturalized streams, floating wetlands, and a closed-loop water recycling system improve stormwater management, enhance water quality, mitigate waterlogging, and create habitats for aquatic and terrestrial species. The replacement of concrete drainage channels with naturalized waterways further restored ecological functions while enhancing recreational and educational value (Landezine, 2025).

Resource efficiency was achieved through the extensive reuse of on-site and recycled materials, including laterite boulders, fallen timber, recycled steel reinforcement, and crushed concrete, which were incorporated into landscape structures, habitat features, public furniture, and interpretive elements. These measures reduced construction waste while reinforcing the park's ecological character (Landezine, 2025). With sustainability and a recreational aim in mind, nature trail features are designed using recycled material salvaged from site during construction. The Canyon is made of existing laterite boulders found across the site, either broken down into small pieces as infill of the gabion or inserted as large laterite boulders among the gabions. The Log Trail is created using wood logs from fallen trees from the previous park (Hwang and Jain, 2021), (Landezine, 2025). The Lone Tree sculpture is made from recycled iron reinforcement bars salvaged from demolished steel-reinforcement forms within old pathways from the site (Landezine, 2025).

The development is further supported by a Sustainability and Technology Masterplan aligned with the Singapore Green Plan 2030. Smart environmental monitoring systems and the use of the gardens as an NParks living laboratory facilitate the testing of innovative landscape management practices and sustainable technologies (Chan et al., 2023).

Social sustainability was promoted through extensive public consultation, environmental education, and community participation. Programmes such as composting workshops, community allotment gardens, and stewardship initiatives encourage long-term public engagement with sustainable practices.

Guided by seven biophilic design principles, the park integrates ecological restoration with recreation and education through features such as Forest Ramble and Rasau Walk, creating opportunities for immersive interactions with nature while strengthening connections between people and the restored freshwater swamp landscape (Landezine, 2025).

8.6.7 Spatial Analysis

Thematic maps created within the process of spatial analysis are shown on Figures 66-77, in Appendix, 3, chapter 3.4.

1. WBUPP Position within national territory

Map 1 presents the position of WBUPP within the belonging country national territory.

WBUPP is placed in Republic of Singapore. The area sits in the Singapore Strait, part of the Straits of Malacca that connect the Indian Ocean (Andaman sea) and Pacific Ocean (South China Sea) (Wikipedia, 2026g).

2. WBUPP Position within urban structure

Map 2 presents the WBUPP representative example cases' Position within urban structure. The graphics aim to illustrate the Spatial relationship with city center.

Republic of Singapore is an island country, a city-state (Wikipedia, 2026g). WBUPP has a central to east position in relation to historic city center. Its position within the city limits is east central.

3. WBUPP area

Map 3 presents the WBUPP representative example cases' area on the scale of 1:15.000. It aims to illustrate criteria named Spatial morphology, Size, Accessibility, and Space management.

WBUPP range is determined by OSM data. OSM Data was further adapted and verified using official internet source (Visit Jurong Lake Gardens, 2026), as well as Google Earth Pro as supplementary tools. WBUPP area is modified to exclude the Singapore Science Centre area in construction, as well as to unite the

Lakeside Garden, Chinese Garden, and Japanese Garden with the surrounding water surface that together form Jurong Lake Gardens.

Water surface is shown as the water body adjacent to the WBUPP area: Jurong Lake.

WBUPP boundaries represent Open boundaries, Water boundaries and Closed boundaries. Water boundary is the lake in the east. Open boundaries are almost non present. They are marked in the south of WBUPP and around the Lakeside Plaza in the northwest of WBUPP. Closed boundaries span throughout the land border. They consist of metal fences (railings), mostly covered or hidden by protective greenery. The entrances to the Park are marked as Access points: open access, ramps or gates, depending on the traffic and operation regime type.

4. WBUPP accessibility, mobility

Map 4 presents the WBUPP representative example cases' area in the scale of 1:11.000. It aims to illustrate criteria named Spatial morphology, Size, Accessibility, Space management, Accessibility (Public Transportation) / Mobility, Public transport (resting places every 300m), Pedestrian/Path/Cycling Path, and Other public areas (heterogeneity).

Cycleways and Footways create irregular network, connecting the programming nodes and the different sections of the Park. There are bridges that connect the island-shaped land called China and Japanese garden with Lakeside Garden.

Bus stops are positioned along tangential major roads, distributed all around WBUPP to provide public transportation access. Two train stations are situated in the north of the Park, next to the major road. Trains are used by residents and visitors as public transportation.

One city bike station is located outside of WBUPP boundaries in the north, close to the east train station.

Two bicycle parking points are found next to the train station on the west.

Pedestrian plazas are public paved surfaces, situated in the northern part of the WBUPP, either marking the Park entrance (Lakeside Plaza) or providing the

adaptable open surface suitable for temporary uses and waterfront enjoyment (Lakeside Green, ABC Waters Plaza, Water Plaza)

Open, uncovered parking areas are placed within and outside of WBUPP boundaries, distributed prevalently on the west of the Park. The two parking areas in the Park are situated next to its boundaries, on each side of the elongated residential zone in the central west portion of WBUPP, parallel to the major road with north-south direction. Their areas are around 8000 m^2 and 9600 m^2.

Buildings within WBUPP area are dispersed all over the Park without obvious rules or spatial direction. They are mostly related to WBUPP amenities and services.

5. WBUPP environmental, health

Map 5 presents the WBUPP representative example cases' area in the scale of 1:11.000. It aims to illustrate criteria named Spatial morphology, Size, Accessibility, Nature – based solutions implementation, Water-sensitive urban design, Climate change adaptation and mitigation, Pedestrian / Path / Cycling path, Urban design (Well-being offered by urban design), Public restrooms, Drinking water fountains (access to drinking water), Adaptable spaces, Visual impact, Sustainable waste management, Green Areas Heterogeneity, Sports/Recreation Areas Heterogeneity, Ecosystem Preservation/Restoration, Resilience, Program / Function, Well-being, Accessibility (Public Transportation) / Mobility, Shelter Areas, Vitality/ Concentration.

Viewpoints are marked on the waterfront (three points with multidirectional visual range), and at the top of the Cloud Pagoda landmark. The first point, on Jurong Lake Floating Boardwalk, built on a wetland area in the northern part of WBUPP, is obtained from OpenStreetMap[45] and processed in QGIS. Additional points (Cloud Pagoda, Twin Pagoda, ABC Water Plaza) were verified and added using auxiliary tools named earlier.

[45] The original Tourism key contains Viewpoint value.

Benches are not marked. The points are not found in OpenStreetMap[46], and could not be added using auxiliary tools for the great WBUPP size and limited visibility in available graphic tools.

Drinking water points are found next to public toilets service points. There are five marked locations. Not all toilets have a drinking water point in their vicinity. One water fountain is found next to the ABC Waters Plaza, on the water surface, but it doesn't serve the same purpose as a drinking water point. It is a water-based attraction.

Toilets are situated in twenty-three locations, serving most of the WBUPP area. They are attached to the Park amenities, standing as individual structures or incorporated in the building with other public services. The highest concentration is noted in the central area.

Waste and recycling points are marked within WBUPP, in three points. There is a lack of points obtained in OpenStreetMap[47]. Additional points could not be added using auxiliary tools for the excessive WBUPP size and limited visibility in available graphic tools.

There are twenty-five sheltered spaces marked within the WBUPP Jurong Lakeside Gardens, distributed all over the area. Most of them are covered spaces, permanently protected from weather conditions with metal, plastic, wood or other suitable material. They are equipped with different types of seating points and coincide with Outdoor seating area spatial symbol category.

Information points are found in the central WBUPP area, within Chinese Garden and Japanese Garden sections. They are physical boards with orientation maps and additional information about the Park.

Playgrounds are situated in the central portion of WBUPP, close to the surrounding residential neighborhood, surrounded by different types of green areas. The density of amenities and services in that section is high, and the playground's concentration takes up the middle third of the Park's solid ground area (as opposed to the island shaped land called Japanese Garden and Chine

[46] The original Amenity key contains Bench value.
[47] The original Amenity key contains values Recycling, Waste basket, Waste disposal.

island, surrounded by water). The playgrounds have different thematic designs and content, with shaded space portions. They are all placed in the same WBUPP section mentioned before. The programming node's size varies from 200 m^2 to almost 17.000 m^2.

Dog park is in the central south portion of WBUPP, next to the west boundary and the residential high-rise neighborhood. Its size is over 2000 m^2. It is situated between a cycling and a footpath, close to the open parking lot.

Sports and recreation areas offer a variety of different activities. The north node, situated next to the major road, on the waterfront, is a Skate park with a covered skate area, Parkour spot, and other related services. The south node is named ActiveSG Park, intended for workout activities. It contains Jurong Lake Gardens Gym building with integrated public services, Rooftop Garden, and open pools (Visit Jurong Lake Gardens, 2026). Another sports and recreation area is found in central Park portion, next to the residential high-risers zone. It is a fitness point with open-air workout equipment. A sports pitch is marked in OpenStreetMap[48], between the Twin Pagoda landmark and the Stone Boat attraction, but its existence is not verified using auxiliary graphic tools or internet sources.

Garden areas are specifically designed pieces of land operating as Park attractions. There are four marked locations, all in the central portion of WBUPP: Bonsai Garden, Floral Garden, Sunken Garden, and Allotment Gardens. Each site has an individual content, different from the others. Every Garden is designed as its own entity, with integrated paths. Bonsai and Sunken Gardens have integrated covered spaces. Allotment Gardens consists of plots with raised planted bed sized 2,5x1 meter, available for lease. It is open to public users who want to grow a mini garden for personal use (Visit Jurong Lake Gardens, 2026).

Grassland areas are found all over WBUPP, since the green surfaces are substantially proportioned.

Wood areas are marked separately, since their surface is significant comparing the other grassland areas and the trees as separate entities are not marked. Their

[48] The original Leisure key contains Pitch value.

locations are next to the Oval in the south, and around Clusia Cove and Passion Wave in the north of WBUPP.

Trees are not marked. The points are not found in OpenStreetMap[49], and could not be added using auxiliary tools for the excessive WBUPP size and limited visibility in available graphic tools.

6. WBUPP social, well being

Map 6 presents the WBUPP representative example cases' area in the scale of 1:10.000. It aims to illustrate criteria named Spatial morphology, Size, Space management, Accessibility, Implement tourist activity, Historical and cultural value, Climate change adaptation and mitigation, Pedestrian / Path / Cycling path, Urban design (Well-being offered by urban design), Adaptable spaces, Sports/Recreation Areas Heterogeneity, Other Public Areas Heterogeneity, Program / Function, Well-being, Heritage, Accessibility (Public Transportation) / Mobility, Vitality/ Concentration, Identity / Sense of Place / Historic Identity.

Building use enclosure and coverage graphic symbols show enclosed, covered, and opened spaces within WBUPP. In Jurong Lakeside Gardens, enclosed are the marked buildings within WBUPP. They mostly contain public amenities and services, as well as catering facilities. Covered are portions of sports and recreation program features, and shelters dispersed all over the Park's area containing an outdoor seating feature. Parts of the landmark and attraction spaces, as well as portions of thematic gardens are also covered, protected from weather conditions. Open spaces are portions or entire sports and recreation programming nodes, playgrounds, a dog park, and attractions that are not covered.

Landmark markers within WBUPP highlight the Twin Pagoda, Cloud Pagoda (Ru Yum T'a), and Jurong Lake Floating Boardwalk. The Pagodas are heritage structures whose height and historical significance dominate the spatial region they sit in. Jurong Lake Floating Boardwalk is a natural attraction, on-the-water program node featuring a wetland area with a boardwalk and covered resting

[49] The original Amenity key contains Bench value.

spaces network above. It is not visible from afar because of its vertical physical presence, but for its peninsular position on the water surface. It is considered a landmark because of its attractive spatial organization, ecological restoration significance, and the contrast it brings into the area surrounded with major roads and dense urban tissue. WBUPP contact area marks one building that is considered a landmark: Singapore Science Centre. The structure is still in construction, but its spatial influence is evident given the location and the culture character it presents.

Artwork locations are marked in the wider central portion of WBUPP. The most south position is within a grassland area next to the Rasau Walk waterfront attraction. The Lone Tree is a metal sculpture in form of a tree. The two Pagodas marked as landmarks are also marked as artwork, even though they have ambiguous character, since they are actual buildings. The Confucius statue stands between them on Chinese Garden island, presenting an actual sculpture. A memorial plaque positioned next to ABC Water Plaza is marked as artwork.

Fishing point is marked at the end of a boardwalk on the water, close to the ABC Water Plaza. It doesn't have designated signage. There is a gate in the railing safety structure. data is obtained from OSM[50] but not confirmed by internet sources. The internet sources that confirm the area designated for fishing state it being in the southern part of the Park (The Smart Local, 2023).

Playground, Dog park and Sports recreation are shown on this map. Their characteristics and their institution are explained in chapter Spatial analysis, section 5.

7. WBUPP self-sufficiency, mixed use, educative, land/building use context

Map 7 presents the WBUPP representative example cases' area on the scale range of 1:12.000. It aims to illustrate criteria named Spatial morphology, Size, Space management, Self-sufficiency, Employment opportunities, Implement tourist activity, Mixed development, Program / Function, Proximity of social facilities (school facilities, home for elderly, health facilities), Proximity of

[50] The original Leisure key contains value Fishing.

commercial facilities, Educative (cultural) facilities / services, Vitality/ Concentration.

Building use shows the built environment within WBUPP area and around its perimeter. The buildings within WBUPP hold a prevalent public use character. Smaller dispersed buildings host catering facilities. One building in the south portion of the Park is a social facility, a home for elderly.

Buildings' outside WBUPP use is mostly residential, commercial, educational, culture, with some infrastructure and public land use. The contact zone presents a strong urban, mixed-use character. The high-risers Edge as a dominant physical presence in space overlooking the WBUPP is formed on the west boundary, in north-south direction along the major Yuan Ching Road.

8. WBUPP brownfield

Map 8 presents the WBUPP representative example cases' area in the scale of 1:10.000. It aims to illustrate criteria named Spatial morphology, Size, Accessibility, Historical and Cultural Value, Heritage, Identity / Sence of Place / Historic Identity.

Building and structures marked as Brownfields are preserved and renovated objects, rejuvenated or adapted from their previous use during the renovation of Chinese Garden, the portion of Jurong Lake Gardens. Cloud Pagoda, Twin Pagoda, Grand Arch, Stoneboat, and Tea Pavillion are traditional structures built in the middle of 1970s, whose presence maintains by the Singapore government decision after performed public citizen consultation. They are claimed to be strong heritage elements with a "distinctive cultural character" (Mediacorp, 2026; National Parks Board, 2024).

9. Conclusions - Conceptual schematic diagrams

a. THE ZONES SCHEME

As shown schematically in **Error! Reference source not found.**, the Jurong Lake Gardens spatial zones are not clearly distinguishable. Although the irregular shape of the water body could potentially influence program distribution, this relationship is not strongly reflected in the overall spatial organization. The WBUPP layout does not correspond clearly to areas of program concentration,

such as the lakefront, the island-like landform, or zones adjacent to the surrounding urban fabric. The scale of the development is substantial, with a total usable surface area of approximately 1.26 hectares.

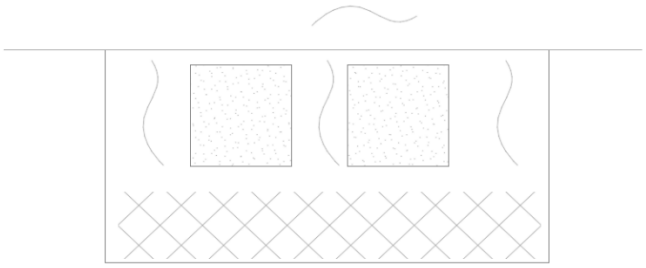


Figure 90. WBUPP Jurong Lake Gardens spatial relation, schematic diagram ZONES, M. Gudac Cvelic

b. THE LONGITUDINAL DISPOSITION SCHEME

As shown schematically in **Error! Reference source not found.**, WBUPPs spatial structure has irregular, but longitudinal form that is greatly intertwined with the adjacent water body: lake Jurong. It is outlined by two primary highways in the north and south, and a tertiary road in the west of the Park. These major roads, though not all of them are in direct contact with the Park, act and influence the WBUPP as Paths.

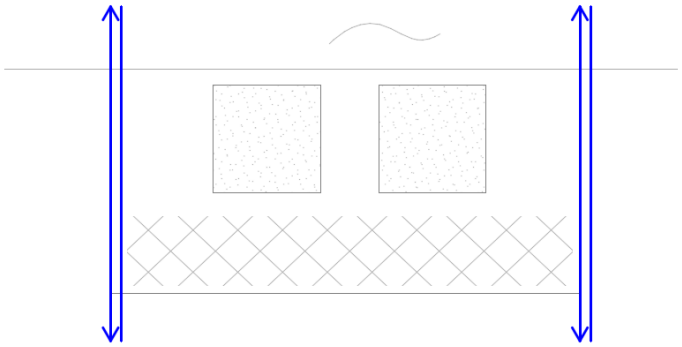


Figure 91. WBUPP Jurong Lake Gardens spatial relation, schematic diagram DISPOSITION, M. Gudac Cvelic

c. THE INTERNAL PATH DISPOSITION SCHEME

As shown schematically in **Error! Reference source not found.**, WBUPPs internal pathways network is irregular. It somewhat follows the longitudinal shape

by definition, because of their purpose to connect different parts, but the rule is not distinct. The pathways differ from densely to sparsely covering areas in the Park, without obvious order that could relate to the program level or function. The connections direction varies from linear, curved, to circular.

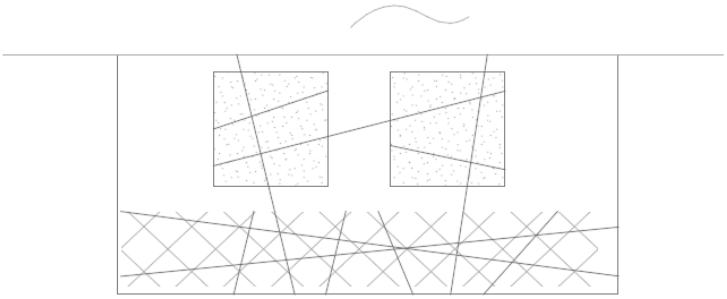


Figure 92. WBUPP Jurong Lake Gardens spatial relation, schematic diagram PATH DISPOSITION, M. Gudac Cvelic

d. THE LONGITUDINAL SCHEME (edge)

As shown schematically in **Error! Reference source not found.**, WBUPP spatial structures Edge is mostly defined by the adjacent high-rises along the western and northern border. Since the western border is much longer than the northern, it is more pronounced. The boundary line along the major road with north-south direction is disrupted by an elongated residential high rises area that faces the central Park area.

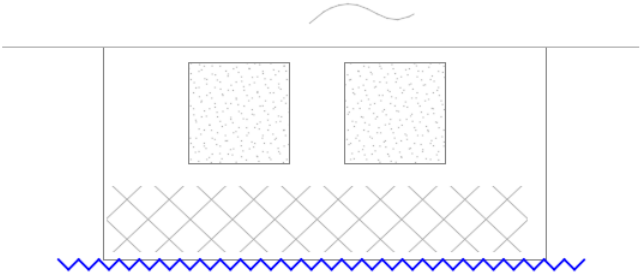


Figure 93. WBUPP Jurong Lake Gardens spatial relation, schematic diagram EDGE, M. Gudac Cvelic

e. THE LANDMARK SCHEME

As shown schematically in **Error! Reference source not found.**, WBUPP does not contain visually prominent elements that can be classified as landmarks with

outstanding visual features. However, the adjacent Singapore Science center building (currently in construction) is expected to be marked as a point of reference when completed. Three major attractions within the Park could be interpreted as landmarks: Floating Wetlands, Floating Pagoda, and Cloud Pagoda.

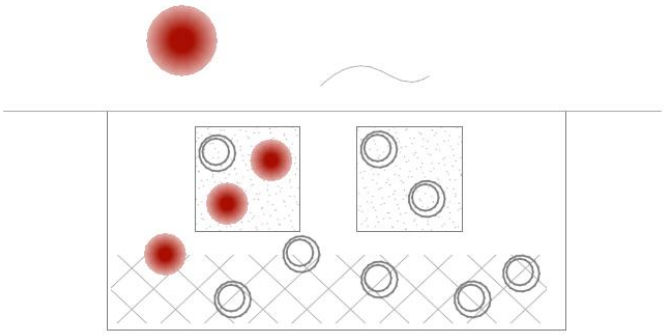


Figure 94. WBUPP Jurong Lake Gardens spatial relation, schematic diagram LANDMARK, M. Gudac Cvelic

f. THE NODES SCHEME

As shown schematically in **Error! Reference source not found.**, this WBUPP example's spatial organization cannot be distinguished or related to the water body contact, urban tissue vicinity, or landmark location.

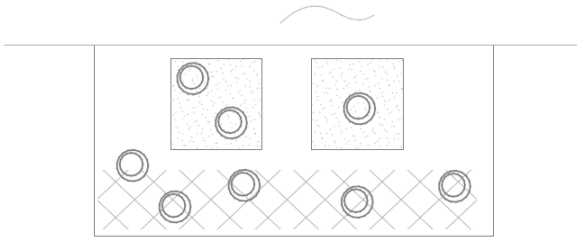


Figure 95. WBUPP Jurong Lake Gardens spatial relation, schematic diagram NODES, M. Gudac Cvelic

8.6.8 Additional Criteria

The WBUPP representative example was analyzed using fifty criteria that originated from scientific literature sources. Additional criteria emerged after the performed analysis. Jurong Lakeside Gardens has an on-the-water program featuring a wetland area with a boardwalk and covered resting spaces network,

marked as landmark based on an alternative, qualitative characteristics (instead of quantitative, such as height, with vertical physical domination).

Water related program brings strong water character to inland water-related attractions interpreted in contemporary design, integrating the educational level into man-made elements evoking natural ambient.

Circular multimodal dense path network allows good connectivity and acts as an attraction itself, offering covered resting points along the pathways.

High concentration program nodes positioned on well connected, distant locations increases WBUPP’s usability, considering it serves an elevated user concentration volume.

Additional criteria proposed based on Jurong Lake WBUPP example case analysis are On The Water Body Surface/Area Related Program, Program On The Water Body, Water Related Program, Landmark Presence, Program Concentration, Circular Communication Network, Waterfront Communication Network, WBUPP Program Integration, Spatial Enclosure Diversity, Edge, Water Contact Intensity.

8.7 WBUPP REPRESENTATIVE EXAMPLE CASE # 5 BIIDASIGE PARK, PORT LANDS, TORONTO, CANADA

8.7.1 Overview

Biidaasige Park is located on Ookwemin Minising (formerly Villiers Island) in Toronto's Port Lands (Figure 96, Figure 97). The park exemplifies an integrated approach to climate resilience, ecological remediation, and placemaking at an unprecedented scale. The name "Biidaasige," pronounced "bee-daw-si-geh," means "sunlight shining toward us" in Anishinaabemowin/Ojibwemowin, reflecting the project's commitment to Indigenous partnership and cultural placekeeping from its inception (Waterfront Toronto, 2026).

The park opened its first 50 acres in July 2025, with an additional 10 acres scheduled for completion in 2026. This project transformed a formerly contaminated, flood-prone industrial landscape into a $1.4 billion tri-government investment that protects 174 hectares of Toronto's eastern waterfront from flooding while creating foundational infrastructure for a mixed-use urban district with approximately 14,000 new residents and 3,000 jobs (Ferreira, 2025). The transformation is shown through Figure 98, Figure 99, Figure 100, Figure 101, Figure 102, Figure 103, and Figure 104.

The park is on the northern edge of Ookwemin Minising, a newly created 39.6-hectare island at the mouth of the Don River. Biidaasige Park demonstrates an integrated response to contemporary urban challenges: it addresses climate adaptation, ecological restoration, contaminated land remediation, and equitable public space creation simultaneously. This integration distinguishes the Port Lands project from conventional approaches that separate these functions into competing infrastructure systems.

Future phases will add more parkland and a learning center in 2026, while residential development on Ookwemin Minising is planned to transform the island into a mixed-use neighborhood by the early 2030s (Ferreira, 2025).



Figure 96 Biidaasige Park, 2025, Google Earth Pro (Google, 2026a)

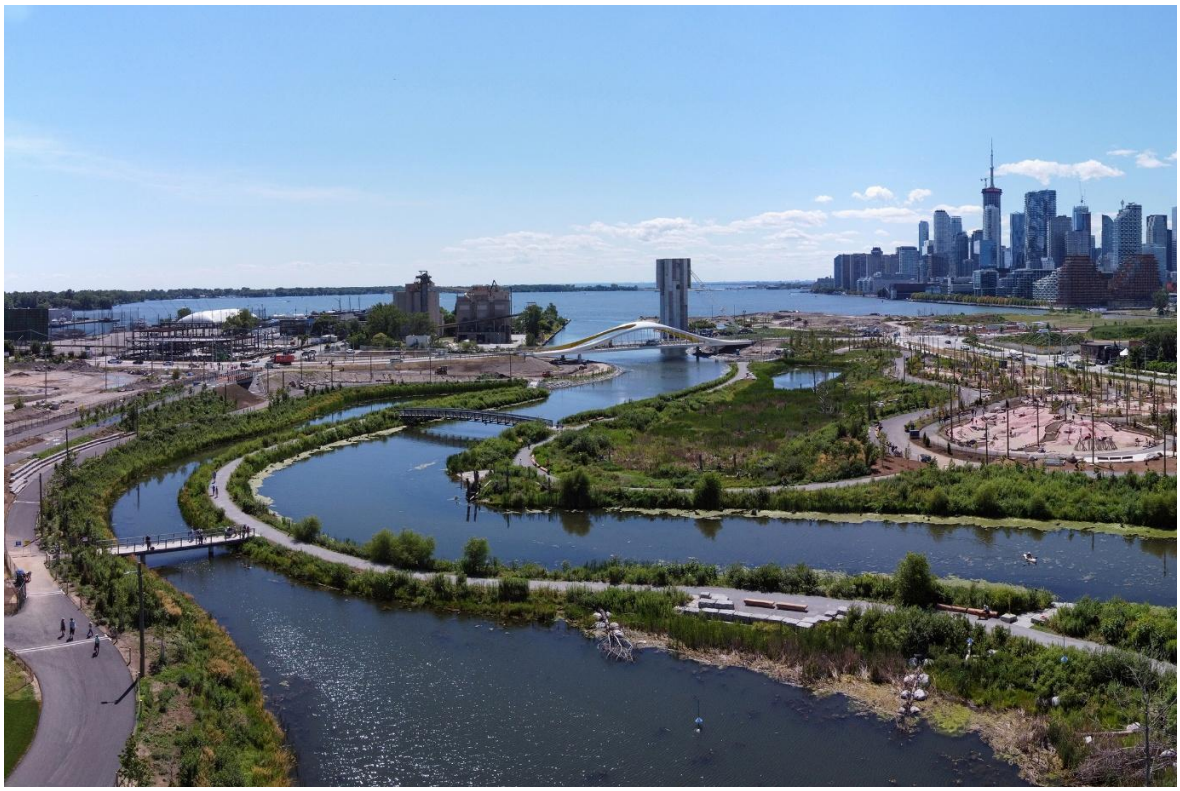


Figure 97 Biidaasige Park, 2025, Credits: By Canmenwalker - Own work, CC BY 4.0, (Wikimedia Commons, 2026. File:Ookwemin Minising 2025.jpg [Online]. Available: https://commons.wikimedia.org/w/index.php?curid=173768534 [Accessed 02.01.2026.]

8.7.2 History/Previous Land Use

The Port Lands, covering 300 hectares, comprise Toronto's southeastern waterfront. Before European colonization and 19th-century industrial development, this landscape was organized around the Don River delta– a complex coastal ecosystem characterized by seasonal inundation, sediment deposition, and shallow-water habitat creation. This area was integral to the territories of the Anishinaabemowin, Haudenosaunee, and Mi'kmaq peoples, who used the productive wetlands and fisheries for sustenance and trade (Ferreira, 2025).

Colonial transformation began in 1912 with the construction of the Keating Channel– a major engineering intervention that diverted the Don River westward into Toronto Harbour via a sharp 90-degree bend, opening the natural delta for industrial development (Wikipedia, 2026h).

The Port Lands became Toronto's primary working waterfront, featuring grain terminals and export infrastructure, shipping terminals, petroleum and chemical processing, heavy manufacturing, and waste management facilities (City of Toronto, 2025).

The Keating Channel and adjacent waterways accumulated contaminated sediments. The rigid 90-degree bend concentrated hydrological stress, creating extreme flood vulnerability during precipitation events. By 1989, the Port Lands had accumulated an estimated 2.5 million cubic meters of contaminated soil requiring remediation or removal. In 1989, the U.S.-Canadian water governing body identified Toronto Harbour as one of 43 "Areas of Concern" on the Great Lakes due to severe contamination and ecosystem degradation. This triggered the establishment of a Remedial Action Plan (RAP) with objectives for environmental restoration and community health improvements (City of Toronto, 2025).

The RAP process initiated collaborative planning among the Toronto and Region Conservation Authority (TRCA), City of Toronto, Ontario Ministry of the Environment, Waterfront Toronto (established in 2002 as an agency dedicated to revitalization), and federal government agencies. Planning from 1989to 2004

produced foundational concepts for the Port Lands transformation: recognition that flood protection infrastructure could be integrated with ecological restoration; commitment to remediate contaminated soils to protective standards; a vision for transformation from industrial monoculture to a mixed-use waterfront neighborhood; and understanding that landscape-based solutions were preferable to conventional gray infrastructure (dikes, levees). By 2004, agreement on the need for an integrated design approach was achieved (Waterfront Toronto, 2022).



Figure 98, Biidaasige Park, Port Lands, 2006., Google Earth Pro (historical imagery) (Google, 2026a)



Figure 99, Biidaasige Park, Port Lands, 2009., Google Earth Pro (historical imagery) (Google, 2026a)



Figure 100, Biidaasige Park, Port Lands, 2015., Google Earth Pro (historical imagery) (Google, 2026a)



Figure 101, Biidaasige Park, Port Lands, 2019., Google Earth Pro (historical imagery) (Google, 2026a)

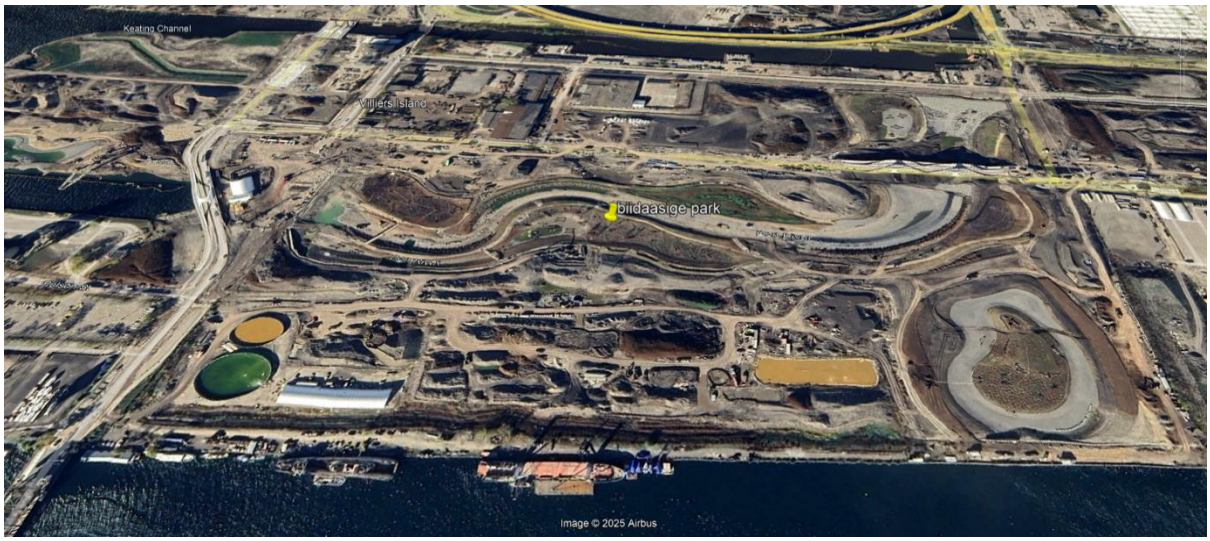


Figure 102, Biidaasige Park, Port Lands, 2022., Google Earth Pro (historical imagery) (Google, 2026a)

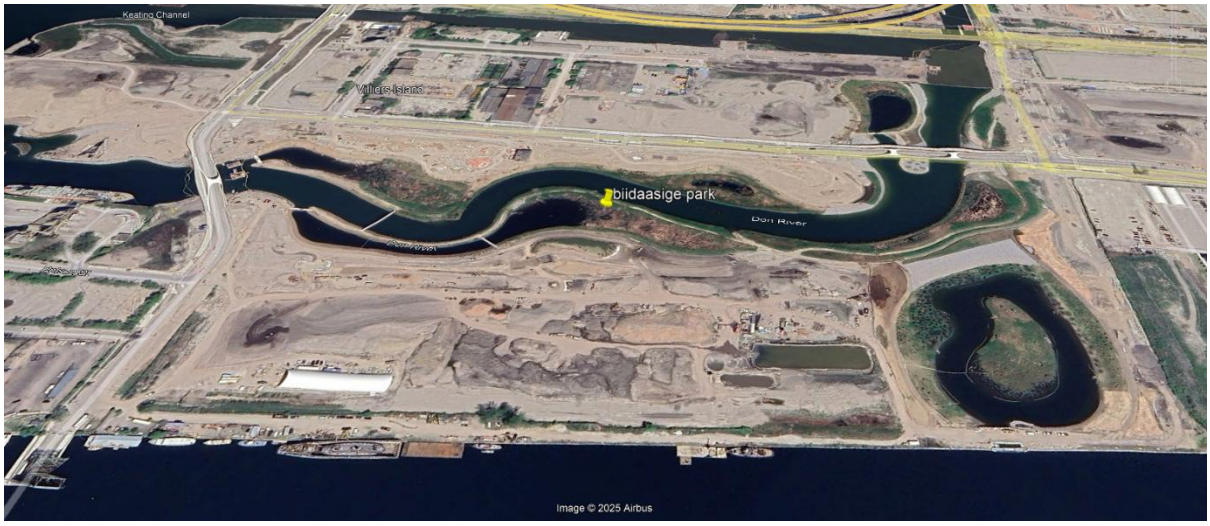


Figure 103, Biidaasige Park, Port Lands, 2024., Google Earth Pro (historical imagery) (Google, 2026a)



Figure 104, Biidaasige Park, Port Lands, 2025., Google Earth Pro (historical imagery) (Google, 2026a)

8.7.3 Planning/Design/Building Process

In 2007, Waterfront Toronto launched an international design competition seeking an integrated solution for flood protection, ecological restoration, brownfield remediation, and future urban development within the Port Lands. The winning proposal by Michael Van Valkenburgh Associates (MVVA), *Port Lands Estuary*, departed from conventional flood-control approaches by restoring the natural mouth of the Don River rather than relying solely on engineered flood barriers. The proposal combined river naturalization, wetland restoration, flood protection, public open space, and mixed-use development within a single landscape framework (Blander, 2025).

The project subsequently underwent a comprehensive environmental assessment process addressing hydrology, ecology, infrastructure, contaminated land remediation, and future urban development. Extensive public consultation, collaboration with Indigenous communities, technical investigations, and coordination among multiple regulatory agencies ensured that ecological restoration, engineering, and land-use planning were integrated throughout the approval process (The Waterfront Secretariat, 2025).

Following regulatory approval, the concept was refined through advanced hydrodynamic modelling, ecological design, and infrastructure planning. River morphology, vegetation communities, floodplain design, and public spaces were developed using scientific modelling and ecological principles, while transportation, utilities, and flood-control infrastructure were coordinated within the broader waterfront redevelopment strategy (LimnoTech, 2025).

A major component of implementation involved large-scale brownfield remediation. More than one million cubic metres of contaminated soil were treated using techniques such as bioremediation and soil washing before being reused within the site where appropriate, substantially reducing waste and supporting sustainable construction practices (Careri, 2026).

Construction was undertaken between 2017 and 2025 through a series of coordinated phases that included river excavation, wetland creation, bridge and infrastructure construction, landscape establishment, and the installation of public amenities. The restored Don River was connected to Lake Ontario in 2024, and Biidaasige Park officially opened in July 2025. Ecological monitoring commenced during implementation to evaluate vegetation establishment, habitat development, and the return of native wildlife, supporting an adaptive management approach (Waterfront Toronto, 2022).

A distinguishing feature of the project was its collaborative delivery model, in which landscape architects, engineers, ecologists, construction specialists, and public agencies worked concurrently rather than sequentially. Waterfront Toronto coordinated the process while maintaining a long-term sustainability vision, and Indigenous communities participated as active partners in governance, design, place-naming, ecological restoration, and cultural interpretation. This integrated

planning approach enabled the simultaneous achievement of environmental restoration, flood resilience, public space creation, and urban redevelopment objectives (Blander, 2025; Ferreira, 2025).

8.7.4 Program

Biidaasige Park adopts a flexible, multifunctional program that integrates recreation, ecological restoration, education, and social interaction within a unified landscape. Rather than assigning spaces to single uses, the park is designed to accommodate a range of activities while encouraging interaction between people and the restored river environment (Blander, 2025).

Recreational amenities include nature-based playgrounds, picnic areas, trails, dog parks, and facilities for canoeing and kayaking. The playgrounds incorporate Indigenous-inspired animal sculptures and landscape-based play elements that combine recreation with cultural interpretation and environmental learning. Approximately six kilometres of pedestrian and cycling trails connect the park to Toronto's regional active transportation network, while accessible pathways and river-edge platforms provide opportunities for walking, birdwatching, and direct engagement with the waterfront (Ferreira, 2025).

The landscape also functions as ecological infrastructure. Upland meadows, forest corridors, wetlands, and the Don Greenway support flood mitigation, habitat creation, biodiversity, and ecological connectivity. Central to the project is the creation of a one-kilometre naturalized river channel and approximately 13 hectares of new coastal wetlands, restoring ecological processes while providing public access to the river (Toronto and Region Conservation Authority TRCA, 20026; LimnoTech, 2025).

Indigenous knowledge is embedded throughout the park through place-naming, interpretive elements, and wayfinding features such as marker trees developed in collaboration with Indigenous partners. Supporting amenities, including seating, picnic facilities, public services, and interpretive signage, enhance visitor experience while reinforcing the park's educational and cultural functions (Ferreira, 2025).

8.7.5 Context

Biidaasige Park is located within Toronto's Port Lands, the city's former industrial waterfront and one of its largest brownfield redevelopment areas. Historically characterized by contaminated land and flood risk, the area required extensive flood protection and environmental remediation before redevelopment could occur, making the park a key component of the broader Port Lands revitalization strategy (Wikipedia, 2026h).

The park functions at multiple spatial scales. At the neighbourhood level, it will serve as the primary public open space for the emerging Ookwemin Minising community, while at the city scale it forms part of Toronto's continuous waterfront park system and regional trail network, linking the Inner Harbour with adjacent parks and recreational destinations (Waterfront Toronto, 2025).

The redevelopment of the Port Lands represents a transition from an industrial waterfront to a mixed-use urban district centred on recreation, ecology, housing, and cultural activities. Biidaasige Park reflects this transformation while acknowledging the site's industrial heritage through the preservation of selected waterfront infrastructure, interpretation of maritime history, and visual connections to active port facilities.

The park is designed to support sustainable mobility through integration with Toronto's public transport, cycling, pedestrian, and waterfront trail networks, while also providing direct access for non-motorized watercraft. The surrounding district is planned as a mixed-use neighbourhood combining residential, commercial, community, and recreational functions, while retaining portions of the Port Lands for continued maritime and industrial activities (Ferreira, 2025).

8.7.6 Sustainability

Biidaasige Park was developed within the framework of Waterfront Toronto's Sustainability Framework, which integrates environmental, economic, and social sustainability through the principle of achieving a positive net impact on both the site and the city (Waterfront Toronto, 2022). The project aligns with the City of

Toronto's Biodiversity Strategy by emphasizing ecological restoration, climate resilience, ecosystem services, and human well-being (Santos, 2021).

Environmental sustainability is achieved through the restoration of natural river and wetland systems informed by advanced hydrodynamic and sediment transport modelling. This science-based approach guided channel design, vegetation establishment, and habitat creation to ensure long-term ecological function and flood resilience. Complementary measures, including bioretention systems, wetlands, permeable surfaces, and extensive native planting, improve stormwater management, water quality, biodiversity, and urban climate regulation (Waterfront Toronto, 2022).

A defining feature of the project is its role as climate-resilient infrastructure. The restored floodplain is designed to accommodate extreme flood events, protecting approximately 174 hectares of downtown Toronto while simultaneously creating high-quality public open space and ecological habitat. Tree planting and native vegetation further contribute to urban cooling, carbon sequestration, and increased ecological resilience (Careri, 2026).

Long-term sustainability is supported through public ownership by the City of Toronto and collaborative governance involving Indigenous communities, conservation organizations, and academic institutions. These partnerships support ecological monitoring, adaptive management, and ongoing research, positioning the park as a living laboratory for urban ecological restoration and climate adaptation (Ferreira, 2025).

Social sustainability is reinforced through universal accessibility, free public access, community programming, and the meaningful integration of Indigenous knowledge throughout the planning, design, and management processes. Rather than treating Indigenous heritage as a symbolic addition, the project incorporates Indigenous perspectives into governance, landscape design, ecological restoration, and place interpretation, providing a model for inclusive and reconciliatory urban waterfront redevelopment (City of Toronto, 2025).

8.7.7 Spatial Analysis

Thematic maps created within the process of spatial analysis are shown on Figures 78-89, in Appendix, 3, chapter 3.5.

1. WBUPP Position within National Territory

Map 1 shows the location of WBUPP within the country's national territory. WBUPP is in southern Canada, in the province of Ontario. The area is situated between Hudson Bay, part of the Arctic Ocean, and four of the five Great Lakes: Superior, Huron, Erie, and Ontario.

2. WBUPP Position within Urban Structure

Map 2 shows the location of the WBUPP case study within the urban structure. The graphic illustrates its spatial relationship to the city center. Toronto is the capital of the province of Ontario, located on Lake Ontario (Wikipedia, 2026h). WBUPP is located within the larger industrial waterfront area known as the Port Lands. It occupies a central position relative to the historic city center and the city’s territorial limits.

3. WBUPP Area

Map 3 shows the area of the WBUPP representative example cases at a scale of 1:10,000. It illustrates criteria such as spatial morphology, size, accessibility, and space management.

The WBUPP range is determined by OSM data, which was further verified by multiple internet sources (City of Toronto, 2025) and the Google Earth Pro tool (Google, 2026a). The WBUPP area includes the completed portion of the intervention, with the remaining part planned for completion in 2026 (The Port Lands, 2026).

The water surface is represented by the water body adjacent to the WBUPP area: Lake Ontario, with the Don River cutting through WBUPP. Additional water surfaces include a pond and a secondary Don River channel.

WBUPP boundaries consist of open boundaries, water boundaries, and closed boundaries. The water boundary is the Don River to the north and west. Open

boundaries are mostly related to the existing adjacent roads that surround WBUPP Biidaasige and the small southwest area next to the LaFarge Canada Technical Centre. Since the park was recently opened, it is possible that the actual boundary has not yet been built or is not clearly visible using available graphic tools for research. Closed boundaries make up more than half of WBUPP's perimeter and refer to brownfield and construction sites in the current redevelopment phase.

4. WBUPP Accessibility and Mobility

Map 4 shows the area of the WBUPP representative example cases at a scale of 1:8,000. It illustrates criteria such as spatial morphology, size, accessibility, space management, accessibility by public transportation and mobility, public transport (resting places every 300 m), pedestrian paths, cycling paths, and other public areas (heterogeneity).

Cycleways, footways, and steps run longitudinally within the WBUPP area, with only two bridges crossing the Don River. The network density is low, with joint cycleways and pedestrian paths throughout WBUPP, and footways in the playground and viewpoint areas. The waterway is marked and highlighted in WBUPP's program along the Don River, continuing north and west.

Bus stops are scarce and are located on major roads north of WBUPP.

Open, uncovered parking areas are outside the WBUPP boundaries, mainly to the west and east of the park.

Bicycle parking points are placed along major roads, with one within the WBUPP area in the west and one outside in the north.

One building within the WBUPP area is the Old Fire Hall 30, a small community building owned and operated by the City of Toronto. It is a historic building, formerly used as a fire station. The building was preserved but relocated to its current position to house the park's amenities and services (City of Toronto, 2025).

5. WBUPP Environmental, Health

Map 5 presents the area of the WBUPP representative example cases at a scale of 1:6000. It aims to illustrate criteria such as spatial morphology, size, accessibility, nature-based solutions implementation, water-sensitive urban design, climate change adaptation and mitigation, pedestrian/path/cycling path, urban design (well-being offered by urban design), public restrooms, drinking water fountains (access to drinking water), adaptable spaces, visual impact, sustainable waste management, green areas heterogeneity, sports/recreation areas heterogeneity, ecosystem preservation/restoration, resilience, program/function, well-being, accessibility (public transportation)/mobility, shelter areas, and vitality/concentration.

The viewpoint is in the central south position. The point is obtained from OpenStreetMap and processed in QGIS. Additional points were not added, and verification could not be performed because the necessary information was not available, as Biidaasige Park was opened recently.

Benches are predominantly placed in Zone 1, on the playgrounds and in the outdoor seating area. Zone 2, on the other side of the river, has sparse bench placements along the water's edge.

Drinking water points are located next to program nodes in Zone 1.

Toilets are situated in two locations, next to the major road that is tangential to WBUPP in the north, on each side of the Commissioners Street Bridge.

Waste and recycling points are marked within WBUPP at four locations: one in Zone 1 between the playgrounds, and three in Zone 2, in the southeast, along the path close to the river. It is possible that some positions are not marked or visible through auxiliary graphic tools.

There is no sheltered space in WBUPP Biidaasige. The outdoor seating area is extensive, situated in Zone 1, next to the river on the eastern playground and to the east of the playground. It is lined with trees and surrounded by grassland and the beach.

Playgrounds and sports and recreation outdoor areas are concentrated in Zone 1, north of the Don River. There are two children’s playgrounds and two dog parks

placed adjacent to each other. The large playground in the west is highlighted by the owl-shaped children's play structure, recognized as a landmark.

Grassland areas are found throughout WBUPP, as green surfaces are substantial. They surround the program features in Zone 1 and cover most of Zone 2.

The water surface is lined with rocky and shingle areas in marked places, serving to maintain the river's shape and course and to mark other separate water elements. The beach area is on the Don River edge, next to the outdoor seating area south of the Commissioners Street Bridge.

Trees are graphically represented according to aerial video of WBUPP (CBC, 2025) and graphic imagery related to the WBUPP project (Michael Van Valkenburgh Associates Inc, 2026b). The number and location of the trees are estimated, as newly planted trees are not easily visible. Lines of planted trees follow internal paths.

6. WBUPP social, well being

Map 6 presents the WBUPP representative example cases' area at a scale of 1:6000. It aims to illustrate criteria such as spatial morphology, size, space management, accessibility, implementation of tourist activities, historical and cultural value, climate change adaptation and mitigation, pedestrian/path/cycling path, urban design (well-being offered by urban design), adaptable spaces, sports/recreation areas heterogeneity, other public areas heterogeneity, program/function, well-being, heritage, accessibility (public transportation)/mobility, vitality/concentration, and identity /sense of place/historic identity.

Building use enclosure and coverage graphic symbols indicate enclosed, covered, and open spaces within WBUPP. In Biidaasige Park, the single building within WBUPP is marked as enclosed. The covered space is a central outdoor seating area with a textile canopy. Open spaces include sports and recreation areas, outdoor seating areas, and playgrounds.

A landmark marker within WBUPP highlights The Owl, a children's playground structure. Although the structure is not visually prominent due to its height, it is

situated on an elevated park point and serves as a distinctive reference point (City of Toronto, 1998 – 2026).

The artwork location is marked in the northeast area below the Commissioners Street Bridge, in Zone 2 of WBUPP.

Fishing points are marked within WBUPP at three locations on the Don River: two in Zone 1 and one in Zone 2. All three are close to the only bridge that allows crossing between zones.

Boat slipways are marked within WBUPP at two locations: one in Zone 1 near the bridge that allows zone crossing, and the second centrally located in Zone 2. Both slipways are suitable for paddle sports equipment users to access the water.

Benches, playgrounds, dog parks, and sports recreation areas are shown on this map. Their locations and characteristics are explained in Chapter Spatial Analysis, Section 5.

7. WBUPP self-sufficiency, mixed use, educative, land/building use context

Map 7 presents the WBUPP representative example cases' area at a scale of 1:8000. It aims to illustrate criteria such as spatial morphology, size, space management, self-sufficiency, employment opportunities, implementation of tourist activities, mixed development, program/function, proximity of social facilities (school facilities, homes for the elderly, health facilities), proximity of commercial facilities, and educative (cultural) facilities/services, as well as vitality/concentration.

Building use shows the built environment within the WBUPP area and around its perimeter. The single building within WBUPP provides public services for the park. Most buildings in the contact area are commercial or house catering facilities. The empty land is either under construction or designated as a brownfield site.

The contact zone has a strong industrial character and is clearly undergoing regeneration.

8. WBUPP brownfield

Map 8 presents the WBUPP representative example cases' area at a scale of 1:6000. It aims to illustrate criteria such as spatial morphology, size, accessibility, historical and cultural value, heritage, and identity /sense of place/historic identity.

The building within the WBUPP area marked as brownfield is Old Fire Hall 30, a small community building owned and operated by the City of Toronto. It is a historic building, formerly used as a fire station. The building was preserved but relocated to its current position to house the park's amenities and services (City of Toronto, 2025).

9. Conclusions - Conceptual schematic diagrams (spatial schemes/conceptual diagrams/schematic diagrams)

a. THE ZONES SCHEME (Association)

As shown in **Error! Reference source not found.**, the Biidaasige Park zones are clearly distinguishable, separated by the Don River water surface. The north and south zones differ in program type and concentration. The construction size is significant; the surface areas range from over 80,000 square meters to over 110,000 square meters of usable space.

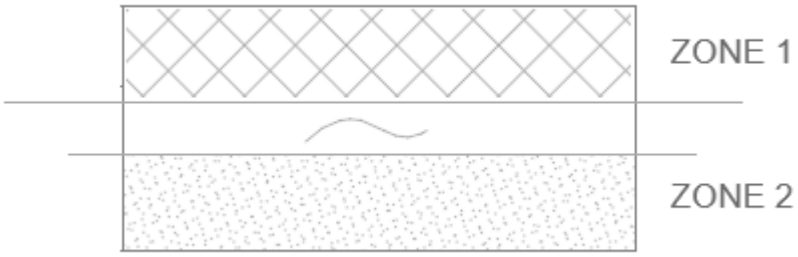


Figure 105 WBUPP Biidaasige Park spatial relation, schematic diagram ZONES, M. Gudac Cvelic

b. THE LONGITUDINAL DISPOSITION SCHEME (Papatheochari and Coccossis)

As shown in **Error! Reference source not found.**, WBUPP's spatial structure has a longitudinal form outlined by two primary highways to the north and west. These major roads act as and influence the WBUPP as paths.

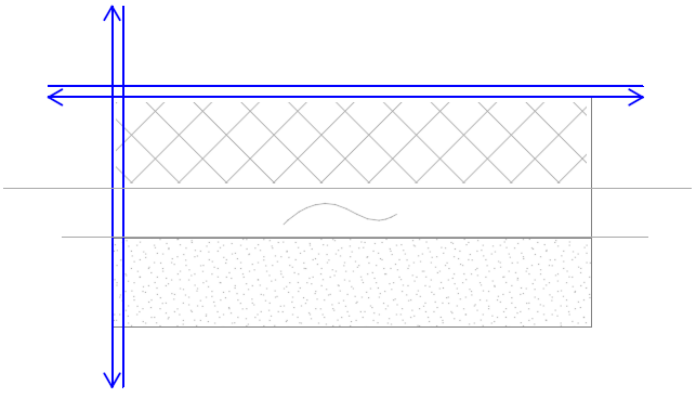


Figure 106 WBUPP Biidaasige Park spatial relation, schematic diagram DISPOSITION, M. Gudac Cvelic

c. THE INTERNAL PATH DISPOSITION SCHEME (Papatheochari and Coccossis)

As shown in **Error! Reference source not found.**, WBUPP's internal pathway scheme is longitudinal, following the park's shape and zone division. There are a limited number of river crossings, which makes the two spatial zones more distinct. The pathways in the north zone cover the area with greater density than those in the south. This is logical, considering most of the program is concentrated in that zone. The pathway network connections vary in direction, including linear, curved, and circular forms.

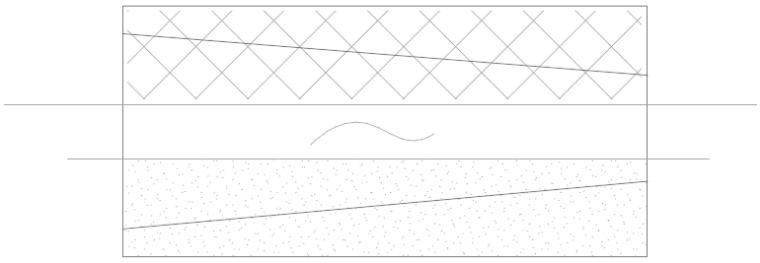


Figure 107 WBUPP Biidaasige Park spatial relation, schematic diagram PATH DISPOSITION, M. Gudac Cvelic

d. THE LANDMARK SCHEME

As shown in **Error! Reference source not found.**, WBUPP does not contain visually prominent elements that can be classified as landmarks with outstanding visual features. However, the closest element that can be defined as a landmark is the playground object called The Owl, based on Indigenous culture placekeeping intentions.

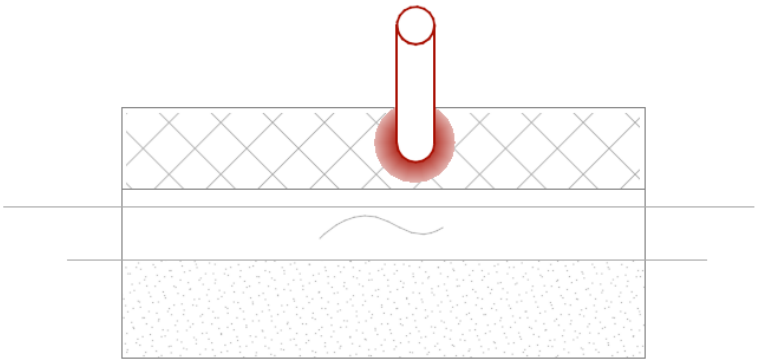


Figure 108 WBUPP Biidaasige Park spatial relation, schematic diagram LANDMARK, M. Gudac Cvelic

e. THE NODES SCHEME

As shown in **Error! Reference source not found.**, Nodes are recognized as significant spots in a city where planned foci are situated. Nodes are program concentration points or areas. In this WBUPP example, their spatial organization is clearly distinguished: almost all program features are placed in the northern zone.

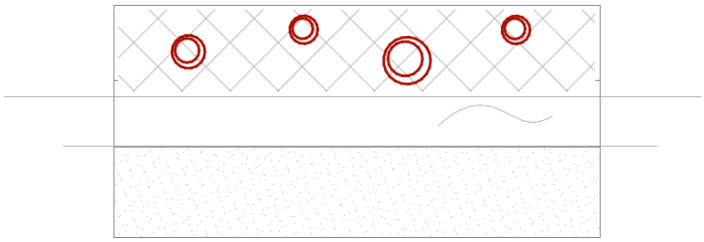


Figure 109 WBUPP Biidaasige Park spatial relation, schematic diagram NODES, M. Gudac Cvelic

8.7.8 Additional Criteria

The WBUPP representative example was analyzed using fifty criteria originating from scientific literature sources. Additional criteria emerged after the analysis.

Biidaasige Park offers a portion of the program that is located on or can be conducted on the water. Paddle sports are facilitated by slipways on both sides of the Don River. The waterway is marked along the park's portion of the Don River and continues further up and down the river. Since the waterway is so clearly marked and these activities are highlighted in the WBUPP amenities program, the water boundary is defined as a type of boundary that would not be considered in urban public parks not adjacent to a water body. Fishing points are designated and marked areas for fishing, and they are adequately paved. The riverbank is constructed using materials resistant to weather conditions.

The park's name and playground equipment are selected and designed with special attention to Indigenous culture. Indigenous placekeeping integrates Indigenous values and teachings into the design. Elements include Indigenous plantings such as Sacred Tobacco, White Sagebrush, and Staghorn Sumac; interpretive signage; Dodem Animal Sculptures; Sturgeon Stones; a Fire Holder for ceremony; a shade structure; public art with the Lassonde Art Trail; and marker trees (Toronto, 1998–2026).

Additional criteria proposed based on the Biidaasige Park WBUPP case analysis are: On the Water Body Surface/Area Related Program, Program on the Water Body, Program in the Water Body, Water Related Program, Multi-Zoned Spatial Organization, Program Spatial Organization, Landmark Presence, Program Concentration, Waterfront Communication Network, WBUPP Program Integration, Spatial Enclosure Diversity, Edge, and Water Contact Intensity.

8.8 Systematic Park Comparison by Categories

After WBUPP representative example cases analysis was performed, a systematic comparison is presented in Table 42 that comprises all criteria through which they were analyzed. The Table 42 presents fifty criteria, systematized in three groups: Economic, Environmental, and Social. Criteria group is stated by color and name, in column 1. Criterion name is stated in column 2. Each criterion has categories according to which WBUPP were classified. Categories range

from Yes and No options, to the numbered descriptive categories. They are stated in column 3. Criteria were found in scientific source literature and modified to achieve applicability for WBUPP representative example cases analysis. Criteria theoretical origin, filtering, classification, modification and application process is explained in Chapter 8. Urban-planning criteria. Criterion scientific source is stated in column 4.

There are five WBUPP representative example cases. Each is presented in two columns. The criterion-based assigned value (response) is inserted in the left column belonging to WBUPP. The checkbox marked YES, if the specific criterion is presented graphically on a spatial organization map, is inserted in the right column belonging to WBUPP. The stated information is presented in columns 5-14. Column 15, last column, names the Map number in case a criterion is graphically presented.

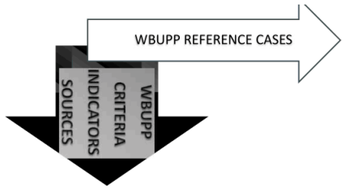
Table 42 WBUPP Representative Example Cases, Comparative Table with 50 Criteria Analysis Result, M. Gudac Cvelic

WBUPP REFERENCE CASES

WBUPP INDICATORS SOURCES CRITERIA

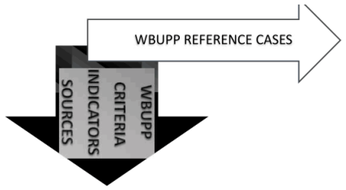
WBUPP REFERENCE CASES ANALYSIS CRITERIA		CATEGORIES	CRITERIONs SCIENTIFIC SOURCE	Abandoibarra Bilbao Spain		Jubileumsparken Gothenburg Sweden		Brooklyn Bridge Park New York City USA		Biidaasige Park, Port Lands Waterfront Park Toronto Canada		Jurong Lake Gardens Singapore Singapore		MAP NUMBER THAT GRAPHICALLY REPRESENTS THE CRITERION
				☐ value	☐ presented in thematic map	☐ value	☐ presented in thematic map	☐ value	☐ presented in thematic map	☐ value	☐ presented in thematic map	☐ value	☐ presented in thematic map	
				empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	
ECONOMIC	**PLANNING**	1. Yes 2. No	Giovinazzi, O. and Moretti, M. (2010); Mrak, I., Ambruš, D., & Marović, I. (2022); Rey, E., et.al. (2022)	●	☐		☐		☐	●	☐		☐	
	PROCESS	1. Regional plan 2. City Zoning 3. Masterplan 4. Individual plot planning	Rey, E., et.al. (2022); Mrak, I., Ambruš, D., & Marović, I. (2022)	3. masterplan	☐	4. Individual plot planning	☐	4. Individual plot planning	☐	4. Individual plot planning	☐	4. Individual plot planning	☐	
	SELF-SUFFICIENCY	1. Yes 2. No	Doick et al. (2009)	●	☑		☑	●	☑		☑	●	☑	**7**
	EMPLOYMENT OPPORTUNITIES	1. Yes 2. No	Doick et al. (2009)	●	☑		☑	●	☑		☑	●	☑	**7**
	LOCAL/REGIONAL ECONOMIC REGENERATION	1. Yes 2. No	Doick et al. (2009)	●	☐	●	☐	●	☐		☐	●	☐	
	ALL YEAR USE	1. Yes 2. No	Mrak, I., Ambruš, D., & Marović, I. (2022)	●	☐	●	☐	●	☐	●	☐	●	☐	**5, 6, 7**
	CIRCULARITY OF CONSTRUCTION	1. Yes 2. No	Mrak, I., Ambruš, D., & Marović, I. (2022); Williams J. (2021)		☐		☐	●	☐		☐	●	☐	**4, 5, 6**
	IMPLEMENT TOURIST ACTIVITY	1. Yes 2. No	Mrak, I., Ambruš, D., & Marović, I. (2022)	●	☑	●	☑	●	☑	●	☑	●	☑	**6, 7**
SUM	**8**		**5**											
	SIZE	1.S small 0-5ha 2.M medium 5-20ha 3.L big 20-100ha 4.XL extra big 100+ha	Matković, I. i Jakovčić, M. (2019)	3.L big 20-100ha	☑	2.M medium 5-20ha	☑	3.L big 20-100ha	☑	3.L big 20-100ha	☑	3.L big 20-100ha	☑	**3,4,5,6,7,8**
	POSITION WITHIN NATIONAL TERRITORY	1. Yes 2. No	Matković, I. i Jakovčić, M. (2019)	●	☑	●	☑	●	☑	●	☑	●	☑	**1**
	POSITION WITHIN URBAN/RURAL STRUCTURE	1. Yes 2. No	Matković, I. i Jakovčić, M. (2019)	●	☑	●	☑	●	☑		☑	●	☑	**2**
	PREVIOUS USE	1.port infrastructure 2.port infra.structure/ industrial 3.industrial 4.infrastructure 5.landfill 6.reclaimed land 7.mixed use	Perović, Kurtović Folić, 2012.; Kranjčević, 2016.; Matković, I. i Jakovčić, M. (2019)	2. port infrastructure / industrial	☐	1.port infrastructure	☐	1.port infrastructure	☐	3.industrial	☐	3.industrial	☐	
	SPACE MANAGEMENT	BOUNDARIES: 1. open 2. closed 3. permeable 4. water	Carmona (2010a); Ching, F.D. (1979)	open boundary, closed boundary, water boundary	☑	open boundary, water boundary	☑	open boundary, closed boundary, water boundary	☑	open boundary, closed boundary, water boundary	☑	open boundary, closed boundary, water boundary	☑	**3,4,6,7,8**

WBUPP REPRESENTATIVE EXAMPLE CASES



				Abandoibarra		Jubileumsparken		Brooklyn Bridge Park		Biidaasige Park, Port Lands Waterfront Park		Jurong Lake Gardens		
				Bilbao		Gothenburg		New York City		Toronto		Singapore		
				Spain		Sweden		USA		Canada		Singapore		
				☐ value	☐ presented in thematic map	☐ value	☐ presented in thematic map	☐ value	☐ presented in thematic map	☐ value	☐ presented in thematic map	☐ value	☐ presented in thematic map	
	WBUPP REFERENCE CASES ANALYSIS CRITERIA	CATEGORIES	CRITERIONs SCIENTIFIC SOURCE	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	MAP NUMBER THAT GRAPHICALLY REPRESENTS THE CRITERION
ENVIRONMENTAL	**HISTORICAL AND CULTURAL VALUE**	1. Yes 2. No	Matković, I. i Jakovčić, M. (2019); Throsby D. (2001)		☑		☑	●	☑	●	☑	●	☑	**6,8**
	SPATIAL MORPHOLOGY	1. central 2. irregular 3. linear 4. longitudinal	Sitte (1889); Zucker (1959); Carmona (2014) in Krmpotić Romić, I. (2025)	4. longitudinal	☑	2. irregular	☑	4. longitudinal	☑	2. irregular	☑	2. irregular	☑	**3,4,5,6,7,8**
	ACCESSIBILITY	1. Yes 2. No	Giovinazzi, O. and Moretti, M. (2010); UN-Habitat, (2020)	●	☑	●	☑	●	☑	●	☑	●	☑	**3,4,5,6,8**
	NATURE-BASED SOLUTIONS IMPLEMENTATION	1. Yes 2. No	Bin Z. (2024)	●	☑	●	☑	●	☑	●	☑	●	☑	**5**
	WATER-SENSITIVE URBAN DESIGN (WSUD) INTEGRATION	1. Yes 2. No	Bin Z. (2024); Mrak, I., Ambruš, D., & Marović, I. (2022)	●	☑	●	☑	●	☑	●	☑	●	☑	**5**
	CLIMATE CHANGE ADAPTATION AND MITIGATION INTERVENTIONS	1. Yes 2. No	Zhang, C., Su, Q., & Zhu, Y. (2023); Sabri, M.S.A., et al. (2024); Ibes, D.C. (2016); Mrak, I., Ambruš, D., & Marović, I. (2022); Doick et al. (2009)	●	☑	●	☑	●	☑	●	☑	●	☑	**5,6**
	PEDESTRIAN AND CYCLING PATH NETWORK	1. YES: Well balanced network 2. NO: Sparse path network (ex. X m1 per every 1ha)	Doick et al. (2009); Mrak, I., Ambruš, D., & Marović, I. (2022)	●	☑	●	☑	●	☑	●	☑	●	☑	**4,5,6**
	URBAN DESIGN (WELL-BEING OFFERED BY URBAN DESIGN)	1. Yes 2. No	Mrak, I., Ambruš, D., & Marović, I. (2022)	●	☑	●	☑	●	☑	●	☑	●	☑	**5,6**
	PUBLIC RESTROOMS	1. Yes 2. No, or 1. Well provided 2. Sufficient 3. Scarse (ex. 1 every 1ha)	Mrak, I., Ambruš, D., & Marović, I. (2022)	●	☑	●	☑	●	☑	●	☑	●	☑	**5**
	DRINKING WATER FOUNTAINS (ACCESS TO DRINKING WATER)	1. Yes 2. No	Mrak, I., Ambruš, D., & Marović, I. (2022)	●	☑		☑	●	☑	●	☑	●	☑	**5**
	RENEWABLE ENERGY SOURCES	1. Yes 2. No	Mrak, I., Ambruš, D., & Marović, I. (2022)					●				●		
	ADAPTABLE SPACES	1. Yes 2. No	Mrak, I., Ambruš, D., & Marović, I. (2022); Michael Hough (1984), Ian Bentley (1990), Graham Haughton and Colin Hunter (1994), URBED (1997), Evans et al. (2001), Hildebrand Frey (1999)		☑		☑	●	☑		☑	●	☑	**5,6**
	PUBLIC TRANSPORT - resting places every 300m	1. Yes 2. No	Mrak, I., Ambruš, D., & Marović, I. (2022)	●	☑		☑		☑		☑	●	☑	**4**

WBUPP REPRESENTATIVE EXAMPLE CASES



WBUPP REFERENCE CASES ANALYSIS CRITERIA	CATEGORIES	CRITERIONs SCIENTIFIC SOURCE	Abandoibarra Bilbao Spain		Jubileumsparken Gothenburg Sweden		Brooklyn Bridge Park New York City USA		Biidaasige Park, Port Lands Waterfront Park Toronto Canada		Jurong Lake Gardens Singapore Singapore		MAP NUMBER THAT GRAPHICALLY REPRESENTS THE CRITERION
			☐ value	☐ presented in thematic map	☐ value	☐ presented in thematic map	☐ value	☐ presented in thematic map	☐ value	☐ presented in thematic map	☐ value	☐ presented in thematic map	
			empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	
WAYFINDING	1. Yes 2. No	Mrak, I., Ambruš, D., & Marović, I. (2022), Jamshidi, S. Ensafi, M. Pati, D. (2020); Chen et al. (2009)	●		●		●		●		●		
VISUAL IMPACT	1. Yes 2. No	Mrak, I., Ambruš, D., & Marović, I. (2022); Zhang, C., Su, Q., & Zhu, Y. (2023)	●	☑		☑	●	☑	●	☑	●	☑	**6**
SUSTAINABLE WASTE MANAGEMENT	1. Yes 2. No	Mrak, I., Ambruš, D., & Marović, I. (2022); Üzümcüoğlu, D. (2023) ; Williams J. (2021)	●	☑		☑	●	☑	●	☑	●	☑	**5**
GREEN AREAS heterogeneity	1. Yes 2. No	Mrak, I., Ambruš, D., & Marović, I. (2022); Carmona et.al. (2001/2003) (editor?), Commission of the European Community (1990), Michael Breheny (1990), Andrew Blowers (1993), Hugh Barton (1996), Evans et al. (2001), Hildebrand Frey (1999)	●	☑	●	☑	●	☑	●	☑	●	☑	**5**
SPORTS and RECREATION AREAS heterogeneity	1. Yes 2. No	Mrak, I., Ambruš, D., & Marović, I. (2022); Fusco Girard, L. & Nijkamp, P. (1997)	●	☑	●	☑	●	☑	●	☑	●	☑	**5,6**
OTHER PUBLIC AREAS heterogeneity	1. Yes 2. No	Mrak, I., Ambruš, D., & Marović, I. (2022)	●	☑	●	☑	●	☑	●	☑	●	☑	**4,6**
REDUCE MARINE AND COAST POLLUTION	1. Yes 2. No	Mrak, I., Ambruš, D., & Marović, I. (2022)	●	☐	●	☐	●	☐	●	☐	●	☐	
ECOSYSTEM PRESERVATION/RESTORATION	1. Yes 2. No	Mrak, I., Ambruš, D., & Marović, I. (2022); Doick et al. (2009);); Zhang, C., Su, Q., & Zhu, Y. (2023);	●	☑	●	☑	●	☑	●	☑	●	☑	**5**
MIXED USE, FUNCTIONAL DIVERSITY	1. Yes 2. No	Fusco Girard, L. & Nijkamp, P. (1997); Mrak, I., Ambruš, D., & Marović, I. (2022); Rey et al. (2022) Hauri (2011) Fusco Girard & Nijkamp (1997) , and Michael Hough (1984), Michael Hough (1984) . Randall & Baetz (2015) Bentley (1990) Breheny (1992) Hildebrand Frey (1999) Mrak, Ambruš & Marović (2022) URBED (1997), Evans et al. (2001), Şenik, B., & Uzun, O. (2022)	●	☑		☑	●	☑		☑	●	☑	**7**

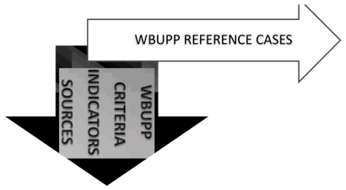
WBUPP REPRESENTATIVE EXAMPLE CASES

WBUPP REFERENCE CASES

WBUPP CRITERIA INDICATORS SOURCES

				Abandoibarra		Jubileumsparken		Brooklyn Bridge Park		Biidaasige Park, Port Lands Waterfront Park		Jurong Lake Gardens		
				Bilbao		Gothenburg		New York City		Toronto		Singapore		
				Spain		Sweden		USA		Canada		Singapore		
				☐ value	☐ presented in thematic map	☐ value	☐ presented in thematic map	☐ value	☐ presented in thematic map	☐ value	☐ presented in thematic map	☐ value	☐ presented in thematic map	
	WBUPP REFERENCE CASES ANALYSIS CRITERIA	CATEGORIES	CRITERIONs SCIENTIFIC SOURCE	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	MAP NUMBER THAT GRAPHICALLY REPRESENTS THE CRITERION
	RESILIENCE	1. Yes 2. No	Mrak, I., Ambruš, D., & Marović, I. (2022); Carmona et.al. (2001/2003) (editor?), Michael Hough (1984), Ian Bentley (1990), Graham Haughton and Colin Hunter (1994), URBED (1997), Evans et al. (2001); (Iturriza et al., 2020); (Wang and Foley, 2021)	●	☑	●	☑	●	☑	●	☑	●	☑	**5**
SUM	**28**		**33**											
SOCIAL	**PROGRAM / FUNCTION**	1. homogeneous 2. heterogeneous	Carr et al (1992); Stanley et al. (2012); Gehl, Gemzoe (2001); Carmona (2015) in Krmpotić Romić, I. (2025); Fusco Girard, L. & Nijkamp, P. (1997)	2. heterogeneous	☑	2. heterogeneous	☑	2. heterogeneous	☑	2. heterogeneous	☑	2. heterogeneous	☑	**5,6,7**
	PROXIMITY OF SOCIAL (SCHOOL FACILITIES, HOME FOR ELDERLY.	1. Yes 2. No	Rey, E., et.al. (2022)	●	☑		☑	●	☑		☑	●	☑	**7**
	PROXIMITY OF COMMERCIAL FACILITIES	1. Yes 2. No	Rey, E., et.al. (2022)	●	☑		☑	●	☑		☑	●	☑	**7**
	WELL-BEING	1. Yes 2. No	Rey, E., et.al. (2022); Zhang, C., Su, Q., & Zhu, Y. (2023);	●	☑	●	☑	●	☑	●	☑	●	☑	**5,6**
	SECURITY (SAFETY)	1. Yes 2. No	Rey, E., et.al. (2022); Üzümcüoğlu, D. (2023); Mrak, I., Ambruš, D., & Marović, I. (2022)	●	☐		☐	●	☐		☐	●	☐	
	HERITAGE	1. Yes 2. No	Rey, E., et.al. (2022) ; ~~*Giovinazzi, O. and Moretti, M. (2010);*~~ Üzümcüoğlu, D. (2023); Ashworth (1999), Mrak, I., Ambruš, D., & Marović, I. (2022), Bilušić M. (2024), Andrew Blowers (1993), and Doick et al. (2009)		☑		☑	●	☑	●	☑	●	☑	**6,8**
	DIVERSITY / SOCIAL INCLUSION	1. Yes 2. No	Rey, E., et.al. (2022); *Doick et al. (2009); Fusco Girard, L. & Nijkamp, P. (1997); Mrak, I., Ambruš, D., & Marović, I. (2022),*	●	☐	●	☐	●	☐	●	☐	●	☐	
	PARTICIPATION	1. Yes 2. No	Rey, E., et.al. (2022); Üzümcüoğlu, D. (2023); Bonney et al., (2023); Green, (2023); Hoyle, (1999); Zakirzianova, (2021); (Moore, 2016)		☐	●	☐	●	☐	●	☐	●	☐	
	EDUCATIVE FACILITIES/SERVICES	1. Yes 2. No	Doick et al. (2009); Burinskienė, M., et al. (2017)	●	☑	●	☑	●	☑	●	☑	●	☑	**7**

WBUPP REPRESENTATIVE EXAMPLE CASES



WBUPP REFERENCE CASES ANALYSIS CRITERIA	CATEGORIES	CRITERIONs SCIENTIFIC SOURCE	Abandoibarra Bilbao Spain ☐ value	Abandoibarra Bilbao Spain ☐ presented in thematic map	Jubileumsparken Gothenburg Sweden ☐ value	Jubileumsparken Gothenburg Sweden ☐ presented in thematic map	Brooklyn Bridge Park New York City USA ☐ value	Brooklyn Bridge Park New York City USA ☐ presented in thematic map	Biidaasige Park, Port Lands Waterfront Park Toronto Canada ☐ value	Biidaasige Park, Port Lands Waterfront Park Toronto Canada ☐ presented in thematic map	Jurong Lake Gardens Singapore Singapore ☐ value	Jurong Lake Gardens Singapore Singapore ☐ presented in thematic map	MAP NUMBER THAT GRAPHICALLY REPRESENTS THE CRITERION
			empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	empty cell= NO evident criteria indicators present ●=YES evident criteria indicators present "text"=criteria category specified within the cell	empty checkbox=criteria IS NOT presented in thematic map checked checkbox=criteria IS presented in thematic map	
ACCESSIBILITY (PUBLIC TRANSPORTATION) / MOBILITY	1. Yes 2. No or 1. no public transport in vicinity 2. mono modal public transport in the vicinity 3. multi modal public transport in vicinity 4. multimodal public transport intersecting	Rey, E., et.al. (2022); Mrak, I., Ambruš, D., & Marović, I. (2022)	●	☑	●	☑	●	☑	●	☑	●	☑	**4,5,6**
INTERVENTIONS THAT DEFINE WATERFRONT	1. Yes 2. No	Mrak, I., Ambruš, D., & Marović, I. (2022)	●	☐	●	☐	●	☐	●	☐	●	☐	
SHELTER AREAS	1. Yes 2. No	Mrak, I., Ambruš, D., & Marović, I. (2022)	●	☑		☑	●	☑	●	☑	●	☑	**5**
VITALITY/ CONCENTRATION	1. Yes 2. No	Carmona et.al. (2001/2003) (editor?), Ian Bentley (1990), Commission of the European Community (1990), Michael Breheny (1990), Graham Haughton and Colin Hunter (1994), Hugh Barton (1996), URBED (1997), Richard Rogers (1997), Evans et al. (2001), Hildebrand Frey (1999)	●	☑	●	☑	●	☑	●	☑	●	☑	**5,6,7**
SENSE OF PLACE	1. Yes 2. No	Carmona et.al. (2001/2003) (editor?), Commission of the European Community (1990), Andrew Blowers (1993), Graham Haughton and Colin Hunter (1994), URBED (1997), Evans et al. (2001), Hildebrand Frey (1999); *Giovinazzi, O. and Moretti, M. (2010)*	●	☐	●	☐	●	☐	●	☐	●	☐	**6,8**
SUM	**14**			**30**									
	50												

8.9 Concluding Remarks on WBUPP Representative Example Cases

The WBUPP representative example cases are selected using an Information-oriented method rather than Random selection to minimize biases. Information-oriented selection maximizes information extraction from limited cases. Cases are chosen based on their anticipated information value, using the method variation called Paradigmatic cases meant for metaphor development in the relevant domain.

Representative cases are chosen in three phases by filtering out those that do not meet specific set of inclusion and differentiation criteria:

First phase excluded WBUPP example cases that are not from the 21st century, near infrastructure, don’t have intense water contact, do not show mostly heterogeneous programs, and do not have a history as industrial or port sites.

First phase resulted in 35 representative cases.

Second phase excluded WBUPP example cases that are not in countries with top 50 GDP per capita income ranking, are not professionally acclaimed and cited in scientific literature, and didn’t meet the medium category of Park green spaces criterion, at least.

Second phase resulted in 12 representative cases.

Third phase excluded WBUPP example cases with sizes S and XL and aimed to select cases that represent the exemplary cases of the regions where majority of example cases included in the screening are located (Europe, North America, Asia), represent different water body types, and have sustainability characteristics implemented.

Third phase resulted in 5 representative cases that are considered as paradigmatic cases and analyzed in detail.

European case Bilbao's Abandoibarra is chosen as a big river case. Gothenburg's Jubileumsparken is selected as a medium sea case. North American cases represent Canada and the USA. Toronto's Biidaasige Park is selected as a big lake example, while Brooklyn Bridge Park is chosen as a big sea example.

Spatial analysis integrates graphic and text analysis from various literature sources. Graphic analysis combines data layers in QGIS, using Open Street Maps and Google satellite as basis maps. Data from Open Street Map's physical features is combined with local open data when available. Verification tools like Google Maps and Google Earth Pro check the accuracy of the information from various sources. Map inaccuracies are corrected directly in QGIS using editing tools.

criteria. The focus is on evaluating the properties of examples to inform future urban-planning criteria for sustainable WBUPP design.

Sustainability characteristics are studied in chapter seven, with additional criteria from literature covering various urban elements. Commonly observed groups include Objectives, Qualities, and Dimensions, among others, which are compared across sustainability aspects. The three primary sustainability pillars—Economic, Social, and Environmental—were selected as the basis for the WBUPP representative cases analysis methodology.

WBUPP representative example cases analysis is performed using fifty criteria selected from the list of 375 identified criteria, emphasizing key spatial elements and characteristics of WBUPP that aid in achieving the final goal. A graphic map set illustrates the broader and detailed spatial context, showcasing WBUPP examples linked to three sustainability dimensions. The map organization process coincided with research analysis, adapting criteria based on results and available information. Criteria categories and ranges were modified several times for clearer presentation. Variations in graphic imagery evolved alongside the research until the final version was finalized for this dissertation.

Graphical data is organized into eight thematic maps, each representing more than one WBUPP factor. Maps are created by extracting elements for visual presentation. Elements are organized with group names, labels, and graphics. Key elements are highlighted for enhanced readability. Total of 39 out of 50 criteria are presented on thematic maps.

As the final WBUPP representative example case analysis part, conceptual diagrams applying Kevin Lynch's (1960) five urban imageability elements are created, by extracting key WBUPP elements from the maps. Paths (movement

channels), edges (boundaries), districts (identifiable areas), nodes (activity foci), and landmarks (reference points)—to abstract WBUPP spatial organization, legibility, and interrelations for enhanced urban functionality and user perception.

The analyzed WBUPP representative example cases show how waterfront parks use culture, water programs, and multi-zoned layouts to create identity and vitality. Culture acts as a contemporary presence, as in Abandoibarra's networked cultural nodes that engage neighborhood, city, and region. Water-based attractions—Jubileumsparken's floating pools, Jurong's wetland boardwalks, Brooklyn Bridge Park's pier reuse, and Biidaasige's paddling spots—serve as experiential generators.

Multi-zoned designs with distinct characters generate dynamism, linked by multimodal paths that structure movement and gather amenities for high user volumes. Anti-pollution features like Brooklyn's sound berms integrate protection into topography. Identity layers emerge through Abandoibarra's cultural reinvention, Biidaasige's Indigenous placekeeping, and broader heritage-ecological strategies that point to proposing criteria additional to the set of 50 analysis criteria. Additional criteria based on the WBUPP representative example cases analysis results are presented in Table 43.

Scientific literature does not cover criteria or standards that involve different water usage, or hybrid implementation of two or more program related criteria into one element.

Empirical analysis of 99 global cases, described in Chapter 7, and five representative WBUPP example cases (Abandoibarra, Jubileumsparken, Biidaasige Park, Brooklyn Bridge Park, and Jurong Lakeside Gardens), described in this chapter, validates systematic criteria application, confirming Hypothesis 3.

Table 43 Additional Criteria For WBUPP Planning And Design, initial proposal, M. Gudac Cvelic

ADDITIONAL CRITERIA, BASED ON THE WBUPP REPRESENTATIVE EXAMPLES ANALYSIS	WBUPP SOURCE
WATER CONTACT INTENSITY	ALL WBUPP
ON THE WATER BODY SURFACE/AREA RELATED PROGRAM	BIIDAASIGE, JURONG, BROOKLYN BRIDGE PARK, JUBILEUMSPARKEN
PROGRAM ON THE WATER BODY	BIIDAASIGE, JURONG, BROOKLYN BRIDGE PARK, JUBILEUMSPARKEN
PROGRAM IN THE WATER BODY	BIIDAASIGE, BROOKLYN BRIDGE PARK, JUBILEUMSPARKEN
WATER RELATED PROGRAM	ALL WBUPP
ANTI-POLLUTION MEASURES	BROOKLYN BRIDGE PARK
CRITERION: SOCIO-CULTURAL AND USER PERCEPTION	ALL WBUPP
COMFORT	ALL WBUPP
USABILITY	ALL WBUPP
PLACEMAKING	BIIDAASIGE
CULTURAL PRESENCE/ACTIVITIES	ABANDOIBARRA, JURONG
MULTI-ZONED SPATIAL ORGANIZATION	ABANDOIBARRA, BIIDAASIGE, BROOKLYN BRIDGE PARK, JUBILEUMSPARKEN
PROGRAM SPATIAL ORGANIZATION	ABANDOIBARRA, BIIDAASIGE, BROOKLYN BRIDGE PARK, JUBILEUMSPARKEN
LANDMARK PRESENCE	ABANDOIBARRA, BIIDAASIGE, BROOKLYN BRIDGE PARK, JUBILEUMSPARKEN
PROGRAM CONCENTRATION, L/XL WBUPP SIZE OR USERS VOLUME	ABANDOIBARRA, BIIDAASIGE, BROOKLYN BRIDGE PARK, JURONG
PROGRAM CONCENTRATION, S/M WBUPP SIZE OR USERS VOLUME	JUBILEUMSPARKEN
CIRCULAR COMMUNICATION NETWORK	ABANDOIBARRA, BROOKLYN BRIDGE PARK, JURONG
WATERFRONT COMMUNICATION NETWORK	ABANDOIBARRA, BIIDAASIGE, BROOKLYN BRIDGE PARK, JURONG
URBAN PARK DESIGN INTEGRATES HERITAGE (HISTORIC LOCAL IDENTITY) ELEMENTS	BIIDAASIGE
URBAN PARK DESIGN INTEGRATES (NATURAL BASED SOLUTIONS) ELEMENTS	BIIDAASIGE
URBAN STRUCTURES DESIGN INTEGRATES WATER (NATURAL) ELEMENTS	BROOKLYN BRIDGE PARK, JURONG
SPORTS AND RECREATION PROGRAM INTEGRATES WATER ELEMENTS	BROOKLYN BRIDGE PARK, JURONG,
SPORTS AND RECREATION PROGRAM INTEGRATES EDUCATIONAL ELEMENTS	BROOKLYN BRIDGE PARK, JURONG
NATURAL PROGRAM INTEGRATES EDUCATIONAL ELEMENTS, BECOMES AN ATTRACTION	JURONG
NATURAL PROGRAM INTEGRATES SOCIAL INCLUSION	JURONG
SPORTS AND RECREATION PROGRAM INTEGRATES CULTURAL ELEMENTS	JUBILEUMSPARKEN
NATURAL INTEGRATES TOURISM (art) INTEGRATES EDUCATIONAL ELEMENTS	JURONG
AQUASCAPING (Wetland design, Phytoremediation design)	JURONG
SPATIAL ENCLOSURE DIVERSITY	ABANDOIBARRA, BIIDAASIGE, BROOKLYN BRIDGE PARK, JURONG, JUBILEUMSPARKEN
EDGE	ABANDOIBARRA, BIIDAASIGE, BROOKLYN BRIDGE PARK, JURONG

9 WBUPP URBAN-PLANNING CRITERIA: RESULTS SYNTHESIS

9.1 Introduction

Urban-planning criteria are defined as systematic, policy-oriented factors that guide the coherent and sustainable development of urban environments. These criteria encompass the evaluative aspects inherent in planning decisions, including social equity, environmental integrity, accessibility, and historical-architectural significance, and serve to establish aims and objectives for planning interventions (Martinelli et al., 2015; Nesticò et al., 2020).

9.2 Development of WBUPP Urban-Planning Criteria

The development of the urban-planning criteria involved a multi-phase process encompassing diverse methodologies, as elaborated throughout the text. A comprehensive overview of this developmental framework is presented in Figure 110.

9.2.1 WBUPP Urban-Planning Criteria Identification

The identified WBUPP urban-planning criteria are based on the WBUPP criteria analysis that guided the detailed analysis of WBUPP representative example cases. The complete process of initial urban-planning criteria identification, analysis, systematization, selection, and refinement is explained in Chapter 6. Cases were first analyzed theoretically using available scientific and non-scientific literature, and then practically through complex spatial-graphical analysis. The practical analysis was conducted using a set of WBUPP analysis criteria in an open-source Geographic Information System tool, specifically QGIS software (QGIS Development Team, 2025), which is well suited for spatial analysis and case study mapping. The analysis results suggested some new criteria, which are explained at the end of each WBUPP representative example case chapter in Chapter 8.

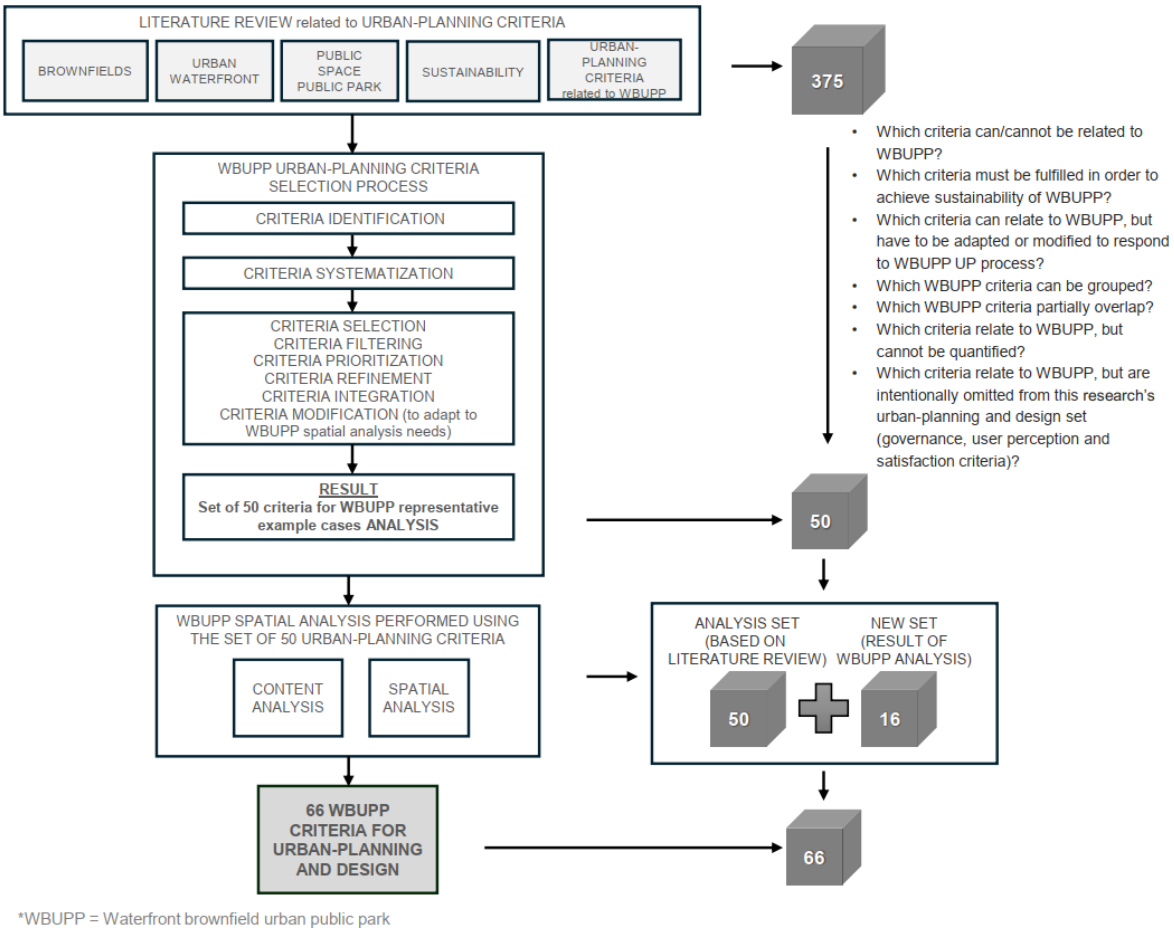


Figure 110 Comprehensive overview of the developmental framework used to derive the 66 WBUPP urban-planning and design criteria, M. Gudac Cvelic

9.2.2 WBUPP Urban-Planning Criteria Filtering and Integration

Criteria identified after analyzing WBUPP representative example cases are filtered and integrated to optimize them both quantitatively and qualitatively, aiming to enhance their specificity. The integration process involved brainstorming ideas and concepts that can be applied using the criteria during the planning and design phase. Certain criteria were classified as extensions of existing criteria already included in the WBUPP analysis set, while others lacked sufficient substance or strength to justify establishing a new individual criterion. Several criteria suggested as direct interpretations of the WBUPP representative

example case analysis results were combined into one. Criteria from the initial selection that were deemed inappropriate for analysis, due to their inability to be represented graphically, were added to the list of “additional” identified criteria. After further consideration, some of these were retained, while others were dismissed as not contributing to the refined set of WBUPP planning and design criteria. Criteria with dismissal and integration properties are presented in Table 44. Strikethrough text with a dark gray background notes the dismissed criterion. Text in the light green background cell marks the integrated criterion. Criteria with no cell background are kept and elaborated further.

Table 44 Criteria For WBUPP Planning And Design, After Identification And Before Integration, M. Gudac Cvelic

Identified Criteria	Source (Scientific Literature, WBUPP Representative Example Case)
Water Contact Intensity	
On The Water Body Surface/Area Related Program	Biidaasige, Jurong, Brooklyn Bridge Park, Jubileumsparken
Program On The Water Body	Biidaasige, Jurong, Brooklyn Bridge Park, Jubileumsparken
Program In The Water Body	Biidaasige, Brooklyn Bridge Park, Jubileumsparken
Water Related Program	
Anti-Pollution Measures	Brooklyn Bridge Park; (Rey et al.) ; Mrak et al. (2022)- Water
~~Criterion: Socio-Cultural And User Perception~~	(Foucault and Miskowiec, 1986; Lefebvre, 1991; Soja, 1996; Dines et al., 2006)
~~Comfort~~	Mrak et al. (2022)
~~Usability~~	
~~Placemaking~~	~~Biidaasige~~
~~Cultural Presence/Activities (Is It Same As Tourism?~~	Abandoibarra, Jurong (Partially)
Multi-Zoned Spatial Organization	Abandoibarra, Biidaasige, Brooklyn Bridge Park, Jubileumsparken
Program ~~Nodes~~ Spatial Organization	Abandoibarra, Biidaasige, Brooklyn Bridge Park, Jubileumsparken
Landmark Presence	Abandoibarra, Biidaasige, Brooklyn Bridge Park, Jubileumsparken
Program Concentration, L/Xl WBUPP Size Or Users Volume	Abandoibarra, Biidaasige, Brooklyn Bridge Park, Jurong
Program Concentration, S/M WBUPP Size Or Users Volume	Jubileumsparken
Circular Communication Network	Abandoibarra, Brooklyn Bridge Park, Jurong
Waterfront Communication Network	Abandoibarra, Biidaasige, Brooklyn Bridge Park, Jurong
Urban Park Design Integrates Heritage (Historic Local Identity) Elements	Biidaasige (Indigenous Elements Integrated Into Childrens Playground Objects)
Urban Park Design Integrates (Natural Based Solutions) Elements	Biidaasige (Indigenous Elements Integrated Into Childrens Playground Objects)
Urban Structures Design Integrates Water (Natural?) Elements	Brooklyn Bridge Park, Jurong (Fountain, Water Wall

Identified Criteria	Source (Scientific Literature, WBUPP Representative Example Case)
Sports And Recreation Program Integrates Water Elements	Brooklyn Bridge Park, Jurong (Childrens Playground With Water Elements Integrated, Clusia Cove Water Playground, Water Wall Court)
Sports And Recreation Program Integrates Educational Elements	Brooklyn Bridge Park, Jurong (Childrens Playground With Water Elements Integrated, Clusia Cove Water Playground)
Natural Program Integrates Educational Elements, Becomes An Attraction	Jurong (Floating Wetlands, Abc Water Plaza)
Natural Program Integrates Social Inclusion	Jurong (Allotment Gardens, Therapeutic Garden For Adults With Dementia, For Children With Autism And Adhd, Dog Park)
Sports And Recreation Program Integrates Cultural Elements	Jubileumsparken (Childrens Playground Hosts Play Structures Created In Collaboration With An Artist)
Natural Integrates Tourism (Art) Integrates Educational Elements	Jurong (Floral Garden)
~~Aquascaping (Wetland Design, Phytoremediation Design)~~	Jurong
Spatial Enclosure Diversity	Abandoibarra, Biidaasige, Brooklyn Bridge Park, Jurong, Jubileumsparken
Edge	Abandoibarra, Biidaasige, Brooklyn Bridge Park, Jurong

The Socio-Cultural and User Perception criterion is dismissed. A more detailed analysis of a greater number of example cases would be required to obtain necessary information, either through an on-site survey in which users' perceptions are collected, or through literature-based data that is not available.

The Comfort, Usability, Placemaking, and Cultural Presence/Activities criteria are dismissed because their properties are already included in other WBUPP planning and design criteria.

Program Concentration, L/XL WBUPP Size or User Volume, and Program Concentration, S/M WBUPP Size or User Volume are combined into one criterion with two categories.

The following criteria are combined into one criterion with nine categories: Urban Park Design Integrates Heritage (Historic Local Identity) Elements, Urban Park Design Integrates (Nature-Based Solutions) Elements, Urban Structures Design Integrates Water (Natural) Elements, Sports and Recreation Program Integrates Water Elements, Sports and Recreation Program Integrates Educational Elements, Natural (Health) Program Integrates Educational Elements and Becomes an Attraction, Natural (Health) Program Integrates Social Inclusion,

Sports and Recreation Program Integrates Cultural Elements, and Natural (Health) Integrates Tourism (Art) Integrates Educational Elements.

The Aquascaping criterion is dismissed because its properties are already included in other WBUPP planning and design criteria.

9.2.3 WBUPP Urban-Planning Criteria Elaboration

The WBUPP urban-planning criteria process continues after identification and integration of the criteria. Each criterion is elaborated individually, either by establishing specific categories or in a descriptive manner. Further development opportunities, constraints, or limitations for each criterion are stated when necessary. Table 45 presents WBUPP urban-planning and design criteria elaboration stage, after they were identified, filtered and integrated. Figure 111**Error! Reference source not found.** illustrates the indicator-development process using a multi-method approach and shows examples of the results produced by each method.

Table 45 50+16 Criteria For WBUPP Planning And Design, After Identification And Integration, M. Gudac Cvelic

WBUPP URBAN-PLANNING AND DESIGN CRITERIA, 50+16 (after identification and integration)	
DIMENSION	**CRITERION**
ECONOMIC	PLANNING
	PROCESS
	SELF-SUFFICIENCY
	EMPLOYMENT OPPORTUNITIES
	LOCAL/REGIONAL ECONOMIC REGENERATION
	ALL YEAR USE
	CIRCULARITY CONSTRUCTION
	IMPLEMENT TOURIST ACTIVITY
ENVIRONMENTAL	SIZE
	POSITION WITHIN NATIONAL TERRITORY
	POSITION WITHIN URBAN/RURAL STRUCTURE
	PREVIOUS USE
	SPACE MANAGEMENT
	HISTORICAL AND CULTURAL VALUE
	SPATIAL MORPHOLOGY
	ACCESSIBILITY
	NATURE-BASED SOLUTIONS IMPLEMENTATION
	WATER-SENSITIVE URBAN DESIGN (WSUD) INTEGRATION
	CLIMATE CHANGE ADAPTATION AND MITIGATION INTERVENTIONS
	PEDESTRIAN AND CYCLING PATH NETWORK
	URBAN DESIGN (WELL-BEING OFFERED BY URBAN DESIGN)
	PUBLIC RESTROOMS
	DRINKING WATER FOUNTAINS (ACCESS TO DRINKING WATER)
	RENEWABLE ENERGY SOURCES

WBUPP URBAN-PLANNING AND DESIGN CRITERIA, 50+16 (after identification and integration)	
DIMENSION	**CRITERION**
	ADAPTABLE SPACES
	PUBLIC TRANSPORT - resting places every 300m
	WAYFINDING
	VISUAL IMPACT
	SUSTAINABLE WASTE MANAGEMENT
	GREEN AREAS HETEROGENEITY
	SPORTS/RECREATION AREAS HETEROGENEITY
	OTHER PUBLIC AREAS HETEROGENEITY
	REDUCE MARINE AND COAST POLLUTION
	ECOSYSTEM PRESERVATION/RESTORATION
	MIXED USE, FUNCTIONAL DIVERSITY
	RESILIENCE
SOCIAL	PROGRAM / FUNCTION
	PROXIMITY OF SOCIAL (SCHOOL FACILITIES, HOME FOR ELDERLY, HEALTH FACILITIES)
	PROXIMITY OF COMMERCIAL FACILITIES
	WELL-BEING
	SECURITY
	HERITAGE
	DIVERSITY / SOCIAL INCLUSION
	PARTICIPATION
	EDUCATIVE (CULTURAL) FACILITIES/SERVICES
	ACCESSIBILITY (PUBLIC TRANSPORTATION) / MOBILITY
	INTERVENTIONS THAT DEFINE WATERFRONT
	SHELTER AREAS
	VITALITY/ CONCENTRATION
	SENSE OF PLACE
ADDITIONAL CRITERIA	WATER CONTACT INTENSITY
	ON THE WATER BODY SURFACE/AREA RELATED PROGRAM
	PROGRAM ON THE WATER BODY
	PROGRAM IN THE WATER BODY
	WATER RELATED PROGRAM
	ANTI-POLLUTION MEASURES
	MULTI-ZONED SPATIAL ORGANIZATION
	PROGRAM SPATIAL ORGANIZATION
	LANDMARK PRESENCE
	PROGRAM CONCENTRATION
	CIRCULAR COMMUNICATION NETWORK
	WATERFRONT COMMUNICATION NETWORK
	WBUPP PROGRAM INTEGRATION
	SPATIAL ENCLOSURE DIVERSITY
	EDGE
	GREEN AREAS

9.2.4 Economic

9.2.4.1 Planning

The Planning criterion defines five categories intended to encompass how the planning process is conducted from a stakeholder's perspective. A public design competition is open to anyone who wishes to participate and must meet the standards set by the client, a public entity. The competition program is established by the client, in collaboration with professionals in the field. A design

competition by invitation restricts participation, allowing the client to determine both the number of participants and the required areas of expertise. A private design competition is organized by a private entity, which decides the number of participants and their areas of expertise. Public bidding is a process in which anyone can apply, provided they meet the specified requirements, and carry out the planning and design if their financial offer is the lowest.

9.2.4.2 Process

The Process criterion defines three categories that address how the planning and design process is executed at different spatial scales. A regional plan is a document that covers planning for an area larger than a city, depending on a country's administrative structure. City zoning is a document that guides and regulates the management and development of a city from an urban-planning perspective. Masterplan is an urban-planning document that outlines the development or redevelopment of a spatial unit, determined by multiple factors, at the city level. Individual plot planning involves a single plot or a small number of plots planned and designed separately.

9.2.4.3 Self-Sufficiency

The Self-Sufficiency criterion guides the inclusion of chargeable amenities and services during the WBUPP planning and design phases. These are permanent, temporary, or seasonal activities located in enclosed, covered, or open spaces. They include various catering services, sports equipment rentals, chargeable attractions , small vendors, vending machines, outdoor space rentals for occasional private gatherings and activities, and permits for creative industry activities in outdoor spaces.

9.2.4.4 Employment Opportunities

The Employment Opportunities criterion requires the presence of amenities and services that create jobs. It refers to employment positions in Wholesale Trade, Professional, Scientific, and Technical Services, Educational Services, Arts, Entertainment, and Recreation, Accommodation and Food Services, or other industries included in the WBUPP program. It also covers management, maintenance, and other related positions necessary for WBUPP operations.

9.2.4.5 Local/Regional Economic Regeneration

The Local/Regional Economic Regeneration criterion refers to interventions that positively impact and revitalize the city or neighborhood. While it is not possible to guarantee that implementing WBUPP will regenerate a wider urban area, successful examples elsewhere indicate that planning and designing a new WBUPP should consider this potential within the specific context. Various mechanisms can stimulate local and regional economies, such as business attraction, increased property values, and consumer spending.

9.2.4.6 All-Year Use

The All-Year Use criterion concerns the availability of amenities and facilities usable throughout the year. This includes activities in enclosed spaces not dependent on weather, seasonal activities limited to certain periods or conditions, or activities adaptable to different environments. Applying this criterion in WBUPP planning and design involves analyzing and evaluating existing natural, cultural, and social resources to develop proposals that leverage available assets.

9.2.4.7 Circularity construction

The Circularity construction criterion is best met when multiple circular strategies are used. WBUPP can demonstrate construction circularity by providing resource banks (scaled to the site), spaces for temporary use, and activities for pop-up spaces. It can also support the pop-up economy by organizing pop-up markets, food trucks, art installations, and related activities.

9.2.4.8 Implement Tourist Activity

The Implement Tourist Activity criterion includes hard, soft, or mixed activities that can transform WBUPP spaces into destination attractions. These include integrating cultural amenities and facilities into the WBUPP program, public art displays, artwork incorporated into sports and recreation programs, artwork integrated into urban design elements, and related features. Their duration varies according to external conditions and user needs. Their dynamics is adjusted to maintain high interest.

9.2.5 Environmental

9.2.5.1 Size

The Size criterion defines four categories for WBUPP area size: S (small) for up to 5 hectares, M (medium) for 5 to 20 hectares, L (big) from 20 to 100 hectares, and XL (extra big) for areas over 100 hectares. This is not an implementable criterion but a classification that helps define and categorize regeneration interventions in relation to other criteria.

9.2.5.2 Position Within National Territory

The Position Within National Territory criterion defines five categories to describe the WBUPP location. These range from a central, well-connected site to an isolated site in a high-quality landscape, and to a peripheral site with limited connectivity and low development potential. This is not an implementable criterion, but rather a classification that helps define the regeneration intervention and relate it to other criteria.

9.2.5.3 Position Within Urban/Rural Structure

The Position Within Urban/Rural Structure criterion defines three categories to describe the WBUPP location in relation to its urban or rural context. The position ranges from central, in direct contact with the urban or rural structure, to peripheral, if it is located farther from the structure it belongs to. This is not an implementable criterion, but rather a classification that helps define the regeneration intervention and relate it to other criteria.

9.2.5.4 Previous Use

The Previous Use criterion defines seven categories to describe the WBUPP's previous land use. Port infrastructure includes all types of port facilities and structures used for maritime activities. Industrial use includes all industry types, as well as military infrastructure. The third category is a mixture where both industrial and port infrastructure are present, with neither prevailing. Infrastructure includes abandoned airports, parking lots, railway infrastructure, schools, neighborhoods, and other urban or rural infrastructure locations. Landfill and reclaimed land are categories for areas that were mostly unbuilt but have features that classify them as brownfields, according to various national

definitions. Reclaimed land include underutilized agricultural and wetland areas, drained rivers, or undeveloped land. Mixed use encompasses different uses where none predominates, such as a combination of cultural, military, and political event sites; industrial and infrastructure; or industrial and landfill sites. The Previous Use criterion is not an implementable criterion, but rather a classification that helps define the regeneration intervention and relate it to other criteria.

9.2.5.5 Space Management

The Space Management criterion defines four types of boundaries around the WBUPP perimeter. An open boundary has no physical restriction and allows users to come and go freely. Closed boundaries are physical barriers, either constructed or natural, such as railings, walls, buildings, land masses, or similar elements. These can provide temporary or permanent access through ramps, gates, doors, or related elements. A permeable boundary is a section of the WBUPP perimeter that allows the movement of people and is wider than a gate or door. It cannot be defined as fully open or closed and it consists of porous green elements like hedges or porous structures such as pillars. A water boundary is a section of the WBUPP external perimeter where physical obstacles do not exist by default, but movement is limited to users with water transportation or swimmers.

9.2.5.6 Historical and Cultural Value

The Historical and Cultural Value criterion defines two categories: WBUPP with and without historical and cultural value. If the site contains existing structures or elements, tangible or intangible components related to its previous use, that can be declared valuable by cultural heritage experts or urban historians, it is positively classified. This is not an implementable criterion, but rather a classification that helps define the regeneration intervention and relate it to other criteria.

Spatial Morphology

The Size criterion defines four categories to describe the WBUPP area shape: central, irregular, linear, and longitudinal. This is not an implementable criterion,

but rather a classification that helps define the regeneration intervention and relate it to other criteria.

9.2.5.7 Accessibility

The Accessibility criterion established in this research can be implemented by planning and designing one or more of the following conditions: WBUPP has more than 40% of the ground boundary open or permeable; WBUPP has more than one gate per 200 m; or WBUPP has an average of more than one entrance point every 200 m along the closed boundary.

9.2.5.8 Nature-Based Solutions Implementation

The Nature-based Solutions (NBS) Implementation criterion established in this research can be applied by planning and designing WBUPP features that align with NBS principles. This involves integrating ecological functions with solutions that address sociocultural needs, creating multifunctional and interconnected green networks. Examples of NBS elements to be integrated according to existing WBUPP conditions include multi-layer tree groves, native meadows, green roofs, ecological corridors, living shorelines, native riparian buffers, natural playgrounds, and others. Implementation should be based on the governing body's capacities, specific site conditions, and the strategic and usage model the planning institution aims to achieve.

9.2.5.9 Water-Sensitive Urban Design (WSUD) Integration

The Water-Sensitive Urban Design (WSUD) Integration criterion established in this research can be applied by planning and designing WBUPP features that align with WSUD principles. This involves integrated management of the three core urban water systems: potable water, wastewater, and stormwater. Examples of WSUD elements to be integrated according to existing WBUPP conditions include rain gardens, bioswales, infiltration trenches, permeable pavements, retention ponds, constructed wetlands, rainwater cisterns, and others. Implementation should be based on the governing body's capacities, specific site conditions, and the strategic and usage model the planning institution aims to achieve.

9.2.5.10 Climate Change Adaptation And Mitigation Interventions

The Climate Change Adaptation and Mitigation Interventions criterion established in this research can be applied by planning and designing WBUPP features that implement related principles. This includes a wide range of planning and design strategies, structures, elements, and procedures that can address different climate change effects and should always adapt to specific microclimate conditions. Examples of responsive interventions include building floodable terraces, shaded structures, elevated paths, and program nodes; integrating drought-tolerant planting, cooling refuges, windbreak belts, and photovoltaic canopies into WBUPP design features; and using low-carbon materials. Implementation should be based on the governing body's capacities, specific site conditions, and the strategic and usage model the planning institution aims to achieve.

9.2.5.11 Pedestrian and Cycling Path Network

The Pedestrian and Cycling Path Network criterion established in this research can be implemented by planning and designing one of the following: a dense multimodal network of paths, a well-balanced multimodal network, or a sparse path network. The specific option chosen is not as important as ensuring mindful integration with other relevant criteria, such as program features, access points, and planned number of users.

9.2.5.12 Urban Design (Well-Being Offered by Urban Design)

The Urban Design (Well-Being Offered by Urban Design) criterion established in this research can be implemented by planning and designing according to universal high-level contemporary standards. While these standards vary between national entities, it is essential that the process of thoughtful planning and design of urban design elements is carried out.

9.2.5.13 Public Restrooms

The Public Restrooms criterion established in this research can be implemented by planning and designing public restrooms within WBUPP. Restrooms must be installed according to the projected number of users and the area to be served. They must be spatially distributed to serve the entire WBUPP. Their structure and features must comply with national or regional standards, accommodate multiple

genders, include child-friendly features, be universally accessible, and be located in an accessible area.

9.2.5.14 Drinking Water Fountains (Access to Drinking Water)

The Drinking Water Fountains (Access to Drinking Water) criterion established in this research can be implemented by planning and designing drinking water fountains within WBUPP. They must be installed according to the planned number of users and the area to be equipped. Water quality must comply with national or regional standards and be suitable for users of all ages.

9.2.5.15 Renewable Energy Sources

The Renewable Energy Sources criterion established in this research can be implemented by planning and designing renewable energy sources within WBUPP. They can be provided and installed according to the governing body's capacities and the specific location's resources. Their structure and location must not negatively affect the WBUPP program, accessibility, or mobility network.

9.2.5.16 Adaptable Spaces

The Adaptable Spaces criterion established in this research can be implemented by planning and designing adaptable spaces within WBUPP. They must be distributed according to program features and the planned number of users.

9.2.5.17 Public Transport - Resting Places Every 300m

The Public Transport - Resting Places Every 300m criterion established in this research can be implemented by planning and designing public transport resting places where possible. The public transport system should offer resting places every 300m, located within or near the WBUPP perimeter, functioning as an open or permeable boundary. They can be distributed according to the governing body's financial resources and specific location opportunities. Their structure and location must not negatively affect the WBUPP program, accessibility, or mobility network.

9.2.5.18 Wayfinding

The Wayfinding criterion established in this research can be implemented by planning and designing signage, landmarks, paths, nodes, or various named elements. The number, type, or physical appearance of these elements is not strictly defined and possibly differs from those listed. The process of

implementing consistent directional logic through physical elements to aid WBUPP users must be carried out.

9.2.5.19 Visual Impact

The Visual Impact criterion defines four categories, each with different implementation options depending on specific WBUPP locations and their surroundings. It is essential to plan and design quality viewpoints in WBUPP: viewpoints from WBUPP toward the surrounding area and water body, as well as viewpoints within WBUPP. Maintaining existing spatial arrangements to preserve urban viewpoint directions and rendering high-quality views from the external area are important in built urban areas. Ensuring that WBUPP design achieves high aesthetic quality is required regardless of governance or location conditions.

9.2.5.20 Sustainable Waste Management

The Sustainable Waste Management criterion established in this research can be implemented by planning and designing recycling points and recycling bins within WBUPP. They must be distributed according to program feature locations, access points, and the planned number of users.

9.2.5.21 Green Areas

The Green Areas criterion established in this research can be applied during the planning and design of WBUPP. It refers to the percentage of green areas within WBUPP and defines three categories: minimal, medium, and significant. The minimal category (0–10%) includes between zero and ten percent green surface coverage. The medium category (10–30%) includes between ten and thirty percent. The significant category (31–100%) comprises WBUPP with predominant vegetation. The variation and scope of implementing this criterion depend on program requirements, the governing body’s capacities, specific site conditions, and the planning institution’s desired strategic and usage model. It is recommended to avoid the minimal and medium categories and to plan and design WBUPP with a significant percentage of green areas.

9.2.5.22 Sports/Recreation Areas Heterogeneity

The Sports/Recreation Areas Heterogeneity criterion defines five categories, each with different implementation options depending on specific WBUPP conditions. Program features relevant to this section are broadly categorized, and

the quantity within each group is not relevant. Sports pitches, sports facilities, recreation picnic or rest areas, recreation grassland areas, and playgrounds can be planned and designed within the WBUPP area. If three out of five categories are implemented, the criterion is met.

9.2.5.23 Other Public Areas Heterogeneity

The Other Public Areas Heterogeneity criterion defines three categories, each with different implementation options depending on specific WBUPP conditions. Program features relevant to this section are broadly categorized, and the quantity within each group or the number of implemented groups is not relevant. Plazas, waterfront promenades, and waterfronts or boardwalks on the water can be planned and designed within the WBUPP area. The element's purpose or physical appearance is not strictly defined, but the implementation of public areas other than Green, as well as Sports and Recreation is required to meet the criterion.

9.2.5.24 Reduce Marine and Coast Pollution

The Reduce Marine and Coast Pollution criterion established in this research can be met by planning and designing various anti-pollution measures within WBUPP, such as soil remediation, stormwater management, and air quality controls. These measures can be applied according to the governing body's capacities and specific location conditions.

9.2.5.25 Ecosystem Preservation/Restoration

The Ecosystem Preservation/Restoration criterion established in this research can be met by planning and designing various ecosystem preservation and restoration measures within WBUPP. These measures can be applied according to the governing body's capacities and specific location conditions.

9.2.5.26 Mixed Use, Functional Diversity

The Mixed Use, Functional Diversity criterion established in this research can be met by planning and designing a variety of cultural, tourism, commercial, and related features within WBUPP. It involves introducing a range of functions in WBUPP, in addition to sports and recreational facilities. This criterion can be applied based on the governing body's capacities and specific site conditions.

9.2.5.27 Resilience

The Resilience criterion established in this research can be applied by planning and designing WBUPP features that incorporate related principles. This includes a wide range of planning and design strategies, structures, elements, and procedures that address different resilience responses and should always be adapted to specific microclimate conditions. Examples of interventions include redundant path networks, modular structures, elevated utilities, diversified access modes, smart monitoring systems, embedded service facilities (such as governance and maintenance facilities within the park to support rapid recovery after shocks), flood-resistant boardwalks, adaptable community hubs, and others. Implementation should be based on the governing body's capacities, specific site conditions, and the strategic and usage model the planning institution seeks to achieve.

9.2.6 Social

9.2.6.1 Program / Function

The Program / Function criterion established in this research can be implemented by planning and designing either homogeneous or heterogeneous program networks within WBUPP. The functions system can be developed according to the governing body's capacities, specific location conditions, and the strategic and usage model the planning institution aims to achieve. Diversity of use and a functional mix of cultural, environmental, and social assets define the WBUPP category. If more than five assets are present, it is classified as Heterogeneous; if five or fewer assets are present, it is classified as Homogeneous.

9.2.6.2 Proximity of Social Facilities (School Facilities, Homes for the Elderly, Health Facilities)

The Proximity of Social Facilities criterion identifies three categories: educational facilities, homes for the elderly with related features, and health facilities. If WBUPP contains these within its perimeter or they exist within a 200 m radius, it is preferable that access points, path networks, and program features are planned and designed considering their presence, respectively. This criterion serves as a classification to help define the regeneration intervention and adapt it to relate to other criteria, rather than as an implementable standard.

9.2.6.3 Proximity of Commercial Facilities

The Proximity of Commercial Facilities criterion identifies six categories: retail shops and kiosks (e.g., bait/tackle, souvenirs, markets); restaurants, cafes, and food/beverage vendors; hotels and hospitality accommodations; marinas, boat docks, ferry terminals, and water-taxi/boat rental services; event venues (amphitheaters, plazas for concerts/festivals); and fitness and recreation rentals (kayaks, bikes, paddleboards, sports equipment). If WBUPP contains these within its perimeter or they exist within a 200 m radius, it is preferable that access points, path networks, and program features are planned and designed with their presence in mind. This criterion serves as a classification to help define the regeneration intervention and adapt it to relate to other criteria, rather than as an implementable standard.

9.2.6.4 Well-Being

The Well-being criterion established in this research can be implemented by planning and designing program features that enhance users' well-being. This can be achieved by making most outdoor spaces accessible to the public and providing multiple amenities and services within WBUPP that contribute to this goal, such as seating areas, vegetation, play areas, sheltered spaces, noise-resistant areas, and related features. The program can be developed according to the governing body's capacities, specific location conditions, and the strategic and usage model the planning institution aims to achieve.

9.2.6.5 Security

The Security criterion established in this research can be implemented by planning and designing program features that enhance users' security. This can be achieved by installing general security measures, in addition to regulatory requirements, such as security cameras, optimal lighting, and enclosed or sheltered spaces. Proposed interventions are not strictly defined. Additional safety-related features are included on an optional basis. These features can be developed according to the governing body's capacities, specific location conditions, and the strategic and usage model the planning institution aims to achieve.

9.2.6.6 Heritage

The Heritage criterion proposes four implementation methods, which can be combined or integrated simultaneously in WBUPP. Application potential depends on existing heritage structures, elements, and the intangible legacy of previous use. Implementation variations include: preserving, restoring, and adapting the function of an existing building or structure; preserving, restoring, and adapting the function of a part of an existing building (such as a roof, wall, or floor); preserving an existing building or infrastructure element (such as a pillar, floor section, or structural component) as a heritage or memorial reminder of past land use; and creating a new physical element to evoke past usage or reintroduce indigenous or historic layers of memory. These features can be developed according to the governing body's capacities, specific site conditions, and the strategic and usage model the planning institution aims to achieve. It is strongly recommended that heritage elements be respected to the greatest extent possible.

9.2.6.7 Diversity / Social Inclusion

The Diversity and Social Inclusion criterion established in this research can be applied during the planning and design phases of regeneration interventions. Elements of these concepts are included in other criteria, such as Accessibility, Urban Design, Program and Function, Well-being, and related areas. It is important to achieve multigenerational and multifunctional program features oriented toward diverse populations. These features should provide physical, social, and cultural inclusivity through various spatial interventions that meet the needs of specific minorities and ensure universal accessibility. The way this criterion is implemented differs from what is described, but respecting diversity and social inclusion during the planning and design process is essential.

9.2.6.8 Participation

The Participation criterion established in this research can be implemented by involving the local community in the WBUPP planning and design phases. This can be achieved through campaigns, workshops and consultations, and advisory structures created for this purpose, both in person and through digital channels. The proposed methods are not strictly defined, and other approaches related to

community participation are added or further developed on an optional basis. The method of implementing this criterion can be adapted to the governing body's capacities, the specific conditions of the location, and the strategic and usage model that the planning institution seeks to achieve.

9.2.6.9 Educative (Cultural) Facilities/Services

The Educative (Cultural) Facilities/Services criterion proposes six implementation methods, which can be multiplied or integrated simultaneously into WBUPP. These are applied during the planning and design phase, at physical locations, or through inclusion in program, usage, and management components. Implementation options include educational buildings; information kiosks; outdoor classrooms; educational boards, panels, screens, or other related elements; interactive educational features incorporated or blended into the WBUPP program, such as children's playgrounds, resting stops, viewpoints, ecosystem-specific locations, and others; and intangible educational features included in WBUPP program events and activities. These features can be developed according to the governing body's capacities, specific site conditions, and the strategic and usage model the planning institution aims to achieve. It is strongly recommended that educational and cultural elements be implemented to the greatest extent possible.

9.2.6.10 Accessibility (Public Transportation) / Mobility

The Accessibility (Public Transportation) / Mobility criterion established in this research can be implemented by planning and designing a multimodal public transport network in the vicinity of and/or within the WBUPP, and by creating entrance points and paths to ensure it is easily and inclusively accessible. Specific interventions are not strictly defined, and others are added or further developed on an optional basis, depending on the location's particular constraints and opportunities. Certain aspects of this criterion are included in other criteria, such as Accessibility, Public Transport, Pedestrian and Cycling Path Network, and related criteria. This provides a broader understanding of how the WBUPP can be accessible from multiple perspectives, considering different users and stakeholders. The method for implementing this criterion can be developed according to the governing body's capacities, the specific conditions of the

location, and the strategic and usage model the planning institution seeks to achieve.

9.2.6.11 Interventions that define Waterfront

The Interventions That Define Waterfront criterion established in this research can be implemented by securing high-quality planning and design project executors and hiring an acclaimed interdisciplinary team of professionals who collaborate throughout the process. The specified methods are not strictly defined, and others are added or further developed on an optional basis. The method for implementing the criterion can be adapted to the governing body's capacities, the specific location conditions, and the strategic and usage model that the planning institution seeks to achieve.

9.2.6.12 Shelter Areas

The Shelter Areas criterion established in this research can be implemented by planning and designing sheltered areas within WBUPP. These areas must be distributed according to program features and the planned number of users. Shaded areas should be associated with playgrounds, outdoor seating, educational or cultural features, sports and recreation nodes, resting areas along pathways or landscaped surfaces, and public transportation stops. Shelter provision – including weather protection, wind buffering, and thermal comfort – enhances park usability throughout various seasons and under different weather conditions. Covered areas and pavilions render events, markets, and community gatherings possible even during rain, snow, or high temperatures. Wind barriers such as vegetation screens, walls, and terrain modifications alleviate wind stress, which is especially important in exposed waterfront locations. Sunshade structures – including trees, pergolas, and retractable systems – provide comfort during extreme heat while preserving visual openness. Bus and other public transportation networks located within or near parks create waiting areas that improve transit accessibility and enhance park connectivity when sheltered. The design and materials of shading elements vary but must align with the overall WBUPP design principles.

9.2.6.13 Vitality / Concentration

The Vitality / Concentration criterion established in this research can be implemented by planning and designing program features within WBUPP. This is reflected in their density across the overall area, aiming to exceed two per hectare on average. The vitality of WBUPP is represented by the concentration of amenities, facilities, and services per unit area, regardless of their type, as every focal program point or area that fosters activity contributes to the overall dynamics of WBUPP. The method for implementing this criterion can be developed according to the governing body's capacities, specific location conditions, and the strategic and usage model the planning institution seeks to achieve.

9.2.6.14 Sense of Place

The Sense of Place criterion refers to how small-scale spaces within WBUPP are designed. In addition to implementing Wayfinding, Safety, Accessibility, Nature-based solutions, Urban Design, Vitality, various Program features, and related criteria, this criterion integrates these elements at a human level through design. A people-oriented scale is evident in the distribution of spatial elements at eye level, their visual variety and dynamics, and details appropriate for pedestrians. Human scale can be achieved by shaping spaces and elements to match how people see, move, and interact at walking speed. Paths and nodes should have comfortable widths, short sightlines, and frequent places to stop, sit, and meet, rather than large empty stretches. Bring detail to eye level through planting structure (varying greenery height and type), human-height edges (physical elements relatable to people's use), lighting poles scaled for pedestrians, and tactile materials for paving and handrails. Keep pavilions, kiosks, and park structures low to mid-rise, with transparent fronts, visible entries, and active edges facing paths and lawns so people feel oriented and observed rather than overshadowed. Break long park axes into smaller segments with varied pergolas, benches, play areas, and micro-topographies to create a sequence of "rooms" that feel intimate and legible. Ensure that key amenities– playgrounds, toilets, drinking fountains, dog areas, and sports courts– are within short, walkable distances and inter-visible, supporting everyday use and social control. The method for implementing this criterion can be developed according to the

governing body’s capacities, specific site conditions, and the strategic and usage model the planning institution aims to achieve.

9.2.7 Additional Criteria

9.2.7.1 Water Contact Intensity

The Water Contact Intensity criterion refers to the strength of the water body's influence on the WBUPP. It is determined by the length of the water-land boundary relative to the total WBUPP perimeter. The criterion defines four categories: full immersion (greater than 60%), intense (40-60%), medium (25-40%), and minimal (0-25%). This criterion serves as a classification to guide regeneration interventions and relate them to other criteria, rather than as an implementable standard.

9.2.7.2 On The Water Body Surface/Area Related Program

The On the Water Surface/Area Related Program criterion established in this research can be implemented by planning and designing program features within WBUPP. It refers to activities that take place on the water surface, such as kayaking and other paddle sports, marinas for nautical vehicles, or similar features. These features allow users to have close contact with the water and enjoy water-related activities. The method for implementing this criterion can be developed according to the governing body’s capacities, specific site conditions, and the strategic and usage model the planning institution aims to achieve.

9.2.7.3 Program on the Water Body

The Program on the Water Body criterion established in this research can be implemented by planning and designing program features within WBUPP. It refers to structures placed or built on the water surface, such as a boardwalk, water sauna, or floating wetlands. A water sauna is an example of a structure that contains a program node but is small enough to maintain the floating effect for the user. A floating wetland is an example of a program node built on the water, also immersed in the water, and provides an emerging effect that users can enjoy by being active or passive on the boardwalk that imbues it. These features allow users to have close and innovative contact with the water. The method for implementing this criterion can be developed according to the governing body’s

capacities, specific site conditions, and the strategic and usage model the planning institution aims to achieve.

9.2.7.4 Program in the Water Body

The Program in the Water Body criterion established in this research can be implemented by planning and designing program features within WBUPP. It refers to activities that take place in the water, such as swimming or diving. These activities are possible if there is supporting infrastructure, such as a beach (made with sand, pebbles, or other suitable material), bathing facilities, lidos, or pools. Named facilities can imitate the natural environment or have a constructed architectural character. They include additional services, such as sunbathing areas, changing rooms, toilets, and showers (integrated specifically for this purpose), as well as other related functions. These features allow users to have immediate and intense contact with the water and enjoy water-related activities. The method for implementing this criterion can be developed according to the governing body's capacities, specific site conditions, and the strategic and usage model the planning institution aims to achieve.

9.2.7.5 Water Related Program

The Water Related Program criterion established in this research can be implemented by planning and designing program features within WBUPP. It refers to tangible and intangible program elements that contain water, integrate water, educate about water, and originate from a connection to water. The structures are placed or built within the WBUPP zone that is not in direct contact with the water body. These features allow users to have close and innovative interactions with water, even in areas where water did not previously exist. They encourage and emphasize the relationship with water, teach about its importance, and enhance awareness. The method for implementing this criterion can be developed according to the governing body's capacities, specific site conditions, and the strategic and usage model the planning institution seeks to achieve.

9.2.7.6 Anti-Pollution Measures

The Anti-Pollution Measures criterion established in this research can be implemented through the planning and design of WBUPP. It refers to measures

that prevent or reduce existing pollution within WBUPP. Mrak et.al. (2022) discuss urban design strategies that reduce noise and light pollution, as well as anti-pollution interventions for coastal and marine areas. Matković and Jakovčić (2019a) define the Pollution criterion with categories that consider the presence of pollution at brownfield locations. Rey et al. (2022) include Air pollution, Noise pollution, and Light pollution criteria within their Context criteria and indicators in the Environmental Impact section. Carmona et al. (2003), Ian Bentley (1990), Commission of the European Community (1990), Andrew Blowers (1993), Hugh Barton (1996), Evans (2001), and Frey (1999) address the principle of pollution reduction by considering natural elements and varying approaches. Burinskienė et al. (2017) establish Heavy industry pollution and Transport pollution criteria within their Environmental criteria group.

The criterion defines four categories: Air pollution, Noise pollution, Light pollution, and Water pollution, each referring to contamination of the respective aspect. The methods are not specified, as many established methods have already been implemented in pollution interventions. One specific method analyzed through WBUPP representative example cases is a noise pollution reduction measure incorporated as a spatial element – a sound berm – completely and seamlessly integrated into the WBUPP design. Methods for implementing this criterion can be developed according to the governing body's capacities, specific site conditions, and the strategic and usage model the planning institution aims to achieve.

9.2.7.7 Multi-Zoned Spatial Organization

The Multi-Zoned Spatial Organization criterion established in this research can be implemented through the planning and design of WBUPP. It refers to the spatial organization of an area and its character in relation to the water body. The criterion defines three categories: waterfront zone, inland zone, and zone on the water. The zones are clearly defined and distinguished by design or specific properties and have internal edges in natural or structural form, though this is optional. This criterion aims to explore and express the relationship with water through spatial relationships.

9.2.7.8 Program Spatial Organization

The Program Spatial Organization criterion established in this research can be implemented by planning and designing program features within WBUPP. It refers to the spatial organization of different program components, whose concentration depends on their proximity to the waterfront. The criterion defines two categories: the waterfront zone and the different zone. The waterfront zone should contain waterfront promenade, rest stops with seating areas, viewpoints, unless the organization does not enable flooding areas creation. Zone names do not determine their content. These zones can be clearly defined, share the same waterfront proximity, but have completely different program components. Through this variation, spatial diversity and dynamics can be achieved. This criterion aims to explore and express the relationship between different program character zones that share a strong connection with water.

9.2.7.9 Landmark Presence

The Landmark Presence criterion established in this research can be implemented through the planning and design of WBUPP. It refers to the presence of a building, structure, sign, or other element that serves as a point of reference in WBUPP. A landmark has outstanding visual features whose physical properties can be used for orientation or guidance. A landmark is distinct within the wayfinding system in WBUPP legibility. It can strengthen the sense of place, highlight elements of the location, and emphasize the importance that the regeneration intervention seeks to achieve. The method for implementing this criterion can be developed according to the governing body's capacities, specific site conditions, and the planning institution's desired strategic and usage model.

9.2.7.10 Program Concentration

The Program Concentration criterion established in this research can be implemented by planning and designing the distribution of program features within WBUPP. It refers to the spatial organization of different program components, with concentration based on three proposed variations: program nodes concentrated near landmarks and attractions; program nodes concentrated within different character zones; and program nodes dispersed to allow park use by a large number of people. These variations can be further

developed depending on specific location factors, but should always consider the size of the WBUPP territory and the expected number of users.

9.2.7.11 Communication Network

The Communication Network criterion established in this research can be implemented through the planning and design of WBUPP. It refers to the communication network within WBUPP boundaries, which includes multimodal transport and distinguishes between pedestrian and cycling levels. The criterion defines five aspects: allowing circular communication, on and around water, high-density path network, primary path direction, and secondary path network. These aspects are neither mutually dependent nor mutually exclusive. They coexist and multiply. Research analysis indicates that integrating these aspects contribute to WBUPP spatial quality; therefore, it is recommended that they be integrated as path design organizational guidelines. The method for implementing this criterion is developed based on the governing body's capacities, specific site conditions, and the planning institution's desired strategic and usage model.

9.2.7.12 Waterfront Communication Network

The Waterfront Communication Network criterion established in this research can be implemented through the planning and design of WBUPP. It refers to the communication network associated with the waterfront. The criterion defines four categories: waterfront promenade (along the water), waterfront path network, paths leading toward the waterfront, and boardwalks on the water. These categories are neither mutually dependent nor mutually exclusive. They coexist and multiply. Research analysis indicates that integrating these categories enhances WBUPP spatial quality; therefore, it is recommended that they be used as guidelines for program design. The method for implementing this criterion is developed based on the governing body's capacities, specific site conditions, and the planning institution's desired strategic and usage model.

9.2.7.13 WBUPP Program Integration

The WBUPP Program Integration criterion established in this research can be implemented by planning and designing program features within WBUPP. It highlights the need for a hybrid approach that combines different program feature types within spatial elements and structures, at least two. The criterion defines

nine categories, as a derivative of a real-life example case: Urban Design Integrates Heritage (Historic Local Identity) Elements; Urban Park Design Integrates (Natural Based Solutions) Elements; Urban Design Integrates Water (Natural) Elements; Sports and Recreation Program Integrates Water Elements; Sports and Recreation Program Integrates Educational Elements; Natural (Urbanism) Program Integrates Educational Elements and Becomes an Attraction; Natural (Urbanism) Program Integrates Social Inclusion; Sports and Recreation Program Integrates Tourism Elements; and Natural (Urbanism) Program Integrates Tourism (Art) and Educational Elements. These categories are neither mutually dependent nor mutually exclusive. They exist or coexist in many variants. Research analysis indicates that integrating different feature types enhances WBUPP program quality; therefore, it is recommended that these categories are used as guidelines for program design. Some aspects of the named categories are already included in other criteria, but this criterion aims to emphasize the hybrid approach rather than list all possible outcomes. The method for implementing this criterion is developed based on the governing body's capacities, specific site conditions, and the planning institution's desired strategic and usage model.

9.2.7.14 Spatial Enclosure Diversity

The Spatial Enclosure Diversity criterion established in this research can be applied through the planning and design of WBUPP. It refers to how spaces are protected from weather conditions and whether they have visual, sound, or heat barriers. The criterion defines three categories: enclosed spaces, covered spaces, and open spaces. Enclosed spaces are those surrounded by vertical structural or related elements and covered with a permeable or non-permeable roof. Covered spaces have a canopy or similar element that protects the surface underneath. Open spaces lack vertical or horizontal structures that provide protection from wind and rain. The method for implementing this criterion is developed based on program requirements, the governing body's capacities, specific site conditions, and the planning institution's desired strategic and usage model.

9.2.7.15 Edge

The Edge criterion established in this research can be applied during the planning and design of WBUPP. It refers to the distinct character of districts or elements, and whether they should be highlighted, protected, or have their existing protection and demarcation enhanced. The criterion defines four categories: tree-lined path, tree-lined urban tissue edge, tree-lined zone border, and tree-lined program perimeter. The variation and scope of implementing this criterion depend on program requirements, the governing body's capacities, specific site conditions, and the planning institution's desired strategic and usage model.

9.2.7.16 Green Areas Heterogeneity

The Green Areas Heterogeneity criterion defines four categories, each with different implementation options depending on specific WBUPP conditions. The categories of green areas that can be planned and designed within the WBUPP area are: 1. protective green areas, 2. dispersed trees, 3. gardens, and 4. grasslands. Program features relevant to this section are broadly categorized, and the quantity within each group is not decisive. The categories diversify the spatial elements in green area type and arrangement, the way they are planned, and, more importantly, how they are maintained, considering the physical effects their presence is intended to achieve. If three out of four categories are implemented, the criterion is met.

9.3 WBUPP Urban-Planning Criteria Systematization

Urban-planning criteria found in scientific literature were organized in groups according to three sustainability principles: Economic, Environmental, and Social. In the systematization process of Urban-planning criteria for planning and designing public city parks in the regeneration of waterfront brownfields, the same methodology was applied. The urban-planning criteria are organized into three groups: Economic, Environmental, and Social. Table 46 presents the resulting 66 WBUPP urban-planning and design criteria, with indicators, after they were systematized. Figure 113 shows the 66 criteria distribution according to the three sustainability pillars.

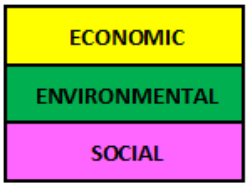
The Table 46's last column associates each criterion with the urban-planning level it could be implemented in. Urban planning implementation considers strategic, planning, and design levels. The strategic level sets long-term objectives, the planning level organizes spatial and policy responses, and the design level refers to concrete projects and built interventions. Criteria distribution by implementation levels is presented in **Error! Reference source not found.**. Criteria proportion by implementation level potential is shown graphically in Figure 114, and numerically in Table 47.

All criteria are considered foundational, with no derived criteria identified. Some criteria developed after the completion of the empirical analysis represent a refinement of previously defined criteria. These adjustments provide a more detailed perspective on aspects that were initially broader in scope, including a clearer distinction between water-related functions and elements. Criterion's origin type is considered in three variations: 1. Criterion derived from scientific literature, adapted for WBUPP; 2. Original criterion, derived from empirical process; 3. Criterion taken directly from scientific literature, minimally adapted to WBUPP. Criteria and corresponding origin type are presented in Table 49.

Criteria assessment can be conducted using different methods, through criteria indicators that have been proposed. Some can be assessed using more than one method. A user survey is a method that gathers information about user experience and perception through a structured questionnaire. An expert survey collects data using predefined instruments such as questionnaires, evaluation matrices, validation forms, or similar inquiry tools. Content analysis is a method that examines data and documents about the subject to derive information relevant to the assessment. Spatial analysis is a method that examines graphical and spatial datasets to derive information relevant to the assessment. Field research is a method that collects data directly at the study location, through appropriate observation techniques. Criteria and corresponding indicators, along with their applicable assessment methods, are presented in Table 49.

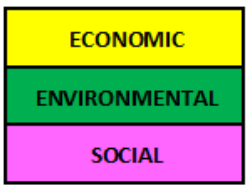
Table 46 66 Criteria For WBUPP Urban-planning And Design, with indicators, after systematization, M. Gudac Cvelic

CRITERIA DIMENSION	WBUPP URBAN-PLANNING AND DESIGN CRITERION	WBUPP URBAN-PLANNING AND DESIGN CRITERION INDICATOR	CRITERION APPLICATION LEVEL
	□ **Theoretical basis**		
	□ **Empirical basis**		
ECONOMIC	PLANNING	1. Public Design Competition 2. Design competition by invitation 3. Private design competition 4. Direct Commision 5. Public bidding	STRATEGIC PLANNING
	PROCESS	1. Regional plan 2. City Zoning 3. Masterplan 4. Individual plot planning	STRATEGIC PLANNING
	SELF-SUFFICIENCY	presence of chargeable amenities and services: catering services, sports equipment rental, chargeable attractions (limited), small vendors, vending machines, outdoor spaces rental for occasional private gatherings and activities, outdoor spaces creative industry activity chargeable permits	STRATEGIC PLANNING
	EMPLOYMENT OPPORTUNITIES	presence of amenities and services that require employees	STRATEGIC
	LOCAL/REGIONAL ECONOMIC REGENERATION	interventions that positively influence and regenerate the city/neighborhood area	STRATEGIC
	ALL YEAR USE	amenities and facilities that can be used all year long	STRATEGIC PLANNING
	CIRCULARITY OF CONSTRUCTION	1. Pop-up spaces 2. Temporary uses 3. Resource banks 4. Pop-up economy	PLANNING DESIGN
	IMPLEMENT TOURIST ACTIVITY	integrating cultural amenities and facilities into the WBUPP program, public art displays, artwork incorporated into sports and recreation programs, artwork integrated into urban design elements, and related features	STRATEGIC PLANNING DESIGN
	8		
ENVIRONMENTAL	SIZE	1. S small 0-5ha 2. M medium 5-20ha 3. L big 20-100ha 4. XL extra big 100+ha	STRATEGIC
	POSITION WITHIN NATIONAL TERRITORY	1. Centrally located position and good transport connectivity WBUPP 2. WBUPP with a centrally located position and good transport connectivity 3. Connected WBUPP with good transport connectivity and development potential 4. Isolated WBUPP in areas of high landscape value 5. Peripheral WBUPP with poor transport connectivity and weak development indicators and potential	STRATEGIC



CRITERIA DIMENSION	WBUPP URBAN-PLANNING AND DESIGN CRITERION	WBUPP URBAN-PLANNING AND DESIGN CRITERION INDICATOR	CRITERION APPLICATION LEVEL
	□ **Theoretical basis**		
	□ **Empirical basis**		
	POSITION WITHIN URBAN/RURAL STRUCTURE	1. WBUPP with a central position in urban/rural structure 2. WBUPP located in the contact zone between urban/rural structure 3. WBUPP with a peripheral position in an urban/rural structure	STRATEGIC
	PREVIOUS USE	1. port infrastructure 2. port infra.structure/ industrial 3. industrial 4. infrastructure 5. landfill 6. reclaimed land 7. mixed use	STRATEGIC PLANNING
	SPACE MANAGEMENT	1. open 2. closed 3. permeable 4. water	PLANNING DESIGN
	HISTORICAL AND CULTURAL VALUE	1. WBUPP with historical and cultural value 2. WBUPP without structure or value in terms of history or culture	STRATEGIC PLANNING
	SPATIAL MORPHOLOGY	1. central 2. irregular 3. linear 4. longitudinal	STRATEGIC PLANNING
	ACCESSIBILITY	more than 40% of the ground boundary open or permeable OR more than 1 gate per 200m OR average entrance points exceed 1 every 200m along the closed boundary.	PLANNING DESIGN
	NATURE-BASED SOLUTIONS IMPLEMENTATION	1. Multi-layer tree groves 2. Native meadows 3. Green roofs 4. Ecological corridors 5. Living shorelines 6. Native riparian buffers 7. Natural playgrounds	STRATEGIC PLANNING DESIGN
	WATER-SENSITIVE URBAN DESIGN (WSUD) I NTEGRATION	1. Rain gardens Bioswales 2. Infiltration trenches 3. Permeable pavements 4. Retention ponds 5. Constructed wetlands 6. Rainwater cisterns	STRATEGIC PLANNING DESIGN
	CLIMATE CHANGE ADAPTATION AND MITIGATION INTERVENTIONS	1. Floodable terraces 2. Elevated paths, program nodes 3. Shaded structures 4. Drought-tolerant planting 5. Cooling refuges 6. Wind-break belts 7. Photovoltaic canopies 8. Low-carbon materials	STRATEGIC PLANNING DESIGN
	PEDESTRIAN AND CYCLING PATH NETWORK	1. Dense multimodal network of paths 2. Well balanced multimodal network 3. Sparse paths network	STRATEGIC PLANNING DESIGN

CRITERIA DIMENSION	WBUPP URBAN-PLANNING AND DESIGN CRITERION	WBUPP URBAN-PLANNING AND DESIGN CRITERION INDICATOR	CRITERION APPLICATION LEVEL
	□ **Theoretical basis**		
	□ **Empirical basis**		
	URBAN DESIGN (WELL-BEING OFFERED BY URBAN DESIGN)	Urban design elements created according to the high level contemporary standards	PLANNING DESIGN
	PUBLIC RESTROOMS	public restrooms presence in WBUPP	PLANNING DESIGN
	DRINKING WATER FOUNTAINS (ACCESS TO DRINKING WATER)	drinking water fountains presence in WBUPP	PLANNING DESIGN
	RENEWABLE ENERGY SOURCES	renewable energy sources presence in WBUPP	PLANNING DESIGN
	ADAPTABLE SPACES	adaptable spaces presence in WBUPP	PLANNING DESIGN
	PUBLIC TRANSPORT - resting places every 300m	public transport - resting places every 300m presence within or in close proximity of WBUPP's perimeter functioning as an open or permeable boundary	PLANNING DESIGN
	WAYFINDING	1. Signage 2. Landmark 3. Path 4. Node	DESIGN
	VISUAL IMPACT	quality viewepoints in WBUPP 1. viewpoints from WBUPP toward surrounding area and the water body 2. viewpoints within WBUPP 3. keeping existing spatial disposition so that the urban viewpoint directions are maintained 4. ensuring that WBUPP design meets high quality esthetic level	STRATEGIC PLANNING DESIGN
	SUSTAINABLE WASTE MANAGEMENT	WBUPP contains recycling points, recycling bins	PLANNING DESIGN
	GREEN AREAS	1. minimal (0-10%) 2. medium (10-30%) 3. significant (31-100%)	PLANNING DESIGN
	SPORTS and RECREATION AREAS heterogeneity	1. sports pitch 2. sports facility 3. recreation picnic or rest area 4. recreation grassland area 5. playground	PLANNING DESIGN
	OTHER PUBLIC AREAS heterogeneity	1. plaza 2. waterfront promenade 3. waterfront or boardwalk on the water	PLANNING DESIGN
	REDUCE MARINE AND COAST POLLUTION	evidence of reduced marine and coast pollution in WBUPP	STRATEGIC PLANNING DESIGN
	ECOSYSTEM PRESERVATION/RESTORATION	evidence of ecosystem preservation/restoration in WBUPP	STRATEGIC PLANNING DESIGN

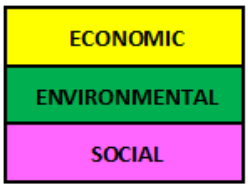


CRITERIA DIMENSION	WBUPP URBAN-PLANNING AND DESIGN CRITERION	WBUPP URBAN-PLANNING AND DESIGN CRITERION INDICATOR	CRITERION APPLICATION LEVEL
	□ **Theoretical basis**		
	□ **Empirical basis**		
	MIXED USE, FUNCTIONAL DIVERSITY	Criterion categories variations: a) Cultural, commercial, housing use diversity (giovinazzi) b) Rey et al: parks serve a spectrum of functions beyond recreation—such as culture, services, and tourism c) evidence of mixed development found in and in close proximity around the WBUPP, d) evidence of functional diversity found in the WBUPP	STRATEGIC PLANNING
	RESILIENCE	evidence of resilience feature elements implementation found in WBUPP - 1. Redundant path networks 2. Modular structures 3. Elevated utilities 4. Diversified access modes 5. Smart monitoring systems 6. Embedded service facilities (governance and maintenance facilities embedded in the park to support rapid recovery after shocks) 7. Flood-resistant boardwalks 8. Adaptable community hubs	STRATEGIC PLANNING DESIGN
	WATER CONTACT INTENSITY	1. full immersion +60% 2. intense 40-60% 3. medium 25-40% 4. minimal 0-25%	STRATEGIC PLANNING DESIGN
	ANTI-POLLUTION MEASURES	1. air pollution 2. noise pollution 3. light pollution 4. water pollution	STRATEGIC PLANNING DESIGN
	GREEN AREAS heterogeneity	1. protective green areas 2. trees disperse 3. garden 4. grassland	STRATEGIC PLANNING DESIGN
	31		
SOCIAL	PROGRAM / FUNCTION	1. homogeneous 2. heterogeneous	STRATEGIC PLANNING
	PROXIMITY OF SOCIAL (SCHOOL FACILITIES, HOME FOR ELDERLY, HEALTH FACILITIES)	social facilities proximity: 1. educational facilities 2. home for elderly 3. health facilities	STRATEGIC PLANNING
	PROXIMITY OF COMMERCIAL FACILITIES	commercial facilities proximity: 1. Retail shops and kiosks (e.g., bait/tackle, souvenirs, markets) 2. Restaurants, cafes, and food concessions/beverage vendors 3. Hotels and hospitality accommodations 4. Marinas, boat docks, ferry terminals, and water-taxi/boat rental services 5. Event venues (amphitheaters, plazas for concerts/festivals) 6. Fitness and recreation rentals (kayaks, bikes, paddleboards, sports equipment)	STRATEGIC PLANNING

CRITERIA DIMENSION	WBUPP URBAN-PLANNING AND DESIGN CRITERION	WBUPP URBAN-PLANNING AND DESIGN CRITERION INDICATOR	CRITERION APPLICATION LEVEL
	□ **Theoretical basis**		
	□ **Empirical basis**		
	WELL-BEING	A large number of outdoor spaces is accessible to the public, with multiple amenities for the well-being of users (seating, vegetation, play area, etc.)	STRATEGIC DESIGN
	SECURITY (SAFETY)	Generalized security measures, in addition to the regulatory aspects : 1. security cameras 2. lighting 3. enclosed and shelter spaces	STRATEGIC PLANNING DESIGN
	HERITAGE	heritage elements implemented: 1. Existing building or structure, preserved, restored and used with adapted function 2. Existing building part (roof, wall, floor, etc.) preserved, restored and used with adapted function 3. Existing building or infrastructure element (pillar, floor portion, structural element, or similar) preserved as heritage, memorial reminder of the past land usage 4. New physical element implemented, to evoke the past usage or reintroduce indigenous or historic layers of memory	PLANNING DESIGN
	DIVERSITY / SOCIAL INCLUSION	respect diversity and social inclusion during planning and design process;	STRATEGIC PLANNING DESIGN
	PARTICIPATION	allow or prescribe community participation in WBUPP planning and design process	PLANNING DESIGN
	EDUCATIVE FACILITIES/SERVICES	include educative facilities and services in WBUPP design and planning (physical locations and included in program/usage/management): 1. educational building 2. information kiosk 3. outdoor classroom 4. educational boards/panels/screens 5.interactive educational elements implemented and/or blended in WBUPP program (for ex. children's playground, resting stops, viewpoints, ecosystem specific locations, etc.)	PLANNING DESIGN
	ACCESSIBILITY (PUBLIC TRANSPORTATION) / MOBILITY	plan a multimodal public transport network in vicinity and/or within the WBUPP, create accessible access and paths to render it easily and inclusively accessible	STRATEGIC PLANNING DESIGN
	INTERVENTIONS THAT DEFINE WATERFRONT	secure high quality planning and design project executors, and hire acclaimed interdisciplinary professionals team who collaborates during the process	STRATEGIC PLANNING
	SHELTER AREAS	sheltered areas presence, shading elements implemented in WBUPP design	PLANNING DESIGN
	VITALITY/ CONCENTRATION	evident density of amenities, facilities, services	STRATEGIC PLANNING DESIGN

CRITERIA DIMENSION	WBUPP URBAN-PLANNING AND DESIGN CRITERION	WBUPP URBAN-PLANNING AND DESIGN CRITERION INDICATOR	CRITERION APPLICATION LEVEL
	□ **Theoretical basis**		
	□ **Empirical basis**		
	SENSE OF PLACE	user-centric design highlights spatial components at eye level, diverse visuals, and pedestrian-friendly aspects to foster a human scale that corresponds with individual perceptions and navigation of their surroundings	PLANNING DESIGN
	ON THE WATER BODY SURFACE/AREA RELATED PROGRAM	activities that take place on the water surface, such as kayaking and other paddle sports, marinas for nautical vehicles, or similar features	PLANNING DESIGN
	PROGRAM ON THE WATER BODY	structures placed or built on the water surface, such as a boardwalk, water sauna, or floating wetlands	PLANNING DESIGN
	PROGRAM IN THE WATER BODY	activities that take place in the water, such as swimming or diving, with supporting infrastructure, such as a beach (made with sand, pebbles, or other suitable material), bathing facilities, lidos, or pools	PLANNING DESIGN
	WATER RELATED PROGRAM	tangible and intangible program elements that contain water, integrate water, educate about water, and originate from a connection to water	PLANNING DESIGN
	MULTI-ZONED SPATIAL ORGANIZATION	1. waterfront zone 2. inland zone 3. zone on the water	PLANNING DESIGN
	PROGRAM SPATIAL ORGANIZATION	1. waterfront zone 2. different zone	PLANNING DESIGN
	LANDMARK PRESENCE	presence of a building, structure, sign, or other element that serves as a point of reference in WBUPP	STRATEGIC PLANNING DESIGN
	PROGRAM CONCENTRATION	1. program nodes concentration close to landmarks/attractions 2. program nodes concentrated according to different character zones 3. program nodes dispersed, to allow the parks usage to large number of people	PLANNING DESIGN
	CIRCULAR COMMUNICATION NETWORK	1. on and around water 2. high density path network 3. primary path direction 4. secondary path network	PLANNING DESIGN
	WATERFRONT COMMUNICATION NETWORK	1. waterfront lungomare (along the water) 2. waterfront path network 3. leading toward the waterfont 4.boardwalk on the water	PLANNING DESIGN

CRITERIA DIMENSION	WBUPP URBAN-PLANNING AND DESIGN CRITERION	WBUPP URBAN-PLANNING AND DESIGN CRITERION INDICATOR	CRITERION APPLICATION LEVEL
	□ **Theoretical basis**		
	□ **Empirical basis**		
	WBUPP PROGRAM INTEGRATION	Program integration examples from WBUPP representative example cases: Urban Design Integrates Heritage (Historic Local Identity) Elements; Urban Park Design Integrates (Natural Based Solutions) Elements; Urban Design Integrates Water (Natural) Elements; Sports and Recreation Program Integrates Water Elements; Sports and Recreation Program Integrates Educational Elements; Natural (Urbanism) Program Integrates Educational Elements and Becomes an Attraction; Natural (Urbanism) Program Integrates Social Inclusion; Sports and Recreation Program Integrates Tourism Elements; and Natural (Urbanism) Program Integrates Tourism (Art) and Educational Elements.	PLANNING DESIGN
	SPATIAL ENCLOSURE DIVERSITY	1.enclosed spaces 2. covered spaces 3. open spaces	PLANNING DESIGN
	EDGE	1. tree lined path 2.tree lined urban tissue edge 3. tree lined zone border 4. tree lined program perimeter	PLANNING DESIGN
	27		
	TOTAL 66		



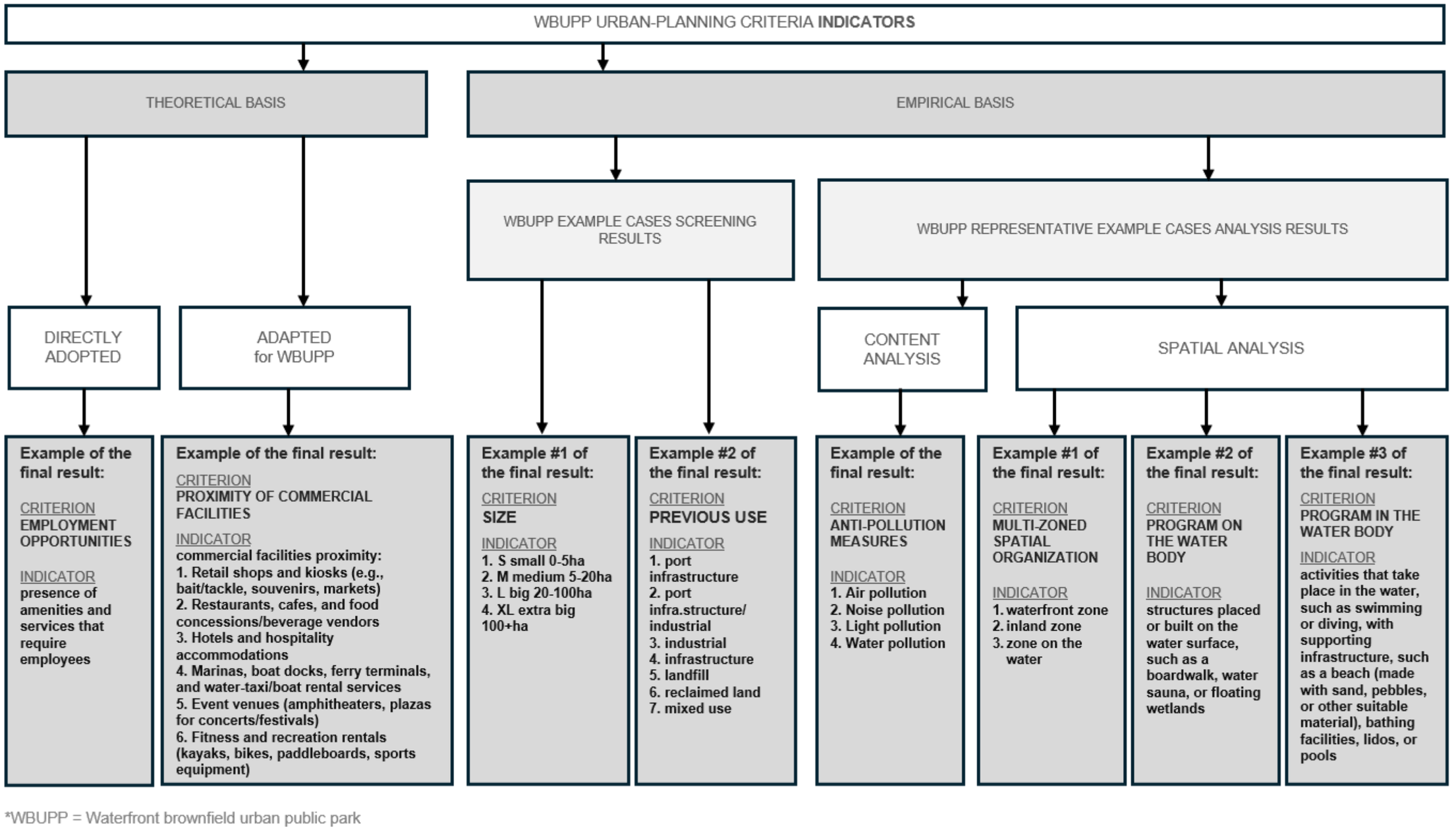


Figure 111 WBUPP urban-planning criteria indicators development process, graphically presented with examples of the result produced by each method, M. Gudac Cvelic

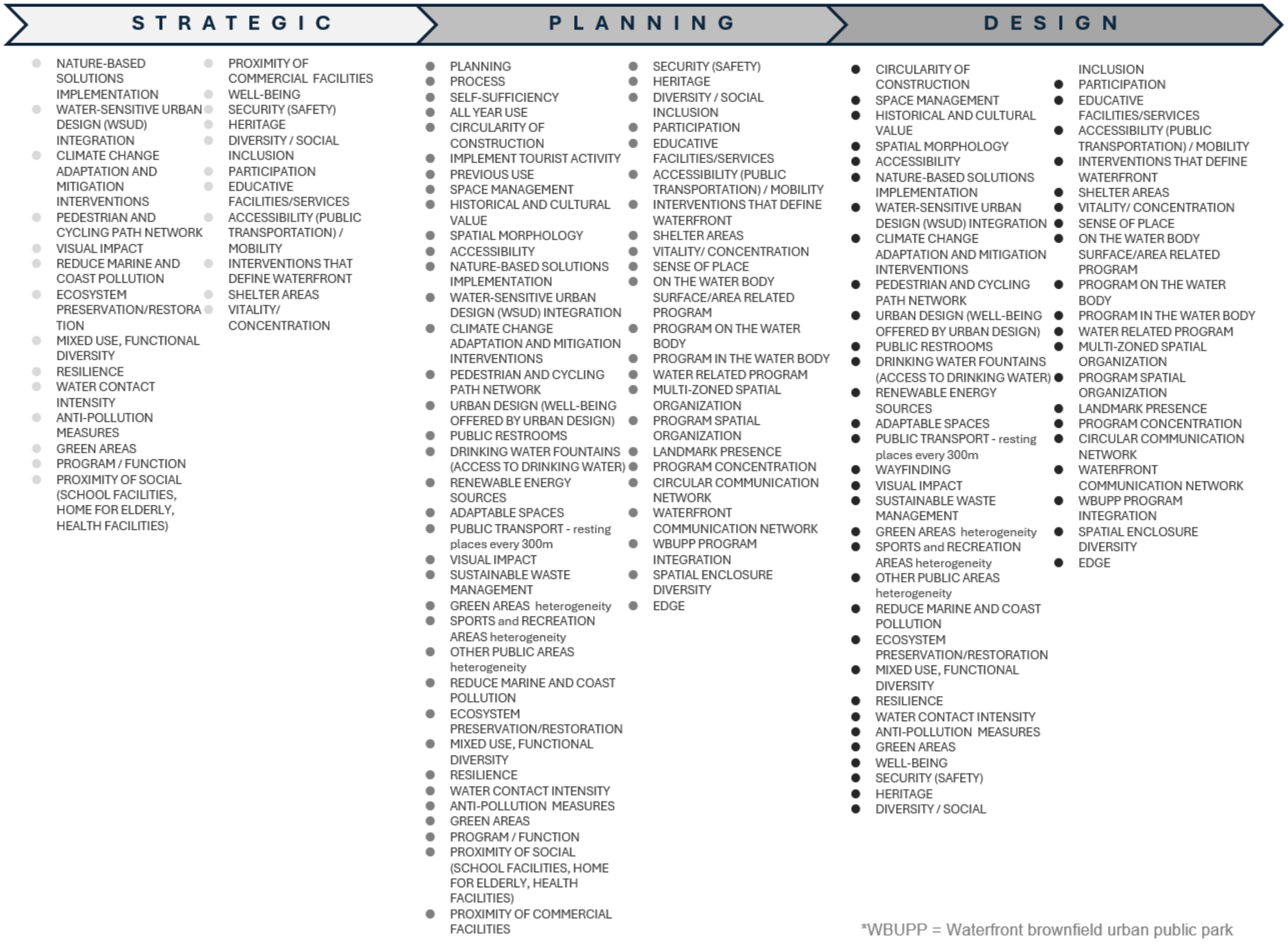


Figure 112 66 WBUPP urban-planning criteria for planning and design: distribution of criteria by implementation level potential, M. Gudac Cvelic



Figure 113 WBUPP urban-planning criteria for planning and design: 66 criteria distribution according to the three sustainability pillars, M. Gudac Cvelic

Table 47 66 WBUPP urban-planning criteria for planning and design: proportion of criteria by implementation level potential, numerical presentation, M. Gudac Cvelic

STRATEGIC	5	8%
STRATEGIC PLANNING	12	18%
PLANNING DESIGN	30	45%
STRATEGIC PLANNING DESIGN	17	26%
STRATEGIC DESIGN	1	2%
DESIGN	1	2%
total number of WBUPP UP criteria	66	

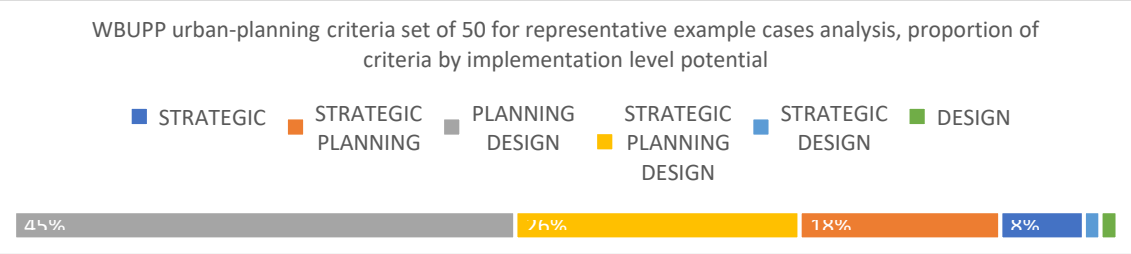


Figure 114 66 WBUPP urban-planning criteria for planning and design: proportion of criteria by implementation level potential, graphical presentation, M. Gudac Cvelic

Table 48 66 WBUPP urban-planning criteria for planning and design: criteria-origin type-assessment method matrix, M. Gudac Cvelic

WBUPP URBAN-PLANNING AND DESIGN CRITERION	CRITERION ORIGIN TYPE, CONTRIBUTION ORIGINALITY	CRITERION ASSESSMENT METHOD
□ **scientific literature origin adapted to WBUPP; original derived from empirical process**		
□ **scientific literature origin, minimally adapted to WBUPP**		
PLANNING	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · FIELD RESEARCH
PROCESS	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
SELF-SUFFICIENCY	taken directly from scientific literature, minimally adapted to WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
EMPLOYMENT OPPORTUNITIES	taken directly from scientific literature, minimally adapted to WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
LOCAL/REGIONAL ECONOMIC REGENERATION	taken directly from scientific literature, minimally adapted to WBUPP	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · FIELD RESEARCH
ALL YEAR USE	taken directly from scientific literature, minimally adapted to WBUPP	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
CIRCULARITY OF CONSTRUCTION	derived from scientific literature, adapted for WBUPP	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
IMPLEMENT TOURIST ACTIVITY	derived from scientific literature, adapted for WBUPP	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
SIZE	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
POSITION WITHIN NATIONAL TERRITORY	taken directly from scientific literature, minimally adapted to WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
POSITION WITHIN URBAN/RURAL STRUCTURE	taken directly from scientific literature, minimally adapted to WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
PREVIOUS USE	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
SPACE MANAGEMENT	derived from scientific literature, adapted for WBUPP	· USER SURVEY · EXPERT SURVEY · SPATIAL ANALYSIS · FIELD RESEARCH

WBUPP URBAN-PLANNING AND DESIGN CRITERION	CRITERION ORIGIN TYPE, CONTRIBUTION ORIGINALITY	CRITERION ASSESSMENT METHOD
□ **scientific literature origin adapted to WBUPP; original derived from empirical process**		
□ **scientific literature origin, minimally adapted to WBUPP**		
HISTORICAL AND CULTURAL VALUE	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · FIELD RESEARCH
SPATIAL MORPHOLOGY	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · SPATIAL ANALYSIS · FIELD RESEARCH
ACCESSIBILITY	derived from scientific literature, adapted for WBUPP	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
NATURE-BASED SOLUTIONS IMPLEMENTATION	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
WATER-SENSITIVE URBAN DESIGN (WSUD) INTEGRATION	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
CLIMATE CHANGE ADAPTATION AND MITIGATION INTERVENTIONS	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
PEDESTRIAN AND CYCLING PATH NETWORK	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
URBAN DESIGN (WELL-BEING OFFERED BY URBAN DESIGN)	taken directly from scientific literature, minimally adapted to WBUPP	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
PUBLIC RESTROOMS	taken directly from scientific literature, minimally adapted to WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
DRINKING WATER FOUNTAINS (ACCESS TO DRINKING WATER)	taken directly from scientific literature, minimally adapted to WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
RENEWABLE ENERGY SOURCES	taken directly from scientific literature, minimally adapted to WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
ADAPTABLE SPACES	taken directly from scientific literature, minimally adapted to WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
PUBLIC TRANSPORT - resting places every 300m	taken directly from scientific literature, minimally adapted to WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
WAYFINDING	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
VISUAL IMPACT	derived from scientific literature, adapted for WBUPP	· USER SURVEY · EXPERT SURVEY

WBUPP URBAN-PLANNING AND DESIGN CRITERION	CRITERION ORIGIN TYPE, CONTRIBUTION ORIGINALITY	CRITERION ASSESSMENT METHOD
□ **scientific literature origin adapted to WBUPP; original derived from empirical process**		
□ **scientific literature origin, minimally adapted to WBUPP**		
		· CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
SUSTAINABLE WASTE MANAGEMENT	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
GREEN AREAS	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
SPORTS and RECREATION AREAS heterogeneity	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
OTHER PUBLIC AREAS heterogeneity	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
REDUCE MARINE AND COAST POLLUTION	derived from scientific literature, adapted for WBUPP	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · FIELD RESEARCH
ECOSYSTEM PRESERVATION/RESTORATION	derived from scientific literature, adapted for WBUPP	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
MIXED USE, FUNCTIONAL DIVERSITY	derived from scientific literature, adapted for WBUPP	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
RESILIENCE	derived from scientific literature, adapted for WBUPP	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
WATER CONTACT INTENSITY	original, new, derived from empirical process	· EXPERT SURVEY · SPATIAL ANALYSIS · FIELD RESEARCH
ANTI-POLLUTION MEASURES	original, new, derived from empirical process	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
GREEN AREAS heterogeneity	original, new, derived from empirical process	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
PROGRAM / FUNCTION	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
PROXIMITY OF SOCIAL (SCHOOL FACILITIES, HOME FOR ELDERLY, HEALTH FACILITIES)	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH

WBUPP URBAN-PLANNING AND DESIGN CRITERION	CRITERION ORIGIN TYPE, CONTRIBUTION ORIGINALITY	CRITERION ASSESSMENT METHOD
□ **scientific literature origin adapted to WBUPP; original derived from empirical process**		
□ **scientific literature origin, minimally adapted to WBUPP**		
PROXIMITY OF COMMERCIAL FACILITIES	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
WELL-BEING	derived from scientific literature, adapted for WBUPP	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
SECURITY (SAFETY)	derived from scientific literature, adapted for WBUPP	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
HERITAGE	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
DIVERSITY / SOCIAL INCLUSION	derived from scientific literature, adapted for WBUPP	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · FIELD RESEARCH
PARTICIPATION	derived from scientific literature, adapted for WBUPP	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · FIELD RESEARCH
EDUCATIVE FACILITIES/SERVICES	derived from scientific literature, adapted for WBUPP	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
ACCESSIBILITY (PUBLIC TRANSPORTATION) / MOBILITY	derived from scientific literature, adapted for WBUPP	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
INTERVENTIONS THAT DEFINE WATERFRONT	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
SHELTER AREAS	derived from scientific literature, adapted for WBUPP	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
VITALITY/ CONCENTRATION	derived from scientific literature, adapted for WBUPP	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
SENSE OF PLACE	derived from scientific literature, adapted for WBUPP	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
ON THE WATER BODY SURFACE/AREA RELATED PROGRAM	original, new, derived from empirical process	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH

WBUPP URBAN-PLANNING AND DESIGN CRITERION	CRITERION ORIGIN TYPE, CONTRIBUTION ORIGINALITY	CRITERION ASSESSMENT METHOD
□ **scientific literature origin adapted to WBUPP; original derived from empirical process**		
□ **scientific literature origin, minimally adapted to WBUPP**		
PROGRAM ON THE WATER BODY	original, new, derived from empirical process	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
PROGRAM IN THE WATER BODY	original, new, derived from empirical process	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
WATER RELATED PROGRAM	original, new, derived from empirical process	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
MULTI-ZONED SPATIAL ORGANIZATION	original, new, derived from empirical process	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
PROGRAM SPATIAL ORGANIZATION	original, new, derived from empirical process	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
LANDMARK PRESENCE	original, new, derived from empirical process	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
PROGRAM CONCENTRATION	original, new, derived from empirical process	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
CIRCULAR COMMUNICATION NETWORK	original, new, derived from empirical process	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
WATERFRONT COMMUNICATION NETWORK	original, new, derived from empirical process	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
WBUPP PROGRAM INTEGRATION	original, new, derived from empirical process	· USER SURVEY · EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
SPATIAL ENCLOSURE DIVERSITY	original, new, derived from empirical process	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH
EDGE	original, new, derived from empirical process	· EXPERT SURVEY · CONTENT ANALYSIS · SPATIAL ANALYSIS · FIELD RESEARCH

9.4 Concluding Remarks On WBUPP Urban-Planning Criteria: Results Synthesis

This chapter develops a refined, implementable set of urban-planning criteria specifically designed for planning and designing WBUPPs. It builds directly on the comprehensive literature-derived inventory from Chapter 6 and the theoretical and practical, multicriteria and spatial analyses of representative example cases in Chapter 8. Through a rigorous process – including identification from case-specific analysis criteria, qualitative and quantitative integration, elaboration with detailed categories and subcategories, and systematization into the three sustainability pillars (economic, environmental, and social)—it produces a flexible, hierarchical framework comprising 66 criteria with actionable guidelines. Key innovations include classifications for non-implementable contextual factors (such as size categories S-XL, previous use types, and water contact intensity) that inform regeneration strategies, alongside prescriptive, implementable standards like adaptable spaces, nature-based solutions, circular communication networks, and hybrid program integrations that emphasize water-centric vitality, resilience, and user well-being. The resulting criteria set addresses gaps in specificity for WBUPP contexts by prioritizing hybridity (for example, multi-functional elements blending heritage, education, and tourism), waterfront-defining interventions, and measurable thresholds (such as more than 40% open permeable boundaries for accessibility and more than two program features per hectare for vitality), while maintaining traceability to sources and strategic models.

Additional criteria are identified based on WBUPP representative example cases analysis results, consequently elaborated to create a consistent set that covers research findings and can serve for the future planning and designing WBUPPs. Water contact intensity and water related program with different modes of interaction with water resulted in creation of five new criteria: Water Contact Intensity, On The Water Body Surface/Area Related Program, Program on the Water Body, Program in the Water Body, and Water Related Program. Anti-pollution measures criterion includes multi-dimensional categories. It includes instructions to implement measures, instead of specifying them. Spatial

organization regarding overall organization and program is contained in three new criteria: Multi-Zoned Spatial Organization, Program Spatial Organization, and Program Concentration. They relate to the new Landmark criteria that highlights the contribution that a physical structure with specific characteristics can have to WBUPP and to a wider urban area. Two new criteria relate to the water and land path network and distinguish four categories each, considering different priority levels, multi-modal transport, and the general necessity of a heterogeneous program requiring a corresponding path network. Multitude of program features that integrate sustainability principles almost always require implementing more than one criterion and feature type into one element. According to research results, using a hybrid approach in creating program features enhances WBUPP quality. Consequently, another new criterion is added as a guideline, with nine stated and non-exclusive categories: WBUPP Program Integration. Spatial Enclosure Diversity offers three categories with enclosed, covered and open spaces which summarize the level of protection that WBUPP spaces possess. Edge criterion defines categories with ways a line of tree can act as a spatial definition element.

The final WBUPP urban-planning criteria set is systematized following the same three sustainability pillar principle. The previous criteria systematization performed on all 375 criteria found in scientific literature in Chapter 6, and this one performed on 66 WBUPP urban-planning criteria, confirm Hypothesis 2. The establishment of Urban-planning criteria for planning and designing public city parks in the regeneration of waterfront brownfields, developed through literature and spatial analysis, confirms the Main Hypothesis.

10 DISCUSSION

This dissertation is centered around the main general question: What are the urban-planning criteria for the planning and design of urban public parks within waterfront brownfield regeneration, and how can these criteria be identified, classified, and systematized? WBUPPs are complex entities that combine public space, heritage, water ecologies, contamination, and sustainability principles. They have not been researched in their entirety even though their role within cities is important and growing.

The research worked toward the main objective complemented by three auxiliary objectives. First, it established theoretical and empirical knowledge base consisting of synthesized findings analyzed from the urban-planning perspective, providing insights into the four compounding WBUPP domains: brownfields, urban waterfront, public park, and sustainability principles. Each domain provided criteria related to WBUPP that were extracted from scientific literature. Second, it developed a structured classification system that organizes urban-planning criteria into scientifically grounded categories and applied it, producing a framework that shows interdependence and translates abstract concepts into actionable requirements. Third, it validated and supplemented the framework through the analysis of 99 global WBUPP example cases and five representative WBUPP example cases: Abandoibarra (Bilbao), Jubileumsparken (Gothenburg), Biidaasige Park (Toronto), Brooklyn Bridge Park (New York City), and Jurong Lakeside Gardens (Singapore). Validation was performed using new methods that were developed to assess criteria application and outcomes, as well as establish the integrated urban-planning criteria set for the planning and design of urban public parks within waterfront brownfield regeneration.

The discussion discusses the knowledge about WBUPP compounding domains, WBUPP example cases screening analysis, representative WBUPP example cases complex detailed analysis, urban-planning criteria identification, organization, and the WBUPP urban-planning criteria set development. Limitations and implications for future research follow the discussion.

Throughout, the discussion maintains focus on the three specific research questions that supplement the main research question, making sure that the narrative directly addresses the defining characteristics of WBUPPs (RQ1), urban-planning criteria theoretical frameworks and conceptual approaches (RQ2), and establishes appropriate analysis and validation methodologies (RQ3).

To answer the research questions, the literature and selected WBUPP example cases are analyzed. In parallel, a criteria analysis is conducted. Innovative aspect of this research explores many scientific domains and creates numerous combinations to produce a comprehensive overview of WBUPP components. The author created several diagrams, as it is very difficult to present the research in an objective and systematic manner. Doctoral dissertation research methodology diagram was created, PRISMA-based diagram showed the WBUPP example cases database screening process, urban-planning criteria selection process for WBUPP spatial analysis with results was graphically represented, WBUPP thematic maps creation process in GIS-based tool was graphically represented, and a diagram representing development process with results for WBUPP Urban-planning criteria for planning and design was created.

The research is relevant because WBUPP development is a growing trend, as shown in literature research as well as by the growing realization number worldwide. WBUPPs relate to social aspects, environmental characteristics, and economic values that by being positioned in dense urban tissue have great influence on the surrounding population. WBUPPs are very important urban interventions that integrate different dimensions and contribute to the quality of urban life.

10.1 Discussion on Literature Review

Literature review shows that WBUPPs consist of multiple mutually integrated domains that relate to brownfield regeneration, waterfront transformation, public park development, and sustainability policy. These domains can present mutual tensions in implementation phases, such as when ecological restoration requires

restricting access, heritage preservation can limit spatial flexibility, and when uses that generate revenue need maintenance which can reduce affordability. Achieving balanced compromises between these tensions is a structural characteristic of the WBUPP typology. WBUPP projects balance these through governance and design strategies or solutions that seek synergies where possible.

Situating WBUPPs within the broader brownfield literature makes it clear why these sites are becoming increasingly in demand. Brownfields are abandoned, underused, often contaminated urban land, and their regeneration involves legal, financial, and institutional frameworks. Countries recognize them more in recent times by defining or acknowledging brownfields in laws and in official registers. Governing bodies offer public–private investment in brownfields. They are aware of that kind of land's value and how it can be financially wise to profit from selling it or renting it. They are also aware how costly the remediation is and that it takes a very long time to regenerate a disused, probably contaminated, former industrial site. In the last decades, urban regeneration process has transformed. From a one-dimension perspective of physical reconstruction, contemporary urban regeneration is approached comprehensively. European initiatives, such as TIMBRE, RESCUE, and HOMBRE, show how projects must respect environmental, economic, institutional, and social dimensions. Comparative WBUPP example cases show how innovation by advanced technical solutions, ecological restoration, preservation of heritage elements or memory, and revitalization from an economic point of view is possible, but it presents issues if there is no continuous political commitment. It is also necessary to apply different level's measures, in different development stages, to act on preventing gentrification.

Waterfront regeneration is also a very complex domain. Former port and industrial zones have busy pedestrian and road traffic that need additional mobility networks. They weren't needed before because user's movements and needs were different. Waterfront regeneration interventions depend on complex financing models where land sales often make the regeneration possible, but it is so challenging that the development needs to proceed in phases. International

cases show that design quality is not sufficient to make the intervention successful. It is necessary to govern the process by an institutional entity composed of experts in all related fields. Experiences in Baltimore, Hamburg's HafenCity, and Toronto show how specialized development corporations and tri-level governance can help resolve jurisdictional fragmentation problems. They also showed how an intervention can result in a failure when a waterfront regeneration model is copied in another location and context without adapting the model to local conditions. They also show how interventions can develop negative consequences such as gentrification if long-term environmental and social factors are not considered during planning phase. Contemporary practice integrates gray, green, and blue infrastructure and has to respond to climate pressures (such as sea-level rise, flooding, rising heat) through ecosystem-based planning as well as continuous strategies and standards adaptation.

Urban parks, as the third domain that is a form of public space, have evolved from elite pleasure grounds into complex social-ecological infrastructures that provide health benefits, climate regulation, biodiversity support, and social cohesion. Theoretical developments from Sitte, Lefebvre, and Carmona, along with the UN definition of public space as free and accessible to all, lead to the conclusion that park quality depends not only on physical design but also on governance, access, and cultural aspects. Research shows that dose–response relationships between park use and physical and mental health exist. It also shows inequalities, such as high-quality parks concentration in wealthier or whiter neighborhoods. Even if a public park gets realized in a low-income community, its existence increases the surrounding property values, so the process of gentrification is initiated by the intervention. These findings show how WBUPPs, are complex sites where multiple aspects of justice must be addressed.

The sustainability framework domain, as the fourth aspect of WBUPPs, has evolved from the Brundtland three-pillar model to a nested, multidimensional system that includes governance. Sustainability requires integrated assessment of environmental, social, economic, and institutional factors, as shown by projects like Houtan Park and Barangaroo Reserve. Inconsistent indicator frameworks and cases such as the failure of ecologically designed wetlands in London show

how good technical solutions are not enough for a project to succeed if funding and maintenance strategy is not adequate.

10.2 Discussion on WBUPP Example Cases Screening

Methodological framework and database construction

The PRISMA-based flow diagram was best suited to present the WBUPP screening analysis methodology. A global database of 99 WBUPPs was created from the initial 151 projects through a transparent PRISMA-guided process, enabling the transition from simple case descriptions to systematic comparison. Thirteen screening criteria included temporal, geographical, water context, spatial form, urban integration, previous land use, landscape quantity, and socio-economic context. They were established due to the lack of an existing classification framework. These criteria contribute to WBUPP's definition, since scientific literature does not consider or research WBUPPs as a distinguished type. An information-oriented method was chosen for WBUPP example cases selection because having many examples to choose from was challenging.

Global distribution, temporal trend, and water context

The geographic distribution of WBUPPs shows that 47% are located in Europe, and more than 90% were completed in the 21st century. This shows that the trend of WBUPP realization is very recent and growing. The finding that 85% of all identified projects are in countries ranked among the top 50 by GDP per capita, WBUPPs seem to be a Global North phenomenon. According to this research, they are concentrated in economically advanced contexts. The timeframe pattern is concentrated within the last two decades. The number of completed WBUPPs in the past decades continues to grow, which confirms waterfront brownfield regeneration as an increasingly important urban development strategy.

Water contact analysis shows that many parks are located on rivers and many on seas. Riverside locations are associated with previous industrial use. Sea waterfronts more often correspond to port infrastructure previous use. This shows that water is a structuring element of industrial location and subsequent WBUPP

planning and design. More than 80% of WBUPPs have strong spatial and programmatic integration with water, confirming that physical and transcendent engagement with water is a defining characteristic of the typology.

Typology, brownfield heritage, and spatial form

The analysis of 99 WBUPP example cases confirms Hypothesis 1: WBUPPs are a specific typology characterized by unique characteristics that emerge from the intersection of its factor's domains: brownfields, urban waterfront, public park, and sustainability principles. Still, they present internal diversity. Approximately 85% of the WBUPP's typology are former industrial or port-related sites.

Spatial form analysis shows diversity: there is no single dominant geometry, but clear correlations emerge between site conditions and design responses. Medium, large and extra-large parks on irregular riverfront locations often have heterogeneous programs within their layouts. Many European WBUPP example cases have linear forms. These relationships demonstrate that WBUPPs are shaped both by inherited industrial morphologies and water-body type. That shows how WBUPPs are a coherent but a varied typology inwardly.

Urban integration, socio-economic context, and spatial justice

Most WBUPPs (around 83%) are located within dense urban tissue areas, often adjacent to residential neighborhoods. More than 95% are well connected by surrounding infrastructure networks that provides high accessibility levels. Nearly all are converted from industrial or port land, and more than half feature extensive green spaces, confirming that the typology is defined by the combination of ecological landscape interventions with the reuse of strategically located, formerly polluting sites. The combination of characteristics such as urban location, infrastructural connection, and ecological regeneration makes WBUPPs powerful instruments that are able to regenerate fragmented waterfronts by connecting them to the urban fabric and by providing the required open public space in dense settings.

The finding that 85% of WBUPPs are located in countries with top-50 GDP per capita makes the typology deeply intertwined with questions of spatial justice. It

suggests that the ability to transform contaminated waterfront brownfields into celebrated public parks is concentrated in wealthy nations and cities, where costly remediation, complex planning procedures, and advanced design processes can be financed and managed. Several mutually reinforcing mechanisms help explain this pattern but did not enter this research as its developing part: higher levels of public investment and environmental regulation, strong redevelopment pressures on waterfront land that make mixed-use regeneration financially viable, and the presence of technical expertise and civic institutions capable of managing long and politically sensitive projects.

WBUPP can exist in a city that has displaced its port infrastructure or industrial production. Many WBUPPs in the created database are former facilities' locations whose activity was moved to other, less regulated and lower income countries, often in the Global South. WBUPPs are therefore not a sign of an actual capitalism production change, but as evidence of a spatial reorganization that places quality amenities in rich urban neighborhoods while the contaminating activities are moved elsewhere.

Empirical validation, contribution, and limitations of the database

The validation of the criteria framework through systematic analysis of 99 WBUPP example cases worldwide provides strong empirical support for recognizing WBUPPs as a distinct project typology.

The WBUPP example cases database represents a significant infrastructural contribution to the field that allows identification of spatial and time related patterns and trends. It enables correlations exploration that would not be possible through individual example cases. It offers a sampling frame that could be reproduced for future research. It offers a basis to compare new or emerging projects with, to determine their status of a standard or an innovative WBUPP. The database is the result of a dynamic and subjectively documented phenomenon. That is evidenced by the following observations: new WBUPPs are being completed continuously, existing WBUPPs are upgraded or poorly maintained, and there are WBUPPs situated in less prominent regions so they remain unrecognized. These limitations show there is a need for continuous

WBUPP maintenance and expansion. WBUPP's development needs to be more inclusive, multilingual, and participatory. Documenting WBUPPs needs to make sure that future changes of the WBUPP database better incorporate the diversity of global practice.

10.3 Discussion on WBUPP Representative Example Cases Analysis

Since classification using descriptive statistics and additional analyses (Multiple Correspondence Analysis and Latent Class Analysis) that aimed to identify the category, characteristic, or combination of interdependent characteristics of the park that is most relevant did not produce conclusive results, representative cases were selected through a deliberately information-oriented, three-phase process. The process was designed to maximize analytical insight rather than statistical representativeness, following Flyvbjerg's (2006) classification of paradigmatic cases, within his analysis methods study, as those that reveal broader characteristics of the researched subject. Starting from a global database of 99 WBUPPs, the sample was progressively narrowed to 35, then 12, and finally 5 cases by applying increasingly stringent inclusion and differentiation criteria. In the first phase, WBUPPs were selected according to their 21st-century completion timeframe. They had to be closely connected to urban infrastructure, characterized by strong water contact, have heterogeneous programs, and industrial or port infrastructure previous use. In the second phase selection requirements were limited to WBUPPs in countries ranked among the top 50 by GDP per capita, that were professionally acclaimed, cited in the literature, and whose area contained at least a medium amount of green space. The third phase selection was made to achieve diversity across continents (Europe, North America, Asia), water bodies (river, sea, lake), and scales (medium, large). It resulted in five representative WBUPP example cases: Abandoibarra in Bilbao, Jubileumsparken in Gothenburg, Biidaasige Park in Toronto, Brooklyn Bridge Park in New York, and Jurong Lakeside Gardens in Singapore.

Because no unified spatial database existed for these parks, a new GIS-guided spatial analysis method was developed to test and refine the urban-planning criteria framework. Multiple data sources such as OpenStreetMap (OpenStreetMap, 2025), Google satellite imagery (Google, 2025; Google, 2026a; Google, 2026b), local open data, and diverse textual and graphic materials, were combined in QGIS (QGIS Development Team, 2025), with Google Maps (Google, 2026b), Google Street View (Google, 2025), and Google Earth Pro (Google, 2026a) used to verify and correct inconsistencies. Conducting comparative international urban research of this type presented a great challenge since differently sourced and represented materials had to be analyzed, systematized, and unified to become appropriately processed and ready for implementation in GIS. For each representative WBUPP example case, eight thematic maps were produced at scales between 1:3,000 and 1:15,000, visualizing national and urban position, boundary conditions, accessibility and transport, environmental and health-related features, social and cultural elements, surrounding mixed-use contexts, brownfield remnants, and the detailed distribution of programs and water-contact infrastructure. These maps made it possible to identify spatial patterns that could not be described textually, such as the clustering of activities around path networks and waterfront edges or the relationship between adjacent land uses and park self-sufficiency.

Conceptual diagrams based on Kevin Lynch's five elements (paths, edges, districts, nodes, and landmarks) were used after theoretical and spatial WBUPP representative example cases analysis to abstract each WBUPP's spatial organization and legibility and determine specific spatial patterns, shown and explained in WBUPP example cases chapters, respectively. The extensive, iterative refinement and the great effort invested in creating these maps and diagrams shows that spatial analysis is not a simple technical procedure but a complex analytically-synthetical repetitive process that determines which patterns are going to be visible and what can be discussed about WBUPPs as integrated systems.

Within this analytical framework, brownfield heritage is something that connects WBUPP example cases, but also the aspect that showed great differences

between them. Although the majority of WBUPPs occupy former industrial or port land, the treatment of industrial remnants ranges from complete erasure to highly accentuated representation, and this contrast is not conditioned by design or funding only. It seems connected to how communities and institutions deal with the traumas associated with industrial decline. In cases where deindustrialization brought social devastation and significantly harmed the environment, erasing bas memories can seem like the good choice. Cities that have transitioned to post-industrial economies without difficulties can interpret industrial structures as authentic historical trace. Those are often high-income cities in which 85% of WBUPPs are located.

The representative WBUPP example cases show how heritage aspect brings most benefits if related elements are integrated multidimensionally, and not just as physical remnants on site. In Abandoibarra, major cultural institutions such as the Guggenheim Museum and Euskalduna Conference Centre occupy the symbolic terrain of former shipyards, translating erased remnants into a contemporary cultural network that functions simultaneously at neighborhood, city, and regional scales. Brooklyn Bridge Park shows how heritage can act as spatial foundation when structural grids of historic piers organize program distribution into a sequence of distinct spatial units along the waterfront. Biidaasige Park changes the focus from industrial structures to Indigenous placekeeping, using Indigenous names, ecological knowledge, and ceremonial practices, challenging the assumption that the brownfield story begins with industrialization. This case underlines the need for layered heritage narratives that recognize pre-industrial, industrial, and post-industrial histories and ask whose memories are foregrounded or silenced when “industrial heritage” is invoked.

Sense of place is enhanced by innovative interventions in program and integrative actions related to heritage. The suggestion that WBUPPs that keep and reinterpret industrial structures show stronger identity than those that erase traces was not fully supported. Parks such as Brooklyn Bridge Park, where heritage is highly legible and actively programmed, are internationally recognizable, suggesting a positive link between heritage representation and

imageability. Jubileumsparken shows that intense water-based programs and architecture can generate equally strong identities even with limited industrial remains. In several parks where structures have been preserved, poor interpretation reduces them to sculptural objects instead of exploiting the opportunity of them becoming strong narrative devices. This shows that preservation of heritage structure alone is necessary but not sufficient for achieving a strong sense of place that evokes past memories.

Contamination and remediation strategies also show how their implementation process can result in creating spatial forms, connecting landscape design with environmental engineering. Capping can produce elevated landforms that function as viewing mounds. Phytoremediation zones can act on the development of planting palettes and restrict certain uses. Containment areas can become “no-go” zones that protect ecological value by restricting access. These processes often remain invisible to users: remediation is conceived as a technical problem to be solved and hidden, not as an opportunity to educate the public about multiple aspects it can relate to. The research shows that WBUPPs should show the processes of healing and transformation that allow them to exist.

Another important contribution is the development of water contact as a gradient. This responds to RQ3 about criteria not found in scientific literature but resulting from realized WBUPP analysis. Empirical observation of the representative WBUPP example cases resulted in a five-level framework– from distant observation, to standing next to the water, to touching it, to using it for sports, and finally to full immersion– which provides a more refined vocabulary for describing how WBUPPs mediate human–water relationships. This gradient reveals why many conventional waterfront designs either stop at visual access or privilege intensive recreation, neglecting quieter or more contemplative engagements. It supports a criterion of differentiated water-contact infrastructure: well-performing WBUPPs deliberately orchestrate multiple modes of engagement, each supported by appropriate safety systems, storage, maintenance, and programming.

The representative WBUPP example cases illustrate how specific infrastructures enable users to utilize this gradient. Jubileumsparken's floating pools and Brooklyn Bridge Park's kayak launches transform the waterfront from a surface to be looked at into a space that can be inhabited and used, while Jurong's wetland boardwalks and Biidaasige's paddling and fishing facilities combine recreation with ecological education and cultural narratives. However, only about 55% of the 99 parks achieve intense water contact, and those that do are disproportionately located in high-income contexts, indicating that higher-level water programs– especially full immersion– are strongly conditioned by economic capacity and regulatory environments. This finding underpins criteria concerning equitable water access and design-based risk management: the right to swim, paddle, or sail in one's local waterfront park is, in practice, unevenly distributed, and risk can be managed through graduated edges, shallow zones, and visible safety infrastructure rather than predominantly through barriers, prohibitions, and surveillance. Water quality emerges as a further constraint, with many parks resorting to constructed pools or fountains that simulate contact where underlying water bodies remain too polluted, highlighting the need for watershed-scale remediation if immersive programs are to be genuinely sustainable.

Testing Hypothesis 3 shows that parks explicitly integrating brownfield, waterfront, public space, and sustainability dimensions tend to display more coherent multi-zoned layouts, higher program intensity, and stronger identity than projects where these aspects are treated separately, although the claim that such integration automatically produces equitable access is not fully supported. Spatial analysis reveals that representative WBUPP example cases such as Abandoibarra and Brooklyn Bridge Park employ clear multi-zoned organization, cluster activities along circulation spines and water edges, maintain program concentrations of more than two features per hectare, and deploy landmarks that are both symbolic and functional. At the same time, their locations in affluent districts and design vocabularies limit use by marginalized groups, and the global concentration of WBUPPs in wealthy cities raises questions of distributional equity beyond the boundaries of individual parks. From these observations, the research formulates additional criteria around multi-zoned and relational spatial

organization, legible anti-pollution design, internal and distributional equity, and transparent communication of planning trade-offs. Together, the findings across heritage, remediation, water-contact gradients, and integrated spatial organization establish WBUPPs as a distinct project typology shaped by the intersection of contamination legacies, waterfront conditions, industrial and Indigenous heritage, public-use demands, and sustainability imperatives, and provide a robust set of criteria for evaluating existing parks and guiding future waterfront brownfield regeneration.

10.4 Discussion on Urban-Planning Criteria Framework Development

The literature review shows how the term “criteria” does not have a unified definition. It does not apply to a generally specified subject, range or use. It is very difficult to determine the notion, meaning, scope or the way a criterion is implemented that can be considered generally acceptable.

The literature review identified many criteria that were incoherent, and whose content could not be compared using a common denominator for comparison. Most found criteria did not have defend indicators or defined measurement methods and often did not specify a clear range. In some cases, the criteria did not have a name or were not categorized by type, dimension, or context.

Substantial effort was required to understand their basic characteristics and determine if they had components that could be identified. Organizing them into a single table and attempting to classify their factors was challenging but necessary to present all identified criteria according to a common, mutually comparable principle. In the attempt to unify and purify the established criteria, the first attempts didn’t have positive results. Efforts to reduce different perspectives, ideas, or elements to a common basis for comparison, understanding, or agreement resulted in failure. This result is shown in the comprehensive table presented in Appendix 2: Urban–planning criteria, Table 29.

It displays various denominations, descriptions, name versions, and interpretation levels. The result highlights the diversity presented.
Systematizing them according to the three sustainability pillars was particularly difficult, because the content of the criteria, what they refer to, determine, or measure, is not uniform and cannot be decisively placed in only one of the three categories. For this reason, some criteria shown in Appendix 2: Urban–planning criteria, Table 30, are marked with multiple colors to indicate their overlapping characteristics: economic (yellow), environmental (green), and social (pink).

Based on these findings, identifying urban-planning criteria related to WBUPPs required changing from generic sustainability checklists and establishing how public space demands, contamination challenges, industrial remnants, and water environment, jointly generate specific planning requirements. The initial inventory of 375 indicators, found through the process of literature review within WBUPP factor's domains, revealed significant heterogeneity. Key terms such as "accessibility," "resilience," or "quality" were used with different meanings, at different scales, and with incompatible metrics.

The refinement process did not try to unify the criteria. It tried to understand the assumptions, measurement strategies, and scales that each criterion was related to. This involved consolidating items that had the same meaning, clearing up terms that had multiple meanings, aligning criteria to park scale, and rationalizing abstract concepts into observable characteristics so that they can become applicable in WBUPP example cases analysis. Through several iterative stages, the list was reduced to 50 criteria applicable in comparative analysis, that was later supplemented with 16 additional WBUPP-specific criteria that resulted from representative WBUPP example cases analysis but were absent from the scientific literature.

This work showed the strengths and limitations of the widely used environmental–social–economic "three-pillar" model. The pillars provided a useful framework, but many criteria could be classified in more than one dimension. For example, a remediated wetland that delivers flood protection, habitat, recreation, and education is simultaneously environmental, social, and economic. Consequently,

the research shows that sustainability should not be understood as a checklist of defined individual items, but as a constellation of spatial relationships. Individual elements– such as a bench, a path, or a pier– gain sustainability significance through the ways they connect users to each other, to ecological processes, and to the broader urban environment. This led to the introduction of a relational-design perspective, in which criteria are evaluated not only for their individual performance, but also for the quality and the type of connections they enable within uses, scales, and time.

Based on this, a hierarchical classification framework was developed to bring order to the refined criteria set. At the strategic level, the three sustainability dimensions are treated as nested and interdependent rather than equal. Economic objectives are active within social systems, which in turn must respect ecological limits. At the thematic level, these principles are translated into domains such as remediation and ecology, water management, accessibility and connectivity, inclusion and well-being, heritage and identity, and economic viability and maintenance. At the operational level, concrete criteria, both literature-derived and WBUPP-specific, are specified and elaborated.

This multi-level structure can show where individual criteria support more than one pillar, where they depend on preconditions such as adequate remediation or governance capacity, and where they come into tension – for example, when maximizing ecological restoration constrains public access, or when free access challenges the revenue generation needed for maintenance.

The analysis of representative WBUPP example cases showed that some of the most important characteristics of WBUPPs were missing from existing frameworks, particularly regarding water and large-scale spatial organization. New criteria such as Water Contact Intensity (a five-level gradient from viewing to full immersion), programs on, in, and on the surface of the water, Multi-Zoned Spatial Organization, Program Spatial Organization and Concentration, Landmark elements, integrated anti-pollution measures, and WBUPP Program Integration were defined. These criteria derived from realized WBUPP example cases analysis, address important gaps in the initially established 50 criteria

WBUPP analysis set. Those gaps can also be noted in sustainability and urban design criteria frameworks.

Developing and supplementing the criteria transforms an incoherent mass of overlapping requirements into a hierarchical framework. This framework does not eliminate the obvious complexity of WBUPPs. It does not assume that all criteria can be unequivocally assigned to a single pillar. It provides a decision-support structure that respects multidimensionality and shows interdependence. It allows framework users to compare projects or to plan and design interventions with greater conceptual and methodological clarity.

Implementation of the WBUPP urban-planning criteria within the spatial planning system of the Republic of Croatia can be conceptualized as an upgrade of the existing legal and strategic framework, aimed at operationalizing green infrastructure and climate adaptation across all planning levels – from legislation and national strategies to urban-planning documents and individual EU-funded projects (Republic of Croatia; Ministarstvo prostornoga uređenja, 2023). In normative terms, the Spatial Planning Act and the Ordinance on Spatial Plans enable the integration of WBUPP criteria into the terminology of spatial planning, mandatory spatial indicators, standards for cartographic representation and implementation conditions, thereby making the criteria measurable and enforceable in all types of plans (Republic of Croatia; Ministarstvo prostornoga uređenja, 2023). Strategic documents – such as the Spatial Development Strategy of the Republic of Croatia and the Sustainable Development Strategy of the Republic of Croatia – already affirm objectives related to urban resilience, green infrastructure and climate-change adaptation, which creates a clear policy framework into which the WBUPP criteria can be embedded as a set of standardized criteria for planning waterfront brownfield areas (Vlada Republike Hrvatske, 2021; Hrvatski sabor, 2009; Hrvatski sabor, 2017). At the operational implementation level, the recently opened opportunities for EU funding of green infrastructure in urban areas – for example, calls such as “Razvoj zelene infrastrukture u urbanim područjima” under the Competitiveness and Cohesion Programme 2021–2027 and pilot projects for green infrastructure and/or circular management of space and buildings – introduce a demand for transparent and

comparable criteria in the preparation of calls and in the evaluation of project proposals (Ministarstvo prostornoga uređenja, 2026; Fond za zaštitu okoliša i energetsku učinkovitost, 2024). In this context, the WBUPP criteria can function as an evaluation matrix that quantifies project contributions to the development of a coherent network of parks and other green–blue spaces, to increased resilience to climate risks and to circular land-use practices. WBUPP criteria can serve as a tool for aligning with guidance provided by European instruments such as the Climate-ADAPT platform, the AdriAdapt platform and the Adaptation Support Tool, which provide staged approaches to climate adaptation planning and highlight the importance of green and blue infrastructure in urban areas (Priority Actions Programme/Regional Activity Centre and Foundation, 2026; European Commission and European Environment Agency EEA, 2026; European Environment Agency EEA, 2026).

A multi-layered validation strategy is recommended to test transferability and strengthen the implementation potential of the WBUPP criteria framework. Possible methods include Delphi studies and expert surveys, application to an additional control sample, comparison with existing evaluation systems, as well as quantification through best-practice examples, legal regulations, and spatial-planning documentation from other countries. The Delphi method enables urban-planning experts to anonymously evaluate and refine criteria through successive rounds until consensus is reached, thereby reducing individual bias. It has been used to identify urban-sustainability components and develop indicator sets for sustainable-city assessment (Chan and Lee, 2019; Meijering et al., 2018). Expert surveys can extend this process to practitioners, academics, and policymakers, supporting the assessment of the criteria’s validity and practical relevance across disciplinary and regional contexts. Similar approaches have been applied to indicator development for historic urban regeneration and neighbourhood liveability assessment (Norouzian-Maleki et al., 2015; Zhao et al., 2023). Applying the framework to an additional control sample of example cases not used in its development would test the reproducibility of assessments across different urban morphologies and governance contexts. Comparable approaches have been used in waterfront-regeneration assessment and plan-quality validation (Hemphill

et al., 2004; Navarro-Yáñez et al., 2020). Cross-comparison with established evaluation systems may further reveal differences in ratings, contextual limitations, and gaps in social or economic dimensions (Berardi, 2013; Sharifi and Murayama, 2014). Existing models provide useful reference points but cannot be directly adopted. Gehl's (2010) 12 public-space quality criteria—grouped into Protection, Comfort, and Enjoyment—overlap with several WBUPP criteria. For example, protection from crime and violence corresponds to Safety, while comfort-related criteria, such as staying, sitting, seeing, and play, relate to Well-being, Shelter Areas, Visual Impact, Sports and Recreation Areas, and Heterogeneity (Gehl, 2010). Similarly, Mrak and Matan's (2022) accessibility model offers relevant assessment insights, although it is designed specifically for cultural locations and users with disabilities or sensory and mobility limitations. Because these models share certain principles but differ substantially in scope, target groups, and assessment structures, future research should prioritize Delphi studies and expert surveys, complemented by analysis of legal regulations and spatial-planning documentation from international good-practice examples.

10.5 Limitations and Implications for Future Research

This research has limitations, which also presents suggestions on how future research can be directed. WBUPP example cases' geographic location limits their generalization, since 85% of WBUPPs are from high-GDP Global North countries (47% Europe, 20% North America). English literature presents language limitations. Findings are not able to transfer directly to Global South contexts, because of the differences in available financial resources, lack of specialized governance entities, and different cultural and environmental conditions. The selected timeframe considers WBUPPs that have been completed recently. Therefore, they do not possess evidence of long-term evolution in use, resilience, maintenance, and ecology. The study relies mostly on spatial analysis and documents. On-site surveys have been carried out on limited number of locations, so user satisfaction, well-being, and equity

conclusions are more related to spatial design and other internet sources information that to measured or surveyed findings. Scale limitations did not allow for the broader neighborhood or city area to be analyzed, to determine the broader WBUPP impact. Methodological limitations include inconsistencies and missing information in OpenStreetMap data. User satisfaction and perception, as well as governance dimensions were not researched in depth. The criteria framework (66 items) is comprehensive but not all-inclusive, because it is guided by the research's theoretical framework.

Future research could involve any of these limitations through longitudinal studies tracking the neighborhood resident's lifecycle changes. Further research could focus on user-centered work using on-site surveys to obtain WBUPP usage information. Analysis of relevant institutions, governing bodies, or funding could be made. Global South cases could be analyzed to test framework adaptability. Ecological monitoring of biodiversity and ecosystem services could be conducted. Equity studies on access barriers and gentrification could be conducted. Research on climate adaptation and resilience strategies could be conducted. Comparative typology study that compares WBUPPs with other green infrastructure could be done to deepen the understanding of WBUPP's uniqueness. The WBUPP urban-planning criteria set can be validated using Delphi method and expert surveys, combined with an analysis of legal regulations and spatial-planning documentation from good-practice examples in other countries.

11 CONCLUSION

Findings from a three-part research design conclude in developing urban-planning criteria for the planning and design of urban public parks within waterfront brownfield regeneration, confirming the main hypothesis. The findings that synthesize literature review conducted within four WBUPP factors' domains confirm the first hypothesis: WBUPPs represent a specific and complex typology in which requirements regarding public space, heritage, water ecologies, contamination, and sustainability principles implementation, create unique planning needs.

WBUPP example cases screening analysis established a strong methodological framework. The PRISMA-based process and the 99-case global database transformed a group of mutually non-related examples into a transparent, comparable dataset. The 13 screening criteria are an important contribution because they help to define WBUPPs as a specific typology, since a previously established classification system does not exist. The WBUPP example cases database is a valuable basis for identifying patterns, improving and updating further research on WBUPPs.

The research showed that when statistical classification did not produce clear results, a deliberately information-oriented three-phase case selection process was the most effective way to identify five representative WBUPP example cases. The analysis confirms Hypothesis 1 that WBUPPs are a specific typology, internally diverse in how they implement heritage aspects, remediation solutions, and water contact features. Important findings show how water engagement is not a unified aspect but a concept that can be translated into features characterized by different water-contact gradients. Successful WBUPPs combine clear spatial organization, strong identity, and multiple forms of human–water interaction.

The literature review showed that existing "criteria" are highly inconsistent, often poorly defined, and difficult to compare because they use different meanings, scales, and measurement approaches. To make them usable for WBUPP

example cases analysis, the research refined the initial 375 indicators into 50 comparable criteria and then supplemented with 16 WBUPP-specific criteria identified through WBUPP example cases analysis. Important finding shows how the three-pillar sustainability model is useful but limited, because many criteria overlap more than one dimension and sustainability in WBUPPs works best as a set of relational connections rather than isolated items. The research developed a hierarchical framework that links strategic sustainability principles, thematic domains, and operational criteria.

Criteria systematization performed on all 375 criteria found in scientific literature, and on 66 WBUPP urban-planning criteria confirms Hypothesis 2, organizing them hierarchically according to economic, environmental, and social dimensions. Empirical analysis of 99 global cases and five representative WBUPP example cases (Abandoibarra, Jubileumsparken, Biidaasige Park, Brooklyn Bridge Park, and Jurong Lakeside Gardens) validates systematic criteria application, confirming Hypothesis 3. Hypotheses with corresponding verifications summary is presented in Table 49.

The research advances theoretical knowledge and research methodology, providing established databases, listed inTable 51, and contributing with created research methods that can be used, adapted, refined, and replicated in different contexts. Scientific contributions organized by thematic segments and aligned with the corresponding results is presented in Table 50. Original criteria, methodology process, and knowledge base are presented inTable 51.

The 66-criteria framework, presented in Table 46, that consists of urban-planning criteria for planning and designing public city parks in the regeneration of waterfront brownfields provides an adjustable tool to transform disused waterfronts into resilient, inclusive public spaces that balance present and future needs.

Table 49 Hypotheses aligned with the corresponding verifications results, M. Gudac Cvelic

HYPOTHESES			VERIFICATION OF HYPOTHESES
MAIN H	**O:** To develop the urban-planning criteria for planning and designing public city parks in the regeneration of waterfront brownfields.	H: Urban-planning criteria for planning and designing public city parks in the regeneration of waterfront brownfields can be developed through literature and spatial analysis.	Main Hypothesis is developed in Chapters 2-9. It is discussed and confirmed in Chapter 10.
H1	**O1:** To establish the theoretical and empirical knowledge base for WBUPP research	H1: WBUPPs are a specific typology characterized by unique characteristics whose urban-planning and design criteria emerge from the intersection of its factor's domains: brownfields, urban waterfront, public park, and sustainability principles.	Hypothesis 1 is developed in Chapters 2 - 5, and confirmed in Chapter 7.
H2	**O2:** To develop a structured classification system that organizes urban-planning criteria into scientifically grounded categories and to explore the relationships and interdependencies among criteria in the context of waterfront brownfield regeneration.	H2: Urban-planning criteria related to waterfront brownfield regeneration can be organized according to a classification system with scientifically grounded categories that recognize their relationships and interdependencies.	Hypothesis 2 is partially confirmed in Chapter 6, and fully confirmed in Chapter 9.
H3	**O3:** To validate the identified criteria framework through the two-level analysis of WBUPP example cases and to develop the analysis methodology that integrates the assessment methods on how criteria are implemented.	H3: The identified criteria framework can be validated through analysis of WBUPP example cases using the developed content and spatial analysis methodology.	Hypothesis 3 is partially confirmed in Chapter 7, and fully confirmed in Chapter 8.

Table 50 Scientific contribution by thematic segments aligned with the corresponding research results, M. Gudac Cvelic

ORIGINAL SCIENTIFIC CONTRIBUTION		RESULT
MAIN SC	**SC:** Development of urban-planning criteria for the planning and design of public city parks within waterfront brownfield regeneration.	• Urban-planning WBUPP criteria set with indicators • Development of the method of integrating the theoretical–methodological WBUPP framework, • WBUPP-related knowledge base establishment • GIS-related analysis method and dataset compilation
SC1	**SC1:** Establishment of a theoretical and empirical knowledge base consisting of synthesized findings analyzed from the urban-planning perspective, providing insights into the four compounding WBUPP domains: brownfields, urban waterfront, public park, and sustainability principles.	• Brownfields, Urban waterfront, Public park, and Sustainability principles knowledge base establishment • Interconnection of various thematic domains defining WBUPP • Identification of over 400 criteria, of which 375 is later systematized
SC2	**SC2:** Development of a structured classification system that organizes urban-planning criteria into scientifically grounded categories. Application of the classification system to the compilation of urban-planning criteria, showing the relationships and interdependencies among criteria in the context of waterfront brownfield regeneration.	• Definition of criteria • Identification of methodological approaches for classifying WBUPP aspects • Methods for the systematization of urban-planning WBUPP criteria • Development of a set comprising 50 WBUPP criteria, derived from scientific literature
SC3	**SC3:** Creation of the first WBUPP global inventory dataset and systematic comparative analysis of WBUPPs with overview, using the established screening analysis methodology. Establishment of a GIS-based spatial analysis method and its integration within the detailed representative WBUPP example cases analysis methodology. Creation of a detailed representative WBUPP example cases database using the established methodology, which will be made available and accessible online.	• Validation of the 50 criteria through the analysis of representative WBUPP case studies • GIS-based analysis method • GIS dataset compilation • Development of 16 new urban-planning criteria for WBUPP, derived from empirical analysis

Table 51 Original criteria, methodology process, and knowledge base list, M. Gudac Cvelic

ORIGINAL CRITERIA	ORIGINAL METHODOLOGY PROCESS	ORIGINAL DATASETS
DERIVED FROM SCIENTIFIC LITERATURE: • PLANNING • PROCESS • CIRCULARITY OF CONSTRUCTION • IMPLEMENT TOURIST ACTIVITY • SIZE • PREVIOUS USE • SPACE MANAGEMENT • HISTORICAL AND CULTURAL VALUE • SPATIAL MORPHOLOGY • ACCESSIBILITY • NATURE-BASED SOLUTIONS IMPLEMENTATION • WATER-SENSITIVE URBAN DESIGN (WSUD) INTEGRATION • CLIMATE CHANGE ADAPTATION AND MITIGATION INTERVENTIONS • PEDESTRIAN AND CYCLING PATH NETWORK • WAYFINDING • VISUAL IMPACT • SUSTAINABLE WASTE MANAGEMENT • GREEN AREAS • SPORTS and RECREATION AREAS heterogeneity • OTHER PUBLIC AREAS heterogeneity • REDUCE MARINE AND COAST POLLUTION • ECOSYSTEM PRESERVATION/RESTORATION • MIXED USE, FUNCTIONAL DIVERSITY • RESILIENCE • WATER CONTACT INTENSITY • ANTI-POLLUTION MEASURES • GREEN AREAS heterogeneity • PROGRAM / FUNCTION • PROXIMITY OF SOCIAL (SCHOOL FACILITIES, HOME FOR ELDERLY, HEALTH FACILITIES) • PROXIMITY OF COMMERCIAL FACILITIES • WELL-BEING • SECURITY (SAFETY) • HERITAGE • DIVERSITY / SOCIAL INCLUSION • PARTICIPATION • EDUCATIVE FACILITIES/SERVICES • ACCESSIBILITY (PUBLIC TRANSPORTATION) / MOBILITY • INTERVENTIONS THAT DEFINE WATERFRONT • SHELTER AREAS • VITALITY/ CONCENTRATION • SENSE OF PLACE DERIVED FROM EMPIRICAL ANALYSIS: • ON THE WATER BODY SURFACE/AREA RELATED PROGRAM • PROGRAM ON THE WATER BODY • PROGRAM IN THE WATER BODY • WATER RELATED PROGRAM • MULTI-ZONED SPATIAL ORGANIZATION • PROGRAM SPATIAL ORGANIZATION • LANDMARK PRESENCE • PROGRAM CONCENTRATION • CIRCULAR COMMUNICATION NETWORK • WATERFRONT COMMUNICATION NETWORK • WBUPP PROGRAM INTEGRATION • SPATIAL ENCLOSURE DIVERSITY • EDGE	**• Development of a method for integrating the theoretical–methodological WBUPP framework**	**Set of 66 Urban-planning WBUPP criteria with indicators:** • Set comprising 50 WBUPP criteria, derived from scientific literature • Development of 16 new urban-planning criteria for WBUPP, derived from empirical analysis
	WBUPP-related process: • Identification of methodological approaches for classifying WBUPPs according to their aspects • Interconnection of various thematic domains defining WBUPP • WBUPP example cases screening analysis methodology • GIS-based WBUPP representative example cases analysis method (including GIS-bases thematic mapping protocol) • Spatial analysis conclusive abstraction, partially based on Lynch (1960)	• WBUPP example cases screening table and classification table • Spatial dataset in GIS-based format (including 8 thematic maps for each WBUPP representative example case) • WBUPP representative example case's schematic diagrams
	Urban-planning criteria-related process: • Definition of criteria • Methods for the systematization of urban-planning WBUPP criteria • Development of a set comprising 50 WBUPP criteria, derived from scientific literature • Validation of the 50 criteria through the analysis of representative WBUPP case studies • Development of 16 new urban-planning criteria for WBUPP, derived from empirical analysis • Development of Urban-planning criteria's indicators	Urban-planning criteria-related database establishment: • 375 criteria dataset (table), originated from scientific literature • 50 WBUPP criteria dataset (table), derived from scientific literature • 16 new urban-planning criteria for WBUPP dataset (table), derived and development from empirical analysis

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Prošireni sažetak

Doktorska disertacija istražuje javne gradske parkove na obalnim brownfield lokacijama, odnosno Waterfront Brownfield Urban Public Parks (WBUPPs), kao specifičnu i sve značajniju tipologiju urbanog prostora koja nastaje transformacijom bivših industrijskih, lučkih i infrastrukturnih područja uz rijeke, jezera ili morske obale u javno dostupne, višefunkcionalne i održive urbane prostore. U suvremenom urbanom kontekstu, obilježenom deindustrijalizacijom, prostornim restrukturiranjem, klimatskim promjenama i rastućom potrebom za kvalitetnim javnim prostorima, regeneracija obalnih brownfielda postaje jedna od ključnih strategija održivog urbanog razvoja. Takvi prostori imaju izniman potencijal jer istodobno omogućuju sanaciju degradiranog zemljišta, obnovu odnosa grada i vode, razvoj zelene i plave infrastrukture te stvaranje novih javnih prostora visoke društvene i ekološke vrijednosti.

Unatoč sve većem broju realiziranih projekata diljem svijeta, WBUPP-ovi dosad nisu bili sustavno istraženi kao cjelovita tema urbanističke teorije i prakse. Dosadašnja znanstvena literatura uglavnom se bavila pojedinim sastavnicama ove problematike zasebno — brownfield regeneracijom, urbanim waterfrontima, javnim parkovima i održivošću — bez razvoja integriranog okvira koji bi objedinio njihovo međudjelovanje. Upravo taj istraživački jaz predstavlja polazište ove disertacije. Temeljni cilj rada jest identificirati, klasificirati i sistematizirati urbanističke kriterije za planiranje i projektiranje javnih gradskih parkova u regeneraciji obalnih brownfielda, pri čemu se razvijeni okvir temelji i na teorijskoj analizi i na empirijskoj provjeri kroz međunarodne studije slučaja.

Središnje istraživačko pitanje glasi: koji urbanistički kriteriji određuju planiranje i projektiranje javnih gradskih parkova u regeneraciji obalnih brownfielda te na koji se način ti kriteriji mogu sustavno identificirati, klasificirati i primijeniti u praksi? Iz tog pitanja proizlazi i niz potpitanja usmjerenih na prepoznavanje teorijskih ishodišta relevantnih za WBUPPs, utvrđivanje međuodnosa između kriterija i njihovu sistematizaciju, kao i pronalaženje odgovarajućeg metodološkog pristupa za identifikaciju kriterija koji nisu zastupljeni u postojećoj znanstvenoj literaturi.

Istraživanje polazi od triju povezanih hipoteza. Prva hipoteza pretpostavlja da WBUPPs predstavljaju specifičnu prostornu tipologiju koja se bazira na integraciji četiriju područja: brownfield regeneracije, urbanih waterfronta, javnih gradskih parkova i održivosti. Druga hipoteza polazi od toga da se kriteriji relevantni za ovu tipologiju mogu organizirati u znanstveno utemeljen sustav klasifikacije koji uvažava njihove međusobne odnose i razine općenitosti. Treća hipoteza tvrdi da se takav okvir može empirijski potvrditi i nadograditi kroz analizu literature i prostornu analizu reprezentativnih primjera iz prakse. Rezultati istraživanja potvrđuju sve tri hipoteze te dodatno proširuju postojeća znanja o planiranju i projektiranju ovakvih prostora.

Konceptualni okvir rada temelji se na definiranju pet ključnih pojmova: waterfront brownfields, urban public parks, waterfront regeneration, planning and design criteria te sustainability. Waterfront brownfields definiraju se kao ranije razvijena, a danas napuštena, nedovoljno iskorištena ili kontaminirana područja uz vodena tijela, koja su prethodno služila industrijskim, lučkim ili infrastrukturnim funkcijama. Iako se nalaze na izrazito povoljnim urbanim lokacijama, ta područja nose niz razvojnih ograničenja, uključujući kontaminaciju tla, kompleksne vlasničke odnose, infrastrukturnu zastarjelost i prostornu fragmentiranost. Istodobno, ona predstavljaju iznimnu razvojnu priliku zbog svoje blizine gradskim središtima, postojeće infrastrukturne opremljenosti i potencijala za stvaranje novih javnih sadržaja.

Urbani javni parkovi shvaćeni su kao javno dostupni otvoreni prostori koji omogućuju rekreaciju, socijalnu interakciju, vizualno i ekološko poboljšanje okoliša te jačanje urbane kvalitete života. U kontekstu obalnih brownfield lokacija, parkovi dobivaju dodatnu složenost jer osim uobičajenih funkcija moraju omogućiti i fizički, vizualni i simbolički kontakt s vodom, interpretaciju industrijske i pomorske baštine, kao i prilagodbu klimatskim i hidrološkim rizicima. Waterfront regeneracija pritom označava višedimenzionalni proces transformacije zastarjelih lučkih, industrijskih i infrastrukturnih zona uz vodu u nove urbane prostore, pri čemu je naglasak na obnovi javnog pristupa vodi, poboljšanju okolišne kvalitete i stvaranju dugoročno održivih urbanih funkcija.

Posebno mjesto u radu zauzima pojam kriterija za planiranje i projektiranje. Kriteriji se u ovoj disertaciji tumače kao kvalitativni, normativni i planski orijentirani standardi koji određuju što bi određeni prostor trebao ostvariti, dok indikatori predstavljaju mjerljive pokazatelje kojima se ti kriteriji mogu operativno pratiti i vrednovati. Autorski pristup jasno razlikuje ova dva pojma: kriteriji služe definiranju ciljeva i planerskih zahtjeva, dok indikatori pripadaju području evaluacije i mjerenja. Ova disertacija razvija kriterije, a ne indikatore, pri čemu buduća istraživanja ostaju otvorena za njihovu kvantifikaciju i operacionalizaciju.

Pojam održivosti u disertaciji se temelji na klasičnoj definiciji Brundtlandove komisije, prema kojoj razvoj mora zadovoljiti potrebe sadašnjih generacija bez ugrožavanja mogućnosti budućih generacija da zadovolje vlastite potrebe. Kao analitički okvir koristi se trodijelni model održivosti — okolišna, društvena i ekonomska dimenzija — uz svijest o tome da se u WBUPPs mnogi kriteriji ne mogu jednostavno svrstati u jednu kategoriju, jer istodobno obuhvaćaju više dimenzija. Stoga se održivost u ovom radu interpretira kao skup međuovisnih odnosa, a ne kao zbroj izoliranih kategorija.

Metodološki okvir istraživanja oblikovan je kao kvalitativni, višemetodni i višefazni proces koji obuhvaća sustavni pregled literature, analizu dokumenata, izradu globalnog inventara WBUPP-ova te detaljnu komparativnu analizu odabranih studija slučaja. Istraživanje je provedeno kroz dvije međusobno povezane istraživačke cjeline. Prva cjelina fokusira se na identifikaciju, selekciju i klasifikaciju WBUPP primjera na globalnoj razini. U početnoj fazi prikupljeno je 151 relevantnih primjera iz različitih znanstvenih, stručnih i ostalih izvora. Nakon primjene kriterija selekcije i provjere dostupnosti podataka, taj je broj reduciran na 99 klasificiranih slučajeva koji čine prvi globalni inventar ove tipologije. Ti su slučajevi dalje analizirani prema 13 kriterija selekcije, što je omogućilo njihovu usporedivost i tipološku strukturiranost.

Druga istraživačka cjelina bavi se urbanističkim kriterijima. Iz literature je inicijalno identificirano više od 400 kriterija, koji su nakon terminološkog usklađivanja, uklanjanja suvišnog i konceptualnog objedinjavanja reducirani na 375 jedinstvenih kriterija. Ti su kriteriji potom sistematizirani prema trima stupovima održivosti te dodatno filtrirani i strukturirani u dva operativna skupa: prvi skup

obuhvaća 13 kriterija za selekciju, a drugi 50 kriterija za analizu. Takva dvostupanjska organizacija omogućila je istodobno prepoznavanje WBUPP-ova i njihovu dubinsku evaluaciju.

Za detaljnu empirijsku analizu odabrano je pet reprezentativnih slučajeva: Abandoibarra u Bilbau, Jubileumsparken u Göteborgu, Brooklyn Bridge Park u New Yorku, Jurong Lake Gardens u Singapuru i Biidaasige Park u Torontu. Ovi su primjeri odabrani namjernim uzorkovanjem kako bi se obuhvatila prostorna, klimatska, kulturna i razvojna raznolikost WBUPP-ova. Analiza svakog slučaja obuhvatila je sedam tematskih područja: kontekst projekta, planerski i projektantski proces, prostorne karakteristike lokacije, primjenu kriterija, održivost, postignute rezultate te implikacije za buduće korištenje. Za potrebe prostorne analize korišteni su GIS alati, prije svega QGIS, uz izradu tematskih karti, a konceptualni dijagrami izrađeni su prema načelima prostorne čitljivosti i organizacije prostora.

Rezultati istraživanja potvrđuju da WBUPPs predstavljaju zasebnu i kompleksnu tipologiju urbanog prostora koja zahtijeva integrirani pristup planiranju. Pokazalo se da standardni trodijelni model održivosti jest koristan kao početni analitički okvir, ali nije dovoljan za potpuno razumijevanje ove vrste prostora, budući da se mnogi kriteriji istodobno odnose na okolišne, društvene i ekonomske aspekte. Upravo ta višedimenzionalnost pokazuje da se WBUPPs ne mogu svesti na jednostavne kategorizacije, nego zahtijevaju pristup koji uvažava njihove međusobno isprepletene funkcije i učinke.

Jedan od važnih rezultata odnosi se na razumijevanje odnosa čovjeka i vode. Istraživanje pokazuje da je kontakt s vodom u WBUPP-ovima višedimenzionalan i da se kreće od vizualne veze, preko prostorne blizine, do izravnog fizičkog pristupa i aktivne interakcije. Uspješni primjeri WBUPP-ova ostvaruju slojevitu organizaciju prostora koja omogućuje različite razine korištenja i doživljaja, istodobno čuvajući ekološku osjetljivost obalnih zona. Dodatno, rezultati potvrđuju važnost jasne prostorne organizacije, snažnog identiteta mjesta, povezanosti s okolnim urbanim tkivom te implementaciju zeleno-plave infrastrukture.

Empirijska analiza pet studija slučaja rezultirala je i identifikacijom 16 dodatnih urbanističkih kriterija koji nisu bili izravno prepoznati u postojećoj literaturi. Ti kriteriji proizašli su iz usporedbe stvarno realiziranih projekata i njihove prostorne logike, što potvrđuje da praksa često nadopunjuje teorijski okvir. Nakon integracije novih elemenata s prethodno identificiranim literaturnim kriterijima, konačni sustav obuhvaća ukupno 66 urbanističkih kriterija. Ti su kriteriji organizirani unutar triju dimenzija održivosti, ali uz jasno naglašene međuodnose i preklapanja, čime je oblikovan fleksibilan i znanstveno utemeljen okvir za planiranje i evaluaciju WBUPP-ova.

Znanstveni doprinos ove disertacije može se sagledati na nekoliko razina. Prije svega, rad razvija integriranu teorijsku osnovu koja objedinjuje četiri dosad fragmentirano istraživane domene: brownfielde, urbana priobalna područja, javne gradske parkove i održivost. Nadalje, razvijen je sustav klasifikacije kriterija koji omogućuje njihovu hijerarhijsku i relacijsku organizaciju, a ne samo popisivanje pojedinačnih elemenata. Poseban doprinos predstavlja prvi globalni inventar WBUPP-ova, koji ima potencijal postati referentna baza za buduća istraživanja. Također, razvijena GIS-temeljena metodologija prostorne analize predstavlja ponovljiv i prenosiv istraživački alat koji se može primijeniti i na druge složene urbane tipologije.

Praktična vrijednost rada ogleda se u mogućnosti primjene razvijenog kriterijskog okvira u urbanističkom planiranju, arhitektonskom projektiranju, procjeni razvojnih prijedloga i oblikovanju politika regeneracije obalnih područja. Okvir može služiti kao pomoćni alat planerima, krajobraznim arhitektima, investitorima, javnim upravama i istraživačima pri donošenju odluka o budućem razvoju zapuštenih obalnih lokacija. Njegova prilagodljivost različitim prostornim i institucionalnim kontekstima čini ga korisnim i u međunarodnom okviru, osobito u sredinama koje tek razvijaju specijalizirane strategije za revitalizaciju priobalnih brownfield područja.

Zaključno, ova disertacija uspostavlja WBUPPs kao prepoznatljivu i autonomnu tipologiju urbanog prostora te razvija cjelovit, empirijski provjeren i znanstveno utemeljen okvir urbanističkih kriterija za njihovo planiranje i oblikovanje. Time se popunjava važna praznina u postojećem znanstvenom znanju i otvara prostor za

daljnja istraživanja, osobito u smjeru razvoja kvantitativnih indikatora, post-occupancy evaluacija, analize upravljačkih modela i testiranja okvira u različitim geografskim i socio-ekonomskim kontekstima. Konačni rezultat rada jest alat koji može doprinijeti transformaciji napuštenih obalnih prostora u otporne, inkluzivne, ekološki vrijedne i društveno relevantne javne prostore budućnosti.

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Biography of the Author and List of Publications

Martina Gudac Cvelic was born in Rijeka in 1981. She holds a graduate degree in architecture, is a licensed architect, and the director of EXPONO Ltd., Bakarac, where she works in architectural design, directly supervising a team of 2-3 professionals since 2010. Her previous professional experience includes positions in architectural firms in Croatia, New York, Barcelona, and Venice.

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Her professional portfolio includes numerous completed projects for private clients, including single-family homes, residential and commercial buildings, tourism accommodation and related facilities. Her work for public sector clients encompasses cultural heritage projects and conservation studies, social housing, maritime facilities, public infrastructure, an animal rescue center, and educational and community facilities. She has also collaborated in the preparation of urban planning documents and studies. She has participated in architectural and urban design competitions, exhibitions, and publications involving projects in Venice, Labin, Senj, Rijeka, Osijek, Pula, Varaždin, Zadar, and Dubrovnik. She received first prizes in competitions at IUAV in Venice and for the POS Škurinjsko Plase housing project in Rijeka. She is fluent in English, Italian, and Spanish; Croatian being her native language.

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