



Water in Urban Environments: The Influence of Blue Infrastructure on Residential Appeal

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Abstract

The study focuses on assessing the quality and functionality of water bodies as components of Blue Infrastructure (BI) in the urban environment, using the city of Olsztyn as a case study. BI, which includes both natural and man-made water features, plays a vital environmental, social, and recreational role in cities. The aim of this study was to carry out a detailed inventory of water reservoirs and assess them in terms of quality and accessibility, considering their various functions (recreational, aesthetic, ecological). All reservoirs within Olsztyn's administrative boundaries were evaluated through cartographic analysis, field surveys, and geo-surveys. The study's findings aim to identify which functional characteristics of water bodies are most relevant to their attractiveness in the context of urban space, providing tools to support the planning of sustainable and environmentally friendly cities.

Key words: Blue Infrastructure, water bodies, urban environment, sustainability, recreational functions, spatial planning,

1. Analysis of Olsztyn Residents' Opinions on the Use of Water Reservoirs in the Context of a Blue Infrastructure Study

As part of a study on blue infrastructure in Olsztyn, a survey was conducted to explore residents' opinions and habits related to the use of local water reservoirs. A total of 448 people participated in the survey. The demographic structure of respondents reveals a predominance of middle-aged individuals. The largest groups consisted of people born between 1980–1994 (39.58%) and 1961–1979 (37.5%). The youngest and oldest age groups were the least represented. The majority of participants were women (58.33%), while men accounted for 41%. No respondents selected another gender or declined to answer.

Respondents rated various aspects of using water reservoirs on a scale from 1 to 5. The highest-rated aspect was the opportunity for swimming and water sports, with 72.92% considering it most important (rating of 5). Other highly rated features included proximity to the reservoir (58.33% gave it a 5) and the presence of educational information boards (62.5%). The diversity of flora and fauna was also valued, with 33.33% rating it as highly important. Other elements such as food services, recreational infrastructure (benches, shelters, fire pits), and scenic beauty received more mixed but generally positive ratings.

When asked about their second-favorite reservoir, respondents most frequently mentioned Lake Ukiel/Krzywe (28.89%), Lake Skanda (26.67%), and Lake Długie (17.78%). Use of the reservoirs was strongly seasonal. All respondents reported visiting during the summer, while 54.17% did so in spring, 45.83% in autumn, and only 14.58% in winter. Visit frequency was also high: 70.84% reported going to the reservoir at least once a week (including 22.92% more than once weekly), and 20.83% at least once a month.

Among the very few people who do not use the reservoirs (just 3 individuals), the most commonly cited reasons were a lack of need (66.67%) and distance from home (33.33%).

When it comes to reservoir preferences, 56.25% of respondents favored locations with developed surroundings (such as sidewalks, benches, and bike paths). Natural reservoirs were preferred by 33.34%, while 10.42% were neutral.

The most frequently mentioned infrastructural deficiency was a lack of toilets, noted by 41.67% of respondents. However, 37.5% felt that their favorite reservoir lacked nothing. Other reported deficiencies included playgrounds (14.58%), small food outlets (12.5%), and benches (12.5%).

In terms of preferred activities, respondents most often mentioned enjoying the scenery (66.67%) and walking or running (58.33%). Wildlife observation (33.33%) and using rental equipment (29.17%) were also popular.

As for companionship, respondents most frequently visited reservoirs with children (56.25%) or a partner (43.75%), though many also reported visiting alone (33.33%) or with friends (37.5%).

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2. Assessment of Accessibility to Functionally Valuable Water Reservoirs in Olsztyn

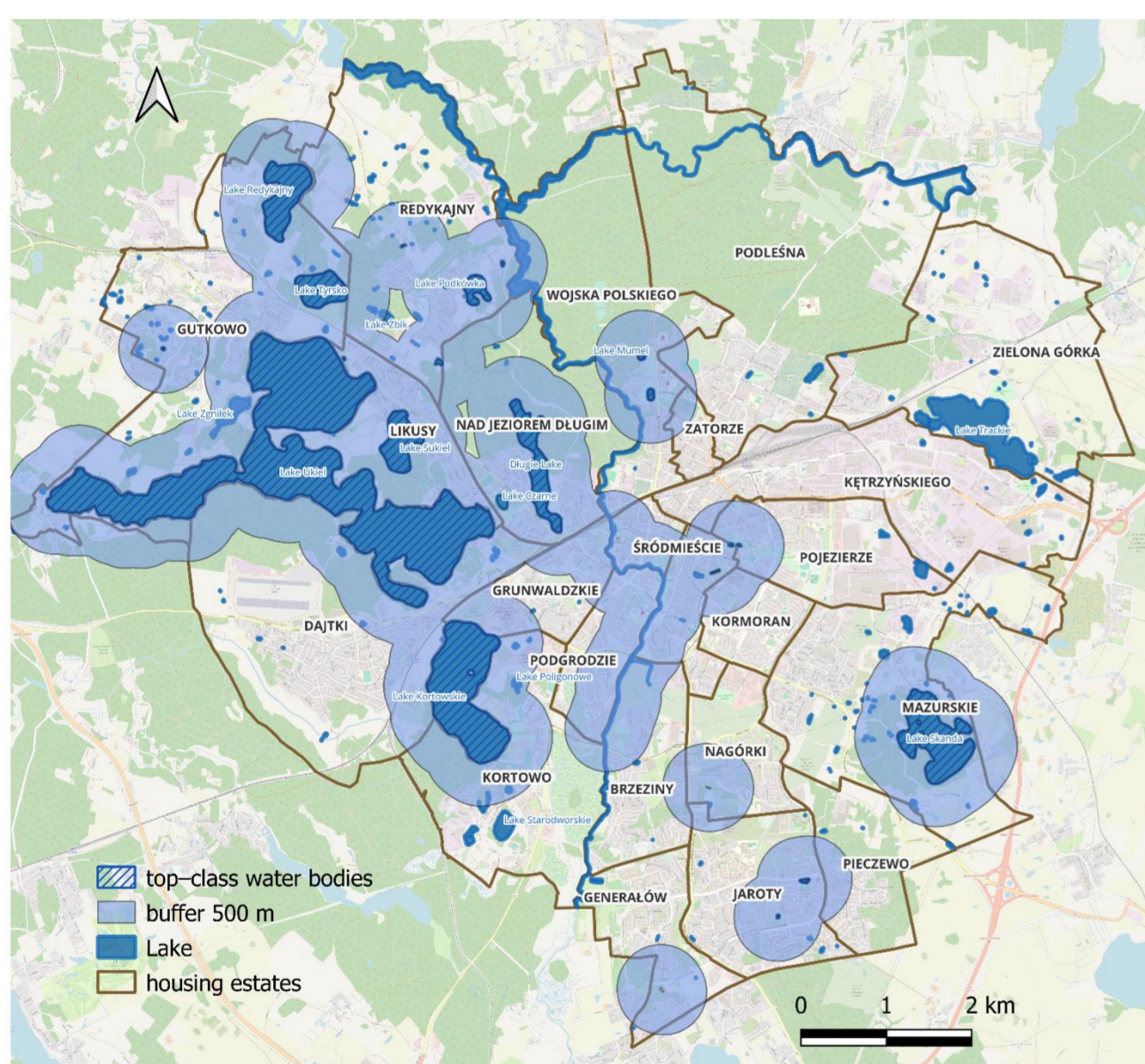


Figure 2. Concentration map and optimal access zones to the most attractive water reservoirs in Olsztyn.

In the context of evaluating the accessibility of water reservoirs within Olsztyn, a 500-meter buffer from the shoreline was adopted as the optimal walking distance, considered comfortable for all age groups. This standard aligns with methodologies employed in similar urban studies.

A geospatial analysis was conducted to assess the spatial distribution of functionally valuable water reservoirs in relation to residential areas. The resulting concentration and coverage map (Figure 2) indicates that the highest-value reservoirs are predominantly located in the western and southern parts of the city.

Conclusions. Spatial analysis showed uneven access to functionally attractive water reservoirs across the city's neighborhoods. Although a significant number of neighborhoods are within walking distance of the water bodies, there are also areas that require planning intervention to improve spatial accessibility. Appropriate measures - such as the development of access paths, recreational zones or landscaping elements - can help increase spatial equality in terms of access to water resources. Olsztyn's water resources perform multiple ecosystem and social functions. In addition to improving the microclimate and mitigating the urban heat island effect, they play an important role in rainwater retention, which is of particular importance in the context of increasingly frequent extreme weather events. At the same time, there is a high level of involvement of residents in the use of waterfront spaces, which translates into an increase in the importance of these areas in the recreational, health and social context.

The water reservoirs in Olsztyn are highly valued and frequently utilized by residents, particularly during the warmer months. The primary attractions are opportunities for swimming and water sports, proximity, and the presence of educational elements, indicating a desire for both recreational and informational engagement with these blue spaces. While a significant majority of users appreciate developed infrastructure, a notable portion also values natural settings. The strong seasonal pattern of use and high frequency of visits underscore the importance of these reservoirs for the leisure and well-being of Olsztyn's inhabitants. Addressing the identified infrastructural deficiencies, most notably the lack of public toilets, alongside considering the preferences for both developed and natural areas, could further enhance the accessibility and satisfaction of residents using Olsztyn's valuable blue infrastructure.

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Figure 1. Research area-Olsztyn

Research area

Olsztyn, the capital of the Warmian-Masurian Voivodeship in north-eastern Poland, is a city with exceptional potential for the development and integration of blue infrastructure (BI). Characterized by the presence of numerous natural water bodies—including 15 lakes and the Łyna River—Olsztyn offers a coherent and interconnected aquatic network that forms an essential component of the urban landscape. This unique hydrological configuration makes the city a valuable case study for examining the role of water resources in urban planning and development.

Blue infrastructure in Olsztyn plays a vital role not only in enhancing the quality of life for residents but also in fostering urban resilience to climate change. The presence of water bodies contributes to the moderation of the urban microclimate by mitigating the urban heat island effect, while also providing crucial retention capacity for stormwater management and flood control. Moreover, these water features serve as key recreational and ecological assets, supporting biodiversity and offering accessible spaces for leisure and environmental education.

3. Further analysis, incorporating the administrative boundaries of city districts, revealed disparities in access to these water bodies among different neighborhoods. To quantify this, the percentage of each district's area within the 500-meter buffer zone was calculated. Based on this metric, districts were categorized into four levels of accessibility. According to the adopted methodology, access to water reservoirs was assessed based on the area coverage of settlements using classifications in 25% increments. The highest level of accessibility was defined as "high attractiveness," while the lowest was "unattractive."

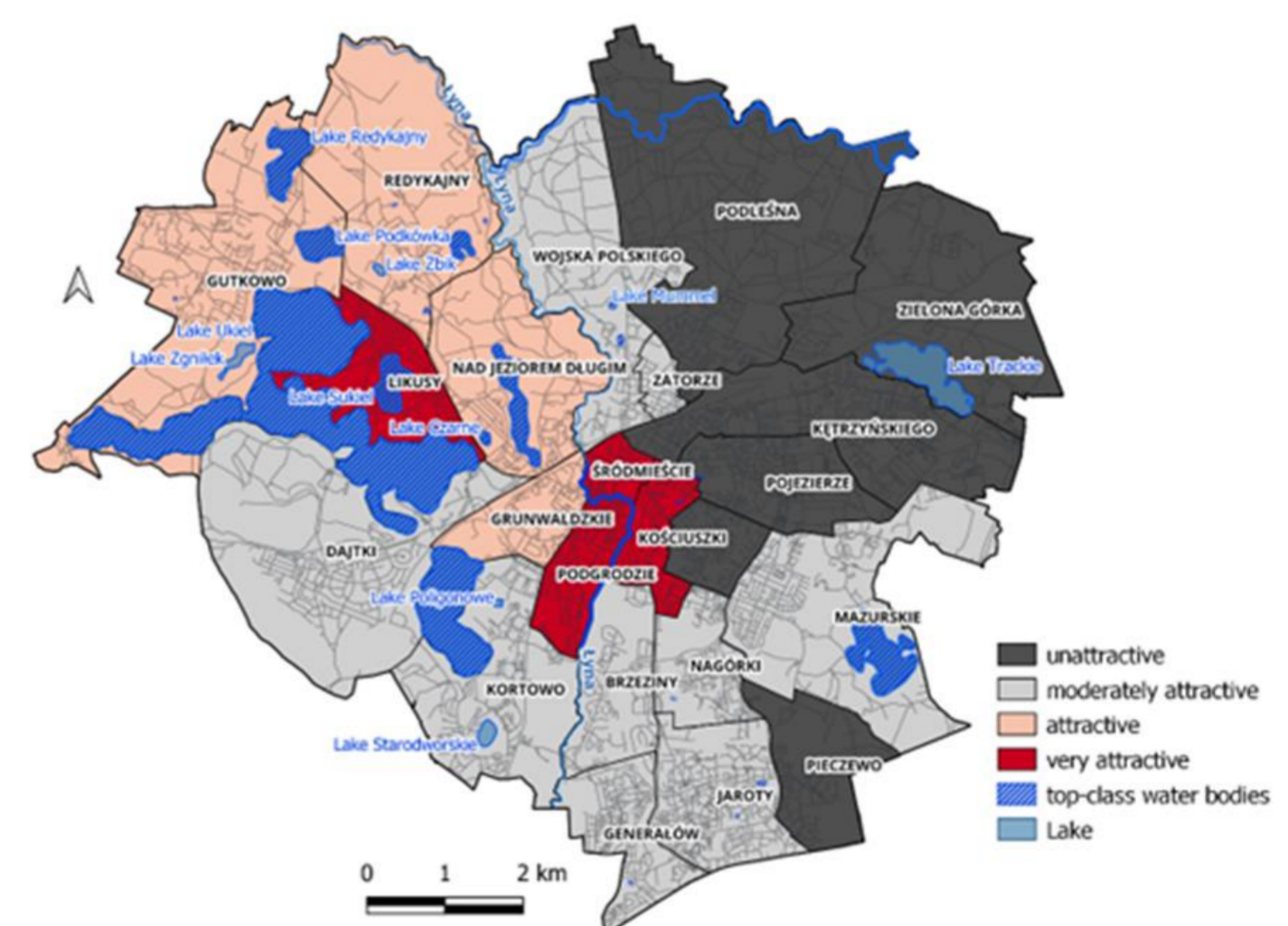


Figure 3: Map of the attractiveness of residential neighborhoods in Olsztyn based on their proximity to the most valuable water bodies.

Of all residential districts in Olsztyn, 17% were classified as highly attractive, another 17% as attractive, 39% as moderately attractive, and 26% as unattractive in terms of access to bodies of water. These results should not be regarded as the sole indicator of neighborhood attractiveness. However, when compared with land and real estate prices across different locations, the findings confirm the significant influence of blue infrastructure on property values in residential areas. Additionally, neighborhoods located near water bodies tend to represent the older parts of the city. This observation aligns with urban development theory [28], which suggests that early human settlements were typically established close to water sources. Historically, access to water has been a key driver in shaping urban growth and structure [29].