D.T 3.3.4

WATER MANAGEMENT STRATEGY FOR THE AREA OF BTOF AND BYDGOSZCZ

RAINWATER, GREY WATER AND TREATED WASTEWATER

Version 2

01 2022

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1. INTRODUCTION

1.1. BASIS OF OPERATIONS

1.2. APPLIED ABBREVIATIONS

Abbreviation	Description
Strategy	This document: „ CLOSED CIRCUIT WATER MANAGEMENT STRATEGY FOR THE AREA OF BTOF AND BYDGOSZCZ: RAINWATER, GREY WATER AND TREATED WASTEWATER”
BDOT	Database of Topographical Objects
BGK	Bank Gospodarstwa Krajowego
BOŚ	Bank Ochrony Środowiska

BTOF	Bydgoszcz-Toruń Functional Area
GDDKiA	General Directorate for National Roads and Motorways
EIB	European Investment Bank (EIB)
JCWP	Homogeneous body of surface waters
MKiŚ	Ministry of Climate and Environment
MPA	(Urban) Climate change adaptation plan
MWIK	Municipal Waterworks and the Sewers in Bydgoszcz
NFOŚiGW	National Fund for Environmental Protection and Water Management
PESTLE	economic analysis with the following components: political, economic, social, technological, legal, environmental
PFR	Polish Development Fund
RDW	Water Framework Directive (Directive 2000/60/EC)
SUiKZP	Spatial development conditions and directions study
SWOT	technique of information analysis dividing data into four categories of strategic factors: S (strengths), W (weaknesses), O (opportunities), T (threats).
WZR	Department of Integrated Development and Environment City Hall in Bydgoszcz
Task Force	Team of key persons implementing the Strategy, appointed in the City Hall for the city of Bydgoszcz, empowered to act inside the structures of the Department of Integrated Development and Environment
IPCC	Intergovernmental Panel on Climate Change

1.3 BROADER CONTEXT AND OBJECTIVES OF THE CWC PROJECT AND THE STRATEGY

The City Water Circles (CWC) project: "Urban models of cooperation for the implementation of rational water use in the Urban Functional Areas of Central Europe according to the idea of a closed circuit economy" aims to promote a culture of water saving, use of rainwater, reuse of grey water and treated wastewater and application of nature-based solutions in water and wastewater management. As part of the project, Bydgoszcz cooperates with 11 partners from Italy, Hungary, Slovenia, Poland, Croatia and Germany. Partners (cities, water utilities, NGOs) from six countries have joined forces to create a knowledge base on the urban water cycle and, together with local stakeholders, develop a set of innovative methods and tools for water management useful throughout Central Europe. The project is scheduled to operate between 01.04.2019 and 31.03.2022 and it is funded in 85% by the European Regional Development Fund under the Interreg Central Europe programme and the budget of the City of Bydgoszcz.

Find out more about the project at:

https://www.bydgoszcz.pl/rozwoj-i-srodowisko/projekty-miedzynarodowe/cwc-city-water-circles/o-projekcie/

This is the first international project of the City Office on the subject of water use with such a strong accent on closed circuit water management. Within the CWC project, Partners will demonstrate pilot solutions, develop local strategies, action plans and policy recommendations for decision makers.

When preparing the Strategy it was decided that 6-8 years is an appropriate perspective for its implementation as the period covered by the subsequent EU financial perspective, from 2021 to 2027, which includes an additional period of settlement of investment activities covered by this perspective.

The strategy should direct Bydgoszcz's activities towards closed circuit water management, building on the city's achievements to date but also drawing on wider experience, including that resulting from the CWC project.

2. AN ABSTRACT IN A NONTECHNICAL LANGUAGE

2.1. ENGLISH VERSION

The “Circular Water Management Strategy for BTOF area and Bydgoszcz” was created as one of the results of the CWC (City Water Circles) project run by the Bydgoszcz Municipality, with the focus on rainwater, treated sewage and greywater. The CWC project considers municipal models of co-operation in implementation of rational, circular water use within Municipal Functional Areas of the Central Europe. Among its aims is promotion of the rational water use, promotion of rainwater collection and reuse as well as reuse of treated sewage and greywater. It also promotes the close to nature solutions in water and sewage management. The Municipality of Bydgoszcz co-operates with 11 partners from Italy, Hungary, Slovenia, Poland, Croatia and Germany.

The Strategy deals mainly with issues related to the town of Bydgoszcz, whereas BTOF area sets some wider context to this picture. The vision was formulated in view of the BTOF as a whole, as follows: “The BTOF area, thanks to the well-considered water and sewage management solutions, uses rainwater and reuses water in adaptation to the climate changes”

Based on the conclusions drawn from diagnosis and thanks to the results of the public consultations process, 4 objectives were formulated, followed by 16 activities. The activities shall be undertaken in Bydgoszcz within the nearest 6 years. The objectives are:

- Objective 1. Effective management of the Strategy implementation process.
- Objective 2. Improved qualification and better knowledge of the circular water management within the group of stakeholders.
- Objective 3. Pilot circular water management investment projects in Bydgoszcz ready for financing.
- Objective 4. Increase of the rainwater use on site.

The most important subject covered by the strategic activities is rainwater use and promotion of the green and blue infrastructure. The need for pilot projects’ preparation has been stressed both in rainwater use for various purposes and grey water use in public buildings. The treated wastewater may be used within the two existing sewage treatment plants. Several activities address the need for promotion and education, especially through “leading by example” initiative and thanks to pilot implementations. Following the inspiring “Green and Blue Infrastructure Catalogue” prepared by the Water Company in Bydgoszcz, specific good practice manuals and procedures shall be prepared for each and every municipal department that has some influence on the rainwater management or green and blue infrastructure.

The Strategy’s implementation shall be governed by the municipal unit or task force, as instructed by the President of Bydgoszcz. The aim of such a team shall not only be leading and co-ordination but also

monitoring and evaluation of the Strategy implementation process, including proper information sharing with stakeholders.

PART 1 – Diagnosis

3. STRATEGY AREA

3.1. MAP OF THE AREA

The following figures show the BTOF area and, in its background, the location of Bydgoszcz itself for which the overall Strategy is being developed.

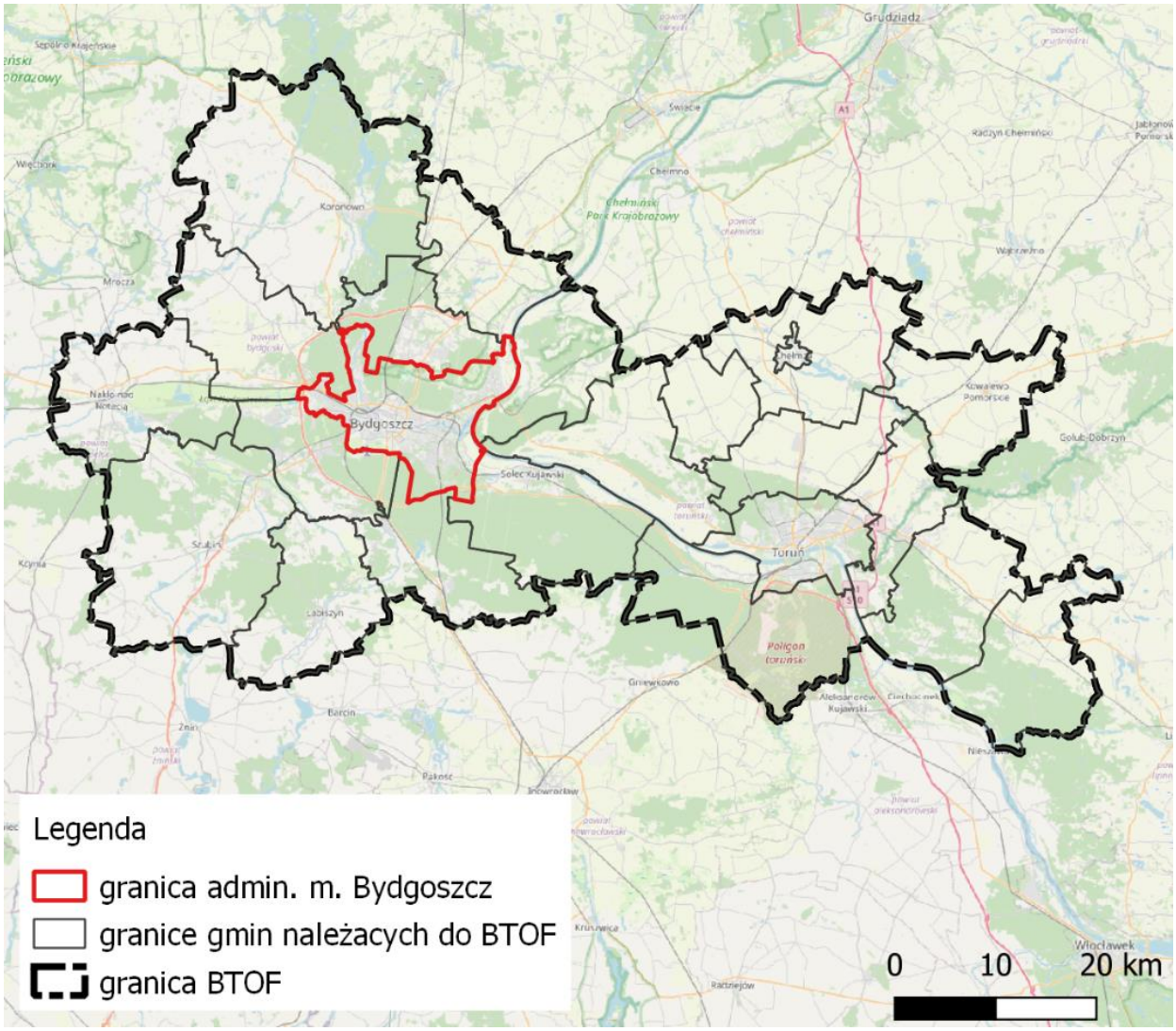


Figure 1: Map of the BTOF area ***(source: own elaboration)***

3.2 BTOF - characteristics

The figure below shows the nature of land use in BTOF divided into urbanized, agricultural, forest and wooded areas and water.

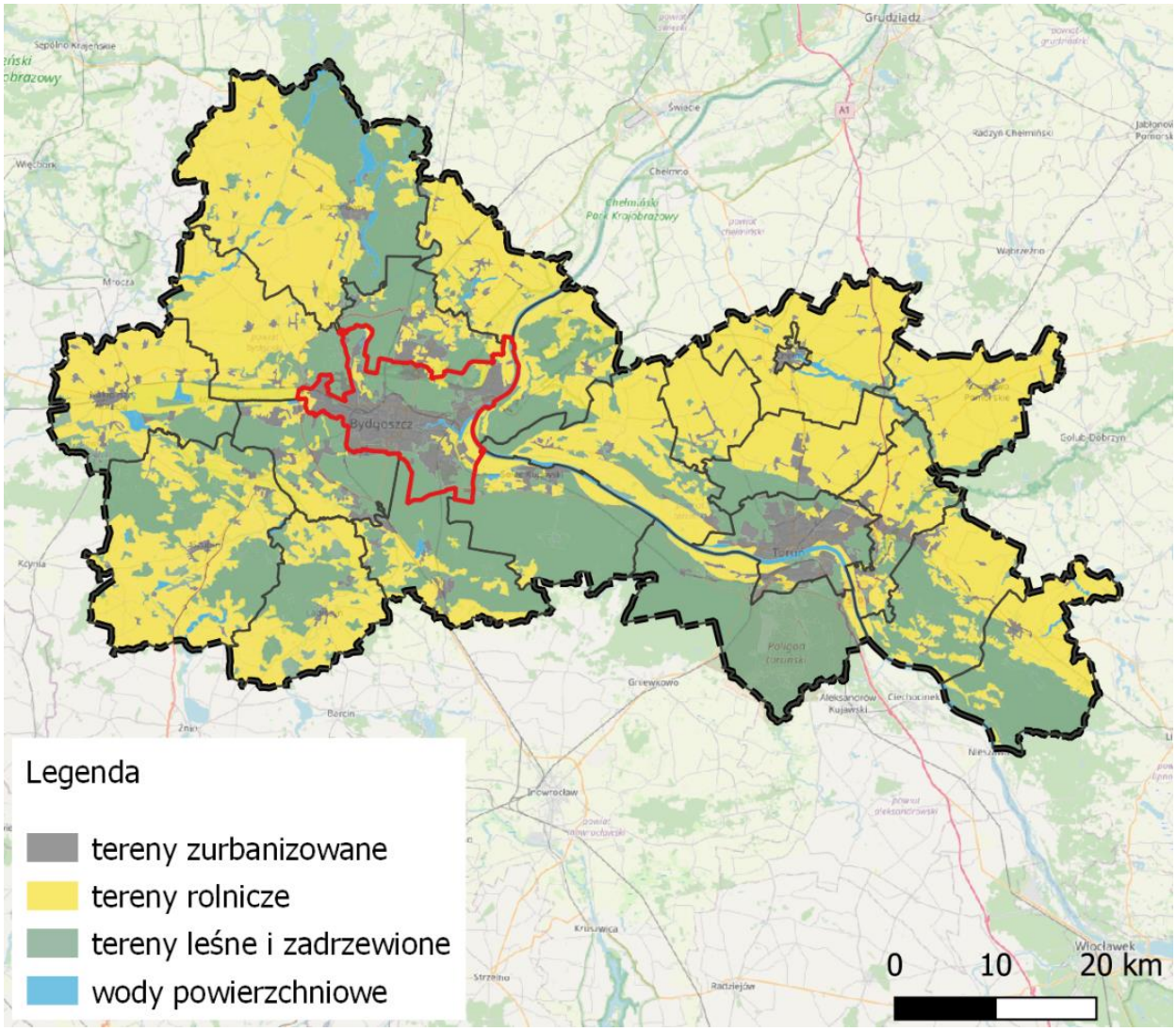


Figure 2: Breakdown of land types in the BTOF area ***(source: own elaboration)***

3.3 City of Bydgoszcz - characteristics

Bydgoszcz is one of the largest cities in Poland. In terms of population, with over 345,000 inhabitants, it is ranked 8th (in 2020), while in terms of surface area, with over 176 km2, it is ranked 11th among Polish cities.

Hydrography

Bydgoszcz is located on the left bank of the Vistula River, at the mouth of the Brda River. The main surface watercourses in the city are the Vistula River and the Brda River (estuary section). The hydrographic network is complemented by the Bydgoszcz Canal, the Old Bydgoszcz Canal, Stream Flis and Stream Młyńska, as well as small watercourses flowing from the escarpments, especially the North

Escarpment (Myślęcinek - Stream Zacisze, Zamczysko, Gdański Forest, Fordon) and the South Escarpment(Miedzyń along Pijarów Street), and small bodies of standing water.

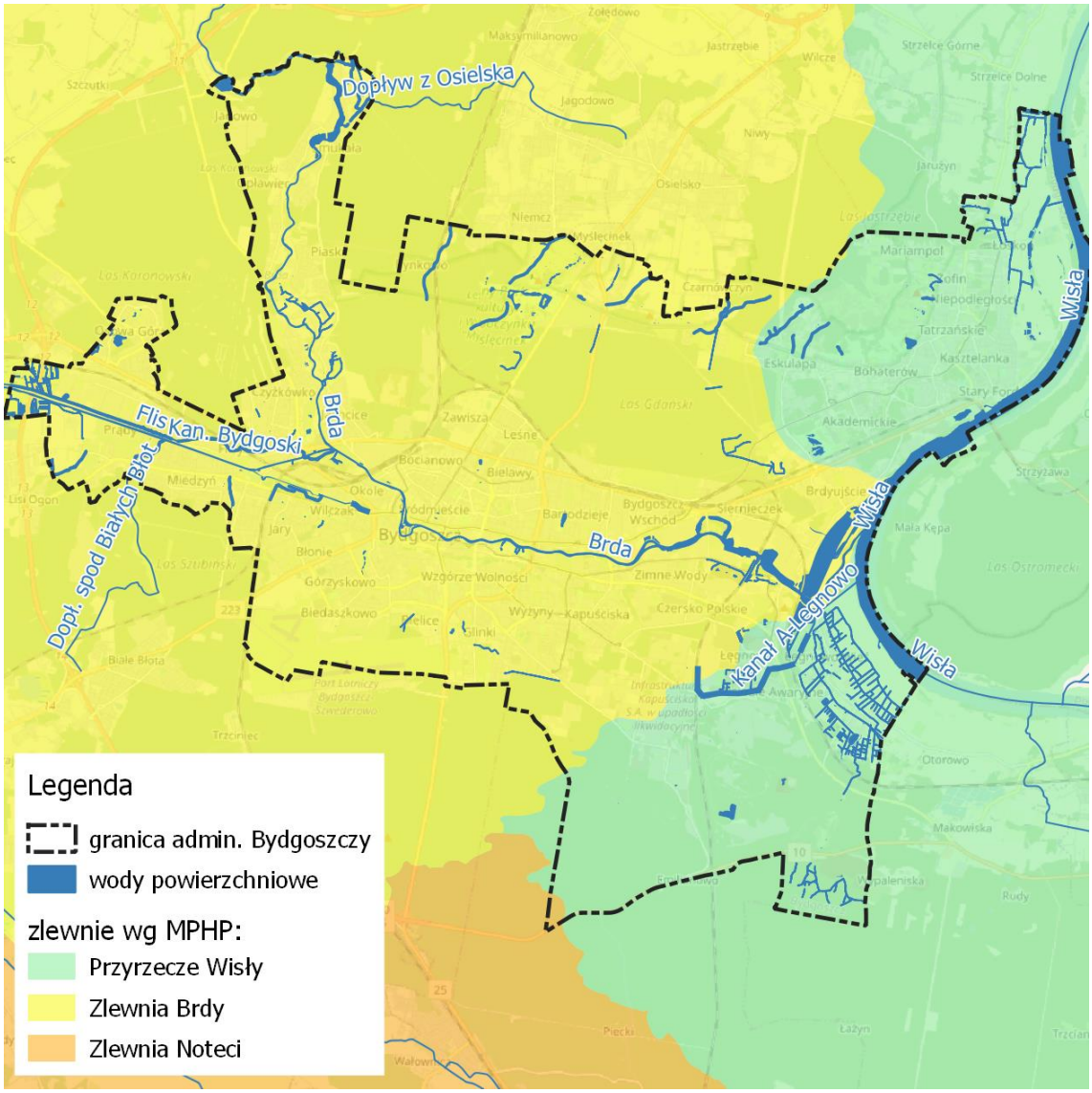


Figure 3: Division into river basins ***(source: Hydrological Map of Poland - MPHP)***

The topography

A characteristic feature of the terrain of the city of Bydgoszcz is the existence of a system of extensive, flat terrace levels and high plateau areas, as well as the edge zones of the river valleys particularly exposed in the city landscape. These are cut by a system of erosion valleys, the bottoms of which are often covered by small watercourses.

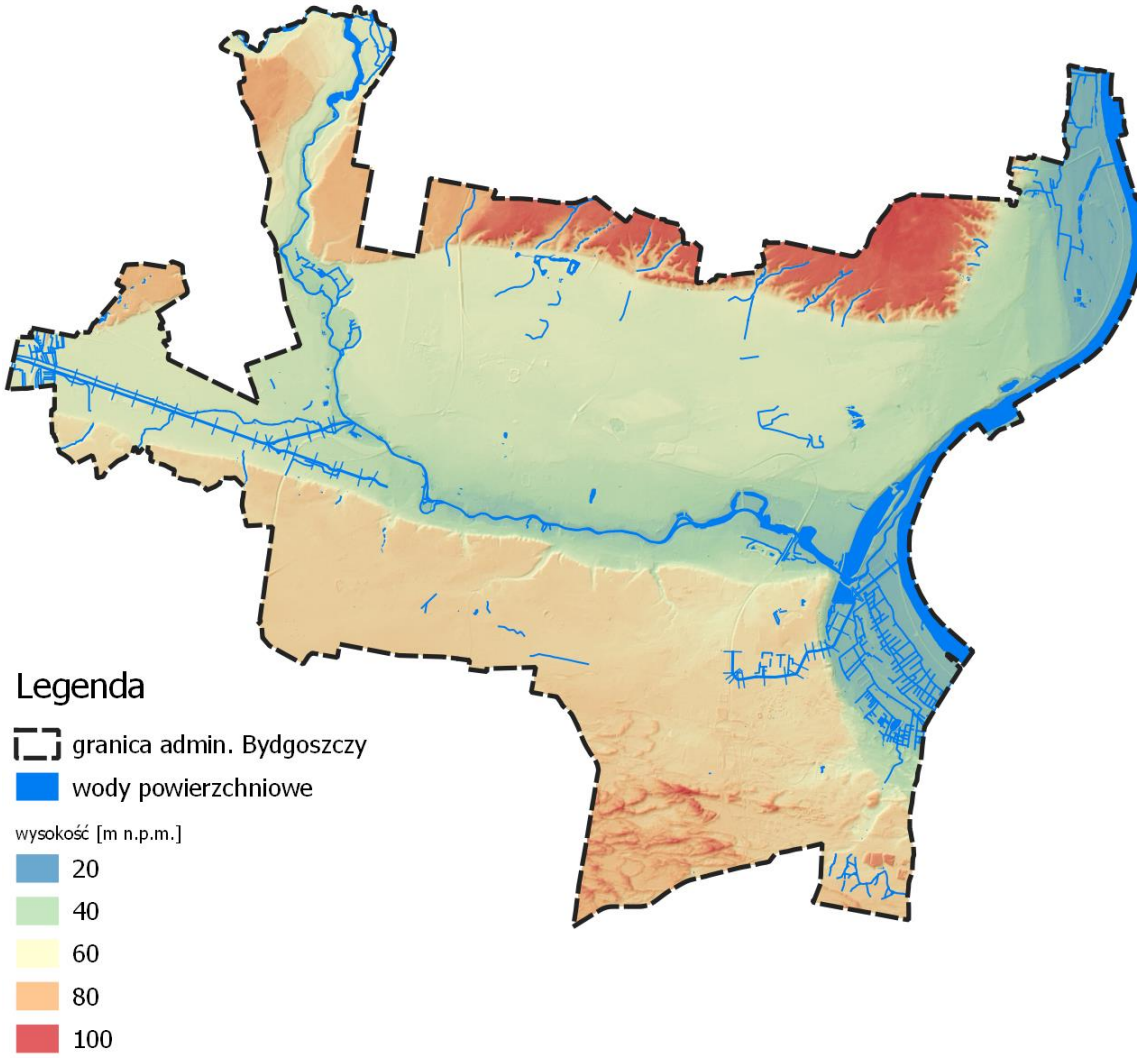


Figure 4: The altitude system in Bydgoszcz ***(source: own elaboration)***

Land coverage

The development of urbanized areas within the limits of Bydgoszcz is closely linked to the hydrographic system of the city. Residential areas extend along the Brda and Vistula riverbeds, while areas near the northern and southern borders of the city remain wooded. Forests cover about 27.6% of the city's area and surround it with large complexes both to the south - the Bydgoszcz Forest, and to the north - the Brda Valley forest complex connecting with the Bory Tucholskie.

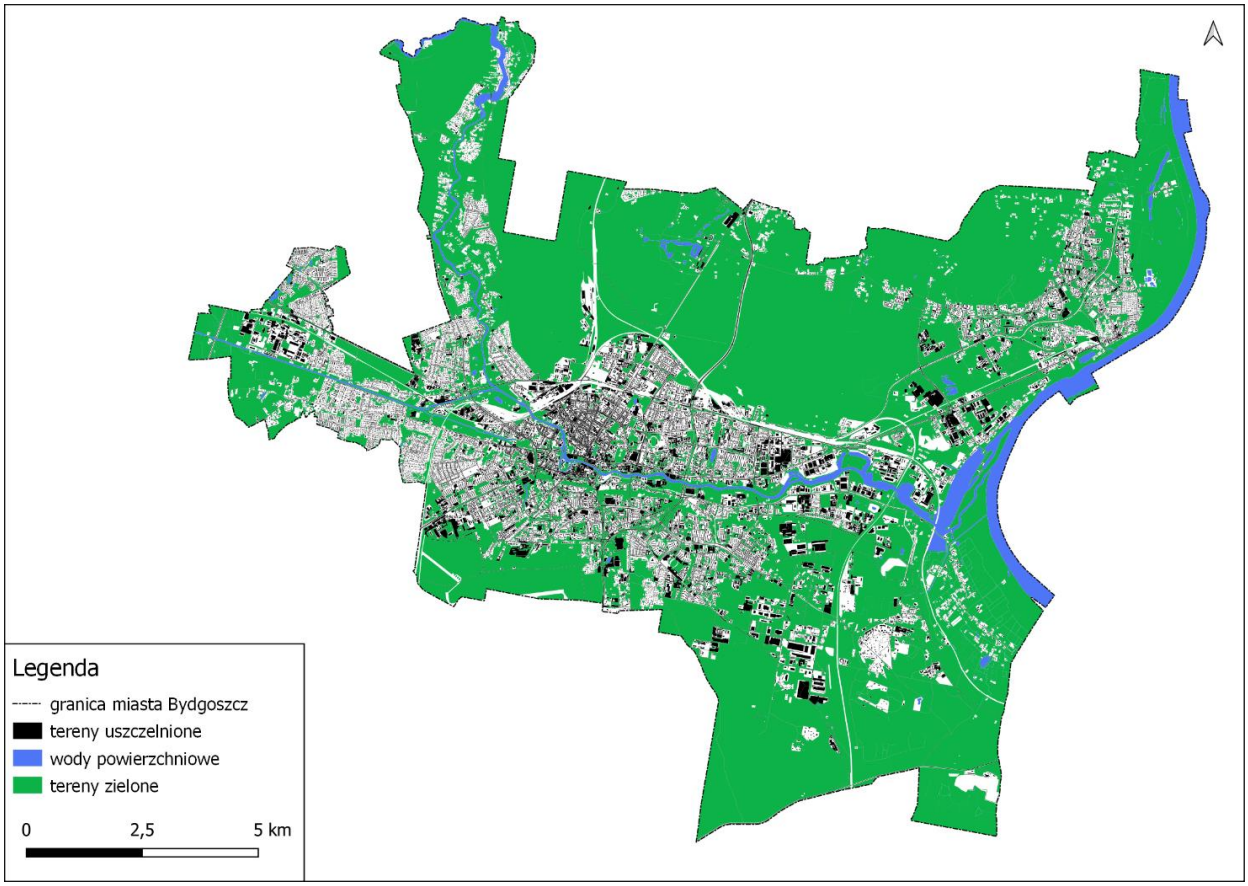


Figure 5: Distribution of sealed and green areas within the city limits ***(source: own elaboration)***

Statistical analysis of the distribution of land types within Bydgoszcz clearly shows that the most sealed areas are concentrated in the inner city, Old Town and Bocianów. Locally heavily sealed areas in Fordon, Brdyujście and Zimne Wody are accompanied by green areas.

According to the land inventory prepared by the MPU and presented in the currently elaborated "Study of conditions and directions of development...", invested areas account for nearly 40% of the city's area, whilst green areas, surface waters and agricultural land cover 60% of the city's area. This translates into the character of Bydgoszcz as a city very much linked to water and greenery. The largest percentage of invested land is occupied by residential areas, accounting for over 12% of the city's area, and a relatively large proportion, as much as 11%, is designated for transport. Waste lands in the city space constitute 4%.

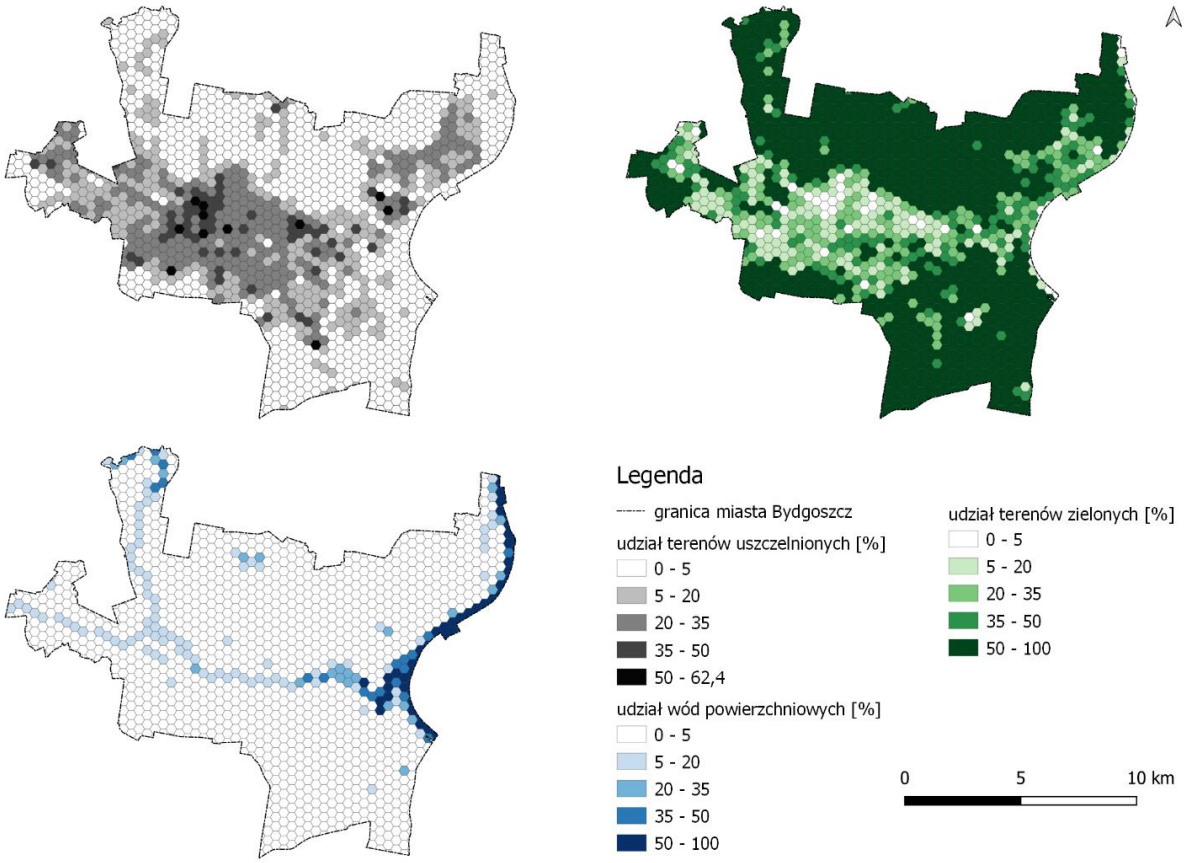


Figure 6: Percentage share of sealed green areas and surface waters within the borders of Bydgoszcz ***(source: own elaboration)***

Climate

The city of Bydgoszcz is located in a temperate transitional climate zone, in the area of mutual permeation of continental influences from the eastern areas of Europe, marine influences from the Baltic Sea area and oceanic influences from the Atlantic Ocean area. This transitional character is evident in the changeable weather conditions which are conditioned by the incoming air masses. In the Bydgoszcz area, the climate can be defined as continental in terms of pluvial (precipitation) and oceanic in terms of temperature.

Garb Pomorski, located to the north of the city, is an elevation where water vapor condenses in the air and precipitation occurs more often than in other regions of the voivodeship. The area around Bydgoszcz is located in the precipitation shadow of Garb, i.e. in a place over which air less rich in water vapor flows, which is why the lowest annual sums of precipitation in Poland are observed in the Bydgoszcz area (Toruń Basin). The average total in the years 1945÷1994 was 512 mm. However, precipitation fluctuations range from 269 mm in 1989 to 809 mm in 1980. The maximum precipitation falls in July (70 mm), minimum in February (20-26 mm). During the vegetation period (April-September), the average precipitation amounts to 318 mm with fluctuations from 113 mm (1989) to 651 mm (1980). The Bydgoszcz area is characterized by significant water deficits. The longest recorded drought periods lasted about 60 days

4. STAKEHOLDER INVOLVEMENT

4.1. STAKEHOLDERS INVOLVED IN THE CONSULTATION PROCESS

Stakeholders from the BTOF area were involved in the process of preparing the Strategy.

The list of stakeholders to whom the invitation to participate was addressed is presented in the table below. The list includes both delegates from the departments of city and municipal offices, representatives of the water and sewage company, scientific centres and the municipal urban planning office. The selection of participants was made by the Contracting Authority on the basis of previous consultations and public participation in the earlier stages of the CWC project.

Organization	Person
ZIT - Integrated Territorial Investments	Romana Cyranowicz
ZIT - Integrated Territorial Investments	Małgorzata Kaczmarczyk
State Water Management Company Wody Polskie, Regional Water Management Authority in Bydgoszcz	Edyta Rynkiewicz
Acting Director of the Department of Environment and Ecology, City Hall of Toruń	Halina Pomianowska
Deputy Mayor - Solec Kujawski Region	Barbara Białkowska
Director of WIPP - Solec Kujawski Region	Krystyna Mikulska
Head of Department at the Department of Municipal Economy of the City of Bydgoszcz, currently acting Director	Sylwia Kubiś
Former Director of the Department of Public Utilities of the Bydgoszcz City Hall	Wiesław Zawistowski
Head of Technology Department, Municipal Waterworks and Sewage Systems in Bydgoszcz	Agnieszka Cendrowska-Kociuga
Specialist, Technology Department, Municipal Waterworks and Sewerage Systems in Bydgoszcz	Jacek Cieściński
Specialist at the Technology Department, Municipal Waterworks and Sewerage Company in Bydgoszcz	Mariusz Zarzycki
Head of Department for Design and Investment Planning, Municipal Waterworks and Sewerage Company in Bydgoszcz	Bartłomiej Szatkowski
Specialist at the Design and Investment Planning Department, Municipal Waterworks and Sewage System Company in Bydgoszcz	Aleksandra Rajczyk
Zakład Gospodarki Komunalnej Sp. z o.o. in Solec Kujawski	Sebastian Wrycza
Chair of Environmental Engineering, Faculty of Construction, Architecture and Environmental Engineering, UTP in Bydgoszcz (Bydgoszcz University of Technology)	Krzysztof Napieraj

Head of Development and External Funds Department, Barcin Municipal Office	Grzegorz Smolinski
Waterworks and Communal Services Company Ltd. in Białe Błota	Mirosław Maciejewski
Deputy Director of the Institute of Geography and Scientific Coordinator of the UK Waterways Revitalization Centre	Dawid Szaten
Department of Municipal Economy, Toruń	Łukasz Łopatowski
Head of the Project Supervision Office Białe Błota	Beata Wilk
Designer of Urban Planning Studio	Agnieszka Słotwińska – Aniszewska

4.2 MANNER AND COURSE OF WORK

The strategy was developed with the participation of stakeholders: discussions took place during meetings; the vision was jointly developed but also the content of the Strategy was consulted during its development. Due to the pandemic period, the first consultation meeting was held online. This meeting focused on the vision and objectives of the Strategy. A survey was also prepared, which was addressed to selected stakeholders from the list above, starting the work on the Strategy. The aim of the survey was to collect information on the current status of rainwater, treated wastewater and grey water use, mainly by public institutions. It was intended to provide a valuable complement to the knowledge gathered in the previous consultation stages of the CWC project.

The survey included 10 questions:

1. In which areas of closed-circuit water management is rainwater already CURRENTLY used by municipal services
2. In which areas of sustainable water management is treated wastewater or grey water already CURRENTLY used
3. In which closed circuit water management areas rainwater could be used in the FUTURE by municipal services
4. In which closed circuit water management areas in the FUTURE treated wastewater or grey water may be used
5. In which area the city already carries out activities related to the use of rainwater, grey water or treated wastewater. Please list it and briefly characterize the activity (open question)?
6. What do you think are the key barriers limiting the possibility to use rainwater, grey water and treated wastewater in Bydgoszcz?
7. What would you see as an opportunity in the implementation of rainwater management in a closed-circuit system (rainwater, grey water, treated wastewater)
8. Could you point to any particular places on the map of Bydgoszcz to which we should pay attention while creating the strategy? What are those places and why?
9. In which specific places in Bydgoszcz would you see the possibility of using rainwater, grey water and treated wastewater? Please specify the type of facilities, location, address, etc. (e.g. Valley of Five Ponds, school no. ..., municipal facility at address ...)
10. Any other indications which may be relevant to the development of the strategy. Free comments, for example indicating other uses for grey water, treated wastewater and rainwater.

The survey was completed online by 8 consultation participants. It is worth emphasizing that its purpose was not to obtain common knowledge but rather the positions of people/stakeholders who, by virtue of

their duties and participation in the creation of the Strategy, are strongly involved in the topic of water management in Bydgoszcz.

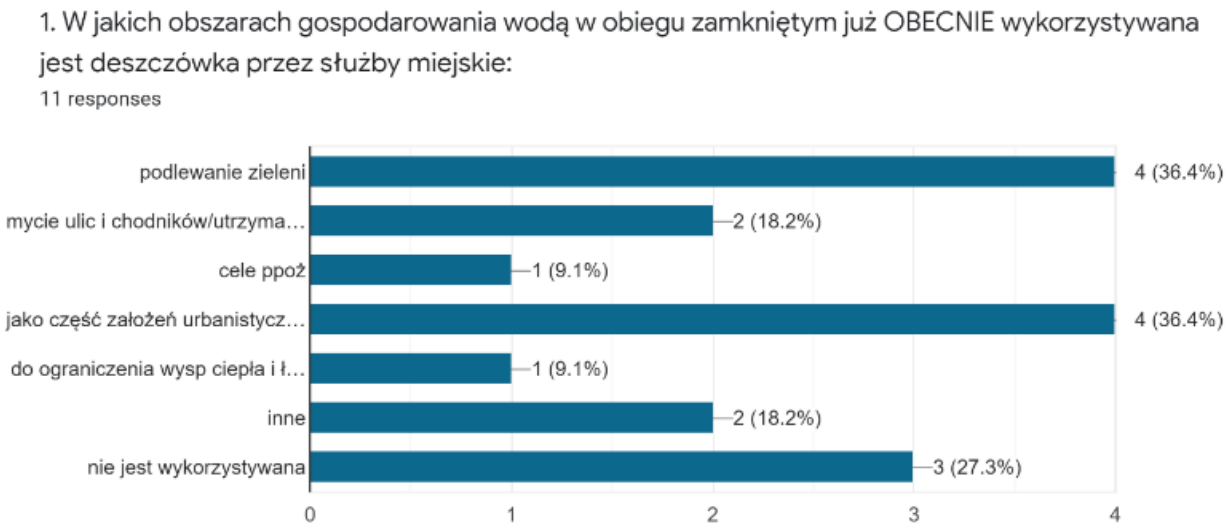
This was followed by a working meeting with the MWIK team in Bydgoszcz and a further consultation with a wider range of stakeholders to discuss the proposed Action Plan and specific objectives. This meeting was held on 2 September 2021.

In subsequent stages of the work, the already formulated preliminary document was consulted both with representatives of the Client and with institutional stakeholders, primarily discussing the list of objectives and actions.

Finally, in the last stage of consultations, in December 2021 and January 2022, another survey was conducted, addressed to the inhabitants of the city. For this purpose, another survey was formulated, made available this time via the Internet, on the official pages of the office[1]. There were 10 closed questions and one open one, in which suggestions and comments were expected, which according to the residents could be important for the creation and implementation of closed-circuit water management in Bydgoszcz.

4.3. CONCLUSIONS DRAWN FROM COOPERATION AND CONSULTATIONS

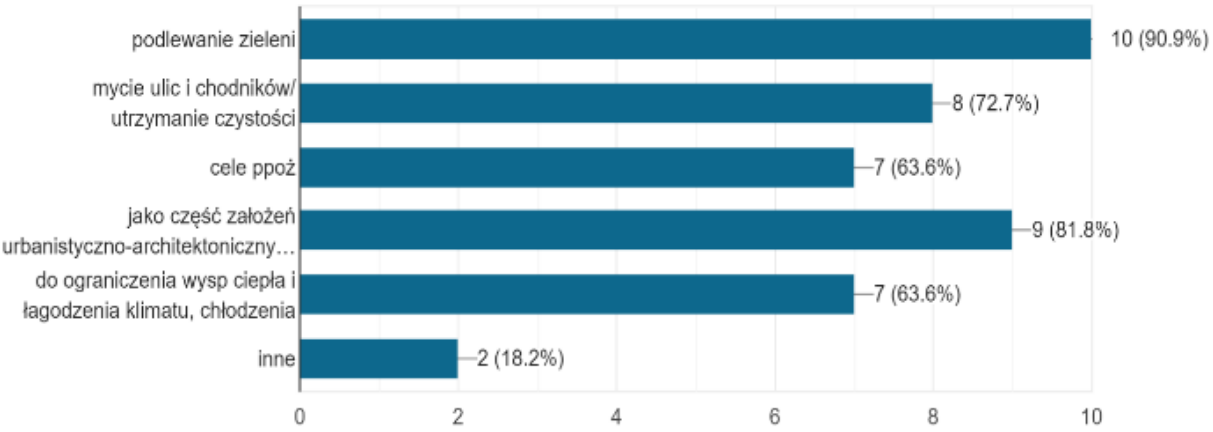
The responses to the first survey are presented below, collating the questions on the current situation and the potential future situation regarding the use of rainwater, grey water and treated wastewater:



[1] (https://www.bydgoszcz.pl/aktualnosci/tresc/obieg-wody-w-miescie-wypelnij-ankiete/, accessed 23.01.2022).

3. W jakich obszarach gospodarowania wodą w obiegu zamkniętym W PRZYSZŁOŚCI może być wykorzystywana deszczówka przez służby miejskie:

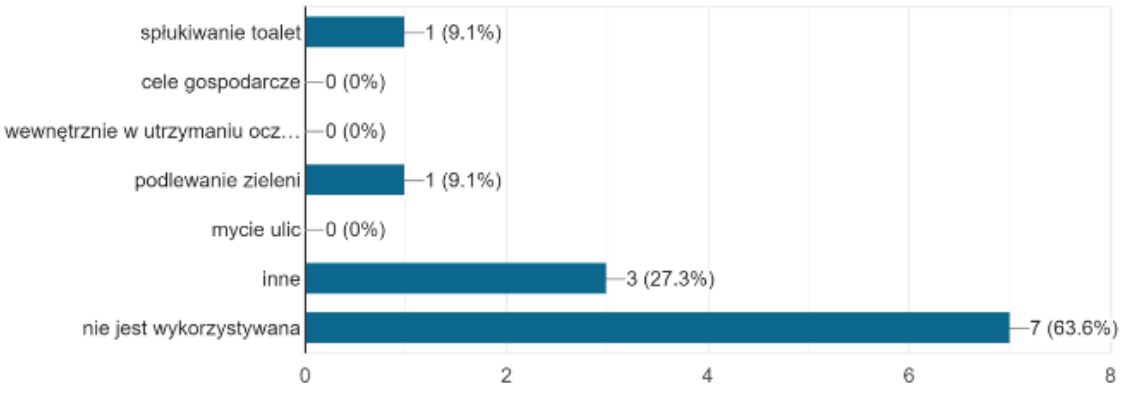
11 responses

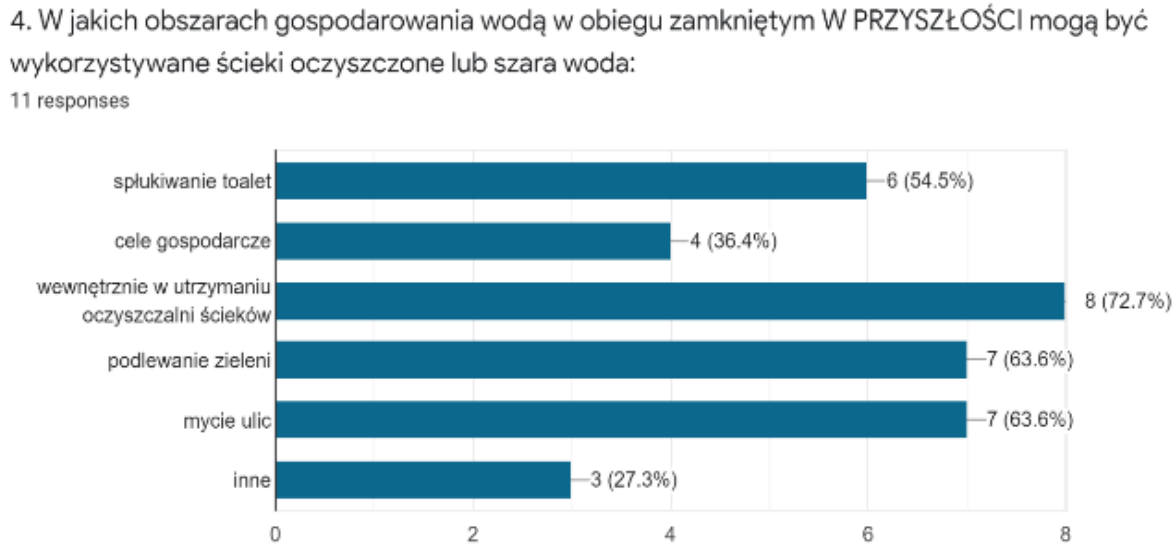


Currently, rainwater is mainly used for watering greenery and as an element of the urban landscape. However, the participants of the survey clearly see the need to increase the use of rainwater in almost all of these areas: for watering greenery, washing streets and pavements, for fire safety purposes and to use rainwater to reduce the heat Island Effect.

2. W jakich obszarach gospodarowania wodą w obiegu zamkniętym już OBECNIE wykorzystywane są ścieki oczyszczone lub szara woda:

11 responses





The use of grey water and treated wastewater at present is small and rather incidental. In the case of future use of treated sewage and grey water, it can be seen that although they are not currently used in the sewage treatment plant, this is where the respondents see the greatest potential for their use. They would also be willing to use grey water and treated effluent for green watering and street washing, indicating a high level of environmental awareness among consultation participants, although it is clear from further responses that they feel the difficulties in closing the closed-circuit economy in this area could be a significant obstacle.

It was also indicated in the questionnaires that public awareness of rainwater use and management is much higher. Bydgoszcz runs programmes to support this area, and as part of the activities of the City Waterworks and Sewage System, a catalogue of inspirations was prepared, which also emphasizes the use of rainwater. Knowledge concerning the use of grey water and treated sewage is not common, there is a lack of generally available information on the subject, guides and support programs aimed at potential users. The problem of the cost of installations for the use of grey water was highlighted as currently limiting its use, as well as the considerable distance of the sewage treatment plant from the city, which limits the use of treated sewage to the area of the plant itself. The consultation participants also identified specific locations where the actions identified in the Strategy could be implemented in the future, including: parks, commercial facilities, schools, public buildings, but also heavily sealed areas of the city.

During the consultations, the strategic vision was formulated, and the objectives were discussed. Participants shared their knowledge and experience from the BTOF area, from Bydgoszcz itself, as well as drawing some broader conclusions.

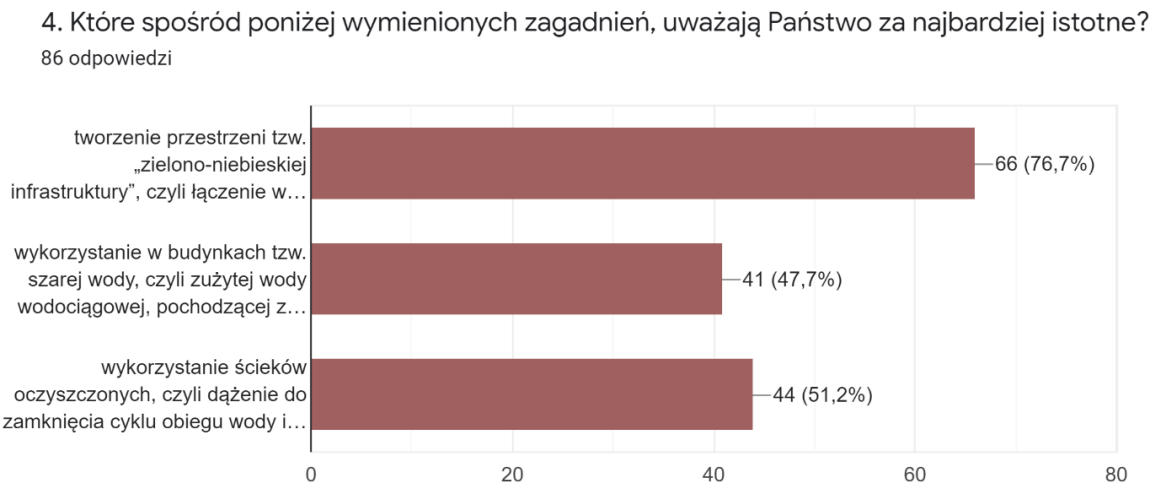
During the next meeting, individual actions within the Action Plan were discussed. It was pointed out that the Strategy could be more oriented towards indicating tasks for different stakeholders, beyond the City Hall, for example including the Bydgoszcz University of Technology in the actions. On the other hand, activities addressed to BTOF outside Bydgoszcz should be included in a broad context rather than made specific in the Action Plan, which in principle concerns Bydgoszcz.

In the consultations on the initial version of the document, the Ordering Party emphasized that the actions should be feasible and not involve excessive costs at this stage, difficult to cover by those

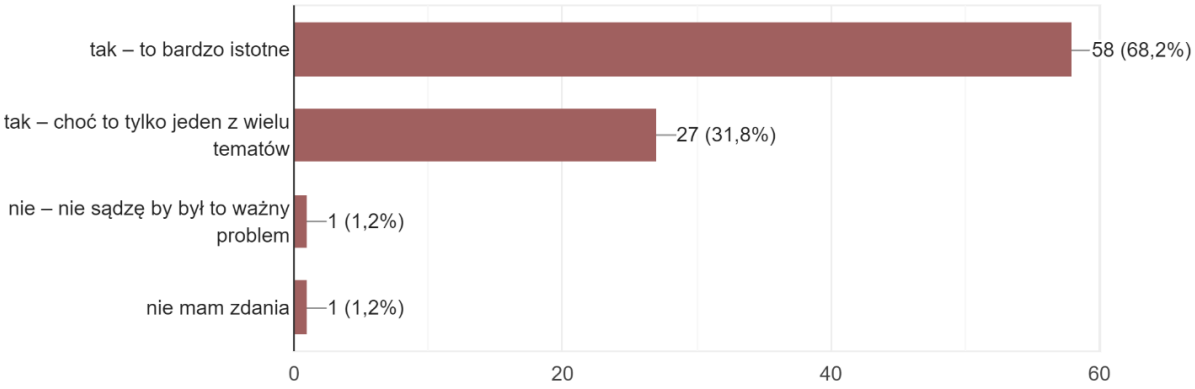
implementing the Strategy. On the other hand, specific comments of stakeholders mainly indicated minor corrections which were introduced to the document up to the most possible extent.

In the last stage of consultations with the residents, 86 participants took part in the survey. 55% of the respondents confirmed that they were familiar with the concept of closed-circuit water management and a further 38%, although familiar with the term, admitted that they would not be able to define it. The vast majority associate the term with rainwater (85% of responses) and treated wastewater (52% of responses), with the fewest associating it with grey water (31% of responses).

In response to the fifth question, namely, "In view of the need to adapt cities to changing climatic risks associated with heavy rainfall and drought, should Bydgoszcz focuson water management as a valuable environmental resource", almost 98% of respondentsconfirmed that this is a very important topic or important, although as one of many. The responses are presented in the chart below.



In response to the fifth question, namely, 'Should Bydgoszcz, in light of the necessity to adjust cities to the changing climate threats related to downpours and droughts, focus on water management as a precious environment resource,' almost 98%of the respondents confirmed that it is a very important or important topic, though one of many. The responses have been presented below.



To the question "What actions do you think the city should take to manage water better?" the distribution of answers was as follows:

- improve the quality of infrastructure, e.g. by repairing the water supply or sewage system - 44% ,
- take care of water quality in every area (sewage treatment, rainwater pretreatment - 58% , water maintenance)
- create friendly green places, green and blue infrastructure - 73%,
- aim to maximize water use and close the water cycle - 73%.

Additional individual responses indicated the need to radically increase tree planting in the city, which also helps to reduce temperatures, reduce concrete (the negative example of the Old Market was pointed out according to the respondents), maintain green areas and floodplains as well as address the issue of a formal definition of a stormwater drainage connection as reaching the border of the plot and not the middle of the street.

Among other suggestions that could be important for the creation and implementation of the closed-circuit water management in Bydgoszcz, the inhabitants also indicated a greater emphasis on education, information, presentation of implemented examples and technical (and financial) support for residents, the replacement of subsidies with a system of tax relief. The need to create green and blue infrastructure places was repeatedly mentioned, including creating small green spaces in housing estates, changing lawns into meadows, planting trees, etc.

The vast majority of the survey participants are interested in rainwater harvesting on their property, although nearly half of them think that it is not possible (e.g. they live in a cooperative block of flats). A smaller group (27%) is interested in using grey water. Also in this case almost half of the respondents think that their place of residence does not offer the possibility of using grey water. However, there are also negative answers, reluctant to do so, which is not the case with rainwater. The answers indicate that financial and technical support would encourage respondents to manage water on their own land or use grey water.

The responding group consists mostly of people with higher education, inhabitants of single-family houses, multi-family houses and cooperative houses.

5. ASSESSMENT OF THE CURRENT STATE

5.1 CONCLUSIONS OF THE ASSESSMENT OF THE CURRENT STATE (SELF-ASSESSMENT) AND THE SURVEY

As part of the research on awareness, attitudes and behaviors related to the use of water by the residents of BTOF, a survey was carried out, the conclusions of which, relevant to the preparation of the Strategy, are presented below (these conclusions are taken from the report summarizing the survey of March 2020 (result D.T.3.1.4):

1. respondents are aware of methods of rainwater reuse (84%) and are favorably disposed towards popularizing and applying such solutions (95%). Fewer respondents are aware of the possibility to reuse used water in their households (64%) but many of them are also positive towards reusing it (91%).
2. The possible effects of climate change cause different concerns among respondents, but not all of them feel them to the same extent. The biggest concerns are droughts (50%) and rising water costs (46%). Floods are of least concern (29%). Apart from this value of 29%, which is an exception, none of the concerns considered weak exceed 17%.
3. According to the respondents, awareness campaigns about water use and reuse are very useful (42%) or useful (53%). Only 4% of respondents found such campaigns not useful. It is

noteworthy that for most respondents both environmental (63%) and economic (62%) considerations are highly motivating for water saving. Only 4% of respondents found both factors to be weakly motivating.

There is a general awareness of the need to save water, with many respondents using popularly promoted water saving methods focusing mainly on individual habits, such as turning off the water and equipping bathrooms and kitchens with appropriate water saving devices. This is motivated both by the environment and their own savings. Respondents are also very open to the use of more advanced water recycling systems at both the individual household and city level.

5.2. CURRENT STATUS OF MUNICIPAL WATER MANAGEMENT SYSTEMS

The total length of the water supply network operated by the Municipal Waterworks and Sewerage Company in Bydgoszcz Sp. z o.o. (MWiK), is approximately 1066 km, including 302 km of connections. The water supply system is used by 100% of the residents of Bydgoszcz.

The water supply system is based on supply from two basic water intakes: the underground water intake at the "Las Gdański" water supply station and the Brda River surface water intake at the "Czyżkówko" water supply station. There are also 20 deep-water intakes in Bydgoszcz, which are emergency intakes and can be connected to the municipal water supply system in case of emergency. 11 of them are owned by MWiK. The city water supply system has retention reservoirs: initial reservoirs at water intakes "Las Gdański" and "Czyżkówko" and final reservoirs "Fordon".

In the area of Bydgoszcz, there is a significant amount of groundwater used for both municipal and industrial purposes. The most important groundwater intakes in Bydgoszcz include:

▪ "LAS GDAŃSKI" intake (resources 1825 m3/h)

▪ “S" drinking water intake in the area of the no longer existing ORGANIKA - ZACHEM CHEMICAL PLANTS (resources of 300 m3/h, the intake is not included in the municipal water supply system),

▪ and also estate intakes, factory intakes and private wells.

In September 2018. MWiK was handed over the stormwater drainage network managed by ZDMiKP. Therefore, in the resources of MWiK there is 506.3 km of stormwater drainage network, of which 504.5 km are conduits in single or stacked system, the remaining length is connections (as of 31.10.2018).

Receivers of rainwater from the existing rainwater drainage system are rivers - Brda and Vistula, Bydgoszcz Canal, Old Bydgoszcz Canal, Struga Flis and Struga Młyńska. An investment project is currently being implemented, based on a design-and-build contract, involving the reorganization and expansion of the rainwater drainage system in Bydgoszcz. Its title is "Construction and reconstruction of the rainwater drainage system and adaptation of the rainwater drainage system to climatic changes on the territory of the city of Bydgoszcz". Its purpose is to adapt the stormwater sewer system to the current land use, to protect the city from the effects of heavy rains and large amounts of rainwater and snowmelt (minimizing flooding of buildings and street flooding), and to allow water to be retained and used during dry periods.

There is also surface drainage in the city: five drainage areas have been distinguished, consisting of drainage ditches for agricultural areas or wetlands related to grasslands:

1. Drainage system Łęgnowo - Otorowo, total length of the ditches about 4.8 km, located on the right side of the road Bydgoszcz - Solec Kujawski in areas used for agricultural purposes and it is maintained by the city.

2. Drainage system of Jachcie - Piaski, total length of ditches about 4.5 km, the system drains agricultural areas and wastelands, it is maintained by the city.
3. Drainage system of Prądy, consists of ditches partially maintained by the City of Bydgoszcz and the Struga Młyńska watercourse, currently under the administration of the Province Marshal.
4. Drainage system of Smukała, total length of ditches approx. 4.1 km, drains mostly wetlands with permanent grasslands, maintained by private owners.
5. The Fordon Polder, total length of ditches about 3.3 km, drains agricultural areas, maintained by the city.

MWiK operates around 886 km of sanitary sewage system, of which around 714 km are conduits in single or stacked systems, while the remaining length - sewage connections. The sanitary sewer system is used by approximately 96.8% of the city's total population. The current wastewater treatment system in Bydgoszcz is based on 2 wastewater treatment plants: "Fordon" and "Kapuściska".

The general sewerage system program adopted by the city authorities has led to the organization of the sewage disposal and treatment system. The core of the system consists of:

- ”Fordon” sewage treatment plant,
- ”Kapuściska" sewage treatment,
- sewage transmission system to the treatment plants "Fordon" and "Kapuściska".

The basic premise of the sewage management arrangement was to exclude the Brda River and the Bydgoszcz Canal from receiving sewage (including treated sewage) and to dispose sewage to the Vistula River after treatment at the "Fordon" and "Kapuściska" sewage treatment plants. In conversation with MWIK it was confirmed that currently treated sewage is not sufficiently used in the sewage treatment plants. This possibility exists and the plan is to take such measures.

5.3. RAINWATER - FACTORS SHAPING STRATEGY

5.3.1 Synergies in climate change adaptation

In preparing the Strategy, other strategic documents already existing in Bydgoszcz were also analyzed. The key issue was considered to be, besides those related to the development of infrastructure and prevention of flooding, the problem of the urban heat island. Therefore, for the purposes of the Strategy, a heat map for Bydgoszcz was prepared and is presented below.

When analyzing the map below, it is worth paying attention, beyond the obvious area of dense development of the city center and the old part of Bydgoszcz, to the Airport area located in the southwest and the industrial areas in the area of Chemiczna and Nowotoruńska streets, on the south-east side. Similarly, large area point investments located north of Brdyujście and south of Fordońska Street, as well as industrial investments in the Osowa Góra area are strongly emphasized. This makes us think about the indicators of biologically active surfaces in industrial investment areas. It may also be an indicator to make these investors interested in the issue of rainwater use, closed circuit economy, creating green roofs and green-blue infrastructure in the vicinity of their investments. It is certainly not an easy task, but it can be seen that the reduction of excessive temperatures in Bydgoszcz also requires focusing on these large-scale investments.

While presenting the heat map, it is worth noting that within the Multiply project an important strategic document has been drafted in Bydgoszcz - SECAp, the Energy and Climate Action Plan. The document is required by the new European Covenant of Mayors, of which the city has been a member since November 2019. By joining the agreement, the City has declared that by 2030 we will have reduced CO2 emissions from the city area by 30%.

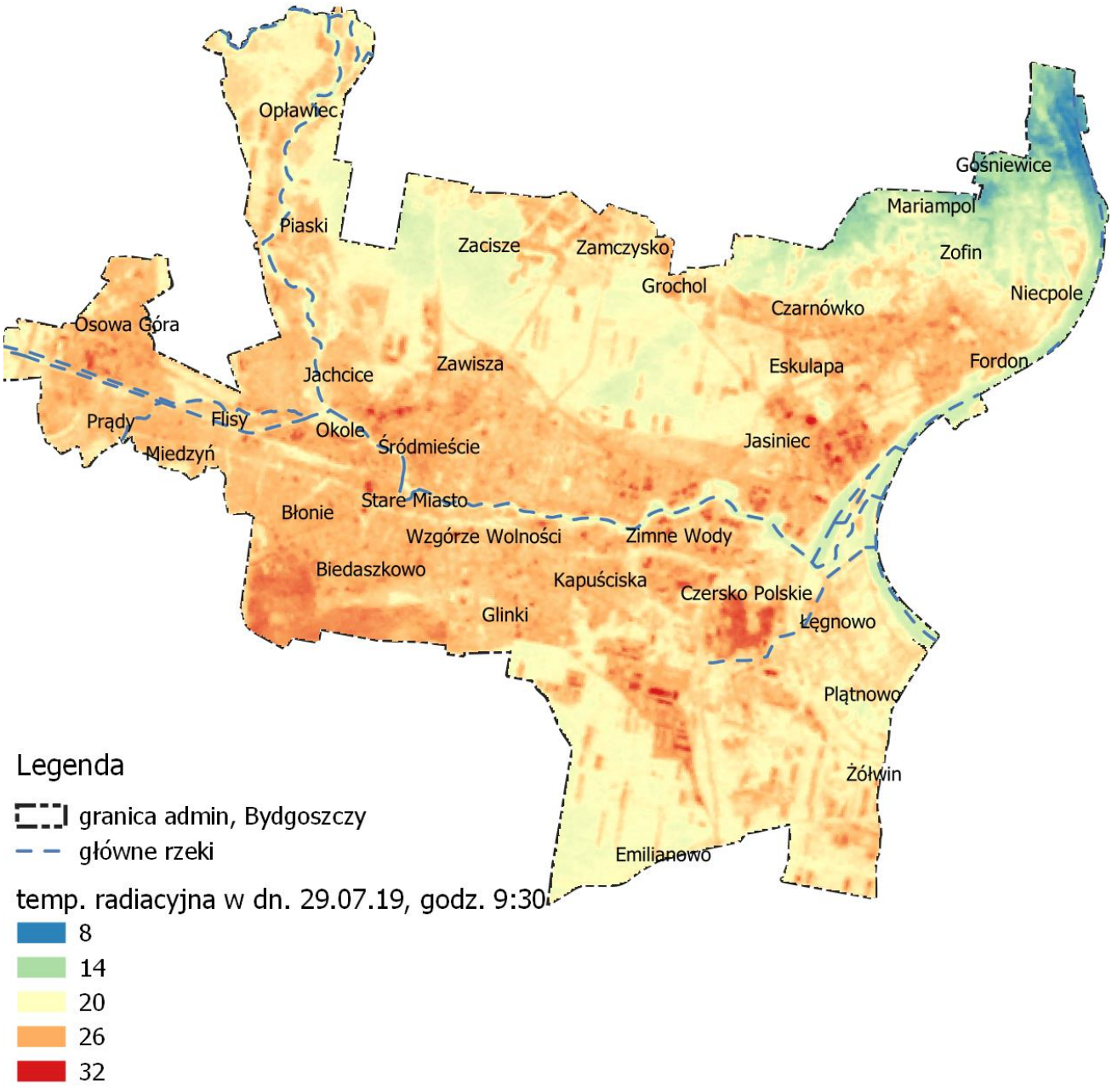


Figure 7: Heat map for Bydgoszcz *(source: own elaboration)*

5.3.2 Quality of rainwater in Bydgoszcz

MWIK Company in Bydgoszcz conducted rainwater quality tests from 2010 to 2018, which were summarized in the study "Bydgoszcz Rainwater Standards", published in 2019. Tests were conducted for two types of catchments with varying percentages of paved area. Carbon, nitrogen, and phosphorus levels were also measured, using standard parameters such as BOD5, COD, phosphorus og. or ammonia NH4. The median COD was 18 or 24 [mg/l] in catchments with 50% and 30% sealing for a rainfall of 15 [l/s/ha], BOD5 2.8 and 8.5 [mg/l], respectively. Selected results from these studies that can be applied to the need for rainwater reuse are presented below.

Table 1 Suspended solids and petroleum hydrocarbon data averaged over all catchment types

Parameter	Median [mg/l]	Range of values [mg/l] (for quartile deviation 25% - 75%)	Comparatively according to the Regulation of the Minister of Maritime Economy and Inland Navigation of 12 July 2019 on substances particularly harmful to the aquatic environment and the conditions to be met when discharging waste water into waters or onto the ground, and when discharging rainwater or snowmelt into waters or into water facilities limit value [mg/l]
Suspension	115	48-234	100
Hydrocarbons	1,85	<1,0 – 7,6	15
Chlorides (winter)	596	414 - 702	Total chloride and sulfate concentrations calculated assuming complete mixing 1000

Table 2 Example of stormwater bacteriology of a catchment with a paved area accounting for 50% of the area and a rainfall intensity of 15 l/s/ha compared to the requirements for driplines

Parameter	Median [cfu/100 ml]	Range of values (for quartile deviation 25% - 75%) [cfu/100 ml]	Comparative limit values for bathing water and places occasionally used for bathing according to the Regulation of the Minister of Health of 17 January 2019 on the supervision of bathing water quality and places occasionally used for bathing [cfu/100 ml]
Escherichia coli	1000	200 - 178 000	≤ 1000
Clostridium p.	500	200 - 850	no requirement
Fecal Enterococci	36	12 – 12 700	≤ 400

The bacteriological background of the Brda River as a receiver and the increase in bacteria after the rainfall period were determined.

Table 3 Background bacteriology of the Brda River and the increase in bacterial numbers occurring after the rainy season

Parameter	Median [cfu/100 ml]	Range of values (for quartile deviation 25% - 75%) [cfu/100 ml]	The number of bacteria present in the river after rainfall [cfu/100 ml]
Escherichia coli	20	9 - 43	130 – 34 480
Clostridium p.	4	1 - 8	-
Fecal Enterococci	8	4 - 17	100 - 2820

Based on measurements in Bydgoszcz, it can be concluded that in order to be used, rainwater flowing down the drainage system should be treated. Of course, the removal of pollutants is already a legal requirement, both in terms of suspended solids and petroleum, but its use for irrigation systems requires the disposal of suspended solids to a much greater extent. In the " Standards..." developed by MWIK, the need for filtration and disinfection of rainwater prior to its use is indicated. Ensuring permeability for irrigation nozzles requires, for example, the use of mechanical disk filters with a flow rate of 40 m3/h. and retaining particles >100 µm. Therefore, in order to close the water cycle, it is worth to pay attention to separating potentially cleaner water (water from roofs, especially in summer) from polluted water (runoff from roads, squares) and to avoid concentrating runoff into the sewage system, for example by draining the sidewalk directly onto the lawn.

As part of the CWC project, there are plans to follow up the aforementioned rainwater quality studies with another series of studies, taking into account separating water from roofs and other surfaces and treating the winter and summer periods separately.

5.3.3. A risk-based approach to stormwater reuse

The basic approach to rainwater reuse, thus introducing the idea of a closed water circuit, should be to avoid mixing water from different surfaces and to manage rainwater as close as possible to where it falls. A typical example of good practice is to allow water to run off from the sidewalk directly onto the lawn, without concentrating the runoff.

Typical problems that hinder water use are:

- unevenness of distribution and supply (e.g., to supply residential systems),
- different purposes of detention (delay) and retention (storage for other purposes),
- location of the problem (flooding) relative to the location of the water demand,
- lack of sufficient space to locate an appropriate solution,
- lack of water quality testing,
- maintenance conditions and associated costs,
- lack of consistency in urban water management (different units, formal issues),
- non-obvious estimation of inputs versus benefits.

At the same time, it is worth noting a number of factors that can stimulate interest in rainwater use. These include:

- rising prices for treated water,
- a fee for tap water consumption,
- a fee for rainwater/sewage discharge to sewers or watercourses,
- a fee for lack of retention,
- investment costs to discharge rainwater instead of managing it on site,
- the satisfaction of closing the water cycle,
- promotion and programs to stimulate a closed-circuit economy, CSR - corporate social responsibility and business strategies of companies,
- increased awareness of responsibility for climate change or the need to adapt to climate change.

Typical pollutants that hinder water use in specific applications are:

- suspended solids → equipment: nozzles of fountains and irrigation systems, street washing or pouring, receiver conditions.
- petroleum → irrigation, equipment, discharge to receiving water body.
- BOD5 and COD, bacteria → spray nozzles, pond feed, receiving water body quality.
- chlorides → irrigation, watering.
- other substances (e.g. heavy metals) → irrigation, watering.

The approach to the use of rainwater proposed in different countries is mostly based on the risk analysis of contact with non-potable water (i.e. when we do not plan to use it for drinking purposes). Examples of risk groups are defined as follows:

- non-potable water (NP), high (WK) probability of human contact with water (NP-WK)
- non-potable water (NP), medium (SK) probability of human contact with water (NP-SK)
- non-potable water (NP), low (NP) probability of human contact with water (NP-NK)

For such defined conditions, the method of stormwater treatment can be selected, resulting, for example, in such a breakdown of the target stormwater quality as shown in the following table.

Table 4 Risk estimation approach method for determining stormwater treatment requirements for stormwater use (*source: own based on WBD-SEQHWP (2009), MUSHaR-NSW(2006), revised, including: NSW RWCC (1993), DEC (2004), ANZECC & ARMCANZ (2000)*)

Use	Limiting public access	Risk level and resulting quality level of stormwater treatment (description of designations above table)
Household (non-potable water)	None	NP-WK
Bathing Sites	None	as per regulation
Outdoor irrigation	None	NP-SK
Decorative bodies of water (non-bathing)	Controlled access (or subsurface irrigation)	NP-NK

Industrial	None	NP-SK
	Controlled access	NP-NK

By analyzing the above groups, the drainage and retention system in an area can be planned accordingly, with rainwater use in mind. For example, a pre-treatment system may be very limited if you plan to dewater the sidewalk to use the water for plant watering with a system without spraying the water and without significant risk of human contact, thus in the NP - non-potable and NK - low probability of human contact groups. Since infrastructure is built for many years and often even assumed to be depreciated at 2% or a 50-year life, it makes sense to plan it in such a way that it does not impede the possibility of future use, even if it is not immediately planned.

5.3.4. Essential observations on the rainwater drainage and retention system in Bydgoszcz

Awareness of the uniqueness of the hydrographic system and the role of water in the city's landscape is present in the city's planning documents (cited SUiKZP). However, in this discussion, flowing waters (rivers, canals) and larger bodies of water are primarily "noticed". Quite generally formulated postulates of climate change mitigation measures related to the introduction of small retention facilities refer to the use of rainwater from urban areas.

Planning and environmental approach to stormwater management in residential areas should also be associated with the need to ensure adequate drainage comfort. The urgent need for action on this issue is evident, for example, from information on the historical location and frequency of flooding during heavy rainfall events - see the following illustration based on data from the past 10 years.

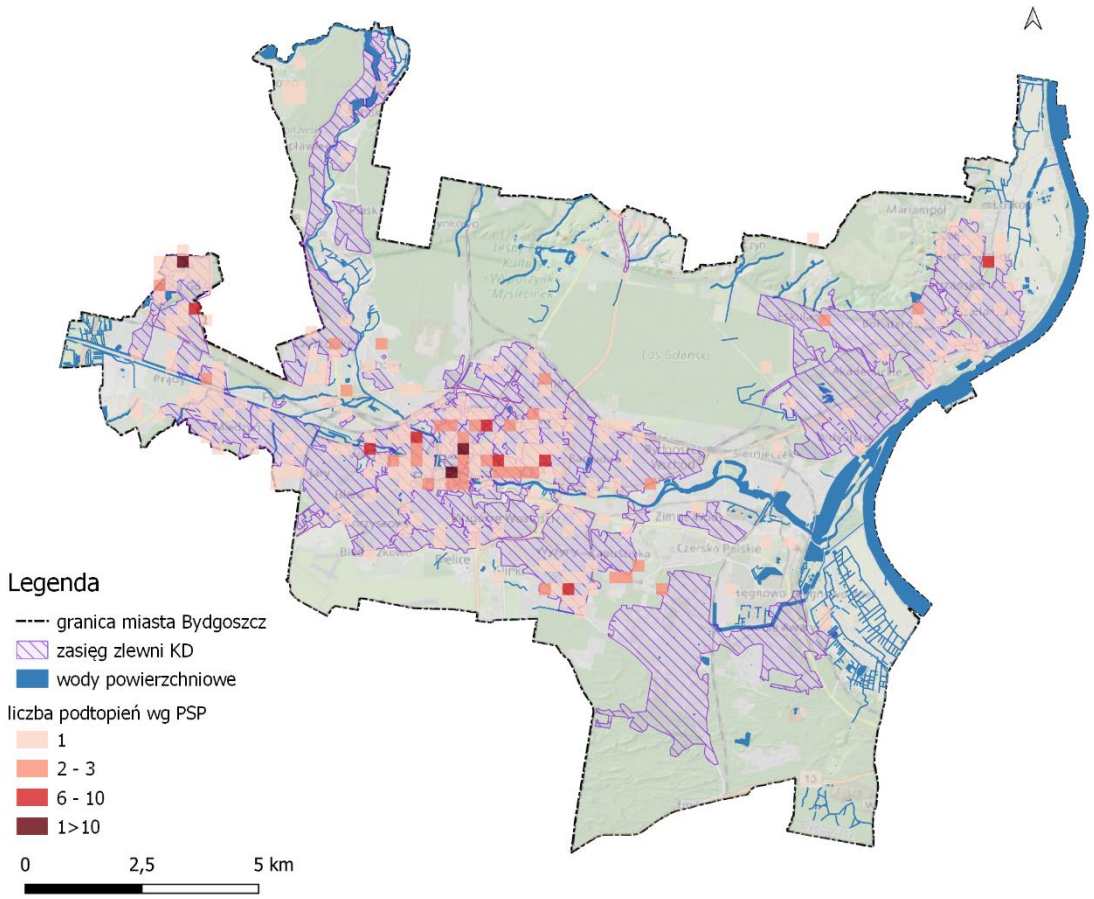


Figure 8: Distribution of KM PSP interventions related to flooding on the background of the rainwater drainage system coverage in Bydgoszcz *(source: own elaboration)*

Most of the flooding requiring intervention is located in areas equipped with a closed drainage system, with a high percentage of sealed surfaces and a lack of larger, spatially coherent green areas (Downtown, Old Town and Bocianowo region).

Diagnosis of the drainage system condition was the subject of MWIK activities more than 20 years ago, and since then, activities aimed at implementation of sustainable rainwater management have been carried out successively, starting from system inventory, through investment in pipelines rehabilitation, to the current program, one of the largest in the country, involving the construction of retention reservoirs and a system of monitoring and counteracting flooding. The value of the project is approximately 258 million PLN, of which the funding was almost 155 million PLN. The result of these activities is, among other things, a plan to create more than 80 retention facilities of various types, whose concepts were based on the assumption of rainwater retention in a place located as close as possible to the location of the problems, as close as possible to the place of outflow formation. Approximately 1/3 of the created retention volume exceeding 37 thousand m3 is to be used in the future for economic purposes - for watering city greenery and supplying ponds (e.g. in the so-called Valley of Five Ponds). Bydgoszcz is right to bet on a system of dispersed, controlled retention that will address the problem of flooding on the spot and allow rainwater to be reused. These actions are consistent with the objectives of the Strategy.

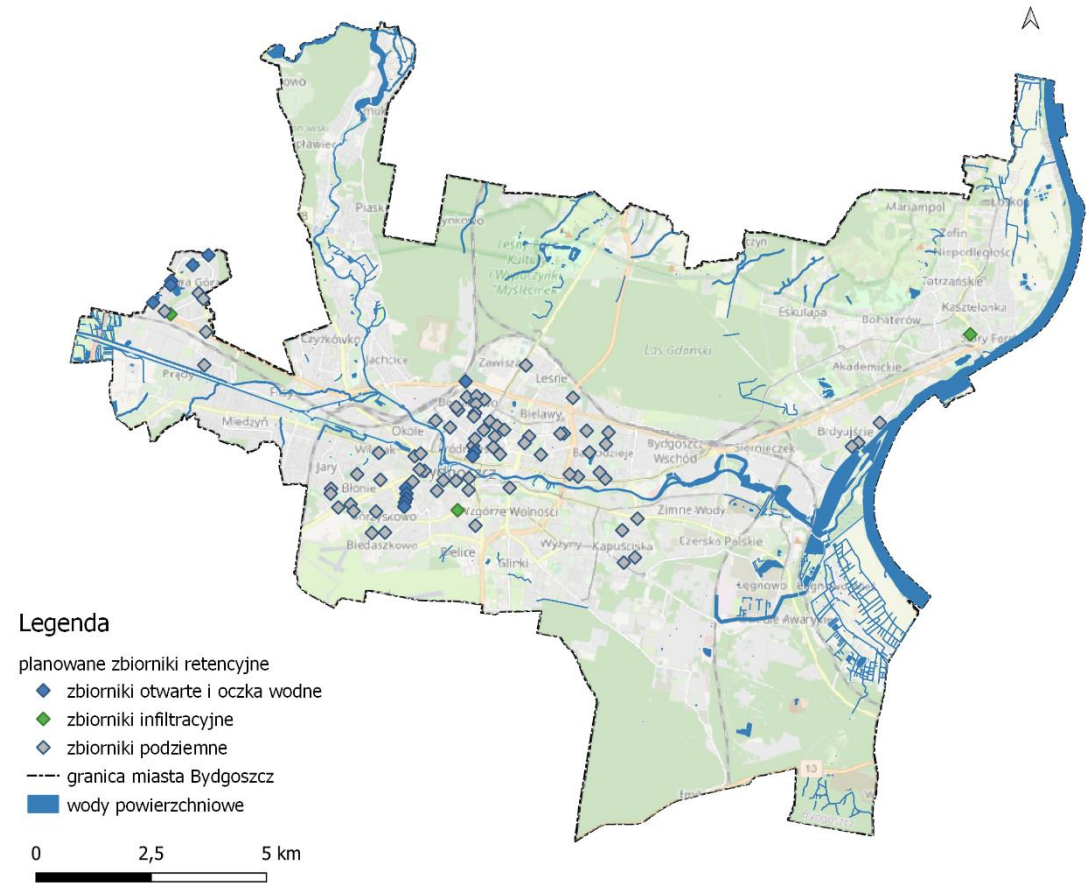


Figure 9: Location of planned rainwater retention facilities within the MWiK investment programs *(source: own elaboration based on information from MWIK)*

Simultaneously with the implementation of the investment project, MWIK has also made efforts to promote the rational management of rainwater on the owners' land, without the need for its immediate discharge into the municipal network. The activities are intended to carry out the slogan of construction "sponge city, which accumulates rainwater during rainfall and gives it back during drought".

The prepared catalog of green-blue infrastructure is an incentive to create such solutions, presenting them in several groups: for single-family houses, roads, housing estates, parks, compact buildings, parking lots, squares and commercial buildings.

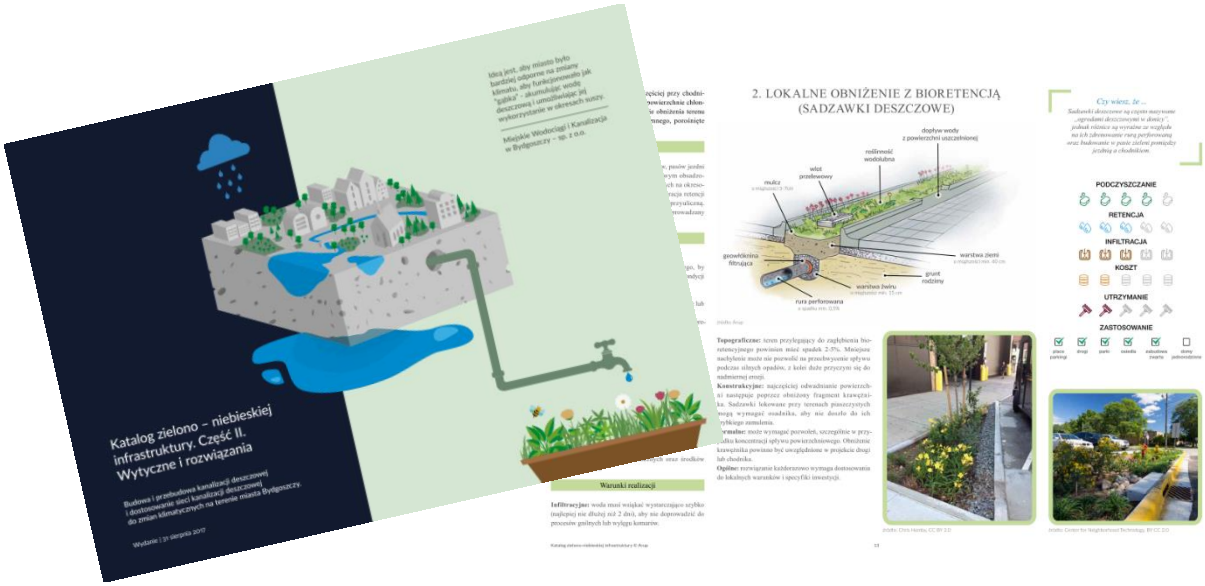


Figure 10: The cover and a sample page of the "Bydgoszcz Green-Blue Infrastructure Catalogue"

The catalog is promoted through a dedicated "Rain is Profit" page. This can also be downloaded as a PDF directly from the MWIK website.

5.3.5. Service charges for rainwater in Bydgoszcz

In Bydgoszcz, since 2019 there have been fees for discharge into the rainwater drainage system of rainwater or snowmelt originating from paved surfaces, including roofs in place. The fee does not apply to surfaces from which rainwater or snowmelt is managed on the property and is not discharged into the stormwater drainage system. The recipients of the service are natural and legal persons, as well as entities without legal personality, using real estate or their parts, including buildings and premises.

The Bydgoszcz City Council in November 2019 adopted Resolution No. XVIII/418/19 on establishing the price for the discharge of rainwater or snowmelt contained in open or closed stormwater drainage systems used for the discharge of precipitation. The following price list was adopted:

- 4.04 PLN/m3 net (4.36 PLN/m3 gross) in 2020,
- 4.44 PLN/m3 net (4.80 PLN/m3 gross) in 2021,
- 4.88 PLN/m3 net (5.27 PLN/m3 gross) in 2022.

Data from the IMGW is used for billing and the average annual precipitation value for 2021 has been determined to be 0.5552 m3/m2 (555 mm).

Services for the city are provided by The Municipal Waterworks and Sewerage Company in Bydgoszcz, as part of the tasks of the City of Bydgoszcz in the field of rainwater or snowmelt management. Bydgoszcz is one of about 80 cities in Poland where such a fee has been introduced. The fee is not exorbitant. The median rate in the cities, where the rate per m3 of run-off is applied (usually also referred only to sealed surfaces: roofs, roads and squares) is about 3.5 PLN/m3/year net. The average value in Poland oscillates around 6 PLN/m3/year net.

In view of the objectives of the Strategy, this should be regarded as a positive factor, putting rainwater management in order and providing an opportunity for rational management and investment planning, while implementing the "polluter pays" principle. The introduction of fees is also in line with the spirit

of the Water Law, where the amendment to the law enacted fees for discharge of water into waters, paid to PGW Wody Polskie.

5.4. GREY WATER - FACTORS SHAPING STRATEGY

5.4.1. The broader context

When considering the use of grey water, it is important to start by looking at the definition. EN 12056-1 defines grey water as fecal-free contaminated water. A common, perhaps more practical definition is given by Wikipedia[2], indicating that in practice it is non-industrial waste water generated during domestic processes such as washing dishes, bathing or laundry, which is recyclable to a limited extent. In a traditional household, 50-80% of the waste water can be used as grey water. Almost all water used in the home is usable, except for toilet flushing water.

According to the European Environment Agency, an average of 144 liters of freshwater per person per day is supplied for domestic use in Europe. This is almost three times the amount of water required to meet basic needs. Much of this water can be both saved and reused. The diagram below shows the activities that generate grey water.

5.4.2. Situation in Bydgoszcz

Significant investments made in the water supply system in recent years have resulted in an upgraded water supply system, which is used by almost 100% of residents. At the same time, the use of EU co-financing and the planning of long-term exploitation and thus low depreciation costs made it possible to effectively finance the expansion and repairs of the infrastructure without significant charges from the inhabitants. The water affordability index fluctuates around 2.5%, which is much lower than acceptable. From the point of view of stimulating the use of grey water, this is not a factor conducive to residents switching to the use of grey water. At the same time, the sum of all the burdens on water farms and the

[2] https://pl.wikipedia.org/wiki/Szara_woda (access: 06.12.2021)

increasing emphasis on climate risks create an atmosphere in which the use of grey water could be considered.

As indicated earlier, a traditional household can reuse between 50% and 80% of its wastewater as grey water. This value is related to the fact that the city of Bydgoszcz is one of the largest cities in Poland, which directly translates into the number of households. As reported in the Local Data Base of the Central Statistical Office, Bydgoszcz has a high ratio of residents to dwellings, with over 150,000 in the city alone. This value represents the potential and opportunity to use grey water as a kind of alternative to tap water in some functions. See the table below.

Table 5: Housing indicators in Bydgoszcz *(source: CSO LDB)*

Podstawowe informacje	2014	2015	2016	2017	2018
Mieszkania oddane do użytkowania:					
mieszkania	1 225	940	864	1 432	1 139
izby	3 564	2 808	2 493	4 186	3 304
powierzchnia użytkowa w tys. m²	73,4	59,8	51,4	90,6	67,3
Zasoby mieszkaniowe:					
mieszkania	147 128	148 055	148 901	150 309	151 316
izby	506 369	509 112	511 524	515 609	518 547
powierzchnia użytkowa w tys. m²	8 514,1	8 572,1	8 621,7	8 710,3	8 769,6
Wskaźniki:					
przeciętna powierzchnia użytkowa w m²	57,9	57,9	57,9	57,9	58,0
przeciętna powierzchnia izby w m²	16,81	16,84	16,85	16,89	16,91
liczba mieszkań na 1000 mieszkańców	411	416	421	427	432
przeciętna liczba osób na 1 mieszkanie	2,4	2,4	2,4	2,3	2,3
przeciętna liczba osób na 1 izbę	0,7	0,7	0,7	0,7	0,7

Źródło: BDL GUS

5.4.3. Use of grey water in other countries

When thinking about the environmental value of using grey water, it is worth looking at a benchmark from other countries. As an introduction, Australia can be considered, where the government has introduced legislation to support the use of grey water in response to the drought. It seems interesting that certified systems for infiltration of such water are fully available. The following list presents examples from different parts of the world, where grey water plays an increasingly important role:

- Mallorca → grey water has a special use in hotels. There it is used to flush toilet bowls.
- Great Britain → student houses in Loughborough operate using grey water.
- Sweden → University buildings in Kalmar have grey water facilities.
- Norway → Oslo University of Agriculture also has an installation that allows the use of grey water.
- India → In schools in the state of Madhya Pradesh, more than 400 systems have been built to treat and reuse grey water.

The culmination of this topic may be that in countries generally considered less developed, the use of grey water has been in operation for almost 20 years. Malaysia, for example, has designed an integrated grey water recycling system for the entire city of Kuching. These are still individual examples, but they are part of an increasingly visible trend.

5.4.4. Examples of grey water applications

Given that grey water resources can translate into significant volumes, it is worthwhile to identify examples of grey water reuse, thinking of it in terms of both economic and ecological potential. Examples of grey water reuse are presented below:

- Flushing in toilets. It is worth pointing out that about 30% of the water generated by a household is used for this purpose.
- Watering green areas. This aspect can be particularly important within the generally prevailing trend related to the creation of blue-green infrastructure spaces. In this case, it should be mentioned that a prior treatment of grey water is required.
- Street cleaning. This issue may be important in larger cities and in view of the need to sprinkle or wash heavily urbanized surfaces while combating dust and pollution or trying to "cool" heated surfaces.
- Building Cleaning. The use of grey water can be important from the perspective of both the city and owners of commercial buildings, such as shopping malls.
- Vehicle Washing. This issue can be considered from the perspective of the use of grey water by the proverbial John Smith. Another area of utilization of such water can be powering of car washes, both automatic and self-service ones, which more and more boldly function in urban spaces.

5.5. TREATED WASTEWATER – FACTORS THAT SHAPE THE STRATEGY

5.5.1. Wider context

Figure 1. Location of municipal sewage treatment plants[3] (source: own elaboration)

The Brda River divides the sewage collection and treatment system in Bydgoszcz in two parts – northern, i.e. the Fordon sewage treatment plant catchment area, and southern, the Kapuściska sewage treatment plant catchment area. As you can see from the map, both of these facilities are already located close to the river, away from the center. From the Strategy's perspective, the management of treated wastewater should be for on-site use without building an expensive transport system or possibly for use at a close location by a significant recipient of treated wastewater. It is worth considering such a resource can be used, given the current industry interest in access to water as a limiting factor for investment. However, it would certainly require further pre-treatment, but could be attractive, for example, for the location of industry in industrial areas near the Kapuściska treatment plant. For example, water-absorbing installations or even the production of hydrogen, which is now considered an extremely future-oriented energy source, could be considered.

5.5.2. Important observations on the sewage treatment system in Bydgoszcz

The "Fordon" sewage treatment plant has an average daily capacity of 41,000m3. Sewage sludge is processed in a thermal sludge utilization station and burned on a fluidized bed. The treated sewage meets the EU requirements in this regard.

[3] Caption: border of the city of Bydgoszcz, municipal sewage treatment plants

The “Kapuściska” sewage treatment plant was built on the premises of the former industrial plants “Organika-Zachem” and “Nitro-Chem,” and its capacity is defined at nearly 72,000 m3/d. The plant requires further modernization, which began in 2019. It seems that due to the location, the treated wastewater from this treatment plant could be recycled back to the system, e.g. industrial, of course after proper preparation. It would be also advisable to use them in the technological process of the sewage treatment plant itself.

5.6. MUNICIPAL AND DEPENDENT ENTITIES AFFECTING THE IMPLEMENTATON OF THE STRATEGY

Presented below are the key units and departments of the City Hall for which the Strategy is of primary interest, and which have a significant influence on its implementation. The scope of their responsibility directly related to the subject of the Strategy is also briefly described:

- Department of Integrated Development and Environment

  The Department coordinates works related to the preparation and implementation of the strategy (including this document but also the Bydgoszcz Development Strategy). Moreover, it conducts and supervises matters related to the formation and implementation of ecological policy and analyses the influence of the city’s economy on the state of environment, as well as grants purposeful subsidy to co-finance investment costs in the field of environmental protection and water management. The Department also manages non-investable projects funded from external sources. The Department is also responsible for coordinating and updating works related to the environmental protection program for the city of Bydgoszcz and the Climate Change Adaptation Plan.

- Department of Building Administration

  In addition to issues in the area of architectural and construction administration, its tasks also include ensuring the sustainable spatial development of the City.

- Department of Municipal Services

  It carries out tasks related to urban greenery, agricultural and forest areas of the city, and takes actions to protect the nature. The Department also ensues maintenance of proper sanitary and orderly condition in the city and creates housing policy by managing the city’s housing stock.

- Department of City Investments

  Cooperating with other departments of the City Hall, this Department prepares municipal investments for realization and supervises their implementation, however it does not deal with road investments.

- Public Communications Office

  The Office coordinates activities in the field of environmental education and supports the implementation of projects aimed at the City’s residents. It also coordinates issues related to the functioning of the Bydgoszcz Civic Budget.

- City Promotion and International Relations Office

  The Office is responsible for coordination and supervision of the performance of tasks related to the promotion of the City carried out by the departments and organizational units of the City, building the image of the City of Bydgoszcz.

- Municipal Artist

Coordinates the activities of the office departments and city organizational units to ensure consistency and a high level of aesthetics in the City's public spaces.

- Municipal Urban Studio

  The main task of the Studio is to carry out the responsibilities of the municipal self-government in the field of urban planning.

- Office of Integrated Territorial Investments for the Bydgoszcz-Toruń Functional Area

  The Office ensures servicing of the Agreement on implementation of Integrated Territorial Investments for the Bydgoszcz-Toruń Functional Area.

- European Funds Department

  The Department monitors the sources of financing from European funds and provides other units with information about funding opportunities.

- And also a municipal water and sewage company – Municipal Waterworks and Sewerage Company in Bydgoszcz

  In addition to its core business of water supply in adequate quality and disposal of sewage and rainwater (as well as rainwater retention), the company offers a wide range of fee-based specialized services in the area of water and sewage.

5.7. PREVIOUS PROMOTIONAL AND EDUCATIONAL ACTIVITIES

Bydgoszcz puts a great emphasis on promoting activities related to water management. The Municipal Waterworks and Sewerage Systems conduct a wide promotional and educational campaign, implementing a TV program, issuing brochures, catalogs and guidelines on rainwater, including the "Catalogue of Green and Blue Infrastructure," and organizing conferences. In turn, the city authorities decided to focus on creation of key strategic documents and the implementation of green and blue infrastructure projects in a participatory manner, consulting with citizens and involving them in the co-creation of the vision of Bydgoszcz. This is the participatory way in which the strategy of "Bydgoszcz 2030. Development Strategy" was created.

The City Hall incorporates the theme of green-and-blue infrastructure development into the process of preparing projects from the civic budget. The catalog was presented to the estate councils to encourage residents to submit proposals in the field of the green-and-blue infrastructure. The number of civic initiatives aimed at the development of urban greenery increases with every year. Additionally, it is planned that 30% of the funds available under civic budgets will be directed towards "green" projects.

Figure 12. Various promotional activities in Bydgoszcz related to rainwater management and water and sewage management ***(source: Internet selection, own source, Municipal Waterworks and Sewerage Company in Bydgoszcz)***

The "City Water Circles – CWC" project is also being conducted in a participatory manner. In addition to the educational value and formulation of this Strategy, the project is implementing pilot investments in the field of green-and-blue infrastructure in three locations:

- A historical palace in the Museum of Waterworks in Bydgoszcz

Models of demonstrational rainwater management systems shall be built next to the renovated Palace, and the green-and-blue infrastructure will be placed around the building, including a rain garden in the ground and in a sealed container. Home retention solutions will also be presented.

- City Hall, Grudziądzka St.

Water from a portion of the building's roof will be diverted into a rain garden in the container. The location at the entrance to the building will be a natural promotion of the green-and-blue solutions.

Their educational and promotional value cannot be overestimated; however it should be noted that these are only pilot implementations and achieving a scale that will translate into effects in the form of a "sponge-city" requires significant dissemination of this idea.

Well-conducted promotional and educational activities are also noticed outside of Bydgoszcz, which is regarded as one of the leaders in adaptation to climate change and "rainwater." However, in order to have a real effect in the city itself, Municipal Waterworks and Sewerage Company, City Hall, Bydgoszcz University of Technology, local civic initiatives or non-governmental organizations must be coordinated or at least mutually supported by units working in the same area and promoting the same idea. Therefore, actions in the Strategy should be aimed at disseminating the idea of Bydgoszcz as a sponge-city, introducing the issues of circular economy, which have been less present so far, and intensifying joint activities.

6. LEGAL ENVIRONMENT

In terms of the legal environment, the key document is the **Water Law** of 20 July 2017. The act defines rainwater and sewage, specifies the conditions for draining and abstracting water, stimulates the increase in retention through a system of fees for water services, and addresses the challenges posed by European directives, most notably including the Water Framework Directive.

The new legislation has also introduced a number of new challenges. However, in some areas the results are not as expected, for example, due to the failure in the method of determining discounts in rates related to retention of systems (rates too low to stimulate the correct behavior, incorrectly defined levels of rates). There are also interpretation issues, e.g. the lack of definition of the word "retention", contradictions with other legal acts, whose provisions have not been fully adapted to the new conditions (another example may be the frequently raised contradiction with the Construction Law, which emphasizes the obligation to connect residents to the sewer system, which is often associated with the rainwater sewage system by planners and hinders the implementation of the rational rainwater management in accordance with the idea of circular economy).

The introduction of **charges for rainwater** discharged into water and the creation of a regulator – The State Water Holding "Polish Waters" – which strongly emphasizes the separation of fees for sewage from those for rainwater, supports the city's operation related to the introduction of a service fee for draining rainwater and snowmelt into the municipal network. By Resolution No. XVIII/418/19 of 27 November 2019, the City Council of Bydgoszcz introduced fees for *"drainage of rainwater and snowmelt included in open or closed rainwater drainage systems used to drain precipitation"*.

The Water Law also introduced a new **fee for reducing natural retention**. The fee applies to *"performing works on a property with an area exceeding 3500 m^2 of works or constructions permanently connected with the ground, having an impact on the reduction of this retention by excluding more than 70% of the property from the biologically active surface, hereinafter referred to as "reduction of the natural terrain retention"*. The obligation to determine the amount of the fee for reducing natural land retention belongs to the municipality, i.e. commune heads, mayors or city presidents. According to the Water Law act in force, 90% of the income from the fees for water services resulting from the fees for decreasing the natural terrain retention goes to Polish Water Authorities and 10% is the income of the budget of the relevant municipality. However, these amounts are small in comparison to those due for rainwater discharge into waters, i.e. the variable and fixed charges for rainwater.

The legislator plans to strengthen the existing provisions of the Water Law through the currently processed **act on investments in counteracting the effects of** drought (the so-called special drought act). It is supposed to facilitate investments in this area and limit the scale of "sealing" the urban areas by paving, asphalting and building over them. Limiting the progress of the so-called "concreteosis" is an enormous challenge, of which a modified legal system may be one of the most important foundations. According to the planned provisions of the law, the fee would be charged for *"the performance of works or constructions permanently connected with the ground on a property with an area exceeding 600 m^2, which would affect the reduction of this retention by excluding more than 50% of the real estate area from the biologically active area, hereinafter referred to as "reduction of the natural land retention"*.

Therefore, it can be concluded that the current law supports the management of rainwater in a closed circuit, although it is not consistent in this regard and contains too many ambiguities.

On the other hand, **water supply and the quality of tap water** are regulated by the Act of 7 June 2001 "on collective water supply and collective sewage disposal", and the Regulation of the Minister of Health of 7 December 2017 "on the quality of water intended for human consumption", taking into account the provisions of European Union Council Directive 98/83/EC. The provisions of this regulation define the

requirements for the quality of water intended for human consumption, including bacteriological, physicochemical and organoleptic requirements, the method of assessing the suitability of water, the minimum frequency and places of taking water samples for testing, as well as the scope of water testing. The State Sanitary Inspectorate supervises the quality of water intended for human consumption by testing water samples and enforcing proper water quality from producers. **The new Directive (EU) 2020/2184 of the European Parliament and of the Council of 16 December 2020 on the quality of water intended for human consumption** introduces management of the water supply system on the basis of a risk assessment covering the entire system from the intake to the consumer's point of use. Implementations of the new directive's requirements will involve costly investments in the water and sewage management section. Member states – including Poland – have 2 years (until 12 January 2023) to implement the new directive into national law. This will mean, among other things, amending the act on collective water supply and collective sewage disposal, and the Regulation of the Minister of Health on the quality of water intended for human consumption.

Regulation (EU) 2020/741 of the European Parliament and of the Council of 25 May 2020 on minimum requirements for the reuse of water sets standards for the **quality of water that can be recovered from treated urban wastewater and used in agriculture for irrigation.** Art. 84. 1. of the Water Law Act allows for the agricultural use of domestic sewage and municipal sewage, biodegradable industrial sewage and used waters discharged from fish farming facilities. Agricultural use is understood as irrigation and fertilization of agricultural land as well as irrigation and fertilization of ponds used for farming or breeding fish. Annual and seasonal doses of wastewater used for agricultural purposes, specified in water permits or integrated permits, cannot exceed the plants' requirement for nitrogen, potassium and water, and cannot hinder the course of soil self-cleaning processes.

However, the use of grey water is not regulated in Polish law. Usually, designers use foreign standards and guidelines. The terms **"grey wastewater"** or **"grey water"** have not been defined in any law or regulation. However, it is included in the standard PN-EN 12056-1:2002 gravity sewage systems inside buildings. The standards of treated greywater used for non-food purposes can be based on the Regulation of the Minister of Health of 9 November 2015 on the requirements to be met by water in swimming pools and requirements for water introduced into the swimming pool basin from the circulation system.

In the context of using rainwater to supply ponds, irrigation systems or fountains, it is also worth paying attention to the Regulation of the Minister of Health of 17 January 2019 on the supervision of water quality in the bathing areas and places occasionally used for bathing.

More on this subject can be found in the study prepared as a part of the CWC project, number D.T. 3.4.2. "COUNTRY REPORTS ON THE ASSESSMENT OF THE NATIONAL LEVEL" of June 2021, which was also used in preparation of the above synthesis of the legal situation.

7. LINK WITH KEY STRATEGIC DOCUMENTS

7.1. Study of Conditions and Directions of Spatial Developmen of the City of Bydgoszcz

The study from 2009 in the field of interest in the current Strategy is no longer relevant. According to the demographic forecasts included in the Study, no increase in the number of populations was expected. Thus, the city's development should be aimed at qualitative changes, while Bydgoszcz will also aim at the development of housing.

The "Study" referring to the functional and spatial solutions, assumed the maintenance of the existing and introduction of new green spaces, forming Municipal Natural System that raises the health and

aesthetic value of the city, allowing the restoration of the opinion that Bydgoszcz is a green city. The emphasis was also put on the conscious shaping of public spaces, especially in the downtown area and in the recreational and coastal areas. In the chapters on infrastructure, the study did not address the issue of water use, treated sewage of grey water. The document focuses more on space planning, emphasizing the need for development of green areas and housing.

Currently, a new study is being developed, with public consultations taking place in June and July of 2021. Comments on the document could be submitted until the end of August 2021.

The new Study project (dated June-July 2021) refers to current demographic trends. Although the number of citizens is systematically decreasing, which is typical for larger urban centers in Poland, the city is an important regional center, inhabited by over 350,000 residents. We can observe a significant increase in the number of inhabitants in the county. This makes us think about the Strategy in the context of the entire city environment. It was also pointed out that green and water areas, covering 9,035 ha, cover more than half of the city's area, and the unique location of Bydgoszcz at the confluence of the Wisla and Brda rivers and the system of canals of the Bydgoszcz Water Junction are a unique feature shaping the city.

The conclusions regarding the water supply system emphasize the necessity of its further development to neighboring communes and the maintenance/increase of reliability of supply through successive replacement of outdated infrastructure.

In terms of the sanitary sewerage system, the need for further development was indicated, particularly in the area of the "Kapuściska" sewage treatment plant catchment area, with the collection of sewage from neighboring municipalities and the expansion of the network for housing estates. The age of some sections and the need for modernization in this area was also indicated.

Most of the existing problems were identified in the field of drainage and retention of rainwater system. The answer to them is, to a large extent, the investment project carried out by Municipal Waterworks and Sewerage Company, as the lack of network, lack of retention facilities, flooding or poor technical condition of channels was indicated. The number of conclusions concerns the reduction of rainwater drainage and increasing infiltration and water retention instead, with a possible recharge of green areas and introduction to the solutions of green-and-blue infrastructure. The need to clean the rainwater is also indicated here.

Analyzing the study's provisions related to water management, it can be concluded that during the planning of space and the development of the city, it is rainwater and its connection with shaping the space and climatic conditions of the city that is the most important, ongoing challenge. The challenge is included in selected directions and priorities of the city's development, for example, in issues such as limiting the urban heat island, shaping recreation and leisure areas, or green areas. They are described in detail in the chapter on the development of small urban retention, very rightly emphasizing the need to "popularize" and increase the scale of implementation of green-and-blue infrastructure ("mass") solutions, as only a significant number of implementations contributes to the achievement of the expected results. It will allow to increase the capacity of the catchment area and reduce the runoff of rainwater to the sewage system and will enable rational management of rainfall during storms, and water during drought. In order to achieve this, it is necessary to heavily rely on the actions of individual users and owners of the land. The planners also try to improve the standard of living by providing access to the natural and recreational system of the city.

In the document, we can notice a drive to create a city that is friendly to its residents, which will be implemented next to the development of grass areas, as well as by supporting public transport increasing the use of bicycles or pedestrian accessibility of the city. These issues are directly correlated with shaping of the space in which water becomes a valuable resource, important in the landscape of Bydgoszcz. The study project also drew the attention to the potential of using the natural and landscape

values of the areas (water reservoirs, water courses, lowlands, relieves of land, plant communities) and the value of rainwater used to improve the quality of the environment and enhancing the landscape, and utility values of recreational areas.

However, at the same time, this subject hardly penetrates other areas except for greenery and water management, such as those related to road planning and drainage methods. This might be due to the structure of the document itself. Nevertheless, it can also contribute to strengthening cooperation within municipal organizational structures and avoiding a “silo” view of the implementation of development plans by individual organizational units. Therefore, as a conclusion for the needs of formulating actions for the Strategy, it is worth stressing the need for synergy and cooperation between various city departments and municipal companies responsible for different areas of planning and economic activity. Bydgoszcz’s unique location favors the city’s sustainable development and provides significant potential for the city to adapt to climate change.

In this context, recommendations for the closed-circuit water management will be pursued, where in addition to basic issues such as avoiding surface sealing or rainwater management at the precipitation site, more ambitious trends should also be promoted and communicated, i.e. regarding the use of water in industry, or the use of grey water and thus reducing the consumption of tap water, especially from the deep-water sources.

Apart from inspiring to act, which is currently being implemented through the promotion of “Catalog of the green-and-blue infrastructure”, it is also worth making an effort to further implement specific, good practices and focus on their promotion associated with specific catalogs of good practices, as well as tools facilitating the practical approach to the implementation of the provisions of the study of conditions and directions of Bydgoszcz’s development.

Photo 1. Water in the urban landscape of Bydgoszcz ***(source: own elaboration)***

7.2. Municipal Climate Change Adaptation Plan and SECAP

This Strategy is an extension and specification of the recommendations of the Municipal Plan of Adaptation (MPA) to climate change for Bydgoszcz from September 2019. This document recognizes water management as one of the four sectors to be the most vulnerable to climate change. The Strategy fits into four out of five specific objectives of the MPA, i.e. resistance to the effects of flooding, high temperatures, smog and torrential rains.

Based on the climate models, the MPA indicated for Bydgoszcz pointed out that by 2050 one can expect:

- Increase in the number of days with maximum temperature and an increase in the intensity of heat waves,
- Increase in the annual precipitation,
- Increased risk of extreme precipitation, as expressed by an increased number of days with precipitation ≥10mm and ≥20mm,
- Decrease in the number of days with snow cover,
- Increased risk of drought, as illustrated by the increased period of no precipitation per year.

The strengths of the city which have a positive impact on the troublesome thermal phenomena, have been shown in this document, including the riverside location, large areas of forest surrounding the city and a significant share of urban green areas with multiple parks and squares. It was also pointed out that the municipal documents emphasize the poor coordination of activities of individual units of the

local government in the field of caring for the green areas and failure to follow the principles determining sustainable development. This diagnosis coincides with the results of public consultations undertaken as a part of the Strategy.

The low risk regarding water sources and water supply was also pointed out, which can be also related to the need of implementing grey water systems. The MPA also positively assessed the city's flood preparations and its low susceptibility to climatic events in this regard. The importance of the investment project of reconstruction of the rainwater sewage system and the construction of reservoir retention led by the Municipal Waterworks and Sewerage Company was also emphasized.

The risks associated with the heat waves and the urban heat island were pronounced most strongly with the MPA, as a significant danger to children and the elderly. This directly contributes to the acceleration in the green-and-blue infrastructure field, which was reflected in the document's proposed funding for the "Rainwater management program which excludes rainwater drainage" and proposes the construction of green roofs. The sprinkling of streets and tracks might also help in lowering the temperature, as proposed in MPA.

The attention was also brought to the danger related to the dam of the Koronowo reservoir and the need to implement an important for the city's water resources threat monitoring system. The need for making the city greener, creating mini parks, as well as municipal bathing areas was also emphasized.

Even though water management has been identified as a vulnerable area in the MPA, and the subsystems of water supply, sewage management and flood protection infrastructure are characterized by medium or high risk, in comparison to other hazards and taking into consideration the adaptation projects that have already been implemented, it seems that in the MPA, the area related to water management is assessed positively. The need for promotion and implementation of the developed "green-and-blue infrastructure catalog" among the citizens was indicated. Attention was also drawn to the need of developing the construction and maintenance of fountains and water curtains, and the maintenance of the water pergola and street water sprinklers, as well as the necessary development of the city's green-and-blue infrastructure.

The MPA did not address the use of grey water or treated wastewater, nor did it pay attention to the issues of circular economy.

On the other hand, the Sustainable Energy and Climate Action Plan (SECAP) for the city of Bydgoszcz until 2030, created by the Association of Municipalities, Polish Network "Energie Cités" (PNEC) supporting Bydgoszcz in the implementation of the Covenant of Mayors – a movement benefitting the climate and energy at the city level among many strategic actions estimated at a total amount of over PLN 5.7 billion, also include the use of hydrogen energy.

In addition, in comparison of the adaptation activities the document lists of following actions in Table 23, such as:

- Construction and development of the blue-and-green infrastructure system,
- Construction of the system of solutions to ensure the thermal comfort of residents (mainly green areas in this area),
- Construction of retention basins with the elements of blue-and-green infrastructure,
- Education/information about threats,
- Education/promotion/information on good practices (actions and attitudes),
- Building the system of information about threats in the public space (the document mentions increasing safety of the facilities of Koronowo, Tryszczyn and Smukała above all else)

It is safe to assume that all actions listed in this table are consistent with the goals of this Strategy, as they relate to ensuring proper circulation of rainwater and creating green-and-blue infrastructure of the city, as well as relating to the issues of health, education and safety in this area.

7.3. Urban strategies

The strategy for rainwater, grey water and treated wastewater fits into the Strategy of Area IV of the "Bydgoszcz 2030. Development Strategy" of 27 May 2020, which includes challenges related to health and safe environment, as well as sustainable resource management. The Strategy of "Bydgoszcz 2030. Development Strategy" indicates the need for education, adaptation to climate change, the need to create high-quality public spaces. It also emphasizes the need to achieve high-quality environment and care for the preservation of resources. The document indicates that the goal is to increase the volume of retention facilities from 10,800 m^3 in 2018 to 45,000 m^3 in 2030, to maintain the share of green areas: forests, parks, lawns and residential and street green areas in the city area, as well as reducing consumption of water from water supply in households from 34.7 m^3/Mk/year to 33.0 m^3/Mk/year.

This strategy is part of the National Environmental Policy 2030 – development strategy in the field of environment and water management (PEP 2030) on 16 July 2019. It directs efforts towards the development of green-and-blue infrastructure in urbanized areas, the development of various forms of retention and the reduction of land take and the sealing of biologically active areas.

8. SWOT AND PESTEL ANALYSIS FOR THE CITY OF BYDGOSZCZ

8.1 SWOT ANALYSIS

STRENGTHS	WEAKNESSES
• Interest in the subject of small retention, • Provisions in the newly adopted zones that favor the management of rainwater in the place of their occurrence, • Occurrence of low flow natural watercourses, semi-natural and artificial water reservoirs, • The rainwater management project implemented by the Municipal Water Supply and Sewerage company, which includes the construction of 66 detention and retention basins, • Prepared pilot projects, included in the CWC project, • Catalog of green-and-blue infrastructure, • Strong substantive support from the Municipal Water Supply and Sewerage company, including conducted research	• Non-developed small retention system, • Pressure on zones to reduce biologically active areas and transform them into sealed surfaces in the process of urbanization, • Lowering of water levels in water bodies located in green areas that are maintained by the City, • Failure to adapt the elements of the city's hydrographic network (i.e. water reservoirs, ditches) to retention of rainwater or snowmelt, • Lack of appropriate tools to work starting from a specific plan to equipment (e.g. sprinkler trucks, watering cans), • Pollution of rainwater, • Multi-story sewage system and the dangers resulting from incomplete separation of rainwater and sewage,

on the quality of treated sewage and rainwater, • Implementation of a hydrodynamic model for rainwater management in the city.	• Lack of separation of „clean" rainwater (from roofs) and rainwater from sidewalks and streets.
OPPORTUNITIES	**THREATS**
• Multiple programs supporting small-scale retention and development of blue-and-green infrastructure, • High awareness of institutional stakeholders resulting from many years of educational campaign, implementation of the Municipal Climate Change Adaptation Plan • Strong emphasis placed by the European Union on adaptation to climate change, • Growing political and social awareness, • Rising water prices.	• Climate change and related risks resulting from the extended periods without annual precipitation and the occurrence of extreme rainfall, • Drought and long periods without rain in the city, • High absorptive capacity of the receivers, reducing the pressure to limit rainwater discharge, • Limited investment outlays.

8.2. PESTEL ANALYSIS

POLITICAL	**ECONOMIC**
• Strong local support, including the water company, • Strong interest in flood and flooding protection, • Political decision to implement the Green Deal, the Reconstruction Fund and the Just Transition Fund to favor the projects emphasizing climate change adaptation, • Slowly emerging political interest in the rainwater use, • Adoption of the Climate Change Adaptation Plan.	• Draining rainwater fees, local and for the regulator – maintenance funds, • Ongoing projects related to rainwater and investments in sewage treatment plans, • Huge commitment of funds in the last 20 years for the renovation of the water and sewage infrastructure, • Still, significant underinvestment in the water infrastructure, • Relatively low cost of water, • High cost of installing grey water usage.
SOCIAL	**TECHNICAL/TECHNOLOGICAL**
• The emerging trend of investing in backyard retention and green-and-blue infrastructure, • Emphasized shift of cities towards their citizens and making their voice count (e.g. civic funds, grassroots initiatives, community engagement and looking for initiatives with public participation),	• Contamination of rainwater, • Location of sources in relation to the location of use, • The quality of water/sewage sent for reuse – sanitary and hygienic conditions, • Storied rainwater and sanitary sewage system.

• Strongly developed Public Relations in the area of rainwater and water in the city of Bydgoszcz. • Migration and competition between cities in terms of living standards, including the creation of urban spaces, city water and the health of residents.	
LEGAL	**ENVIRONMENTAL**
• New water law, rainwater as a resource, although with a lot of ambiguities, • Conflict of water and construction law (e.g. disconnecting the property from the rainwater drainage system), • Problems with implementing payments from residents, • Difficulties in cooperation with the regulator – State Water Holding „Polish Waters" on the background of legal interpretations. The law is still "young" and underdeveloped, and there is no practical experience in many areas.	• High use of groundwater in Territorial Bydgoszcz-Toruń Functional Areas, • High quality of the Brda's waters, • Impact on groundwaters, • Impact on surface waters, • Periods of drought and the condition of urban greenery, as well as pollination. • Drought and agricultural conditions.

Part 2 – Vision, Objectives and Activity Plan

9. VISION

The vision is formulated as follows:

„BTOF (Bydgoszcz-Toruń Functional Area) thanks to well-thought-out water and sewage management solutions uses rainwater and recovers water, adapting activities to climate change."

10. IMPLEMENTATION OF THE VISION IN PROBLEM AREAS - CONCLUSIONS FROM THE DIAGNOSIS

10.1. CLIMATE CHANGES RESILIENCE

The published 6th report of the Intergovernmental Panel on Climate Change (IPCC) released in August 2021 leaves no doubt about the ongoing climate change and its effects. This panel collects and presents scientific knowledge on the effects of climate change. Experts agree that a number of risks are either highly likely or more likely than not. The scenarios outlined in the report clearly show that for the Central and Eastern European region, periods of drought and heat will become a serious problem, and that a greater threat from changes in rainfall patterns and intensity is highly likely. Cities must prepare for this threat. The information contained in the IPCC report strengthens the message of the analysis contained in the Municipal Adaptation Plan to Climate Change for Bydgoszcz.

10.2. RAINWATER

Bydgoszcz is one of the first cities that have taken up the challenge of wise rainwater management. The activities that have been implemented for several years in a thoughtful way lead to the goal of creating a city that works like a sponge: accumulating rainwater during precipitation and using rainwater during the dry season. Thanks to the use of EU funds, water and sewage management has been put in order and, at the same time, the quality of water in receiving waters has been significantly improved, which results in the annual Brda River swimming competition organized in the city. However, the currently implemented activities related to rainwater require development, consistency in implementation and continuation in the form of greater emphasis on the spread of green-blue infrastructure with simultaneous management of reservoir retention and use of rainwater. In this, strategic activities will be guided in the implementation of the vision.

10.3. GREY WATERS

The sequence of past activities over the past decades, which have been driven significantly by pre-accession and European funds, has prioritized water treatment, wastewater treatment, ensuring water supply and wastewater collection, and increasing efficiency in water and wastewater management. Currently, the funding stream is directed towards increasing resilience to climate change. The issue of grey water use is not currently a priority in Poland. However, looking at global trends, climate change

and rising prices of water and wastewater services associated with increased prosperity, one should think that also in Poland, the use of grey water will become an important element of increasing resilience to climate change. In this regard, a barrier is also the price of the technology and the need to adapt individual recipient installations to separate grey water from drinking water and tap water. Under these conditions, realizing the vision contained in the Strategy one should rather focus on promoting and monitoring the development of technologies and single applications or pilot implementations increasing experience and knowledge. They will result in increased awareness of officials, but also specialists dealing with water management.

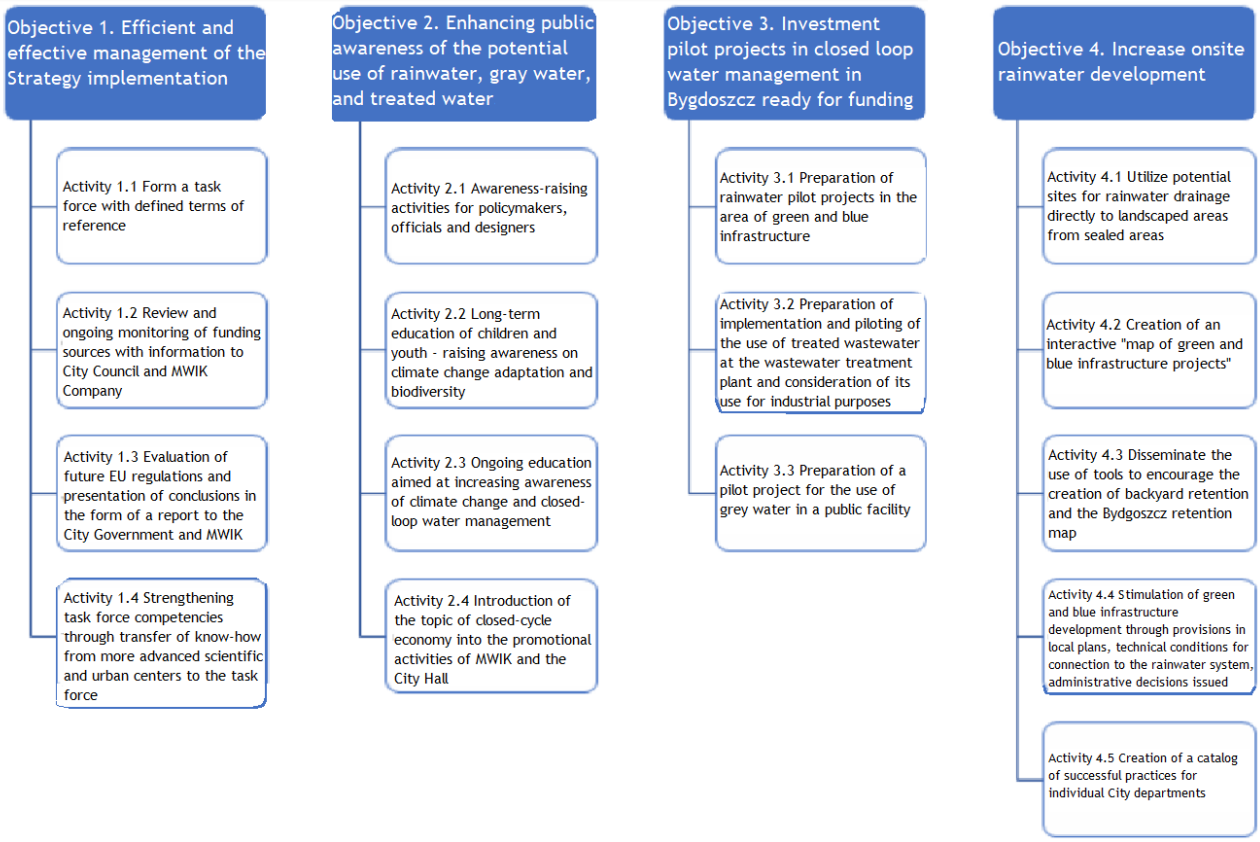
10.4. TREATED WASTEWATER

The common use of treated wastewater in the perspective covered by the Strategy is considered unreasonable. On the other hand, the use of treated wastewater by MWIK (Municipal Water and Sewerage Company) in wastewater treatment plants is considered highly justified and supported by examples from other facilities in Poland. The unit is well prepared for this and implementations are already planned. The expected effect should be a significant decrease in the proportion of tap water used as process water in the Fordon and Kapuscinski WWTP, which are gradually being prepared to implement appropriate projects.

11. STRATEGIC OBJECTIVES

11.1. Summary of objectives and activities.

The diagram below presents the objectives and activities defined in the Strategy. There are 4 main objectives and 16 activities. Their identification was based on the diagnosis and results of public consultations, consultations with stakeholders and the commissioning party.



11.2. Objective. 1. Efficient and effective management of the Strategy implementation.

11.2.1. Activity 1.1 Form a task force with defined terms of reference

Activity 1.1 Establishment of a coordinating unit and a team for the implementation of the Strategy	
Strategic objective and the need from which it derives	Objective 1. Efficient and effective management of the implementation of the Strategy. Effective implementation of the Strategy requires not only knowledge, but also **a specific organizational and legal framework and financial resources** for the implementation of particular activities. The current activities, although undertaken by different units, are not yet coordinated and supported in a coherent manner, and the units implementing them, despite attempts at joint activities, encounter organizational difficulties. There are problems with the transfer of information, the use of the effects of work already achieved, tasks are duplicated or not undertaken. As a result, despite significant efforts of individuals or units, the effects achieved are smaller than expected.
Description of activity	Thanks to the participatory formula of the CWC project implementation as well as the process of developing the Urban Adaptation Plan, it was possible to create a team that can be involved in further activities related to the implementation of the Strategy. This team can be naturally formed by the people involved in the creation of the Strategy from the WZR and

	implementing development and investment projects in MWIK, promotion teams of both these units. However, it is necessary to involve more strongly specialists from MPU, Road Authority, as well as educational units in the region.
Expected outcome	A cohesive 10–15-person task force that has a good understanding of the goals of the Strategy and is ready to implement it through the activities of their parent units.
Implementing entity	A unit designated by the Mayor.
Other entities/partners involved in the implementation	MWIK, MPU, Road Authority, Bydgoszcz University of Science and Technology and representatives of educational units.
Estimated time of completion	2022
Estimated cost and resources	3-4 key figures to coordinate the formation of a 15-person team. No additional external costs.
Measurable indicator	**Quarterly work team meetings** taking specific activities identified in the Strategy, regular multi-directional communication via email between meetings.

11.2.2. Activity 1.2 Review and ongoing monitoring of funding sources with information to City Authorities and MWIK Company

Activity 1.2 Review and ongoing monitoring of funding sources with information to City Authorities and MWIK Company	
Strategic objective and the need from which it derives	Objective 1: Effective and efficient management of the implementation of the Strategy. A large part of investment activities in the area of infrastructure, but also those related to promotion and dissemination of knowledge and stimulation of proper behaviours of the inhabitants is based on **financing from external sources**. It will also be no different in activities related to adaptation to climate change and increasing the resilience of cities. **Permanent observation of the situation and trends should enable Bydgoszcz to prepare early to apply for and absorb those funds.**
Description of activity	The activity includes maintaining current contact with governmental entities, NFOŚiGW (National Fund for Environmental Protection and Water Management) and the Ministry of Climate and Environment, current reading of documents published on the Internet, analysis of guidelines and indications related to the implementation of the Green Deal in Europe, the

	new financial perspective including not only EU but also Norwegian and Swiss funds, the FENIKS (European Climate, Infrastructure and Environment Executive Agency) initiative, but also establishing relations with financial institutions, NGOs, scientific entities capable of obtaining funds for the implementation of the Strategy. Monitored sources of information: European Commission, NFOŚiGW, Ministry of Climate and Environment, EIB, BOŚ, BGK, Polish Development Fund. **Thanks to active monitoring it will be possible to prepare short notes or reports for the City Council and policymakers of relevant units with the description of possible financing sources and stimulation of City Hall activities.**
Expected outcome	Policymakers and relevant officials informed of funding opportunities in time to be well prepared to apply for and implement specific projects.
Implementing entity	A unit designated by the Mayor.
Other entities/partners involved in the implementation	WF, WZR, MWIK, NGOs, Bydgoszcz University of Science and Technology.
Estimated time of completion	Ongoing activity, implemented quarterly throughout the duration of the Strategy.
Estimated cost and resources	2-3 key team members to coordinate and prepare quarterly notes, based on information from various sources. Time dimension: approximately 2 days of work per quarter. No additional external costs.
Measurable indicator	Quarterly notes sent to elected policymakers and officials.

11.2.3. Activity 1.3 Evaluation of future EU regulations and presentation of conclusions in the form of a report to the City Government and MWIK.

Activity 1.3 Evaluation of future EU regulations and presentation of conclusions in the form of a report to the City Government and MWIK.	
Strategic objective and the need from which it derives	Objective 1: Effective and efficient management of the implementation of the Strategy. Changing European policies caused by the desire to reduce negative impacts on the climate requires regular monitoring of the directions in which the EU regulations will go.
Description of activity	**Ongoing monitoring of the direction of EU regulations.**

Expected outcome	**Early identification of trends** will enable the City to be well prepared for upcoming changes.
Implementing entity	A unit designated by the Mayor.
Other entities/partners involved in the implementation	MWIK, the Chamber of Commerce Polish Waterworks based in Bydgoszcz, MEPs from the region, the Chamber of Commerce Polish Waterworks.
Estimated time of completion	Ongoing activity, implemented throughout the duration of the Strategy, every six months.
Estimated cost and resources	2-3 key team members to coordinate and prepare quarterly notes, based on information from various sources. Time dimension: approximately 4 days of work in total every six months. No other external costs.
Measurable indicator	**Semi-annual notes** sent to elected policymakers and officials.

11.2.4. Activity 1.4 Strengthening task force competencies through transfer of know-how from more advanced scientific and urban centres to the task force

Activity 1.4 Strengthening task force competencies through transfer of know-how from more advanced scientific and urban centres to the task force	
Strategic objective and the need from which it derives	Objective 1: Effective and efficient management of the implementation of the Strategy.
Description of activity	This **activity covers further know-how transfer from scientific and consulting units to the task force as part of experience exchange, workshops, study visits and implementation of projects in cooperation between units in Poland, but also projects with foreign partners.** The activity also includes **the transfer of knowledge from MWIK to City Hall units and vice versa**, within the framework of jointly undertaken initiatives.
Expected outcome	Increased knowledge and engagement of the task force.
Implementing entity	A unit designated by the Mayor.
Other entities/partners involved in the implementation	Project partners CWC, scientific and research institutions in Poland, MWIK, NGOs.

Estimated time of completion	Ongoing activity, implemented throughout the duration of the Strategy.
Estimated cost and resources	4000 - 10 000 PLN annually for participation in study visits, workshops and conferences. 5,000 - 10,000 PLN per year for preparation of joint projects, which will increase knowledge and involvement.
Measurable indicator	**Participation of the representatives of Bydgoszcz City Hall in 2 conferences/workshops per year.** **One specific project activity other than a conference or workshop prepared during each year of the Strategy's implementation** carried out jointly with an external partner (e.g. implementation of the pilot project, application for external funding, participation in the international project).

11.3. Objective. 2 Enhancing public awareness of the potential use of rainwater, grey water, and treated wastewater.

11.3.1. Activity 2.1 Awareness-raising activities for policymakers, officials and designers.

Activity 2.1 Awareness-raising activities for policymakers, officials and designers.	
Strategic objective and the need from which it derives	Objective 2: Increasing social awareness of the possibilities of using rainwater, grey water and treated wastewater In addition to the information and promotional activities aimed at the broader community in Bydgoszcz, it is also necessary **to raise the awareness of policymakers, officials and designers, whose influence on the activities taken in the city is much higher.** Although these activities have a similar goal as other promotional activities, they should be implemented differently because of the different target group of addressees.
Description of activity	**Promotion of professional tools, standards, procedures, guidelines** helpful in undertaking activities in the area of interest of the Strategy. **The co-organization of workshops and trainings for officials and planners**. Organization of presentations for decisionmakers. **Implementation and presentation of results of pilot projects.**
Expected outcome	Increased awareness of a specific target group: policymakers, officials and designers.
Implementing entity	A unit designated by the Mayor (Task Force).

Other entities/partners involved in the implementation	MWIK. Bydgoszcz University of Science and Technology.
Estimated time of completion	Ongoing activity, implemented throughout the duration of the Strategy.
Estimated cost and resources	Task force, 3 days every six months.
Measurable indicator	Number of undertaken and implemented initiatives oriented to this specific group of addressees. Minimum - 2 per year.

11.3.2. Activity 2.2 Long-term education of children and youth - raising awareness on climate change adaptation and biodiversity.

Activity 2.2 Long-term education of children and youth - raising awareness on climate change adaptation and biodiversity.	
Strategic objective and the need from which it derives	Objective 2: Enhancing public awareness on the possibility of using rainwater, grey water and treated wastewater. Education of children and teenagers is an important factor in shaping the behaviour not only of future generations, but also through children and young people their parents, relatives and environment.
Description of activity	This can include various specific initiatives, e.g. devoting a session to this topic during a conference (e.g. Bydgoszcz Retention 2050), mentioning specific activities and this Strategy in local TV programs, e.g. "Bydgoszcz Water", preparing specific substantive information, informing about pilot activities, stimulating discussion and exchange of information from experts to the broader local community, promoting activities resulting from the CWC project, etc. It is suggested to identify local specialists in particular units, enthusiasts and NGO activists who can participate in this activity, organizing activities, or even becoming a "face" of the undertaken activities, a kind of local authority, strongly identifying with the objectives of the Strategy. Another method of activity could be the introduction of climate change education to school and preschool education. It is also recommended to develop a long-term approach based on consistent syllabus for school and preschool education.
Expected outcome	Increasing awareness of what the closed circuit economy is in water management in general, but also increasing awareness of residents regarding activities taken by City entities and MWIK.

Implementing entity	A unit designated by the Mayor.
Other entities/partners involved in the implementation	Other stakeholders, if available, MWIK, educational units (schools, kindergartens in cooperation with the appropriate department of the City Hall responsible), Bydgoszcz University of Science and Technology, City Hall promotion office - Bank of Poland.
Estimated time of completion	Implementation throughout the duration of the Strategy.
Estimated cost and resources	Depends on specific initiatives taken.
Measurable indicator	Number of educational campaigns conducted. Minimum 1 per year.

11.3.3. Activity 2.3 Ongoing education aimed at increasing awareness of climate change and closed circuit water management.

Activity 2.3 Ongoing education aimed at increasing awareness of climate change and closed circuit water management.	
Strategic objective and the need from which it derives	Objective 2: Enhancing public awareness on the possibility of using rainwater, grey water and treated wastewater. This activity comes from the typical approach to the promotion of the idea: in addition to training, workshops, activities targeting specific groups and stakeholders, it is recommended to promote the closed circuit economy idea itself as one that fosters resilience to climate change and reduces the negative impacts of human activities on the climate.
Description of activity	The activities include all the promotional activities undertaken by the City Hall and other stakeholders: from public speeches, through including the idea of a closed circuit economy in the documents being developed, preparing materials promoting this idea, leaflets, providing information emphasizing that specific activities result precisely from the idea of a closed circuit economy.
Expected outcome	**Enhancing public understanding of the need to shut down water cycles.**
Implementing entity	A unit designated by the Mayor.
Other entities/partners involved in the implementation	Other stakeholders, depending on their level of involvement.

Estimated time of completion	Throughout the implementation of the Strategy.
Estimated cost and resources	Depends on specific initiatives undertaken.
Measurable indicator	**Number of educational campaigns conducted. Minimum 4 per year. Other initiatives will also be counted in this scope (this activity gathers all promotional initiatives of objective 2).**

11.3.4. Activity 2.4 Introduction of the topic of closed circuit economy into the promotional activities of MWIK and the City Hall

Activity 2.4 Introduction of the topic of closed circuit economy into the promotional activities of MWIK and the City Hall	
Strategic objective and the need from which it derives	Objective 2: Enhancing public awareness on the possibility of using rainwater, grey water and treated wastewater. **Currently developed promotional activities include a number of initiatives in the area of water and waste water, and rainwaters. The next natural step in promotion should be to spread knowledge about the closed circuit economy.**
Description of activity	Preparation by the PR team at MWIK of possible activities promoting closed circuit water management. Involving the Bydgoszcz City Hall team in these activities, e.g. by informing about the CWC project or joint pilot activities.
Expected outcome	**Strengthening the PR of both units. Introduce the topic of the circular economy as the next step in the development of MWIK operations.**
Implementing entity	MWIK.
Other entities/partners involved in the implementation	Promotion Office City Hall - Bank of Poland, promotion team in MWIK.
Estimated time of completion	Ongoing activity, implemented throughout the duration of the Strategy.
Estimated cost and resources	10,000 PLN Stock involvement of promotion teams.
Measurable indicator	**Number of initiatives** related to the promotion of closed circuit water management undertaken and thus promoted. Expected amount: **2 initiatives per year**.

11.4. Objective. 3. Investment pilot projects in closed circuit water management in Bydgoszcz ready for funding

11.4.1. Activity 3.1 Preparation of rainwater pilot projects in the area of green and blue infrastructure.

Activity 3.1 Preparation of rainwater pilot projects in the area of green and blue infrastructure.	
Strategic objective and the need from which it derives	Objective 3: Investment pilot projects in closed circuit water management in Bydgoszcz ready for financing. **The best way to promote proper activities is to show them in practice, on a working example**. It is therefore necessary to execute exemplary pilot projects.
Description of activity	The subject of pilot implementation of the Strategy will be **rainwater management projects for: Complex of Schools and Institutions No. 1 at 53 Stawowa Street, the youth centre at Leszczyńskiego Street and further projects of 3 schools and an animal shelter.** For the projects already prepared in terms of concepts, it is necessary to obtain financing for the investment and obtain any permits (notifications) and approvals, and then announce a tender based on the previously prepared Functional and Utility Program. As part of pilot projects, various activities described in the green and blue infrastructure catalogue are proposed, for example: • landscaping to allow water runoff into green areas, • depressurization of the terrain - increasing the amount of semi-permeable paving, • rain gardens/absorbent basins/flower meadows, • green wall/green roof, • construction of reservoir retention, • construction of an irrigation system.
Expected outcome	Projects prepared for implementation or prepared so that external funding can be applied for with a high chance of receiving external funding for construction. The activity will be considered completed when 6 locations are prepared for implementation. Expected effects included in technical projects should cover selected from the following issues: • retention and reuse of water for irrigation or infiltration purposes, assuming the use of about 40% of rainwater; • a significant increase in biodiversity through a change in management from mowed lawns to rain gardens, absorbent basins, planting of low and high greenery; • reduced heating of the terrain and the local heat island effect through the reduction of airtight areas; • improved landscape quality in the school surroundings;

	• increased involvement of the local community - participation of parents, teachers, residents and children; • reducing neglected and degraded areas, improving the quality of the surroundings which affects well-being and health; • improved comfort of children and parents in the school area; • education and promotion of circular economy among inhabitants and local community, and through the promotion of the pilot project also among officials, designers and policymakers.
Implementing entity	A unit designated by the Mayor.
Other entities/partners involved in the implementation	Relevant City Hall units responsible for investments; Principals and Parents Council of School Complex no. 1 and other schools, management of other facilities.
Estimated time of completion	By the end of the new financial perspective 2021-2027, which is related to the necessity of obtaining financing for this investment.
Estimated cost and resources	The cost of preparing the projects is estimated at around 85 000 PLN net.
Measurable indicator	**Completion and settlement of the investment according to the created concept.**

11.4.2. Activity 3.2 Preparation of implementation and piloting of the use of treated wastewater at the wastewater treatment plant and consideration of its use for industrial purposes.

Activity 3.2 Preparation of implementation and piloting of the use of treated wastewater at the wastewater treatment plant and consideration of its use for industrial purposes.	
Strategic objective and the need from which it derives	Objective 3: Investment pilot projects in closed circuit water management in Bydgoszcz ready for financing. **Treated wastewater are not yet used in Bydgoszcz**. Their use at the treatment site is reasonable. However, for this to be possible, changes need to be made to the treatment plant.
Description of activity	The activity covers **the preparation of a concept and feasibility** and economic viability analysis for the introduction of **the use of treated wastewater in the treatment plant**, e.g. for rinsing of sludge management facilities, washing of chemical dilution facilities, etc. Implementation is not covered by the Strategy; it goes beyond the framework currently covered by it.

	In the first step the activity will concern Fordon WWTP. As alternative solutions especially for Kapuściska WWTP, the use of treated wastewater for hydrogen hydrolysis or for industry which could be located after the reclamation of former Zachem areas could be considered.
Expected outcome	Reduction of tap water consumption and tangible savings, currently difficult to estimate. This is why it is necessary to undertake pilot activities and start implementation work. In the perspective of this Strategy, the goal is to start implementing the project at the treatment plant site by taking concrete investment activities.
Implementing entity	MWIK.
Other entities/partners involved in the implementation	N/a.
Estimated time of completion	2026 - preparation of implementation. 2027 - implementation at Fordon WWTP (implementation itself is not included in the activity).
Estimated cost and resources	MWIK technology team, investment preparation team, external fundraising specialist, WWTP management.
Measurable indicator	Preparation of implementation concept - concept document. Preparation of feasibility analysis - feasibility analysis. Commencement of works at the treatment plant site - entry into the field of the works contractor.

11.4.3. Activity 3.3 Preparation of a pilot project for the use of grey water in a public facility.

Activity 3.3 Preparation of a pilot project for the use of grey water in a public facility.	
Strategic objective and the need from which it derives	Objective 3: Investment pilot projects in closed circuit water management in Bydgoszcz ready for financing. **Currently, there are no known examples in Bydgoszcz of using grey water** in public facilities (public buildings). Carrying out such an activity will allow for the assessment of the effects and obtained benefits as well as it will have a high educational and research value, also for the City Hall's clerical staff.

Description of activity	The activity includes: • analysis of available technologies and potential for grey water use, • facility selection, • preparation of a concept, • preparation of a feasibility study, • design, obtaining approvals and permits, • preparation of grant applications (it is assumed that a grant will be obtained for project implementation). Construction/reconstruction of installations in a public facility is not included in the Strategy.
Expected outcome	**One example of a public facility using grey water prepared for implementation**. The result should also be the development of an optimal path for the implementation of such a project based on the analysis of available technologies.
Implementing entity	A unit designated by the Mayor.
Other entities/partners involved in the implementation	The direct head of the public facility. City Hall units responsible for preparing engineering designs.
Estimated time of completion	2027
Estimated cost and resources	It is estimated that the project preparation should not exceed, depending on the scale and complexity, 10-20% of the expected investment. Estimated project cost 60 000 PLN net.
Measurable indicator	**Completed design with permits for construction/reconstruction of utilities in a public facility.**

11.5. Objective. 4 Increase onsite rainwater development.

11.5.1. Activity 4.1 Utilize potential sites for rainwater drainage directly to landscaped areas from sealed areas.

Activity 4.1 Utilize potential sites for rainwater drainage directly to landscaped areas from sealed areas.	
Strategic objective and the need from which it derives	Objective 4: Increase onsite rainwater development. MWIK in Bydgoszcz commissioned the development of the Green-Blue Infrastructure Catalogue. Its first part identifies the potential for direct introduction of rainwater into the ground and its soaking in green areas. An assessment was made on a macro scale of the entire city, indicating that even at a high rate of implementation of these activities, the progress of urbanization, and therefore sealing the city is difficult to balance. Documents related to the implementation of investments in rainwater drainage in Bydgoszcz strongly emphasize the need for parallel activities to reduce the degree of sealing of the city surface and the management of water in the place where it with rain falls to the ground. Only the surplus of water in the case of heavy or prolonged rainfall should be either collected or discharged into the rainwater system.
Description of activity	**The activity should focus on creating, in cooperation between the City and MWIK, an effective mechanism for identifying and implementing solutions in which rainwater, e.g. from a sidewalk or roof, can be discharged to the area without the need to concentrate the runoff, and therefore without the need to perform costly design concepts or obtain water permits.** **Maintaining a database of implementations and their promotion.**
Expected outcome	Promoting the in-situ management of precipitation without its discharge into the already overloaded rainwater drainage network. Reducing the issuance of technical conditions for connection to the network in places where this connection is not necessary. Reducing the costs of rainwater management.
Implementing entity	MWIK, a unit designated by the Mayor.
Other entities/partners involved in the implementation	Non-governmental organizations - NGOs, MPUs, housing associations.
Estimated time of completion	Development of method of activity and collaboration: first half of 2022. Analysis and selection of first 10 sites: second half of 2022. Implementation of 10 deployments: 2023. Then continuous activity implemented throughout the duration of the Strategy, combined with promotion and monitoring of impacts.

Estimated cost and resources	Task force of the Department of Integrated Development and Environment and two people from MWIK. The cost of implementation of particular 10 sites should not be higher than 20 thousand PLN per site.
Measurable indicator	**Number of projects implemented: 10 by the end of 2023; then 10 in each year of the Strategy.**

11.5.2. Activity 4.2 Creation of an interactive "map of green and blue infrastructure projects."

Activity 4.2 Creation of an interactive "map of green and blue infrastructure projects."	
Strategic objective and the need from which it derives	Objective 4: Increase onsite rainwater development. For several years, Bydgoszcz has been working to increase the share of green-blue infrastructure in the city. The publication of a catalogue of green-blue infrastructure, promotional and pilot activities should result in an intensive increase in the share of these solutions in the coming years. For this, it is necessary to promote them and take specific activities.
Description of activity	**Creation of an interactive map of green and blue infrastructure/retention map of Bydgoszcz, which would present locations, photos and descriptions of various implementations. The map is intended to be interactive - it would allow residents to add new objects on their own, which entries would be moderated or approved by the map administrator.**
Expected outcome	**Promotion and increase of knowledge about this type of solutions among residents.**
Implementing entity	MWIK, a unit designated by the Mayor.
Other entities/partners involved in the implementation	Promotion Department, Building Administration Department.
Estimated time of completion	Development of an interactive map: 2022 Subsequently, a continuous activity implemented throughout the duration of the Strategy, combined with promotion and monitoring of effects.
Estimated cost and resources	20,000 PLN

Measurable indicator	**Number of deployments presented in the interactive map:** **2022: 15** **2023: 45** **2024: 100** **2025: 250** **At least 50% increase year-on-year in subsequent years.** **At the beginning and end of the period, surveys to assess the change in residents' awareness of green and blue infrastructure.**

11.5.3. Activity 4.3 Disseminate the use of tools to encourage the creation of backyard retention and the Bydgoszcz retention map.

Activity 4.3 Disseminate the use of tools to encourage the creation of backyard retention and the Bydgoszcz retention map.	
Strategic objective and the need from which it derives	Objective 4: Increase onsite rainwater development. To enable and increase the number of implementations, good examples and pilot implementations are needed, but also practical **tools to help e.g. calculate the required retention capacity, sets of good practices, sectoral design guidelines.** Successful transformation of a city into a "sponge city" requires dissemination of the use of green-blue solutions for rainwater management, which, in turn, is difficult due to the lack of skills and knowledge of designers and investors regarding calculation methods and selection of specific volumes or solutions. **The activity can also increase the level of use of national funds in Bydgoszcz, e.g. from the program "My Water".**
Description of activity	Linking the retention map/green-blue infrastructure map with active tools for selecting solutions that make it easier for residents to calculate and select devices or tanks and, for example, to obtain funding for the construction of rain gardens. Solutions of this type are implemented by MWIK, therefore **their use should be popularized and linked with other already existing tools, and they should be promoted as part of promotional campaigns (e.g. through the website and the "Rain is a profit" campaign, the "Bydgoszcz Water" program, etc.).**
Expected outcome	Dissemination of the use of green-blue infrastructure solutions. Spike in implementations.
Implementing entity	MWIK, a unit designated by the Mayor.

Other entities/partners involved in the implementation	Promotion Department, Building Administration Department.
Estimated time of completion	Linkage of tools: 2022. Subsequently, continuous activity implemented throughout the duration of the Strategy, combined with promotion and monitoring of effects.
Estimated cost and resources	10,000 - 25,000 PLN per year for dissemination of tools.
Measurable indicator	250 separate users of the selection tools who introduced information on the green-blue infrastructure map within 5 years.

11.5.4 Activity 4.4 Stimulating green and blue infrastructure development through provisions in urban plans, technical conditions allowing connection to rainwater systems, released administrative decisions

Activity 4.4 Stimulating green and blue infrastructure development through provisions in urban plans, technical conditions allowing connection to rainwater systems, released administrative decisions	
Strategic objective and need from which it stems	Objective 4. Increasing rainwater management in the rainfall locations It is necessary to strengthen and the already undertaken actions and to harmonize the approach whereby construction of green and blue infrastructure objects by investors is expected in a formal manner.
Activity description	Increasing pressure upon formal arrangements and upon the issuance of conditions for investors for the connection to the drainage and retention system (open and closed sewage system) and while elaborating projects realized by the City as well as while preparing Urban Plans. Preparing relevant typical provisions to functional-usable programmes, tenders etc.
Expected effect	Set of homogenous formal requirements and common, coherent approach of organizational units in Bydgoszcz.
Unit responsible for implementation	Unit indicated by the City President as coordinating actions of the remaining units.
Other units/partners engaged in the implementation	Departments of the City Hall, above all, Department of Construction Administration, WGK, WZR as well as MWIK, MPU, road administration (urban and poviat).
Planned completion time	2023

Estimated cost and resources	Approx. 20,000 PLN for external industry consultations In total approx. 30 days of work of two persons from the task force.
Measurable indicator	Units defined as key for the task have approved requirements/guidelines/procedures of action in order to increase pressure on the green and blue infrastructure.

11.5.5. Activity 4.5 Creating a catalogue of good practices for individual departments or urban units

Activity 4.5 Creating a catalogue of good practices for individual departments of the city	
Strategic objective and need from which it stems	Objective 4. Increasing rainwater management in the rainfall locations Necessity to translate inspirations from the catalogue of green and blue infrastructure into the practice of actions carried out by clerks and designers and investors. Lack of this type of guidelines in Poland.
Activity description	Preparing guidelines of good practices for individual City departments based on the review of foreign projects and those realized in Poland. Specific practical guidelines both organizational as well as technical.
Expected effect	Ready guidelines and through them, realized specific investments.
Unit responsible for implementation	Unit indicated by the City President.
Other units/partners engaged in the implementation	Departments of the City Hall, above all, Department of Construction Administration, WGK, WZR, City Investments Department as well as MWIK, MPU, road administration (urban and poviat).
Planned completion time	2023
Estimated cost and resources	Approx. 50,000 PLN for realizing the guidelines.
Measurable indicator	Catalogue of good practices

12. Monitoriing, reporting and evaluating

Impact of the Strategy should cover possibly the broadest group of stakeholders. Task force should inform about the progress in its implementation as well as stakeholders remaining outside the group of partners who realize specific actions but may use the transfer of knowledge and experience. Obtaining

and coordinated distribution of information between the stakeholders will enable them also to participate in the realization of the Strategy and a broader promotion of the undertaken actions.

In order to achieve the above, it is necessary to elaborate the principles of monitoring and reporting progress in realizing the Strategy with regards to the stakeholders by the task force.

At the current stage it is assumed that the information will be passed onto the stakeholders every half a year in the form of communication via email with an attachment (graphic, descriptive or/and voice recording/video), in the possibly easy and friendly form according to the specified scheme.

At the same time, the task force, through the unit indicated by the City President, and responsible for realization of the Strategy would report not less frequently than once a year to the city authorities the progress of works related to the realization of individual tasks. The form of this monitoring and reporting ought to comply with the procedures already implemented in the City.

Evaluation and potentially formulating the plans designated to correct the implementation (reparatory plans) ought to be performed after 2 years from adopting the Strategy. Application of expert evaluation is suggested while at the same time connecting specific effects with individual tasks.

In 2027, a comprehensive evaluation of Strategy realization results should be carried out. Apart from the evaluation of effects of undertaken actions, one should also draw reference to the situation of Bydgoszcz within each of the three areas:

- rainwater,
- use of grey water,
- use of treated wastewater.

The evaluation should also draw reference to the European trends and regulations stimulating water economy growth in a closed circulation identified by the task force.

13.1. Possibility of establishing broader cooperation in the scope of BTOF in the future and impact of the Strategy on the area linked to the city

13.1. Introduction

Specific plan of actions and set of goals should concern the area Strategy of Bydgoszcz itself. It seems reasonable however to consider a larger area that depends on the city and notice at this stage the broader context of the document while implementing specific actions in the area of the city itself. It is also crucial on account of participation of the stakeholders from the BTOF area while formulating the Strategy vision and the discussion regarding its objectives.

Potential directions towards which the initiatives extending beyond the Bydgoszcz area are leading, addressed to the stakeholders from the city area, which are also beneficial for the inhabitants of Bydgoszcz itself have been presented below.

13.2. Increasing retention and use of rainwater in extra-urban areas

- **Increase of plantings in mid-field zones "field margins" or along water courses.** This initiative is targeted at forming buffer zones and habitats along the watercourses and trenches which positively impacts the level of ground waters, temperature of water in a watercourse and

limiting the inflow of organic compounds from fertilization of fields. It is also recommended to increase participation of ventures in the scope of agroforestry as beneficially impacting water hydrological ratio in the city surroundings and stimulating the increase of attractiveness of leisure and pastime areas. It is all the more important when the Kujawsko-Pomorskie region is one of the most exposed to droughts regions of Poland.

- **Retention of rainwater in areas of large containment.** In the first order it is important to verify whether sealed large terrains have an ensured retention of rainwaters. There is no such knowledge at this point in time and the initiative strongly depends on the awareness of municipal authorities. Based on the identification of sealed areas one may subsequently define the conditions of water discharge for those areas and the existence or lack of retention. In case of lack of retention or detention (delays in water outflow) it is worth to make an effort to cooperate with owners and to direct them towards retention through increasing awareness, discussions with decision-makers, creating positive climate and underlining responsibility for the common good. One may consider also the conduct of surveying among owners in order to identify the obstacles in implementing sustainable wastewater economy. The initiative ought to be targeted at an increase in awareness of its addressees but also factual decreasing of water outflow through implementing actions while directing them towards such units as GDDKiA, poviat road management units, churches/religious associations, networks of large stores, municipal offices, industry, private persons.
- **Promotional and educational actions oriented towards extra-urban areas.** This initiative is targeted at promoting the PR actions conducted in the cities within the whole agglomeration. Its assumption would be the cooperation with the neighbouring municipalities, trainings, passing over of materials, sharing experiences and good practices. This will result in an increase in awareness and tightening of cooperation within the BTOF area through joint initiatives oriented towards economy in a closed-area as well as care for water, undertaken together with public authorities of the neighbouring municipalities, the university, schools or waterworks companies of the neighbouring municipalities.

13.3. Improvemnt of the quality of environment, education and promotion contributing to the implementation of objectives of the Framwork Water Directive

- **Stimulating an increase of infiltration areas and waterlogged areas.** The initiative would cover identification of swamps and wetlogged areas and subsequently undertaking actions targeted at their protection, supply and even increase of their areas. Subsequent steps would cover: identifying persons managing these areas, specifying possible common actions, establishing cooperation, common initiatives. This initiative may be jointly undertaken by PGW Wody Polskie.
- **Strengthening natural protection of areas against dependant waters.** This initiative might cover identification of areas from dependant waters and conclusions concerning indications of maintaining or improving the state of relevant JCWP (homogenous surface water body) as well as specifying the possible conscious actions targeted at protection of areas against dependant waters. The activity is not targeted at substituting the units designated for it but rather at raising awareness about how important the task is for the whole BTOF area and potentially elaborating common actions with PGW Wody Polskie or ones that may supplement actions of this organization on the side of the local territorial government.

Promotion and education in the scope of objectives of the Framework Water Directive, climate changes and issues of biodiversity. In the area of promotion and education it is crucial to present good examples of implemented actions. The initiative could cover identifying pilot projects that may be implemented in this scope through a sample transfer of know-how based on examples from abroad, similar to actions undertaken in the course of exchanging experiences as part of the CWC project. Mutual promotional initiatives of municipalities from the area of Bydgoszcz should strive to increase the awareness of the basic issues such as climate changes, objectives of the Framework Water Directive, biodiversity in a broad scope.