Interreg Danube Region

Co-funded by the European Union

SpongeCity

SPONGECITY

Best practice catalogue

	Best practice catalogue of ecosystem-based approaches D.1.3.3 – version 1
	PP responsible for coordination/collection: PP2 - KC VODE
	Finalised by 10 partners in period 1 Missing practices: PP8 (PMC), PP6(UCM)

Content

Preface

The catalogue was created in the SpongeCity project, financed by the Interreg Danube Region Programme. The partners of the cooperation have set the target of promoting successful rainwater harvesting solutions to decrease the damage caused by urban flash floods. Danube Region is affected by natural disasters resulting from climate change, increasing the intensity and frequency of heat waves, droughts, fire incidents, and heavy rainfalls with flash floods on local level. Since 75% of the region's population lives in cities, these anomalies put the citizens at particular risk. Local community leaders must be prepared for these weather anomalies. Urban water management have so far mainly followed traditional approaches, including large-scale grey infrastructure investments, lacking innovation and the exploitation of ecosystem services. Their social acceptance is usually hindered as citizens are not involved in design and testing. Settlements have different micro-climatic, infrastructural, financial, legal and social backgrounds in DR, but they all need support in forecasting local climate risks and identifying effective interventions.

Transnational cooperation is needed for this knowledge exchange and for mainstreaming the conclusions to macroregional level. The cross-sectoral partnership aims to spread the Sponge City concept in DR to answer these challenges. A sponge city is an urban area which has been designed to cope with excess rainfall using a variety of techniques. It mitigates/prevents urban floods by providing the area with the ability to naturally absorb the water. It reduces the extent of impermeable surfaces and increases the amount of absorbent land: green surfaces, green walls, bioswales, inner-city lakes, rain gardens, permeable pavements. Supplementing this approach with channelling and storage systems also helps to counter water shortages. The project analyses the hydroclimatic characteristics and water management practices of 12 pilot settlements, sets up a toolbox to support the planning of sponge city measures, tests and promotes the tools by participative elaboration of local action plans, feasibility studies and demonstration investments. Partners mainstream the results to national and EU level.

The current document presents those practices, which can be recommended for other municipalities as a part of their SpongeCity programs. The catalogue describes the technologies, introduces the locations, presents the efficiency of the practices and provides contacts for interested cities.

Practice from Hungary

Stockholm system (Stockholm tree pits)

The method was developed by the City of Stockholm to address the challenges of green infrastructure as well as stormwater management of urban environment. Integrated into the urban structure, the alternative underground system simultaneously provides stable base layer for surface pavements for also heavier traffic loads, offers long-term stability and extensive space for tree roots with adequate room to growth. The system can mitigate runoff from a catchment area 10-20 times of surface area of the system.

The base of Stockholm system is structural soil consists of medium to large (22/90-100/150 mm) stone aggregates and soil substrate including biochair and humus compost.

Prepared by: Város-Teampannon Kft.

Location 1: Arany János Street, 1051-Budapest, Hungary (Stockholm system)

Investor: Belváros-Lipótváros Önkormányzata (Budapest, Vth district Municipality)

Funding source: Municipality budget

Type on investment: Trees planted with Stockholm system in an urban paved environment

Year of investment: 2022

Contact

Name: Szőllősi Gábor

Position: Chief Executive Officer

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Description

Due to the poorly drained, oxygen-poor soil and the root zone constrained by utilities, the possibility of tree planting is limited, which is addressed by the Stockholm tree planting method. In 2022, the renovation of Arany János Street took place, including pavement replacement. Trees were planted by Stockholm method, tree pit was filled with structural soil consisting of larger fraction stones, mixed with biochar and compost. The special layering system allows for higher traffic loads and can accomodate water from the sidewalks and parking areas. The controlled water supply and gas exchange for the trees are ensured by the built-in aeration shafts and the drainage layer.

The is applied as a street-level solution, where the structural soil continues beneath the roadway, and stormwater management is implemented in a complex manner, addressing all precipitation of the catchment area. As part of this, permeable paving, rain gardens, and direct water inlet are used depending on the location. The stormwater infiltrated under the street helps with retention, and its temporary storage can further mitigate the heat island effect and reduce the load on the public sewage system.

Location 2: Bakáts Square, 1091-Budapest, Hungary (Stockholm system)

Prepared by: Garten Stúdió Kft.

Investor: Ferencváros Önkormányzata (Budapest, IX. district municipality)

Funding source: Municipality budget

Type on investment: Trees planted with Stockholm system in an urban paved environment

Year of investment: 2021

Contact

Name: Szőllősi Gábor

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Description

Bakáts Square project: total of 1,730 m² of green space. Using the Stockholm Tree Planting Method (Stockholm System), new trees were planted and existing trees were also rehabilitated using the Stockholm method. A total of 740 m³ of structural soil ensures the trees' growth environment, while also accommodating 222 m³ of stormwater runoff from a catchment area of 2,490 m².

In relation to Stockholm technology, other features include recessed curbs, swales, and permeable pavements to facilitate stormwater flow. The trees were planted in a mix of paved areas and open soil beds with shrubs and perennials. In the open beds, a planting medium containing crushed brick, resistant to compaction and silting, was used to improve water infiltration.

Location 3: Csengery Street, 1061-Budapest, Hungary (1/c Csengery utca – Stockholm tree pits)

Prepared by: BFVT Kft.

Investor: Terézváros Önkormányzat (Budapest, VI th district municipality)

Funding source: Municipality budget

Type on investment: Trees planted with Stockholm system in an urban paved environment

Year of investment: 2024

Contact

Name: Szőllősi Gábor

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Description

Csengery street project also constructed by using Stockholm method. The street was fully renovated with extended tree pits as stormwater runoff mitigation solution accommodating the rainwater from roofs.

Practice from Croatia

Prepared by: KCVODE, PP2

Location 1: The City of Pula, 10 city locations (The King's Tomislav Square, Nazorova street, Lošinjska street, Pula City Mall, Šijan crossroad circle ...), Croatia

Investor: The City of Pula

Type on investment: Public investment focused on climate changes adoption

Year of investment: 2007 - 2023

Type of green infrastructure: rain gardens, underground retentions, separated drainage, pavements, porous concrete and asphalt.

Contact: info@pula.hr

Description

The city of Pula, through the project CREATE - "Climate REsponses for the AdriaTic rEgion" funded by the Interreg programme Italy-Croatia, received the main prize Adriatic Adaptation Award for an example of GP (good practice) for the design and implementation of rain gardens, i.e. natural infiltration systems that protect against flooding using natural structures such as gardens. The purpose of 'rain gardens' is to minimise the amount of rainwater by retaining it on green areas and, after treatment, further infiltrating the terrain. This was achieved by applying NBS (nature-based solutions) stormwater drainage systems. NBS drainage systems have been selected for their adaptation to climate change, multiple financial and economic impacts and socially acceptable solutions in line with environmental protection and biodiversity enhancement.

Rain gardens are designed for a maximum area of 10 per cent of the total basin area. For example, for 1,000 square meters of road, a rain garden is about 100 square meters that can always be placed alongside a road, park or other green space. Rain gardens act as natural filtration systems, removing pollutants and sediments from stormwater. This reduces the amount of pollutants

entering local water bodies and protects aquatic ecosystems. By allowing rainwater to infiltrate the soil, rain gardens also contribute to the restoration of groundwater, thereby maintaining the long-term availability of water. It also increases the visual appeal as it involves the inclusion of green spaces and vegetation that contribute to urban greening and create a pleasant environment for residents and visitors. In Croatia, the responsibility for managing urban waste water currently lies with local authorities, cities or municipalities. The same problems arise systematically - inadequate drainage infrastructure, poor management of floodplains and disregard for their natural functions in urban planning. Giving priority to these activities can greatly help mitigate the risk of flooding in regions and ensure more efficient management of stormwater.

A concrete example is the King Tomislav Square in Pula, where citizens will testify that just a few years ago it looked like a parking lot prone to flooding with every heavy rain. Thanks to the rain garden project, we can say that Pula falls into the category of sponge cities. The circular streams are no longer just ordinary circular streams, they are actually sponges, as are the large number of green oases that are found throughout the city and there are at least 10.

The King's Tomislav Square on Verudela, Pula, Rain garden

Šijan crossroad circle

Šijan crossroad circle

Prepared by: KCVODE, PP2

Location 2: Park Vruljica, Zadar and Ploča, Biograd na moru, Croatia

Investor: Zadar County

Funding source: STREAM project

Type on investment: rain garden

Year of investment: 2020. – 2023.

Contact: zadra@zadra.hr

Description

Rain gardens at Park Vruljica, Zadar and Savska street, Biograd na moru are results of the Strategic Flood Management Development project STREAM. Modern, green solutions are crucial in the fight against urban floods, especially in light of climate change. The STRAEM project allowed the construction of pilot solutions for intelligent drainage systems such as rain gardens that seek to avoid catastrophic scenarios in the future. The construction and decoration of the Vruljica rain garden amounted to €176.000. Before the construction and equipment of the rain garden, the torrential rainwater from the parking platform was poured into the kindergarten entrance and the transit pedestrian path, causing erosion and devastation of the existing road.

Result

After the works, rainwater from the gravitational collection is directed to the oil separator through grilles and pipes and then poured onto the ground, through the drainage layers of the system, in the form of a rain garden.

Rain gardens and a smart drainage system installed in the garden of a school in Zadar

Description

This Savska street, Biograd na moru, experienced frequent floods around a decade ago. Although the problem was eventually resolved by investing a significant amount of money into stormwater management, this approach was deemed to be too costly.

Result

The construction of a rain garden smart drainage system is more economical and practical and a more environment-friendly solution.

Rain garden in Biograd Biograd na Moru, Savska street

Practice from Austria

Prepared by: Paris-Lodron University Salzburg (PLUS), PP3

Location 1: Koppl, Austria

Investor: private investments

Funding source: private sources

Type on investment: Creation of a green roof top

Year of investment: 2017

Contact

Name: Hermann Klug

Position: Assoc Prof Dr (Researcher)

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Description

Depending on the roof size, rooftops collect a lot of fast accumulating water during heavy rainfall events. Either they contribute to flooding or filling up of local drainage systems. The latter consequently spill over and contribute to flooding locally or in downstream areas. At the same time during sunshine, rooftops are local heat islands impacting humans and the environment.

Results and conclusions

With green rooftops, the underground operates as a sponge and stores water in place. This contributes to reduced water runoff and growth of vegetation; the latter having a cooling effect and thus improving micro-climatic conditions.

Prepared by: Paris-Lodron University Salzburg (PLUS)

Location 2: Koppl, Austria

Investor: Municipality

Funding source: Municipality budget

Type on investment: Creation of a retention basin

Year of investment: 200?

Contact

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Description

In hilly landscapes, heavy rainfall on clay-loamy soils contribute to fast runoff. When the geological conditions provide additional water masses from the hinterland, flooding endangers a part of the local settlement.

Results and conclusions

To provide water storage functionalities, a smaller retention basis has been created. This is a depression in front of a street able to store water coming from upslope. During dry periods this grassland area is used as a football playground used for younger and older generations

Prepared by: Paris-Lodron University Salzburg (PLUS)

Location 3: Salzburg, Austria

Investor: City Council

Funding source: City Council budget

Type on investment: Flood locks

Year of investment: ????

Contact

Name: Hermann Klug

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Description

Due to extended heavy rainfall events in the past decades, alongside the riverbanks the walls of Salzach have been topped up with concrete blocks. To ensure pedestrians and cyclists get along the riverbanks, locks in between the concrete blocks have been designed to avoid the lower lying city centre being flooded.

Results and conclusions

Due to a time-reasonable flood forecasting, “gates” could be closed with particular metal plates to prevent the city and its surrounding being flooded.

Prepared by: Paris-Lodron University Salzburg (PLUS)

Location 4: Salzburg, Austria

Investor: Salzburg AG

Funding source: Salzburg AG

Type on investment: Hydropower plant

Year of investment: 2011

Contact

Name: Hermann Klug

Position: Assoc Prof Dr (Researcher)

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Description

Water masses coming from the inner alpine area passing through Salzburg fastly accumulate and endangers the downstream cities Oberndorf (Austria) and Laufen (Germany).

Results, conclusions

To ensure water regulation and to combine it with power production a local energy distributor invested into this hydropower plant within the Salzach river. Fish steps and surroundings have been established to ensure mobility of fish and other water animals.

Practice from Czech Republic

Prepared by: Municipality Prague, PP5

Location: The meanders of Rokytka river (Meandry Rokytky (Přírodní zajímavost) • Mapy.cz)

Investor: The Prague City Council through its Department of Environmental Protection

Funding source: The budget of Prague City Council

Type on investment: A public investment focused on the restoration of natural watercourses and flood protection, falling within the scope of ecological and climate adaptation measures

Year of investment: 2014-2015

Description

Project: Meandry Rokytky (The meanders of Rokytka river)

The meanders of Rokytka are located in the area above Hořejší Pond in the Prague districts of Hloubětín and Hrdlořezy in Prague 9. The revitalization of this section took place between 2014 and 2015, initiated by the Prague City Council. The goal of the project was to restore the natural character of the Rokytka stream, which had been straightened in the past, thereby improving the landscape's ability to retain water and enhancing biodiversity.

As part of the revitalization, the Rokytka streambed was reshaped into a natural form with new meanders and widened in some areas. Floodplains were created along the stream, and its banks were planted with greenery, contributing to the creation of a nature-friendly environment. These adjustments help combat both drought and flooding, as the restored floodplain acts as an extension of the streambed, allowing water to safely spread and significantly slowing the water flow in these areas.

The project was funded through the Department of Environmental Protection of the Prague City Council, which manages the Rokytka stream. The maintenance of the stream, under the administration of Prague, is carried out by the organization "Forests of the City of Prague."

The revitalization of Rokytka above Hořejší Pond has been recognized by both the public and experts as one of the most effective measures for cooling Prague and combating drought and floods.

Tropical days are over for this year, but during the year, people may be less aware that drought still persists in Prague. Rainfall is scarce, and the soil lacks moisture. That is why it is essential to seek solutions in nature that help combat this phenomenon and tackle climate change. In addition to efforts to plant more trees in the streets of the overheated city, it is necessary to look into Prague's natural nooks and crannies and find measures that help the metropolis.

This is why the Arnika organization organized and evaluated a summer survey to determine where "Prague's most effective air conditioning" is located. The winner was the meanders of the Rokytka stream. The City of Prague Forests, which carried out the revitalization of the area in 2014–2015 at the behest of the city council, even jokingly refer to these meanders as "miraculous"—fighting not only drought but also floods.

How is this possible?

It is probably not surprising to hear that greenery cools its surroundings. This "simple" knowledge was fully utilized in the revitalization of the Rokytka. "Originally, this area featured wet meadows that were backfilled in the 1960s, and the stream's bed was straightened. However, it was not lined with concrete, which allowed us to restore the floodplain as part of the revitalization. The new channel retains more water. Because it is designed based on natural models, it alternates between deep pools and shallow fords. The pools are especially important during droughts, providing refuge for aquatic life even when water levels are low," explained Vít Hofman, a spokesperson for the city council, describing one of the functions of the Rokytka meanders.

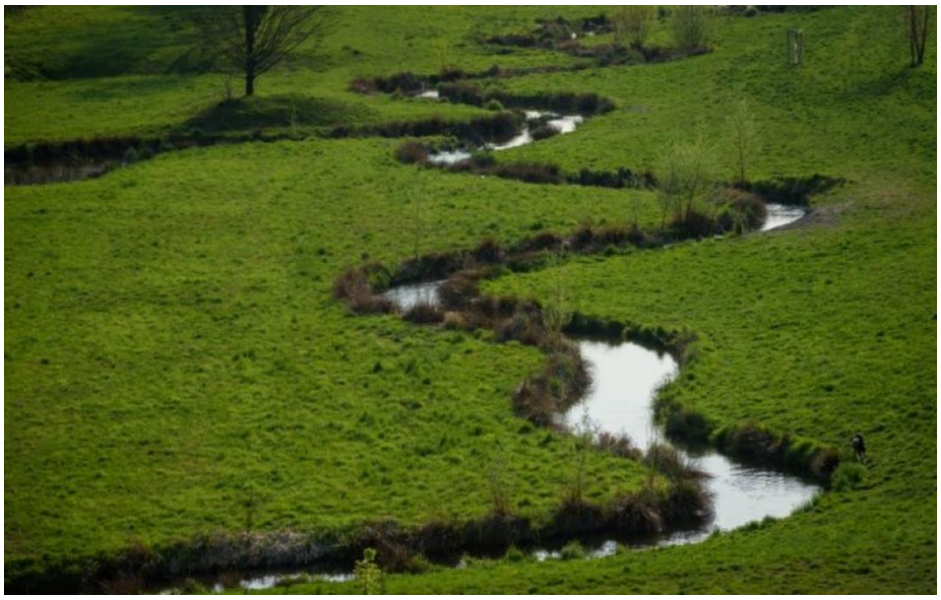
By "wavifying" the straightened bed of the Rokytka, the stream has been lengthened, allowing water to remain in the area longer. The meanders promote vegetation growth, which evaporates more water, contributing to the water cycle and cooling the surroundings.

How does it help during floods?

"In terms of flood prevention, restoring the floodplain has several benefits. The restored floodplain serves as an extension of the channel, allowing water to spread safely. The speed of the water flow significantly decreases in these areas, and the volume of water that can spread harmlessly into the floodplain is substantial," Vít Hofman explained, highlighting the advantages of such adjustments.

Similar revitalizations have taken place in Prague in Šárecké and Prokopské valleys in the past. The most recent adjustment was made to Brusnice near Patočkova Street, where water was brought back from pipes into greenery. Additionally, one of Prague's largest revitalizations is being prepared—the nearly two-kilometer-long section of the Lipanský stream.

Annex



The meanders of Rokytka river (source: Meandry Rokytky jsou podle lidí nejlepší řešení pro ochlazení Prahy - Ekolist.cz)

The meanders of Rokytka river, Source: Meandry Rokytky

Practice from Slovakia

The Green Lungs of Trnava: 12-hectare green belt in Štrky

Prepared by: University of Ss. Cyril and Methodius in Trnava

Location: outside of the municipalities build-up area, approximately: 48.399240, 17.569811

Investor: City of Trnava

Funding source: local sources and planned European funds

Type of investment: the revitalization of the forest and creation of the protective greenery of the agricultural landscape in Štrky

Year of investment: 2019 - Ongoing

Description

The project aims to revitalize and protect a natural site in the vicinity of Trnava and transform it into an ecologically and environmentally more valuable area. The project aims to create a "green lung" of the city, providing not only a recreational zone for the inhabitants but also a significant ecological contribution in the fight against air pollution reducing temperatures in urbanized areas and increasing local biodiversity.

Located on the outskirts of Trnava, the area is partly urbanised but still retains significant natural potential. The aim is to use this area to protect and develop the local flora and fauna and to ensure that the inhabitants have access to the natural environment for rest, walking and recreation.

As part of the implementation of the activities, a detailed analysis of the site was carried out, which included botanical, zoological and environmental studies to ensure as far as possible the ecological principles of the revitalisation. This survey helped to identify suitable plant species for planting and provided valuable information used to protect local biodiversity. Areas of greatest ecological potential and sites where conservation measures were needed were identified.

As part of the initial phase of revitalisation, planting of native trees and shrub species typical of the area was carried out. These tree species will help to improve air quality, provide shelter for various animal species and contribute to improving the microclimate. In the first phase of planting, in 2021, more than 200 trees with a trunk thickness of 12-14 cm were planted, mainly maples, lindens,

cherries, elms and hornbeams. The greenery planted will gradually improve the ecological stability of the agricultural landscape, slowing down soil degradation processes such as erosion, compaction and loss of organic matter. The microclimate will be mitigated, and plant and animal species will be added. In the second phase, more than 4,000 trees have been added, mainly oaks, hornbeams and maples; these are seedlings, trees that are grown from seed and are easier to root, coming from Czechia, from a location that has similar climatic and soil conditions, so they have a better chance of taking root. The surface area of the area under consideration is 119 136 m^2.

Results, and conclusions

The revitalization process of the 12-hectare forest aims to transform this area into a functional local forest ecosystem with a high level of biodiversity. Several key activities within the project have been implemented (site analysis and survey, site clearance, project documentation and the first stages of planting of native tree and shrub species that are typical of the site) and the next steps are currently underway.

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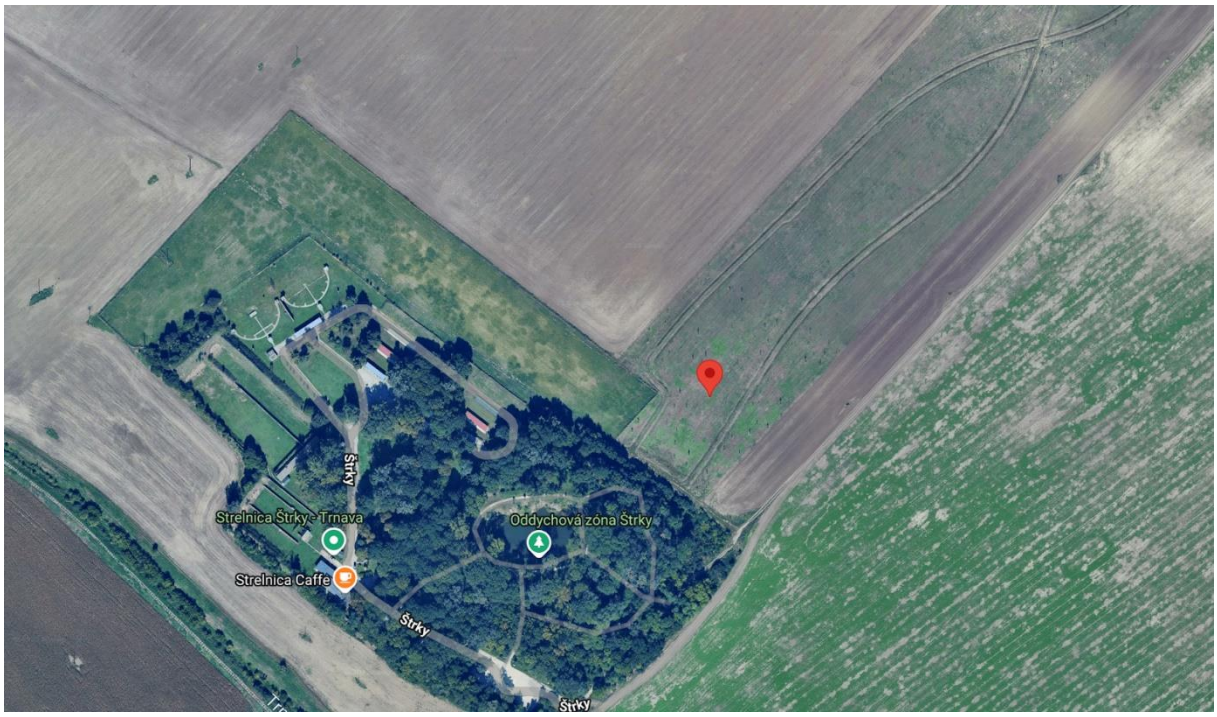
Annexes

Revitalized part of the forest after the first stage of tree planting (https://www.trnava.sk/userfiles/image/Dizajn%20bez%20n%C3%A1zvu%20(2).png)

Location of the revitalised zone (https://www.trnava.sk/userfiles/image/Dizajn%20bez%20n%C3%A1zvu%20(2).png)



The satellite map of the monitored area

The recreation zone Štrky

Prepared by: University of Ss. Cyril and Methodius in Trnava

Location: Štrky 5099, 917 01 Trnava, Slovakia (48.39967055677456, 17.572147705799253)

Investor: City of Trnava

Funding source: Interreg Central Europe (Projekt LUMAT CE89) a resource of the city of Trnava

Type on investment: protective greenery of an agricultural landscape in Štrky and recreational area

Year of investment: 2018 - 2019

Description

The area of Štrky is in outside of the municipality build-up area, on the northern side of the cadastral territory of Trnava, in the urban district of Štrky. From the western side, it is defined by

the watercourse of the Trnávka River, from the southern side by an out-of-level crossing of the outer urban road circuit of the I/51 road and an access road continuing along a dirt road, from the eastern and northern sides by a dirt road and arable land used for agricultural purposes.

The site suffered from several pressures for which it was considered a 'green brownfield': the regulation of the Trnávka River was problematic; according to the current territorial system of ecological stability, the woodland is an important local biocentre, but in the past, before regulation, the river flowed directly through it, as evidenced by the riverbed at the bottom of the terrain depression. There is a water table at a depth of about 4-5 m is the position and species composition of the nearby floodplain forest habitat with a high representation of invasive trees, up to 50%. The Trnávka watercourse is polluted by several sources and regulated by older treatment from the first half of the 20th century, but it is also an important trans-regional bio corridor that functions as a migration corridor for aquatic and water-bound animals. Other significant pressures are traffic, which forms a barrier to animal migration, and the adjacency of an industrial and warehousing zone and intensively used agricultural land, a wild landfill site.

The main objective of the LUMAT project was to respond to and contribute to solving the problems manifested by the growing negative phenomena such as land grabbing, the existence of brownfields, and the threat of climate change. The project focused on the implementation of sustainable land use strategies and was implemented in seven Central European Functional Urban Areas and includes planning strategies with innovative technologies and with the support of citizen participation. The project focused on the integration of environmental methods and tools related to land.

The creation of the Štrky recreation zone was one of the main activities of the LUMAT project funded under the Interreg Central Europe Programme. By restoring the neglected Štrky Nature Park, the City of Trnava also revitalised a biocentre of local importance, restoring its former ecological value and stability, given the fact that it had been abandoned and unmaintained for a long time. In the framework of the LUMAT project, it was transformed into a natural, safe, attractive and publicly accessible area used for sport and relaxation and contributing to climate change adaptation as an important cooling element.

As part of the revitalisation, the entire site was cleaned up, diseased, damaged and destroyed trees were removed, as well as emergent greenery. The site was prepared for the dredging of the water area, which was the focal point of the entire project investment. This created a pond with water and marsh vegetation. The area around the pond is currently richly grassed with meadow vegetation, while dozens of native tree species have been planted around the pond.

A former black waste dump has been transformed into a recreation area and has restored the landscape to its original appearance: a floodplain forest has been added to the water feature, which helps local biodiversity. The trees have been fitted with boxes for various feathered species, prepared in close cooperation with ornithologists (bat boxes and insect houses are also included).

In this way, the city of Trnava has gained a valuable green zone in close connection with residential areas. The revitalisation of the entire site has had a positive impact on the environment around the town. The planting of native vegetation will help to strengthen the ecological value of the woodland, and the construction of a pond will help to cool the town down during hot summer days.

Results, and conclusions

Through the revitalization of the defined area of the Štrky forest, the City of Trnava has ensured the complete revitalization of this biocentre of local importance The activity has restored the original ecological value and stability of this place. The revitalised site has had a positive impact on the microclimate in the Trnava urban functional area and the site has been made available for recreational, sporting and leisure activities for the public in the vicinity of the city.

At the same time, this pilot investment within the LUMAT CE89 project has provided an interesting example of greenfield revitalisation that can be beneficial, replicable and applicable in other regions of Central Europe.

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Annexes

Sketches and visualisation of water surface from Realisation Project Documentation for Building Permit (https://programme2014-20.interreg-central.eu/Content.Node/LUMAT/INVESTMENT-REPORT---TRKY-FINAL.pdf)

The visual sketch of the water surface built up within the Štrky area revitalisation. (https://programme2014-20.interreg-central.eu/Content.Node/LUMAT/INVESTMENT-REPORT---TRKY-FINAL.pdf)

Pond in the recreational area Štrky
(https://www.regiontrnava.sk/produkt/oddychova-zona-strky#)

Pond in the recreational area Štrky
(https://msmt.trnava.sk/zariadenia/oddychova-zona-strky/)

The recreational area Štrky
(https://gomoravia.cz/sk/body-zaujmu/2603-oddychova-zona-strky-trnava)

Revitalisation of the Agátka housing estate yard

Prepared by: University of Ss. Cyril and Methodius in Trnava

Location: Trnava, aproximately 8.376549, 17.595618

Investor: mesto Trnava

Funding source: Integrated regional operational programme and local sources

Type of investment: revitalisation of the housing estate courtyard to adapt to climate change

Year of investment: 2017 - 2023

Description

A participatively planned project that was created as a joint work of the city and its residents. A large safe space was created, serving as a recreation area for both children and adults. It includes play elements for children, a community garden, an artificial creek and public toilets with a green vegetated roof and a façade covered with climbing plants.

Climate change adaptation and stormwater management measures are part of the revitalisation.

The revitalization includes a 250-foot-long stream, a community garden, wooden play elements, water features, and an adult slide. The water playground features 3D and 2D play elements and a misting area, and two 3D elements will spray water or a thick water mist for refreshment during the summer months.

The central water feature is a meandering stream with a course of approximately 280 metres, flowing into a constructed pond with a water level of approximately 2.5 metres. It is a closed water cycle; its source is a well that was built in the past to irrigate the surrounding greenery. From the cascading waterfall, the flow of the stream will gradually calm down until it is just a slow-flowing stream. Its total water volume is approximately 60$m^{3,}$ and the pond, which is located in a depression in the terrain, is oversized for this volume and will thus serve as an important water retention measure. It is also capable of absorbing torrential rainfall, which can seep into the coastal greenery and gradually into the groundwater. The intention is that all rainfall water will be retained on the site and used to improve microclimatic conditions.

In the construction of the community garden, all trees in the area were retained, the garden is locked and fenced. Its main features are raised beds and raised beds for growing vegetables, herbs and small fruits. It includes its own compost heap for plant waste and a water connection with potable water for irrigation needs.

In October 2024, Trnava was the only city in Slovakia to receive the URBACT Good Practices 2024 award for the Agátka estate courtyard revitalisation project. This award is given by the URBACT Monitoring Committee to cities that have applied to the call of the EU Operational Programme URBACT IV and whose management and initiative are impressive, participative, integrated, relevant and easily applicable to other European cities.

The awarded cities will be part of the communication campaign of the Operational Programme in 2024-25 and will be the main actors of the URBACT Urban Festival, which is an opportunity to showcase their sustainable development initiatives and be an inspiration for other European cities.

Results, conclusions

The participatory project created a revitalized Agátka housing estate in Trnava, which includes a meandering stream, a community garden with raised beds, water features and play elements that

support ecological and climate adaptations, including stormwater management. Considering sustainability and improving microclimatic conditions, this project won the prestigious URBACT Good Practices 2024 award in October 2024 for its innovation and exemplary collaboration.

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Annexes

Overall revitalised area (https://planujmesto.trnava.sk/wp-content/uploads/2022/03/agatka-1.jpg)

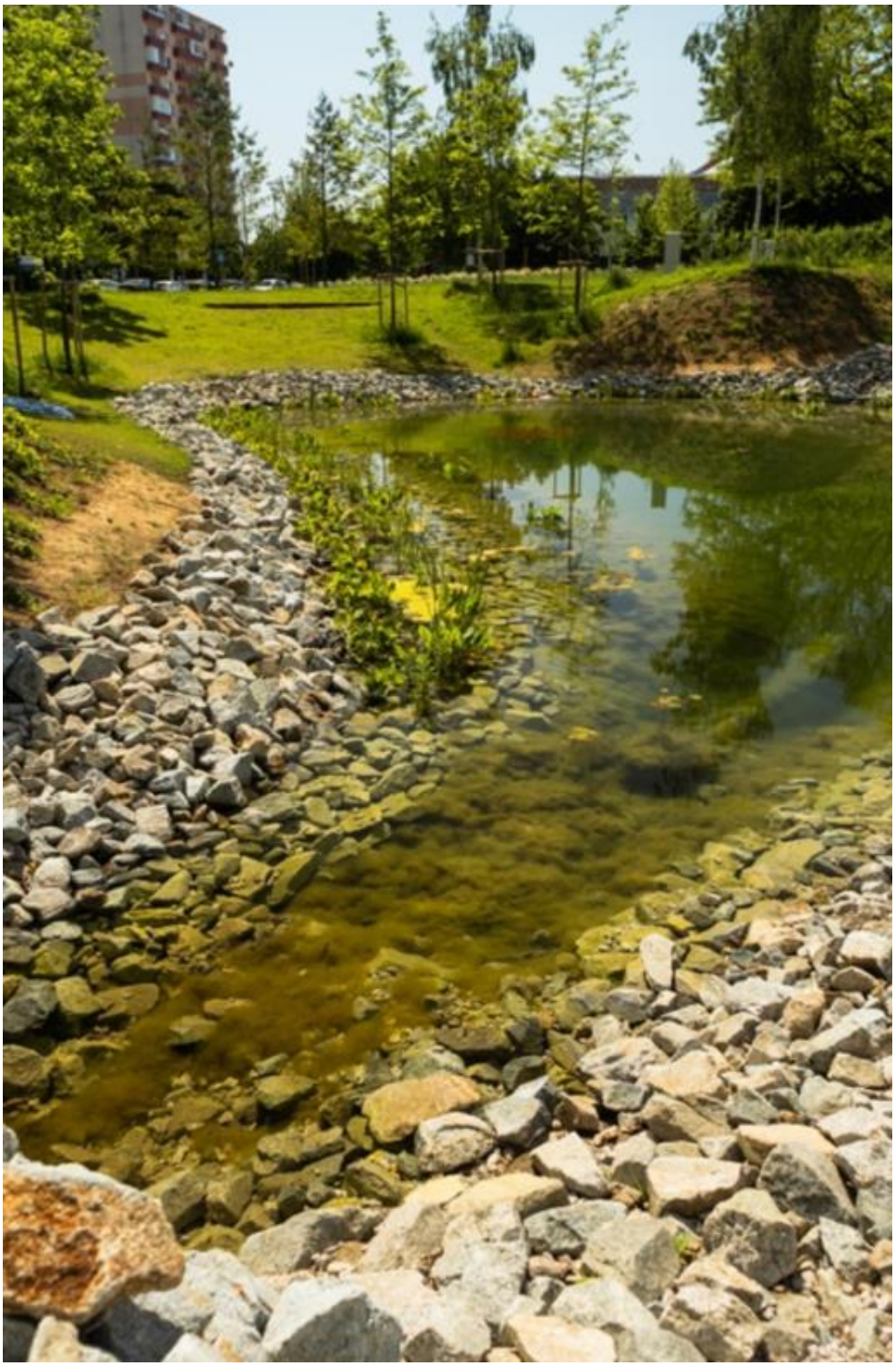
Revitalised area

https://planujmesto.trnava.sk/trnava-ako-jedine-mesto-zo-slovenska-ziskala-europske-ocenenie-urbact-good-practices-2024/

Artificial lake in the revitalised area

https://planujmesto.trnava.sk/projekt/revitalizacia-sidliskoveho-dvora-agatka/

Slow-flowing stream in the revitalised area
https://planujmesto.trnava.sk/projekt/revitalizacia-sidliskoveho-dvora-agatka/



Slow-flowing stream in the revitalised area
https://planujmesto.trnava.sk/projekt/revitalizacia-sidliskoveho-dvora-agatka/

The revitalised area
https://www.green-architecture.sk/referencie/verejne-priestory/revitalizacia-sidliskoveho-priestoru-agatka-trnava/#groupidm340-1

Practice from Bosnia and Herzegovina

Prepared by: University of Mostar, Faculty of Civil Engineering, architecture and Geodesy, PP 7

Location 1: Federation Bosnia and Herzegovina, Sarajevo, Elementary school “Hasan Kikic”

Investor: The project was implemented with the support of the Municipality of Centar, the UNDP Challenge Fund and UNDP in Bosnia and Herzegovina, and in partnership between the Czech organization Empress, the local association FEA - Initiative for Forestry and Environment and the UNDP Accelerator Lab in Bosnia and Herzegovina.

Funding source: The project was financed through the Challange Fund with financial assistance from the Ministry of Foreign Affairs of the Czech Republic. The Municipality of Centar co-financed the construction of a flat roof on the "Hasan Kikić" elementary school in the amount of 10.254 KM

Type on investment: like green surface development

Year of investment: 2021-2023

Description

According to the strategic document "Adaptation Plan to Climate Change of Bosnia and Herzegovina NAP" which BiH adopted in 2022, by 2030, BiH should allocate three million KM through grants, funds, budgets and credit funds for the construction of 300 pilot green roofs. The biggest obstacle in defining the tasks of individual institutions is currently the absence of a law on climate change in Bosnia and Herzegovina. The plan for adaptation to climate change proposes that such a law be enacted, but the question arises whether we first needed a strategic document or the law itself.

The "Green Roofs of Sarajevo" project advocates environmental protection, increasing green areas in urban areas, reducing heat island effects, improving air quality, reducing greenhouse gas

emissions, and providing modern and green urban facilities for various target groups through the creation of green roofs.

Important steps in the installation of a green roof are checking the static stability of the building by a civil engineer, that is, determining whether the building can "carry" it, and it is necessary to ensure that the height of the fence is at least one meter.

Results and conclusions

The once impassable roof has now been transformed into a multifunctional green garden, a real outdoor classroom and a colourful playground enriched with sandboxes for the youngest students, tall buildings for urban gardening, a library, boards and creative elements, a weather station, hotels for insects, planters with over a hundred decorative plants , fruit trees, lots of spices and flowers. This is now a little green paradise for the children, the teaching staff and the town>

When the installation of green roofs becomes mandatory on new buildings, as is already the case in some countries, the load-bearing capacity of the roof structure should also be mandatory, so that every new roof is strong enough to withstand more than 80 kilograms of water-saturated weight per meter. square which is common. This load-bearing capacity is often a limiting factor in existing buildings.

More information: https://oshkikic.edu.ba/2023/06/10/otvoren-zeleni-krov/

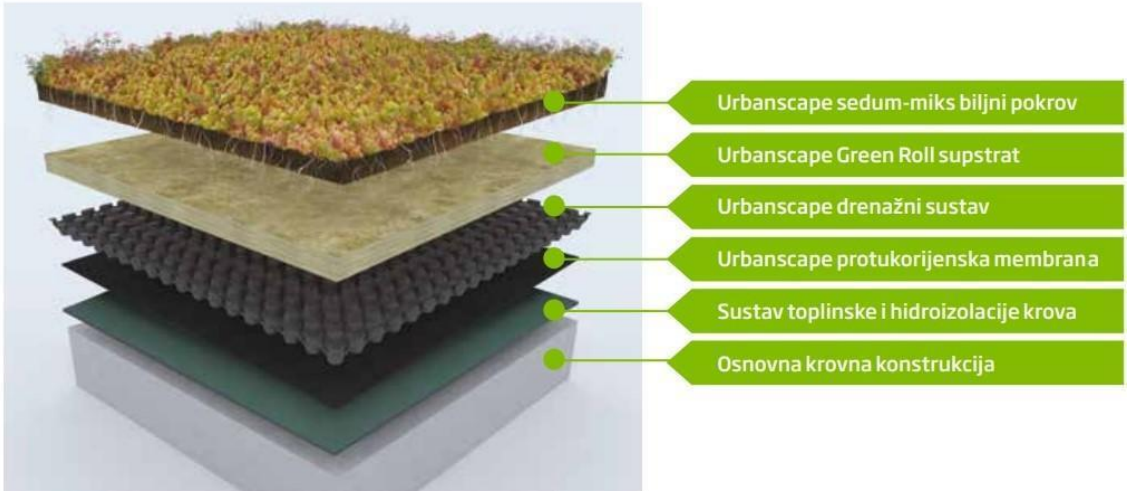
More information: https://naukagovori.ba/zeleni-krovovi-vrtovi-na-zgradama-za-nize-temperature/

As green roof technology advances around the world, there are more and more types and subtypes, but the usual division into intensive and extensive green roofs is still common. Extensive roofs are generally simpler maintenance, cheaper and involve small plants, while intensive roofs that can even be planted with trees and shrubs cost more and are more demanding.

Any type contributes to improving biodiversity and affects the surrounding climate, and this is especially important in those parts of cities that are called "heat islands", where temperatures rise significantly compared to the outskirts of the city. These heat islands occur because surfaces like asphalt and concrete absorb and emit more solar energy than green surroundings.

https://www.fmoit.gov.ba/bs/okolisne-dozvole/statistika-okolisne-dozvole/izdate-okolisne-dozvole-u-2024-godi/bs/novosti/vijesti/projekti-zeleni-krov-i-energetska-efikasnost-u-drugoj-gimnaziji-sarajevo

One of the more significant initiatives that they are trying to implement in this school is the greening of the roof of the building. The idea was supported by the former students of this Sarajevo high school, who today deal with the topics of sustainable development. Currently, the project is in the phase of obtaining the necessary permits from the local authorities. The school hopes that this project will be realized as soon as possible, considering that green roofs are efficient thermal insulators, and absorb precipitation, thus reducing the load on the sewage system. This would also reduce energy consumption.



More information: https://potkrovlje.ba/2022/01/urbanscape-zeleni-krovovi/

Prepared by: University of Mostar, Faculty of Civil Engineering, architecture and Geodesy, PP 7

Location 2: Federation Bosnia and Herzegovina, Mostar

Investor: University of Mostar

Funding source: The Environmental Protection Fund of the Federation of Bosnia and Herzegovina financed the project in the amount of 100,000.00 KM, and the Construction Research Center d.o.o. Mostar in the amount of 25,000.00 KM

Type on investment: green zone

Year of investment: 2019

Description

On October 15, 2019, the implementation of the project "Main Project for the Rehabilitation and Development of the Park within the Campus of the University of Mostar" was completed.

The University of Mostar is focused on transforming its campus with an emphasis on green spaces and defining a spatial identity. The project includes a strategy for developing environmentally conscious green spaces within the campus, while promoting sustainability through the use of environmentally friendly materials and energy-efficient solutions. The projects for the entrance and road infrastructure within the campus, sports fields, parking lots and the so-called green zone, i.e. the central park with an open amphitheatre that represents a green oasis for students, have been completed. The key element of this project are the so-called "green islands", i.e. green hills, which represent an aesthetic and functional concept for designing the terrain. These hills combine to create a dynamic and attractive landscape that further enriches the spatial identity of the campus. This integrated approach emphasizes the importance of preserving the environment and creating a pleasant, visually attractive environment for all campus users.

Practice from Moldova

This best practice catalogue from Chisinau will feature two types of entries - one being a project in the preparation phase that concerns the rehabilitation of the Bic River in Chisinau, and the second one is a project that has already been implemented and is still being improved in the area known generically as “La Izvor”.

Project 1

Prepared by: SpongeCity Chisinau PIU (Victor Buzu/Vadim Butnaru).

Location: Bic River riverbank

Investor: PMC

Funding source: Municipality budget

Type on investment: Blue-green infrastructure improvement, CCTV monitoring, Digital asset management and flood statistics database

Year of investment: tbd

Workplan Description:

Flood Propagation Process

Remove trees from the minimum/average flow cross-section and main channel, except those not obstructing flow. Maintain vegetation to support flood propagation while allowing the river’s natural morphology and ecology to recover. Design landscaping and furniture in the river corridor to avoid obstructing water flow or accumulating waste.

Nature-Based Design

Reform the Minimum/Medium Flow Channel to mimic natural forms, with sinuous shapes, varied cross-sections, natural substrates, and depths to encourage diverse channel morphology. This

promotes habitat diversity, supports various species, and enhances ecosystem resilience to extreme conditions.

Removal of Hydrotechnical Nodes

Eliminate the hydrotechnical node between Mihai Viteazul Street and Grigore Vieru Boulevard. This node impedes aquatic species migration, reduces flow velocity, degrades water quality, and increases sediment accumulation, necessitating frequent maintenance.

Transport Networks and Crossings

- Minimize the impact of transport networks on river flow. Demolish or adapt crossings where feasible:
- Relocate transport infrastructure underground, considering flood levels and maintenance needs.
- Elevate crossings above flood levels, using supports if necessary.
- Expand or deepen river cross-sections to enhance flood capacity.
- Compensate for restrictions on one bank by widening the opposite side or installing localized flood protection measures.

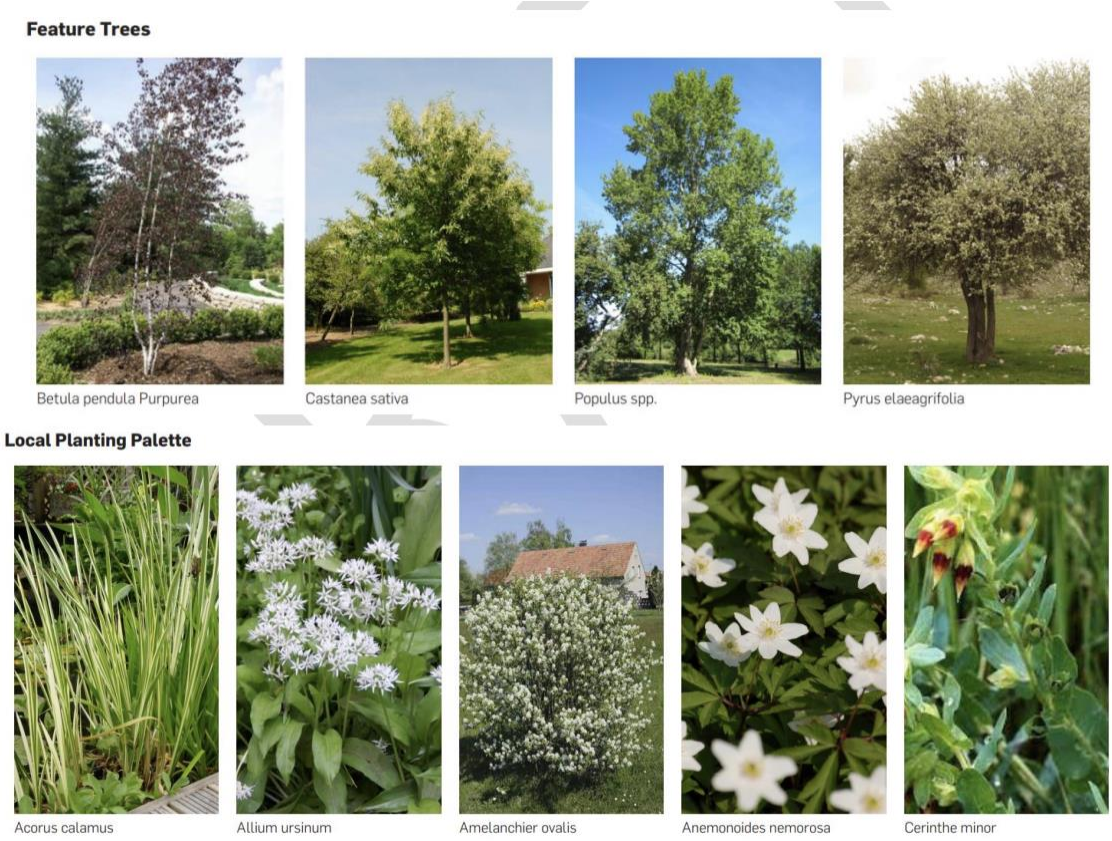
Erosion Management

Address erosion risks at transition points between hard materials (e.g., concrete) and natural substrates. Design measures to mitigate increased erosion caused by these transitions, particularly during floods.

Annexes:

Figures 1, 2: The Urban Vision for the Bic River presents a vision of the future potential of the Bic River if regularization is undertaken in a similar, environmentally focused manner.

It is recommended that a planting regime be identified that will provide the river corridor with a natural and attractive space for recreational use. This type of planting will promote biodiversity as well as provide screening from the wider city environment. Planting within the floodplain, as well as within the boundaries of the high and low embankments, should also be considered, as detailed in the full feasibility study.



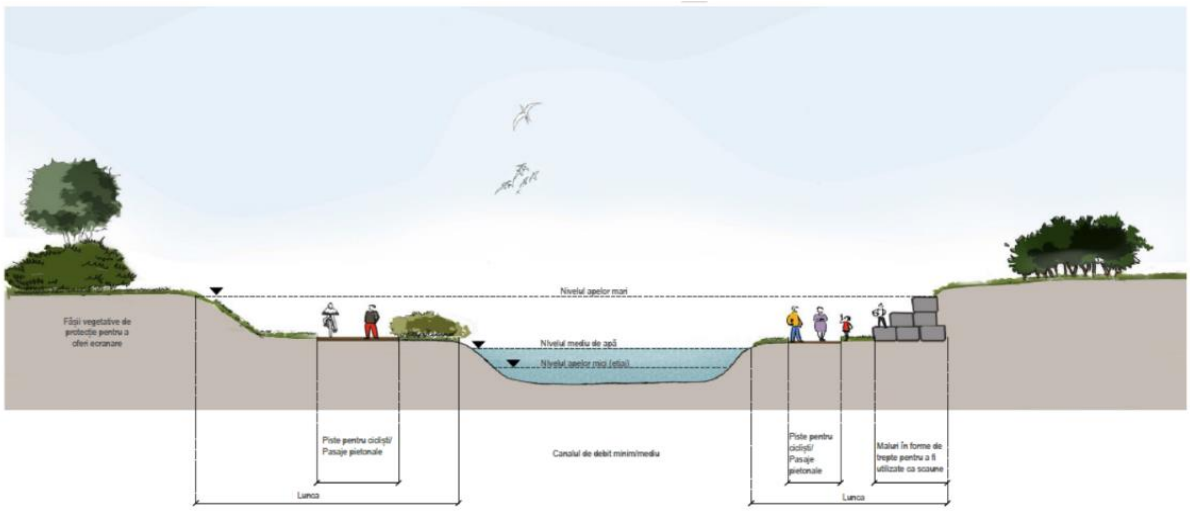
Extract from the planting palette

• If boating is desired within the regulated section of the river, canoes are possible. The river will be too narrow for rowboats. To facilitate this, canoe launching areas will need to be provided, which should be possible in the meadow/riverbank.

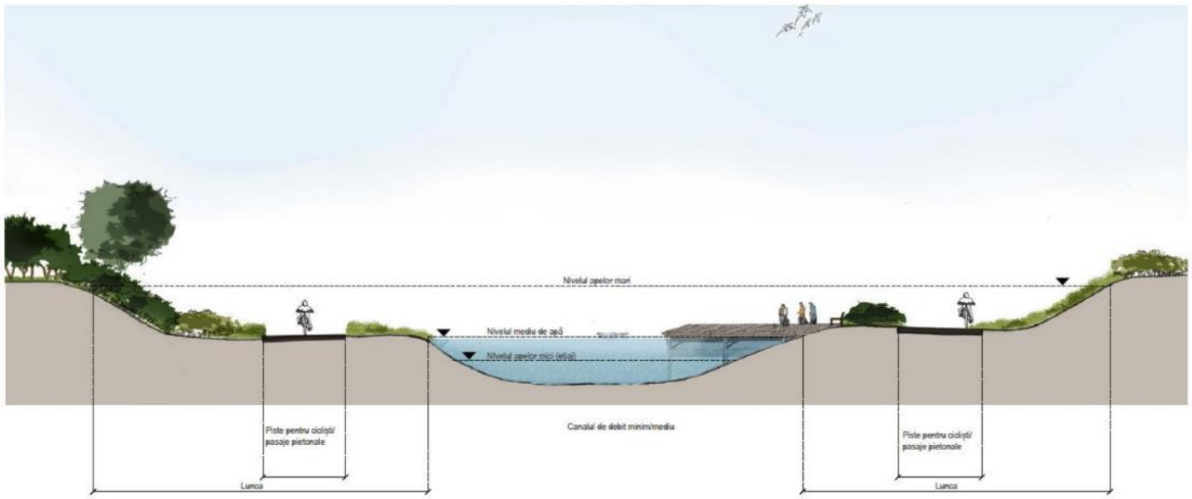
• If seating/relaxation areas are desired, then these could be implemented by small stepped bank areas, either made of concrete or gabion baskets with timber boards fixed on top.

• There could also be areas with gently sloping banks to allow access for people to fish etc.

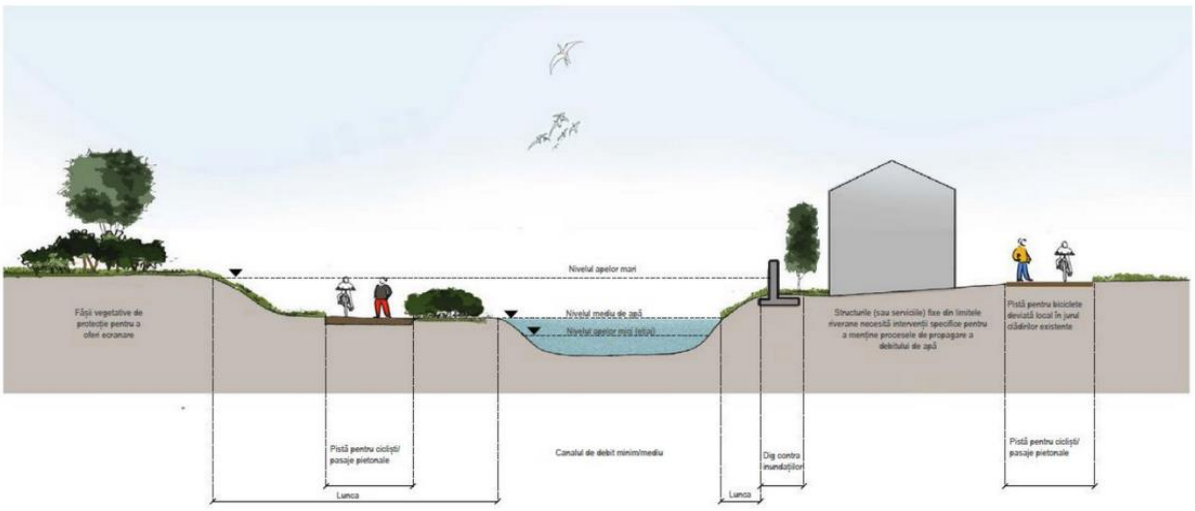
• A cycle track has been included in all cross sections. It is anticipated that the future urban development of the city will be able to connect the bike paths to each other creating a network. As recommended in the EIG (gender inclusion assessment), this type of intervention should always be complemented by universal design considerations so that these spaces are safe and accessible to all.



Cross Section 1 – Typical Section with Optional Leisure Seating



Cross section 2, including a potential mooring station for recreational use (small boats, fishing, etc.)



Cross section 3, including immovable building and screening

Project 2

Prepared by: SpongeCity Chisinau PIU (Victor Buzu/Vadim Butnaru).

Location: Parcul „Alunelul”

Investor: PMC

Funding source: The budget of Chișinău Municipality – A significant portion of the funds was allocated from local financial resources managed by the Chișinău City Hall.

Type on investment: Rehabilitation and improvement of the lake side

Support from the City Hall of Bucharest, Sector 6 – An important contribution in the form of a grant was provided as part of a bilateral partnership aimed at supporting cultural and urban development initiatives.

Year of investment: The renovation of Alunelul Park in Chișinău took place between 2019 and 2021, carried out in two main stages:

First Stage (2019-2020):

The initial work focused on rehabilitating the basic infrastructure, including the reconstruction of pedestrian pathways and the installation of a modern public lighting system.

New benches and trash bins were installed, and the green areas were redesigned with the planting of trees, shrubs, and flowers.

During this phase, the lake was cleaned, and its shores were reinforced.

Second Stage (2020-2021):

This phase focused on adding additional facilities, such as installing a modern fountain and completely renovating the amphitheater.

Playgrounds for children, outdoor fitness zones, and cycling paths were created.

Landscaping work was finalized, integrating all elements into a cohesive and functional park.

Description:

Alunelul Park in Chișinău has undergone extensive modernization, transforming it into one of the most attractive green spaces in the city. The renovations focused on upgrading existing infrastructure and adding new facilities to meet the diverse needs of visitors, regardless of age.

Key improvements include the reconstruction of pedestrian pathways with a modern and durable design, installation of ergonomic benches, and the implementation of an energy-efficient LED lighting system to enhance safety during evening hours. Eco-friendly trash bins were placed throughout the park to maintain cleanliness, and new cycling routes were created.

The park's green areas were revitalized with the planting of a variety of trees, shrubs, and flowers, carefully chosen to create a harmonious landscape and improve air quality. Large open lawns were also added for relaxation, picnics, and outdoor activities.

A highlight of the renovations is the park's lake, which was cleaned and redesigned. The shores were reinforced, and railings and pontoons were installed to provide safe access. The lake was stocked with new species of fish to promote biodiversity and enhance its natural charm.

A modern fountain near the lake adds to the park's appeal with its mesmerizing display of water, light, and sound, attracting visitors of all ages. Additionally, the park's amphitheater underwent a complete makeover, featuring comfortable seating and improved acoustics, making it an ideal venue for concerts, performances, and cultural events.

Alunelul Park has been transformed into a true city landmark, offering a space for recreation, socializing, and entertainment that meets modern standards and significantly enhances the quality of life for the community.

The renovation and cleaning of the lake in Alunelul Park have had a significant impact on the city of Chișinău, both ecologically and socially, as well as aesthetically. The main contributions include:

1. Ecological Impact

- Improved water quality: Cleaning the lake removed accumulated waste and sediments, preventing pollution and promoting the regeneration of the ecosystem.
- Biodiversity enhancement: The lake was restocked with new species of fish and aquatic plants, creating a balanced natural habitat for local fauna.
- Reduced flood risk: The reinforcement of the lake's shores improved stormwater management in the area, reducing the risk of erosion and flooding near the park.

2. Social Impact

- Increased park attractiveness: The renovated lake has become a key attraction, providing a peaceful and enjoyable space for residents and tourists. The shores, equipped with pontoons and resting areas, support recreational activities such as walking and fishing.

- Community event opportunities: The lake's proximity to the amphitheater and the fountain creates an ideal setting for cultural events, concerts, and other social activities.

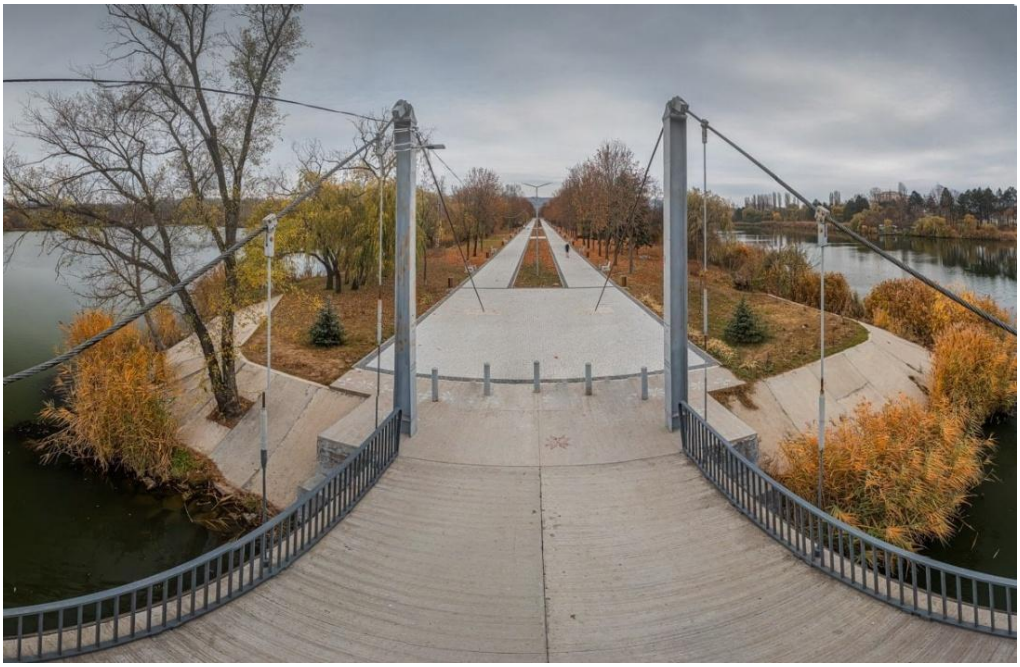
- Educational value: The lake and its biodiversity serve as an educational tool for children and youth, raising awareness about ecology and the importance of environmental protection.

3. Aesthetic and Urban Impact

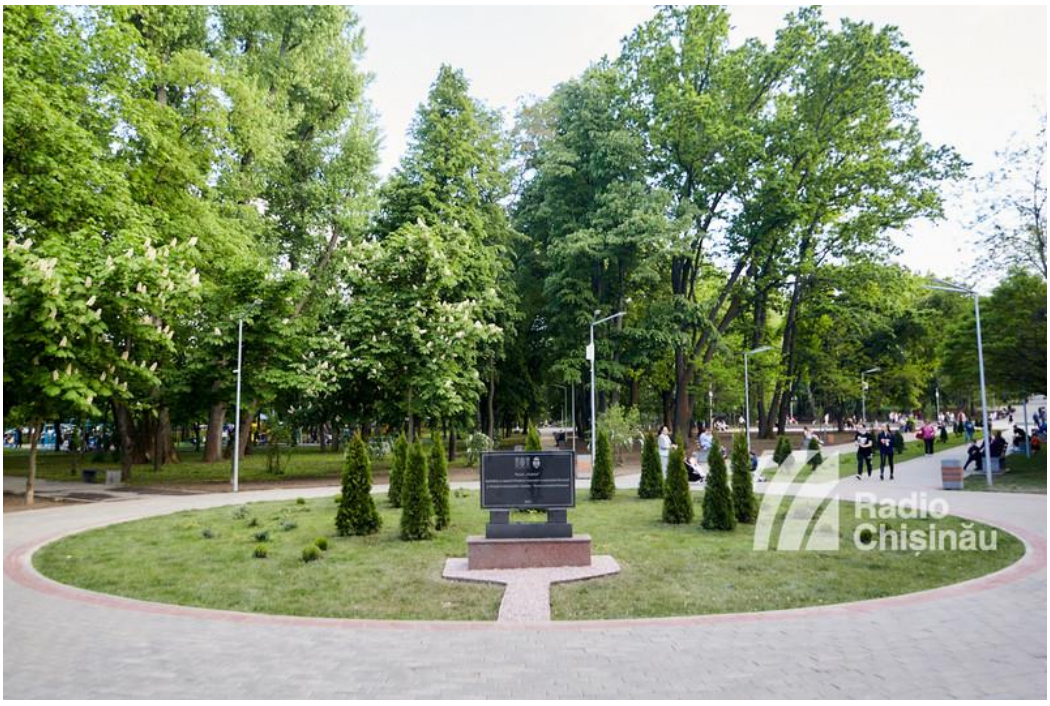
- Enhanced urban landscape: The renovated lake, alongside the fountain and landscaped areas, has transformed the park into an aesthetic landmark for Chișinău, offering a tranquil retreat in the urban hustle.

- Increased property value: The modernization of the park and the lake's restoration have boosted the appeal of the surrounding area, potentially increasing property values nearby.

Annexes



Figures 1, 2: The lakes in the La Izvor Park and the bridge between them



Figures 3, 4: Alunelul Park in Chișinău is home to a variety of tree species, including oak, maple, pine, linden, and birch. These trees provide a diverse green canopy, enhancing the park's aesthetic appeal and supporting local biodiversity. The selecti

Overview

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Practice from Serbia

Prepared by: RARIS, Branko Brković; PP 9,

Location: 10 Cities in Serbia - Belgrade, Novi Sad, Subotica, Novi Pazar, Smederevo, Kragujevac, Čačak, Niš, Bečej and Sombor

Investor: A1

Funding source: A1 and Cities

Type on investment: Construction of 10 rain gardens

Year of investment: 2023

Description

Project: Niklo kao ja (Sprouted like me)

Cities and urban environments are increasingly faced with flooding due to heavy rainfall that turns city streets into rivers, while sewage systems become congested, increasing the risk of damage to infrastructure and property. But there are world practices that can help solve this problem, and one of them is rain gardens.

Rain gardens are a sustainable and economical system for the collection, storage and use of rainwater that falls on surfaces such as roofs, courtyards or sidewalks and aims to reduce the negative impact of rainfall on urban infrastructure and the environment. Most often, they are built near roads or impermeable soil, and as such they have the task of absorbing excess stormwater caused by sudden heavy rainfall with the aim of relieving the sewerage network. By planting suitable plants with a deep root system, the gardens become self-sustainable, as plants are used that can survive in conditions of excessive amounts of water, as well as in totally dry conditions. These gardens are a key part of the socially responsible project "Niklo kao ja", which aims to reduce the negative consequences of climate change in urban areas.

The project was initiated by the Faculty of Forestry from Belgrade and the company A1 - mobile phone operator. The project was implemented in cooperation with the European organization

Propulsion and with local governments in selected cities. This project is part of the wider socially responsible platform The World You Want.

In the first phase of the project, 10 cities were selected where rain gardens will be installed.

In the second phase, rain gardens were created. In each city, the local population had the opportunity to work together with professional gardeners, but also with the help of the project's patrons, actress Mione Marković and travel writer and TV author Andrej Maričić, to work on the same task: creating and arranging a rain garden, in accordance with the needs of each city individually 10 cities in Serbia got rain gardens: Belgrade, Novi Sad, Subotica, Novi Pazar, Smederevo, Kragujevac, Čačak, Niš, Bečej and Sombor.

In the third phase, after they were posted on the website www.svetkakavzelis.rs, online voting was organized in which all citizens of Serbia could vote for the most beautiful. More than 22,000 people participated in the vote, and the one in Bečej was chosen as the most beautiful rain garden.

Results and conclusions

These rain gardens are a key part of the socially responsible project "Niklo kao ja", which aims to reduce the negative consequences of climate change in urban areas. Through this pilot project, 10 rain gardens were created in 10 cities of Serbia: Belgrade, Novi Sad, Subotica, Novi Pazar, Smederevo, Kragujevac, Čačak, Niš, Bečej and Sombor. As part of the Niklo project, 10 public areas were transformed into rain gardens and green oases that will serve as places for rest, education, socializing and entertainment for citizens. This is a pilot project in which rain gardens were created for the first time in Serbia.






Practice from Bulgaria

Prepared by: ASPECT – Management and Intercultural Relations, Plovdiv, PP 10

Location: 8 municipalitites in Bulgaria -Sofia, Plovdiv, Burgas, Varna, Ruse, Stara Zagora, Sliven, Kardzhali and the National Trust Eco Fund (NTEF) as a lead partner.

Investor: Iceland, Lichtenstein and Norway grants (the EEA financial mechanism 2014-2021); Ministry of Environment and Water, Bulgaria

Funding source: National – 15%, EU funds – 85% EU

Name the programme: Financial Mechanism of the European Economic Area 2014 -2021

Project name: Implementation of innovative measures for climate change mitigation and adaptation in Bulgarian municipalities

Type on investment: Concreate measures for adaptation to the climate changes in the big cities

Year of investment: February 2021 – April 2024

Description

Climate change scenarios for Bulgaria show a trend toward increased frequency and magnitude of extreme weather events like heavy rainfalls, heat and cold waves, floods and droughts, hurricane winds, forest fires, and landslides, several of which are already experienced. For example, the Department of Meteorology and Hydrology (NIMH-BAS) projects an increase of the average temperature from 1,6°C to 3,1°C by 2050 and 2,9°C to 4,1°C by 2080, which will pose risk to cities. Measures to reduce urban heat, such as green and blue infrastructure and reflective roofs and pavements, are proven efficient in terms of delivering benefits to cities and their residents.

The main purpose of the project was to adapt cities to climate changes which will pay off not only in means of decreased temperatures and saved lives, but improved air quality, daily life functioning of a city and its activities, and general well-being of the city's inhabitants. Through this project eight municipalities had opportunity to undertake concrete measures for meeting the consequences of these changes that were mainly expressed in heat island effect; alternation of urban floods from heavy rainfalls with periods of drought and drinking water shortage and urban landslides activation. Cooperation between institutions and Bulgarian experts and the donor countries

(Iceland, Liechtenstein and Norway) provided wide information about the issue were additional added value to the project.

Working on this project, eight municipalities - Sofia, Plovdiv, Burgas, Varna, Ruse, Stara Zagora, Sliven, Kardzhali – had opportunity to analyse current situation, accumulate experience and experiment with non-traditional solutions, and update and complement local climate action policies. Based on the analyses, eight municipalities proposed and implemented selected investment measures to the climate change adaptation connected to the rainwater drainage - Plovdiv, new green areas - Burgas, prevention system for monitoring and control of the negative geodynamic processes- Varna, The street with the rose lane - Sliven .

The pilot investment activity of Plovdiv Municipality represented rainwater drainage of impounded critical sections of the road infrastructure, resulting from intense rainfalls, through an ecologically complex solution. The drainage activity was expressed in the construction of rainwater dischargers and rainwater diverting into Maritsa River at two critical locations through the construction of a rainwater collection facility, from which the adjacent green area to be irrigated. Thus, the citizens of Plovdiv will be able to move without impediments on the street along the Maritsa River, even during heavy rain, and the water will be collected and used to maintain the adjacent green areas during hot and dry days. To monitor the effectiveness of the ecological solution, rainwater level sensors were installed. The data will be entered into a database, for which specially purchased hardware and developed software will be used.

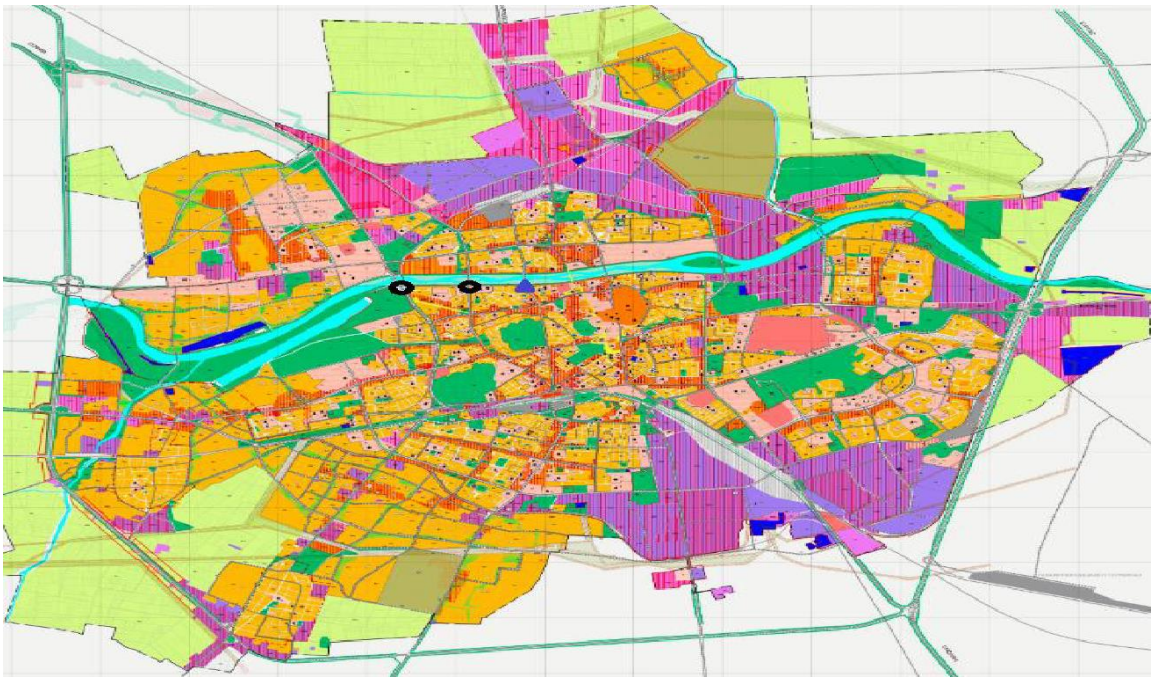
Results and conclusions

The project improved capacity of the local authorities, accumulate experience with non-traditional solutions.

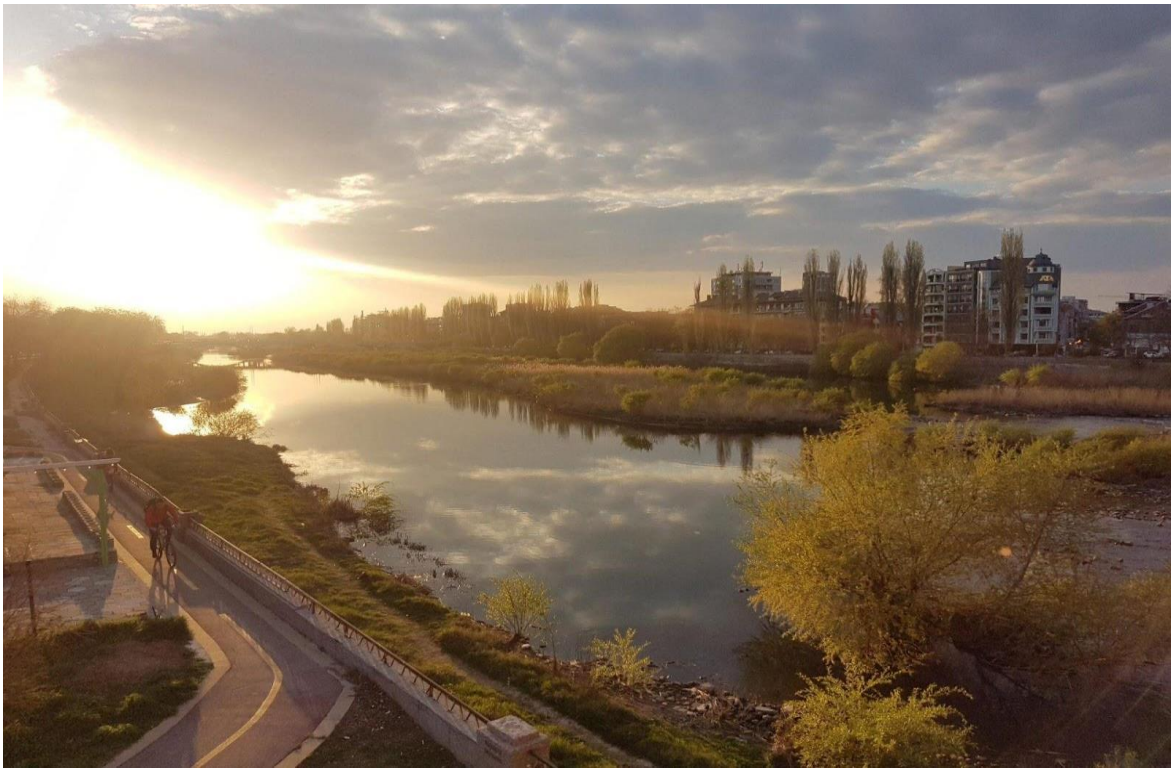
Municipalities together with the citizens implemented eight innovative investment measures as a prevention from the climate change consequences.

During the project were designed justified proposals for updating municipal strategic and planning documents, national and local legislation and local policy, which will contribute to the climate change adaptation, and will prepare authorities for extreme weather events and reduce greenhouse gas emissions.

Figures



Plovdiv example: map and connections of the rainwater drainage places



Practice from Montenegro

Prepared by: Mr Željka Čurović, Mr Golub Ćulafić, Branka Knežević, Stefan Đukić,

Teodora Kusovac, Albina Međedović, PP 11

Cities and urban areas are increasingly facing floods caused by heavy rainfall that turns city streets into rivers, while sewage systems become overloaded, increasing the risk of damage to infrastructure and property. However, there are practices that can help address this problem, such as increasing the share of green spaces in cities, creating rain gardens, establishing green roofs, using permeable materials for paving, constructing retention basins, and similar solutions.

In Podgorica, such practices are still in their early stages, but there are a few examples that could be classified as good practices when it comes to measures for mitigating the impacts of heavy rainfall.

The area of Podgorica is made up of rocks of different and complex geological structure, both from the aspect of stratigraphic-lithological-facies composition, and from the aspect of geotectonic structure. Thanks to the geological characteristics, the territory of Podgorica has quite favorable absorption characteristics, but this must be adequately utilized in the drainage and reception of atmospheric precipitation and its adequate management.

Location1: Podgorica, Montenegro

Investor: Capital City Podgorica

Funding source: City Climate Finance Gap Fund

Type on investment: Pilot project for implementing green roofs on public buildings

Year of investment: 2023

Description

One example is a project “Assessing the potential for green roofs, façades and de-sealing of surfaces in Podgorica, Montenegro” financed for the city of Podgorica by *The City Climate Finance Gap Fund* project. The fund serves as support for cities in their efforts to reduce pollution and adapt to climate change through the implementation of various measures, including project development, planning, technical support, and strengthening human resource capacities.

The purpose of this Assignment is to assess the potential for implementing green roofs combined with facades and opening of sealed surfaces in Podgorica, as foreseen by the city’s Climate Change Adaptation Strategy. This assignment will test this hypothesis on a pilot of public buildings and identified public areas in Podgorica. The project included the screening of public buildings owned by the Capital City Podgorica to identify their potential for installing green roofs. Three pilot projects were selected which have the highest priority for the city.

Three public buildings have been identified as "pilot projects" for the implementation of green roofs:

1. City Parliament Building

2. Rescue and Protection Service Facility

3. Cultural and Information Center "Budo Tomović"

A feasibility analysis has been conducted for the selected "pilot projects" along with recommendations for the next steps.

The implementation phase for greening the roof of the City Parliament building is currently in progress.

Location 2: City of Podgorica

Investor: University of Montenegro

Funding source: Own sources

Type on investment: Construction of new urban park on location of parking plot with retention basin

Year of investment: 2021

Description

The park in front of the Rectorate building with a retention basin. The project was implemented by the University of Montenegro on former parking plot.

Such a solution is an excellent example of sustainable urban planning and climate change adaptation. Transforming a parking area into a green park surface with a retention well allows for effective rainwater management, reduces the risk of flooding, and contributes to environmental conservation.

Advantages of this approach:

Rainwater absorption: The retention basin collects excess water during heavy rainfall, easing the burden on the city's drainage system.

Green spaces: Converting a concrete area into green space improves air quality, reduces the urban heat island effect, and provides a pleasant area for citizens.

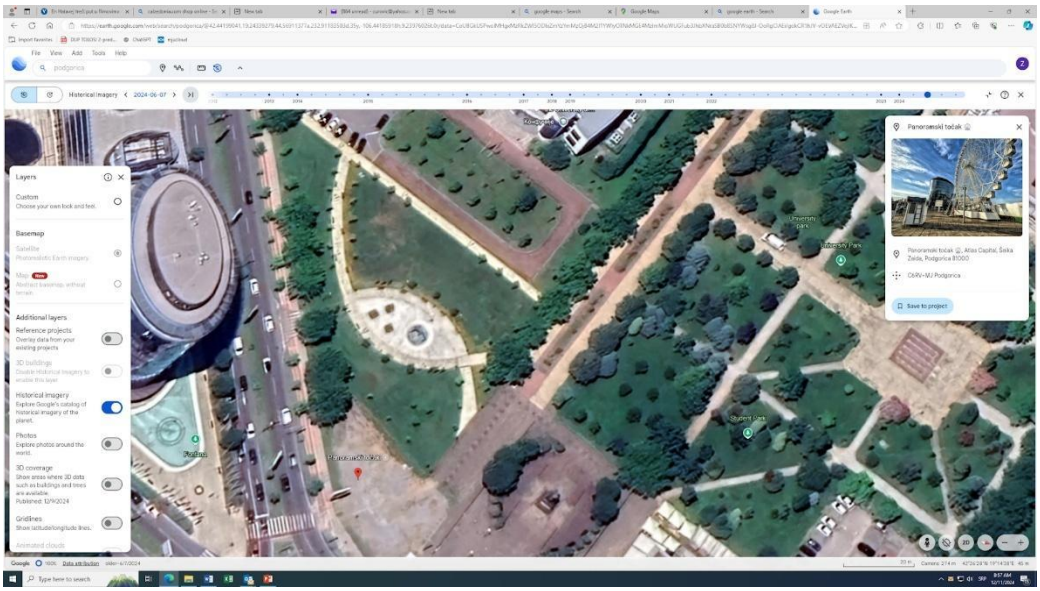
Biodiversity: The park can serve as a habitat for plants and animals, enhancing biodiversity in an urban environment.

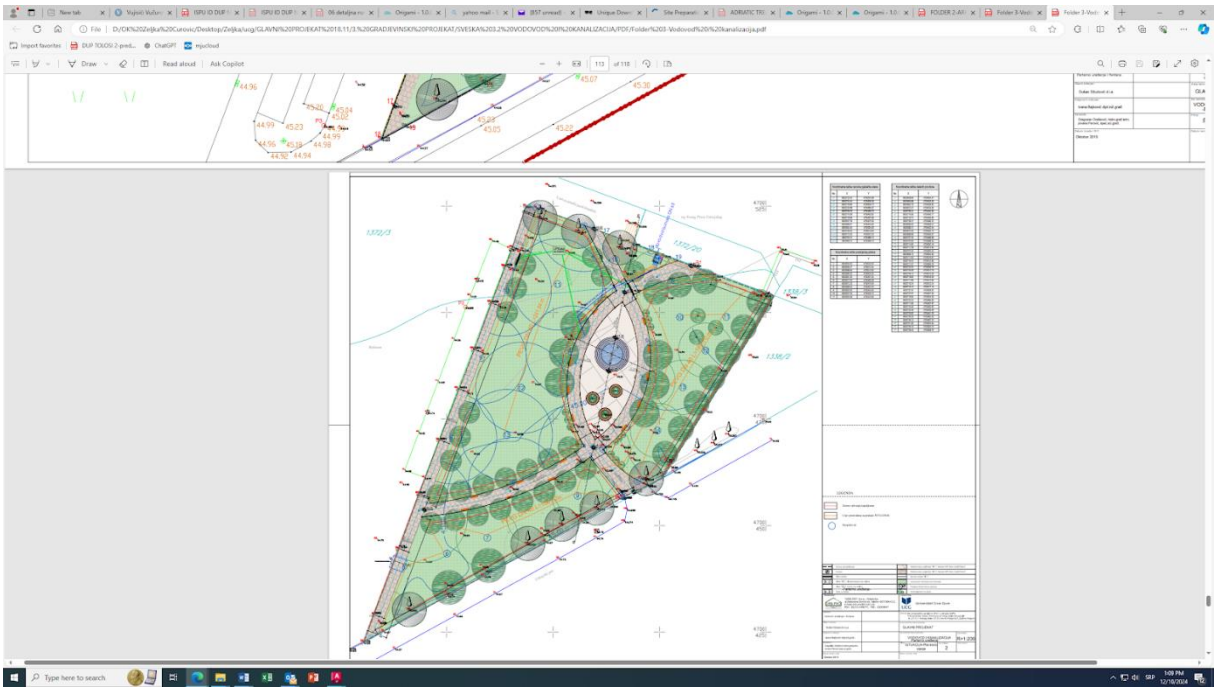
Aesthetic and social value: Such spaces are not only functional but also enhance the city's appearance and offer the community a place for recreation and relaxation.

Use of native plant species that are resilient to local climate conditions.

Installing of benches, pathways, and lighting make the space more accessible and appealing.

Annexes





Good examples of stormwater drainage regulation:

Practice from Romania

Prepared by: Livada Town Hall, PP 12

Location: Livada Town

Investor: Livada Town

Funding source: Regional Operational Program 2014-2020, Priority Axis: 5 – Improvement of the Urban Environment and Conservation, Protection, and Sustainable Capitalization of Cultural Heritage

Investment Priority: 5.2 Actions aimed at improving the urban environment, revitalizing cities, regenerating and decontaminating disused industrial land (including reconversion areas), reducing air pollution, and promoting noise reduction measures

Project Code (SMIS): 115626

Type of Investment: Development of leisure spaces and green areas in Livada Town, Satu Mare County

Investment Period: 2019 - 2023

Description

General Objective of the Project

The general objective of the project is to improve the urban infrastructure in Livada Town, ensuring an increase in the quality of life and the attractiveness of the town both for the local population and for those in transit.

The lands on which the project was implemented were in a state of degradation, having not been used for many years. Through the implementation of the project and the creation of recreational spaces for the population of the town on these two plots of land, the revitalization of the urban

area is promoted, making the investment appropriate for the development of the locality, being in line with the general objective of the project and the specific objective of Investment Priority 5.2.

The investment sought to increase the attractiveness of Livada Town in Satu Mare County by providing appropriately equipped recreational spaces. The project also aimed to implement a series of investments to promote equality and non-discrimination by increasing access to recreational activities for people with disabilities, so that they feel part of the community and so that the local public authorities demonstrate their efforts to create the necessary infrastructure for them.

The lands subject to the investment are located less than 500 meters from inhabited areas, in the town center:

- Plot CF 102792, located in Unirii Neighborhood

- Plot CF 103882, located on Viitorului Street 1

The arrangement of the northern plot is aimed at children and families with children. It is located in close proximity to a kindergarten, nursery, kindergarten for children with disabilities, and a residential neighborhood. The proposal for the arrangement highlights the playful nature of the place by installing a playground for children and play equipment for children along the pedestrian alleys.

The arrangement of the plot located south of National Road DN19 is aimed at people who wish to engage in sports activities in the open air, as well as those who want to spend their leisure time in a relaxed way. Bicycle tracks have been arranged around the entire perimeter of the plot, as well as a skateboard park, a zone with outdoor fitness equipment, some accessible to people with disabilities, a public restroom, and the area deemed to be the most attractive: a fountain ensemble with the possibility of sitting around the basin.

All these have contributed to the improvement of the town's appearance, as the lands on which the investment was made had not been used for a very long time, thus remaining neglected and in an advanced state of degradation. The works carried out have led to an increase in the area of green space per capita, improved access for people with disabilities, enhanced environmental quality, and increased public safety, which will contribute to the retention of the town's population and the creation of favorable conditions for raising children, as well as attracting people from neighboring areas.

Through the investment, equality, non-discrimination, and a healthy lifestyle are promoted, and, not least, the quality of life is improved. At the same time, it represents a place of interaction for the people of Livada Town. The refunctionalization consists of creating open green spaces, the construction of pedestrian alleys and bicycle tracks, a skateboard park, a playground, a platform

with fitness equipment, a fountain ensemble, as well as the installation of lighting fixtures equipped with photovoltaic panels, a wireless system, and surveillance cameras.

Through the achievement of this specific objective, the effective completion of construction and installation works, as well as the equipping of recreational spaces, was pursued. Furthermore, the project aimed to increase the green space per capita to 22.46 m² per inhabitant. Livada Town had 13 hectares of green space, but it was undeveloped. Undeveloped green spaces pose risks to public safety, as they are often untended, unsanitary, and unsupervised. Through the implementation of the investment, the green space per capita increased from 17.7 m² to 22.46 m².

The project has brought numerous investments in infrastructure for people with disabilities, facilitating their access to recreational spaces, such as the construction of a platform with fitness equipment for people with disabilities, the inclusion of equipment in the children's play area specifically designed for children with disabilities, the arrangement of a restroom for people with locomotor disabilities, and a parent-and-child room within the restroom.

Environmentally friendly investments were also included, such as lighting equipped with photovoltaic panels, the construction of a green roof for the restroom, the use of ecological materials such as recycled plastic curbs and prefabricated concrete paving tiles, and selective waste collection measures through the installation of urban trash bins for selective waste and collection containers. Implementing environmentally friendly solutions in construction works and equipment placed in the newly created green spaces leads to improved urban infrastructure in Livada Town and increased quality of life.

Maintaining public safety in the arranged spaces was also a priority in this project through the installation of a video surveillance system, with 14 cameras placed on the playground and recreational areas to maintain a high level of safety for the citizens of Livada Town in public spaces.

Acquisitions and Results

The project has led to the following acquisitions and developments:

- Pedestrian alleys covering an area of 1,875.81 m², providing citizens with pleasant and safe walkways.

- Bicycle tracks spanning 1,043.43 m², designed to prevent minor accidents by separating cyclists from pedestrians. This ensures that those riding bicycles can safely enjoy the park without disrupting walkers.

- Skateboard park covering 150.00 m², offering a dedicated area for practicing this sport safely. This reduces risks associated with improvised or unsuitable locations while encouraging more young people to take up skateboarding.

- Playground covering 140.20 m², designed to provide children with a friendly and safe environment. Public playgrounds stimulate creativity, social skills, and provide a secure area for children to play, especially for families in nearby residential areas. Play equipment, including some accessible to children with disabilities, is distributed along the pedestrian alleys.

- Public restroom with a parent-and-child room, covering 64.34 m². The facility is essential in public spaces and is fully accessible to people with disabilities, featuring a dedicated access platform. The parent-and-child room ensures that both men and women accompanying children can use it, addressing gaps in similar facilities elsewhere.

- Fitness platform for people with disabilities covering 15.00 m², designed to promote non-discrimination and inclusion in recreational activities.

- Fitness platform for general use covering 35.00 m², encouraging the population to engage in outdoor sports, improving health, and reducing risks associated with sedentary lifestyles.

- Irrigation system equipped with a humidity sensor to ensure efficient and precise watering of green spaces.

- Fencing totaling 1,300 linear meters, consisting of bordered panels and hedges made of Ligustrum species, ensuring the safety and proper delimitation of parks.

- 12,327 dendro-floral species, including trees and flowers, planted to enhance the visual appeal and environmental benefits of the park. Trees reduce temperatures, wind speeds, and pollution levels while serving as natural air filters.

- Fountain ensemble covering 74.24 m², providing a relaxing and aesthetically pleasing feature. The fountain area includes seating and a pedestrian bridge for visitors to enjoy the water display from above.

- 143 lighting fixtures, equipped with photovoltaic panels and LED lights for energy-efficient public lighting.

- Urban furniture such as benches, bike racks, trash bins for selective waste collection, and tactile maps for visually impaired visitors.

Results and Conclusions

The project has enriched Livada Town with a new open-air park in its centre. Citizens now have a space where they can exercise, relax, and enjoy fresh air in a 3-hectare green area. For children,

the park offers a safe and enjoyable environment, featuring playgrounds, slides, a skateboard park, fitness areas, a fountain, illuminated bicycle tracks, and pedestrian alleys.

The modern park, spanning 3.5 hectares, was developed on a previously neglected, waste-filled plot. Through the redevelopment of these degraded lands, the following key outcomes were achieved:

- Reutilization of degraded and unused areas within the town, transforming them into leisure spaces.

- Increase in green space per capita in Livada Town.

- Improved quality of life through the creation of recreational, play, and sports areas.

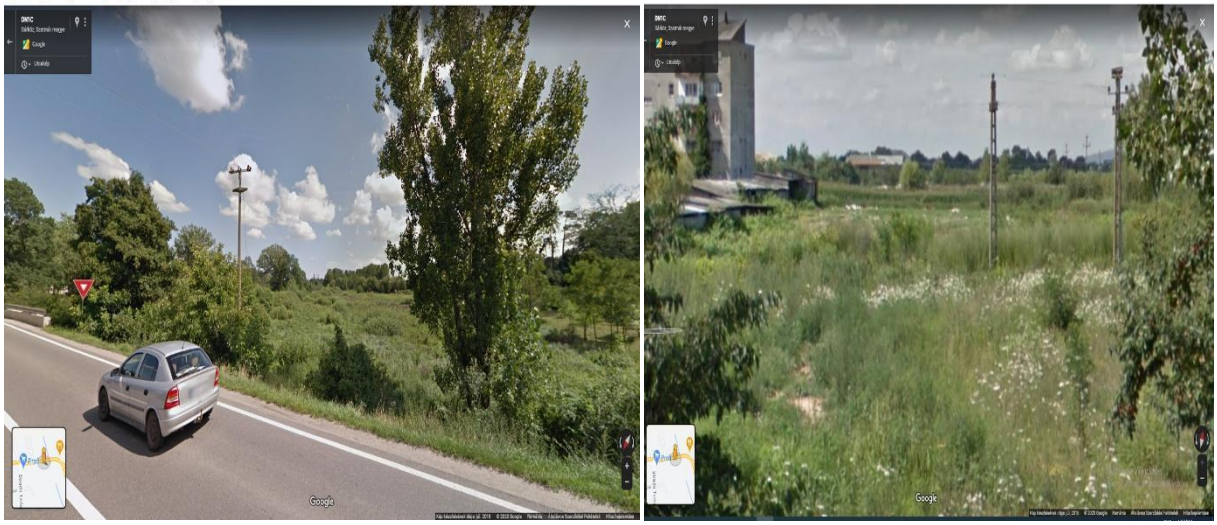
- Enhanced image of the town, creating a more positive perception of Livada.

- Population growth projections, as favorable living conditions attract residents and visitors from neighboring areas.

Annexes:

Photos:

Before:



After

Practice from Slovenia

Prepared by: E-zavod, PP13

Location 1: Maribor, Slovenia, GPS coordinates: 46.521096, 15.699536

The pilot project is located in the area of the Municipality of Maribor, on a degraded urban area in Dogoše, close to the wastewater treatment plant and in the immediate vicinity of the plant for the production of secondary raw materials for construction materials. The City Council of the Municipality of Maribor has confirmed the spatial rearrangement of the location where the demonstration will be implemented (the degraded area in Dogoše) as a basis for further actions. The demonstration is dependent on the SRM based construction products production process, since it will run concurrently, it is foreseen that the demonstration will take place at the latest in the second part of the 2020 (after August).

Investor: Maribor Water Supply company, in partnership with Nigrad d.o.o., public utility company and Municipality of Maribor.

Funding source: Interreg Central Europe, ERDF funds, pilot investment in the amount 29.149 €.

INVESTMENT TYPE:

- Rainwater harvesting
- Treated wastewater reuse

Use of rainwater and purified wastewater for producing recycled construction material in Maribor. The pilot demonstrates the usability of harvested rainwater and treated wastewater for the production of secondary raw materials (SRM) based construction products. Rainwater is harvested on site and stored in an underground reservoir, whereas reclaimed wastewater is transported from the nearby wastewater treatment plant and stored in a second reservoir. Both water flows are mixed and used for the production process in a mobile onsite plant.

Year of investment: January 2020 – March 2022

Description:

1.CHALLENGE AND OBJECTIVES RELATED TO THE PILOT ACTION

In Europe's urban and suburban areas, where most construction activities take place, large amounts of different types of waste are generated by utilities, the construction sector and other industries. This waste can be a valuable source of local secondary raw materials for construction work as a substitute for construction materials, while also being a business opportunity for construction companies (circular economy). Due to the lack of appropriate knowledge, technologies, good practices and incentives, the actors of supply and demand are modestly involved in such processes.

In 2016, 5.498 million tons of waste were collected in Slovenia, of which most was construction (2.165 million tons or 39%), followed by municipal (0.982 million tons or 18%) and industrial waste from thermal processes (0.905 million tons or 17%). Given that construction is the largest producer of waste in the execution of construction works (especially earthworks) and it is possible to use processed waste in large quantities in construction, entry into the cycle of the circular economy is inevitable and necessary.

Pilot investment demonstrates the usability of recycled water for the purpose of production of secondary raw materials (SRM) based construction products. Produced materials are used for road maintenance works and for revitalisation of degraded areas by public company Nigrad d.d, majority owned by Municipality of Maribor and concessionaire for public road maintenance. Maribor Water Supply company showed purified wastewater combined with harvested rainwater is suitable to be used in the production process.

The objectives of the pilot investment were the following:

• maximum rainwater retention,

• saving drinking water,

• promotion of biodiversity,

• water and soil protection,

• environmental education, etc.

2. TECHNICAL PRESENTATION

The investor built a facility with an available total area of 220 m2 (roof and parking lot) from which rainwater flows into the municipal sewer. In the production of construction products, up to now they do not use recycled wastewater, but drinking water from the water supply network.

Technical description

Two plastic reservoirs are installed underground, with installed concrete shaft in front of them in which there are installed filters, pumps and other necessary equipment.

System operation

The shaft has a built-in hydro booster station with two pumps, both pumps frequency controlled, control to maintain a constant pressure in the pressure system. Two probe modules are installed in the energy cabinet for each pump separately. As long as both pools are full, both pumps are running, each approx. 50%. If one of the pools is emptied, that pump does not run to the set level in the pool. An additional box with two switches for remote switching on and off the pump is installed separately. The cabinet contains fuses for each pump separately, FID switch, power switch, two probe modules with six enclosed probes, additional fuse for light in the shaft, manual-automatic switch for each pump separately. Drain taps for water sampling are installed on the pressure side for each pump. An additional cabinet with pump control is located outside the shaft in any room.

Water usage and analysis

The water was used for production of construction products that are based on secondary raw materials. Mobile production plant will be at the same location.

As part of the project, several water sources are foreseen to be analysed for their properties, which will be done concurrently with demonstration start. Types of recycled water to be analysed:

- Purified wastewater from WWTP
- Harvested rainwater

The samples were taken in the equipment shaft next to the reservoirs or at the service point before the water is used for production process, with monitoring and analysis performed by National Laboratory of Health, Environment and Food.

Construction products made with recycled water were also be tested.

Consumption for production process

- Average water consumption: 3 m^3/day
- Maximum water consumption: 10 m^3/day
- Maximum water flow: 1,5 – 3 l/s.

Water collection

Rainwater

Rainwater was harvested from roof surface of the building and the nearby parking lot. We are also considering rainwater harvesting from courtyard. Breakdown of surfaces:

- Roof approx. 120 m2
- Parking lot approx. 100 m2

Courtyard approx. 100 m2

Runoff coefficient (Metal roof) = 0.8

Annual precipitation in Maribor FUA (10-year average) = 962 mm

If we consider roof and parking lot surfaces for rainwater harvesting, we can estimate the amount of rainwater that can be harvested in a year, based on following calculations.

220 m^2×962 l/year×0,8=169,310 l/year=169.31 m^3/year

We could estimate to harvest about 170 m^3 of rainwater annually or 14 m^3 a month.

Results, conclusions:

BENEFITS:

- Amount of rainwater and recycled wastewater collected and used in the production of building materials:30 m^3/month

IMPACTS:

- Increase rainwater retention on site
- Reduce stormwater flow and drainage on site and protect against flooding
- Preserve water resources and save drinking water
- Enhance and encourage the use of rainwater and treated wastewater in industrial processes.

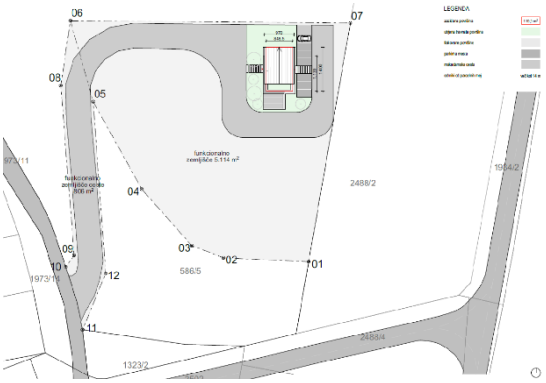
Monitoring results:

Samples taken from the construction material which was processed using recycled water and analysed according to SIST EN 1008 standard were tested for oils and fats, detergents, colour, settleable solids, suspended solids, smell, pH and chlorine and Sulphate contents. According to Maribor Water Supply company and Nigrad, results have shown that treated wastewater is suitable for the manufacturing of SRM based construction products.

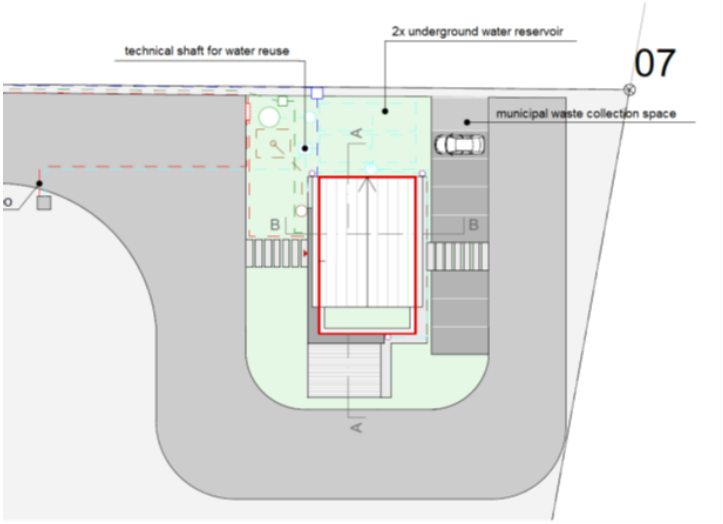
The Biochemical Oxygen Demand (BOD5) of the effluent from the treated wastewater reservoir was < 5 mg/l, thus meeting the requirements for service water for indoor use, such as for toilet flushing.

Annex

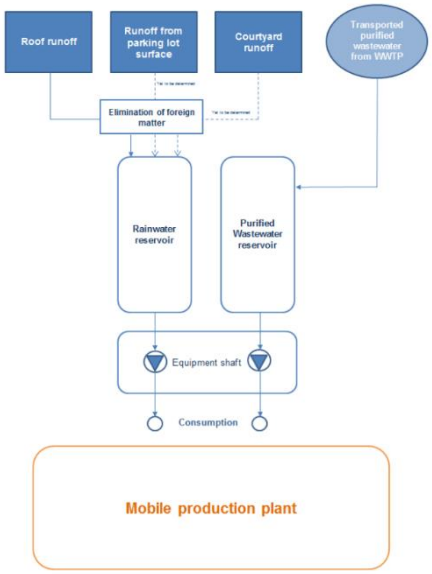
Location of the pilot project



Pilot project plan



Detailed pilot project plan



Schematic view of water collection

Prepared by: E-Zavod

Location 2: Ptuj, Župančičeva ulica 10, 2250 Ptuj, GPS coordinates 46.429, 15.876

Investor: City Municipality of Ptuj

Funding source: local, national funds

Type of investment: dry detention basin on the playground area

Year of investment: 2020, 2021

Description

In the Ljudski Vrt pond, water collects from a 1.81 km long valley, with a catchment area of F = 0.39 km², which extends above the pond towards the north. Water flows into the pond through a torrential stream that originates on the slopes of the Slovenske Gorice hills. The stream flows through a narrow and deeply incised valley, mostly in areas covered with deciduous forest, and discharges into the pond in the city park in Ptuj. During heavy rainfall, the stream erodes and carries away soil and forest humus – mainly leaves, which, due to unmaintained hydraulic structures upstream in the riverbed, are deposited in the city park pond. Furthermore, stormwater and the stream from the Ljudski Vrt pond are diverted through a separate volumetric sewer system, which exclusively discharges rainwater. During intense rainfall, the pond outlet cannot handle all incoming water, causing the pond level to rise and overflow over the pond's edge towards Ljudski Vrt Primary School and Župančičeva Street, resulting in significant damage. The situation was particularly critical during the storm between May 3 and 5, 2018, but issues of varying severity occur almost every year or even multiple times a year. Since the sewer section downstream from the pond has a limited capacity of 1.12-1.26 m³/s and no reconstruction of this section is anticipated, it is not possible to increase the outflow from the pond.

To address the issues arising from intense rainfall events, solutions must be sought to reduce the outflow from the pond, which can only be achieved by retaining water and reducing the peak of the flood wave.

In 2018, a conceptual design for the Ljudski Vrt area was prepared, showing that the risk of flooding of the primary school and Župančičeva Street can be successfully reduced by constructing a dry detention basin on the playground area on the right bank of the pond above the street Ulica 5. Prekomorske Brigade. Along the lower edge of the area along the street Ulica 5. Prekomorske Brigade, it is necessary to construct an earthen embankment approximately 150 meters long, install a safety spillway on the right bank of the pond, and arrange the outflow from the detention basin into the storm sewer. The capacity of the storm sewer along Župančičeva Street is known, and the pond outflow must be adjusted accordingly. In the pond area, embankments need to be raised by approximately 20 cm, sediment removed, and damaged embankments secured.

The planned dry detention basin and associated pond improvements in Ljudski Vrt park were designed to enhance flood safety by redirecting the excess water (flood wave peak), which currently floods the southeastern pond bank towards Ljudski Vrt Primary School and Župančičeva Street, over a spillway (lowered pond embankment in the southwest section) to a part of the Ljudski Vrt park, where a drainage platform and embankment for retaining the flood wave – the dry detention basin – is planned. A new outlet structure is also designed here to allow controlled discharge of retained water into the existing storm sewer and an emergency spillway over the embankment, which is activated if the outlet structure fails (blockage, malfunction, etc.) or if the flood wave exceeds the designed safety capacity. The emergency spillway is part of the access path leading from Župančičeva Street towards the Ljudski Vrt park.
The dry detention basin functions by diverting excess water (flows greater than 1.12-1.26 m^3/s) to the detention basin area, where the water is temporarily accumulated. When the outflow from the pond falls below 1.12-1.26 m^3/s, the dry detention basin begins to empty (through the new outlet structure). The outlet structure is designed to prevent an increase in hydrostatic pressure in the storm sewer downstream of the park area when it reaches its maximum capacity.

A landscape architect was involved in the design and final placement of embankments and other hydraulic structures to implement park landscaping (blending embankments with the surrounding terrain, arranging existing vegetation, etc.).

Results, conclusions

To partially compensate for the retention volumes lost due to urbanisation and to address the flooding issues in the Ljudski Vrt pond area, a proposed solution aims to improve flood risk and drainage conditions by placing a dry detention basin at the southern edge of the area in question – the grass area between the playground, pond, and the street Ulica 5 Prekomorske Brigade.

It has been demonstrated that relatively small interventions can ensure the retention of flood wave peaks and consequently prevent significant damage that would otherwise occur due to flooding. The planned arrangements in the accumulation area are not expected to cause damage during the operation or performance of the detention basin's primary function, except for the accumulation of debris and silt in the pond and detention basin. This, however, can be relatively easily resolved by restoring the function of hydraulic structures located in the torrential streambed along an 800-meter section upstream of the pond inlet (sediment barrier, weirs, channelized section with sediment grates).

The implemented flood protection measures have also been landscaped, while the pond and forest offer the potential for the development of a water-forest educational trail. The area around the pond is equipped with educational boards that introduce the local plant and animal species and can serve as a additional tool for primary school fieldwork in natural science subjects.

The pond and its associated water infrastructure require regular maintenance, which will necessitate periodic cleaning of sediment from the sediment barrier and the pond.

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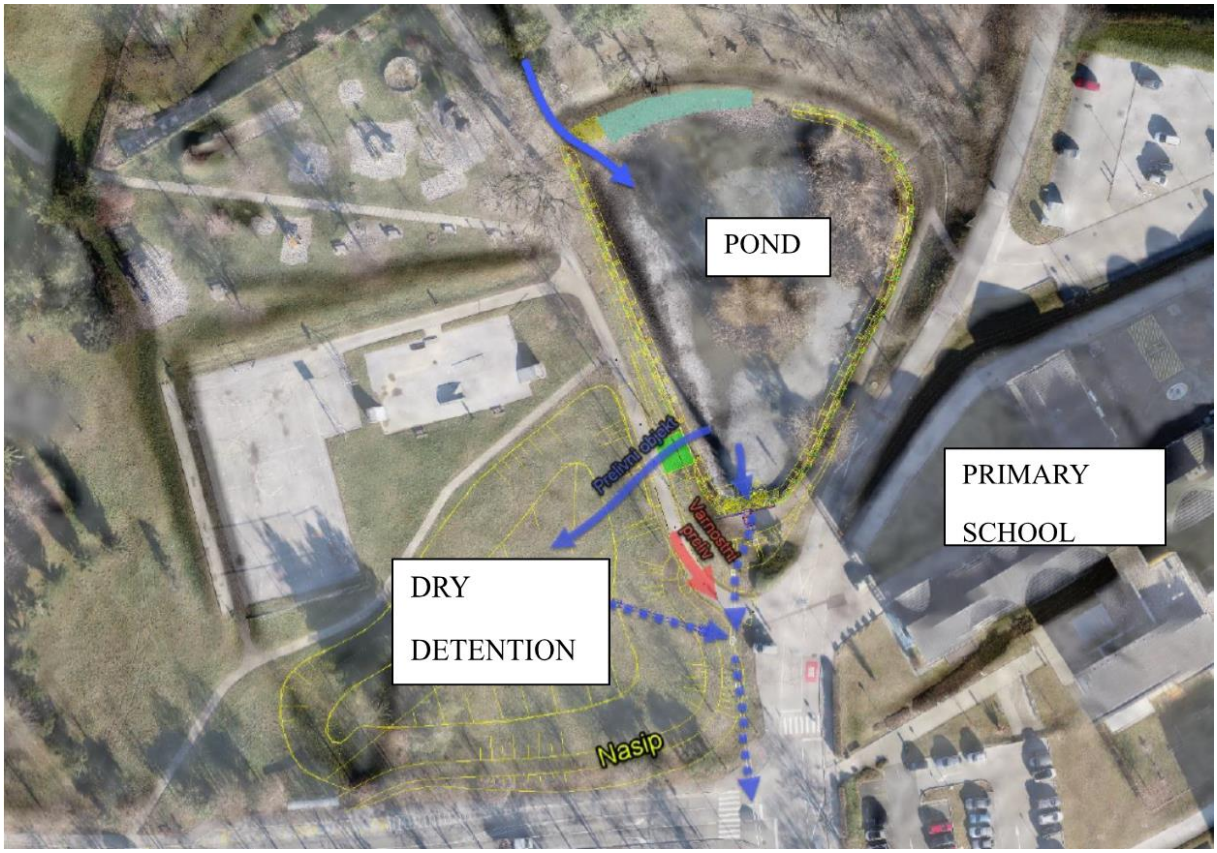

* dashed lines represent the channelized drainage

Conclusion

Presented examples address good sponge solutions and practices; rain gardens, rainwater storages, green roofs and belts, accumulation ponds and lakes and de-asphaltisation and de-concreteisation of city surfaces. Most of solutions are green, natural friendly and win-win; preventing urban floods, enhance ground infiltration balance, decrease overheating phenomena and have benefit ecological and social effects.

This spongecity practices of all of project partners are notable and useful materials for stakeholder and public meetings and presentations, so they can perceive necessity and benefits for facing with climate changing impacts in urban areas.