

# Green areas along rivers' frontline. Case studies Budapest, Prague and Warsaw

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This article reviews the existing situation of the riverbanks development in three Eastern European capital cities. The aim of the work is to compare the riverbank management in Warsaw, Budapest and Prague and describe the main features of greenery system along the rivers. The material taken to the analyses was gathered by European Environment Agency and published in GIS format under the project Urban Atlas. The delimitation of the research area covers 500m from each site of the river beds. The research has shown that Warsaw has the biggest rate of the green area, especially along the Vistula right bank. It is still a great potential of land to develop for the city. Danube's greenery in Budapest is concentrated mostly on the Margaret Island, whereas the Vltava greenery in Prague consists in majority of the pocket parks along the river. The low amount of green area at the rivers in the last two case studies and their patchwork location makes those systems too small to think about green riverbanks as a big scale and coherent linear project. Current trends of waterfront management are slowly entering those three cities mostly in a form of small social participation initiatives. It seems that the waterfronts will change their face soon in all analysed cities commenced by the urban acupuncture initiatives.

**Keywords:** Eastern European city, waterfront policy, riverbanks land management.

## Background

River management policy varies depending on the country and the city. In Europe, there are metropolitan areas that have already developed certain policy patterns with respect to the areas located directly at the riverfronts (e.g. Vienna-Danuba Island, Munich – Isar deregulation) However, there are also cities still only at the beginning of riverfronts sustainable development. [1] In some of them there is a great potential of green land still possible to develop, for instance like on right bank of Vistula river in Warsaw. Preserved semi-natural character of the right Vistula river bank in Warsaw, an area that was for years neglected in city land development strategy, allows the sustainable development in accordance with the spirit of contemporary trends in urban landscape design and space planning procedures applied in other western Europe cities.

## Material and methods

The choice of cities for the case study was dictated by several factors. The scope was limited to the major cities of continental Europe (population over 1 million inhabitants), located in the East-Centre of the continent, situated over a large river or the rivers of the width corresponding to the Vistula's size in Warsaw (approx. 500m), and also about the course of the river through the centre of the city, not peripherally. After the selection, Budapest and Prague were chosen as examples of the eastern European metropolises, where the development of spatial policy may be similar because of common history and may be compared to

spatial planning policy in Warsaw, Poland. In addition, Budapest is the only city in Europe which shoreline - one located on the cliff edge, the second – in a valley, in fact corresponds to the situation in Warsaw. As far as the functions of the city is, Budapest, Prague and Warsaw play a role of a capital cities which justifies the choice as well.

Summary data covering land-use types located at the riverbanks for the analysed cities have been developed on the basis of the Urban Atlas – a joint project of the European Environment Agency and the European Space Agency.

Analysed land use areas have been limited to 500 meters from the each site of the riverbed, as it regarded as an accessible for all people distance from a housing to public transport, bus and tram stops (400-500m). [2] It is assumed that it is the optimum distance to overcome for the elderly, the disabled, and children, which can provide pedestrian access to the river.

Assumption is confirmed by further Jan Gehl's research [3], which says that „the radius of action of people moving on foot limited to 400-500 m. It is one of the aspects to be taken from the account when planning the concentration of people „and that an acceptable walking distance for most people in ordinary, everyday situations. For children, the elderly, the disabled distance should be shorter. In determining the distance it is not only the actual distance, but also the subjective distance. A straight path is perceived as boring and long way, but if divided in steps, and curving, it appears to be shorter. It is suggested to avoid designing long, straight, hiking trails. [3] Susanne Hagan in her monograph „Ecological urbanism: the nature of the city,”

describing a model of sustainable development, argues that a distance of 500m is the right distance designed to overcome foot and optimum space designed for one function to serve as a place of concentration of the people. [4]

A special interest is focused on the green space located at the rivers frontline covering private and public forms of ownership. In fact, the analysis is based in the Urban Atlas dataset classification that has: green urban areas, forests and semi-natural agricultural areas and wetlands. It is a mathematical presentation of the land use where the minimum mapping unit is .25 ha and the analysed type covers more than 80% of the total area of the unit.

There are different drivers that influence the presence of the green space into a city. In some metropolis the goal is to improve the life's quality in the dense urban fabric (Lyon- Parc Gerland, Hamburg- Marci Polo Terraces, Magellan Terraces). The other follow a long term strategy covering hydrological analysis confirming that natural environment along the river alleviate flood effects (Munich – Isar deregulation, Vienna – Danube Island). However, it is possible to distinguish the main direction promoted in the well-developed countries of the West Europe as a the return of the biodiverse green spaces along rivers. The aim of this study is to check what is the situation in the East of European cities, if they follow the same path. There is a significant disproportion in the performed research concerning Western European rivers versus Eastern European ones (on plus for the first mentioned group). It seems to be a need to fill the gap.

## Results

It is difficult to find three similar rivers in Europe. Table 1 shows the differences between the chosen case studies and the same time it proves that a successful solution to river problem could be difficult to copycat and cannot be performed without adjusting to a particular situation. It may suggest as well that there is a great probability that land cover around the rivers may differ.

Table 2 shows % values for total area, residential areas, forests, green urban areas, construction sites, infrastructure and etc. for Budapest, Prague, Warsaw. There are some similarities between the cities as there certain types of the land use that do not occur at the rivers frontline such as: airports, large area of commercial concentration, very extensive residential and commercial areas. The rest indicators occur in the analysed cities, but differ in the amount. The visible deviations appear with the area of forests and semi-natural, agricultural areas and wetlands where one city is definitely a leader (Warsaw). However Warsaw shows a great gap compared with Prague and Budapest in the amount of industrial and commercial areas at the riverfronts.

The research showed that in Budapest (population: 1,7 mln , city area: 525 km<sup>2</sup>) the majority of the areas located directly at the river banks (within the distance of 500m from the riverbeds) are residential areas of different intensification consisting ca. 16,74% of the whole analysed space. Industrial and commercial areas cover 16,87%, forests - 4,91%, green areas - 8,46% and semi-natural and wetland areas - 8,09%. Residential areas are located in the central and north part of the city, whereas the industrial areas are located in the south. Green areas located mostly

Table 1. Case study rivers general comparison based on Wikipedia

Indicator	Danube	Vltava	Vistula
Length in km	2,860	430	1,047
River discharge in m <sup>3</sup> /s	2,350	149.9	1,080 *
River regulated yes/no	yes	yes	no (semi-natural)
Cross border river yes/now	yes	no	no

Source: by the author

Table 2. Land use/cover as a share of total analysed area (500 m from the river bed) based on Urban Atlas 2006 (EEA)

Indicator	Budapest %	Prague %	Warsaw %
Semi-natural agricultural areas and wetlands	8,09	16,61	23
Residential and commercial areas - very dense (> 80%)	13,25	10,49	6,66
Residential and commercial areas - dense (50% - 80%)	3,3	6,99	1,77
Residential and commercial areas - extensive (10% - 30%)	0,19	0	0,19
Residential and commercial areas - medium density (30% - 50%)	0,7	0,48	0
Residential and commercial areas - very extensive (<10%)	0	0	0
Forests	4,91	5,43	15,24
Green areas	8,46	14,65	10,24
Industrial and commercial areas	16,87	15,88	5,66
Large areas of commercial concentration	0,01	0,09	0,1
Sports and recreation areas	2,41	3,94	4,45

Source: by the author

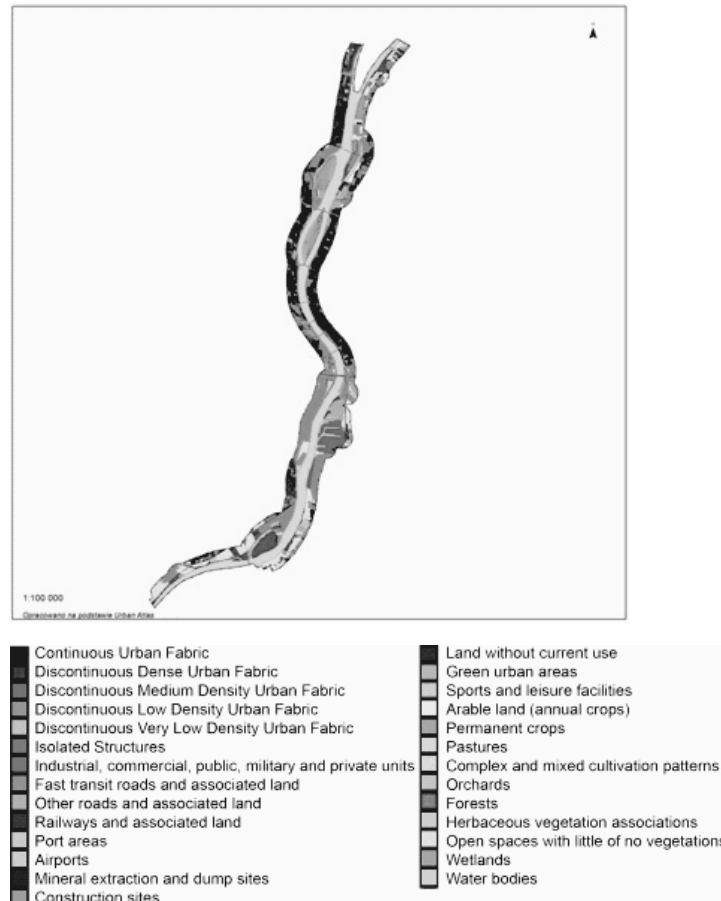


Figure. 1. Land use/cover as a share of total analysed area (500m from the Danube's river bed) based on Urban Atlas 2006 (EEA) Source: by the author

on two river islands in the central part of the city but not at the riverbanks. Semi-natural and wetland areas are located in the south part of the city.

The dominant land-use type in Prague (population: 1,2 mln city area: 496 km<sup>2</sup>) are : residential areas ca. 17,96% and industrial and commercial areas – ca. 15,88%. Forests cover 5.43%, green areas - 14,65%, semi-natural wetlands - 16,61%. Residential areas, as well as industrial and commercial areas are located in the central part of the city. The majority of forests and green areas are located in the north part of the city, semi-natural and wetlands are located in the south part of the city, so the city down is a densely built environment.

The majority of land located at the Vistula riverbanks in Warsaw (population: 1,7 mln city area: 517, 24 km<sup>2</sup>) is covered by semi-natural and wetland areas 23%. Residential areas cover ca. 8,62%, industrial and commercial areas cover ca.5,66%, forest - 15,24%, green areas 10,24%. Residential areas are located in the central part of the city. Contrary to the prior case studies the majority of forests, green areas are located in central and north part of the city directly at the riverbanks. In the south part of the city there are semi-natural and wetland areas.

Further research enabled selecting few examples from the chosen cities which present the process ongoing at the river frontline.

### Hungary

Danube has been regulated in the middle of 19<sup>th</sup> century – not independently of the big flood's lesson. The built supporting wall of the river and the retaining wall of the upper quay defended the city against flood as well. Danube divides the city into two parts: Buda on the right bank (mountainous, old, antique, more calm) and Pest on the left (lowland, modern, vibrant). As mentioned above, the intensive concentration of green areas in Budapest is located on the Danube's islands, especially on Margaret Island. There is a perfectly decorated city park - 85 hectares bathed on all sides by a wide stream of the Danube river, and thus insulated from the big city even though it is located in its downtown. On the island there are hotels, sports facilities (fields, tennis courts, swimming pools), clubs, restaurants, numerous green spaces with bicycle and jogging paths, spacious lawns ideal for picnics, leisure facilities and medieval ruins. In administrative terms the island belongs to the XII district. It was artificially created with three, lying close to each other smaller islands in 1950

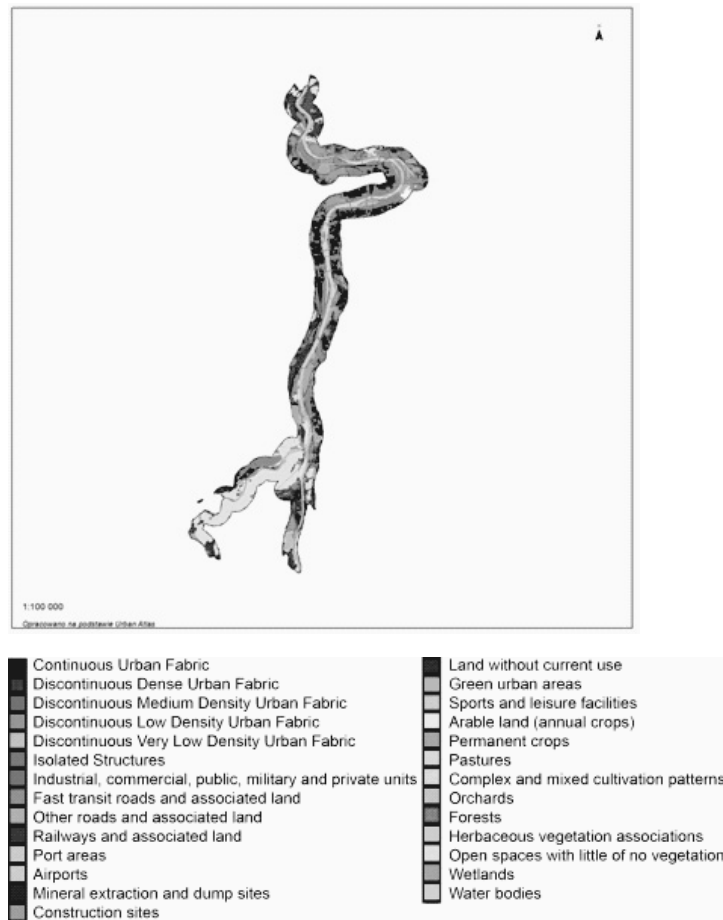


Figure. 2. Land use/cover as a share of total analysed area (500m from the Vlatva's river bed) based on Urban Atlas 2006 (EEA) Source: by the author

during the regulation works of the Danube. It has a 2,5 km long, is 95.6 hectares, and its widest width is 500 m.[ 5]

Riverbanks in Budapest are undergoing a process of transformation that began in the 1990s. The development of certain districts and their transformation from a derelict land into living areas show a linear mechanism of development. The transformation of the district XI (Kelenföld, Lágymányos) and district XIII (Újlipótvaros, Angyalföld) was preceded by a series of treatments. Both districts are located at the Danube river and are relatively close to the city center. In the district XIII metro line 3 was built in 1970, and in XI district two major expressways No. 1 and No. 7, also 3 roads lead to the southern part of Buda and an outer ring road No. 0 were built at that time. These two areas revitalization projects began after 1990.

District XIII Újlipótvaros, Angyalföld consists of two different areas. In the southern part it includes some of the most valuable intensive residential development(Újlipótvaros) raised in the interwar period. The northern part (Angyalföld) was a working-class district and a location of many industrial plants. In 1990-95 the percentage of closed factories in the area (along Váci utca) was the largest in the city. It was followed by conversion of industrial buildings, banks and offices and shopping centers (West End Shop-

ping Centre) by three models: large-scale projects related to the demolition of industrial buildings (banks, new offices, shopping centers); revitalization of existing buildings (furniture and automobile showrooms, restaurants), renovation of buildings. After 2000 there have been created over 2000 new dwellings. In 2006 and 2007 Újlipótvaros and Angyalföld excelled in the statistics in the amount of the newly established buildings in Budapest (mostly intensive housing development). The district's development strategy includes a series of support measures (Studio Metropolitana, 2001, 2007), such as the introduction of taxes free zones for companies that are there or moved there. Thanks to the conservative policy of Budapest city hall building does not allow for the construction of skyscrapers and buildings of poor quality.

The restructuring process of XI district, housing Lágymányos was very similar to what took place Újlipótvaros and Angyalföld. Construction of a new bridge (Lágymányosi) and a new street (Szeremi) in the early 1990s was the impetus for change of land development along the street Budafoki up to the national road No. 6. In the north bridge a new campus of the University and „knowledge park” have been built, which covered 13 hectares and has attracted international companies such as IBM, Hewlett-

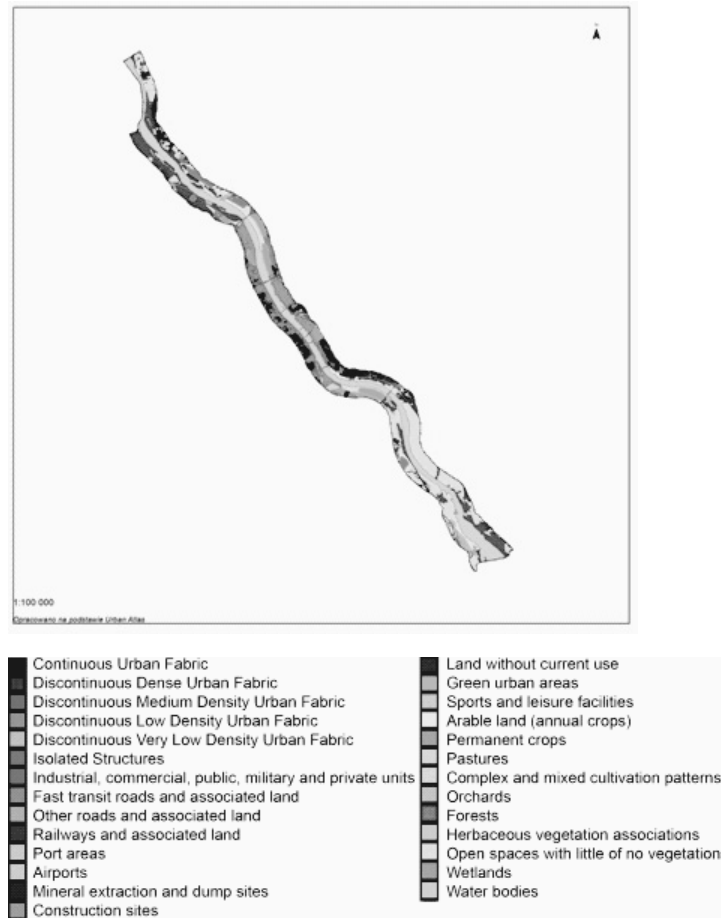


Figure 3. Land use/cover as a share of total analysed area (500m from the Vistula's river bed) based on Urban Atlas 2006 (EEA) Source: by the author

Packard, Panasonic, Pantel, Axelero, Maxell. Infopark Ltd. The park has been built on the principles of public-private partnership. The plots are cast in the lease for 99 years. The new development established in XI district is similar to that in district XIII, with the difference that there is no malls and there is no residential development along the Danube. Housing is implemented at more distant from the river. The linear nature of the restructuring land on the opposite bank of the Danube was initiated by the Hungarian government in the late 1990s (Millenium City Centre). Abandoned railway premises was converted into a mixed-function residential and service area. Flagship projects of the National Theatre and the Palace of Culture became a stimulus of development land along the street Soroksári. [6]

### Czech Republic

Vltava's riverbanks regulation has started in the second half of 19<sup>th</sup> century at Podskalí Quarter. It was when wealthier citizens have constructed buildings up along the embankments, followed shortly by a flowering of art nouveau apartment houses. The timber-rafting houses in the area Under the Rocks were the most architecturally imposing and were concentrated in the long Podskalská (Under the Rocks) Street (approx. 900 metres long), which actually

had one end only, as the other end was formed by the river. The number of timber-rafting houses did not exceed forty. At their backs there were gardens and yards and, where the ground started ascending gently, there were the small houses of artisans and workers. Enclosures with platforms for lifting the logs, which were located across the street towards the river, also belonged to the timber-rafting houses. [7].

Prague, similar to Budapest, is well developed on both sides of the river Vltava. On the left bank there is a castle, while the center-right is bourgeois area - these are the areas of equal rank in the city. In addition, it is well integrated by densely located bridges and buildings close to the river, making Vltava an integral part of the city landscape. Between the Old and New Towns river provides forum sites and allows to admire the panorama of the city. The river banks in Prague are mostly built, but they are small islands that are a good place to water ski equipment, sporting, recreational and playground equipment. Prague has 10 different islands, for example: Słowiańska and Strzelecka that allow to rest from the urban bustle at Vltava River. They constitute the most green areas of Prague [8]. Along the Vltava River has also led a greenway bicycle route, leading from the north (of Troy) to the south (to Modran) [8]. On the island around the National Theatre hosts concerts

under the open sky. Quite a large island Stavnice is a sports and entertainment area. By contrast, descending to the river Letna hill opposite the Old Town decorated park, with panoramic views of the entire city

In the early 20th century, residential development along the river gave way to industry. In 1918, about 70 percent of the Austro-Hungarian empire's industry was in the Czech regions, which had become a factory for textiles, glass, shoes, sugar, and porcelain. In the 1920s, Czechoslovakia had the 10th highest industrial output per capita in the world. In addition, war time imposed arms production and mechanical engineering there. By World War II, numerous industrial buildings had appeared on the banks of the Vltava.[ 9]

After World War II, many factories, with their attendant pollution, were located by rivers. As the communists gave way to the Velvet Revolution, so, too, did heavy industry give way to light industry. The CKD (state engineering company) exported its large, heavy products such as cranes, locomotives, and trams on ships on the Vltava for decades. These days, the industry structure has transformed from heavy to lighter branches of industry. Under communism, the water was intensely polluted by heavy industry, which wasn't helped by the city's inefficient water treatment plants. Meanwhile, the government was investing money into tall apartment complexes on the outskirts of the city and neglecting to invest in adequate flood protection measures. Vltava became then just a channel for effluent or a barrier to be crossed on a bridge. After 1989, a similar time to Hungarian case, the situation slowly began to change. The city made a major investment into a new water treatment system. That and the phase-out of heavy industry led to an improvement in water quality. Nowadays, fishermen find that new species are returning to the river.

In the Karlin district, once home to factories and cheap workers' housing, old buildings have been renovated since the floods into offices and multi-use spaces. The Karlin theater, a large hall for musicals and operettas, was modernized after the 2002 flood. It has encouraged developers to invest at the riverside, especially the heavily flood-damaged districts of Karlin, Liben, and Holesovice. Among major projects planned or under way are the 340-apartment Prague Marina; from 150 to 200 apartments, along with shops and offices, on Rohansky Island; and The Dock.[9]

### Poland

The first regulation draft of the Vistula River in Warsaw was prepared in 1873 by engineer Kostanecki and conducted in the years 1884 -1889 in the area of the proposed water intake. 1910 there was carried out regulation of the section of Wilanow Kierbedzia Bridge. Another regulations draft were developed the years 1960-1970. Installation of cross-channel system caused narrowing of the river. The first short lengths of shafts were built in the first half of the nineteenth century, but only in the 70s of the twentieth

century was Warsaw's embankment system was completed. As a result of the construction the riverbed was narrowed to 450-500 meters in the city downtown.

Right-bank part of the city – Praga district, it was initially disproportionately small, and later disproportionately neglected compared to the left-bank part. Despite the expansion of residential areas at Praga district, there haven't been any balance, as the left river side was always more convenient situated on the hill and richer area. Another problem of the city was not to many bridge connections. It is important that the Warsaw bridges do not connect the beaches but areas far from the coast, because of irregular water level. As a result, cars are moving away from the coast, so the two parts of the city are not integrated with each other. The natural conditions on the Vistula give Warsaw great landscapes: the river is wide, one embankments is on the hill, the other is flat. In Warsaw, there are good natural conditions for recreational use of the river due to the width of the mainstream. Right Bank closed off sections of the small centres is left in a state of savagery, neglected and not used. [10]

To modernize the left bank in the 70s and 80s there were built specific concrete stairs from the water intake filters to areas of the „Spójnia” club. However, in the 70s Vistula deserted. The promotion of road transport resulted in almost complete elimination of inland navigation on the Vistula. With the withdrawal of steamships ended a cruise shipping. There were only cruises conducted by motorized vessels.

Right river side hasn't been used for navigation. It was not until the interwar period, when Port of Prague has been constructed. Right river bank was always a sand bank, that in 19<sup>th</sup> century began slowly to change into riverside beaches with a place to rest for the inhabitants of Warsaw. After that there were water sportsmen clubs appeared there. In the 60s of the twentieth century a swimming pool complex was built. Beaches on the right bank were also in the postwar period. Unfortunately, the increasing pollution of the Vistula River led to the introduction in the '70s bathing prohibition in the river. Which in turn discouraged the residents of Warsaw to visit the area. In the 80s, the beaches have begun increasingly overgrown which was the result of negligence in the management of the river. In this way, during last 30 years, there have appeared almost in the center of Warsaw a wild riparian forest typical of the floodplains of rivers in the lowlands of Europe. This area has also become a place to live for many wild animals, especially birds. Some of them are protected species. When an idea to restore the Vistula Warsaw also appeared the problem of how to develop the Prague wild shore. Excision of trees has met with opposition from organizations involved in nature conservation.

Finally, the whole right river bank was covered by 'Natura 2000' valuable space for nature. Trees typical of riparian areas have been decided to be remained, the others with bushes were removed. It was decided also that a walk-

cycle path would be constructed through the floodplains. The path has a natural surface. Instead of concrete curbs it was decided to build its banks with fascines. The impetus to develop land at the Vistula were European football Championship 2012. The compromise between the requirements of environmental protection and the needs of the city led to development of a project that in fact consisted of three concepts that have been developed into variants. Those options differ in the approach to river morphology. The most 'invasive' option W2 involves widening the riverbed. This option also envisages the development of the edges and wharves. It distinguishes 3 node areas: Węzeł Saska Kępa, Węzeł Stadion Narodowy and Węzeł ZOO and Prague Park at the right river bank. Left riverfront is planned to develop on a linear way in a form of a boulevard.[11]

## Discussion and Conclusions

Regulation works have taken place at the 3 analysed venues in a similar period. However, Vistula has been only partially regulated. It resulted into preserving a great area of green land (whole right river bank) within the borders of the city. It seems that Warsaw is the real green river city, as the dominant land-use types at the riverbeds are forests, sports and recreational areas, green areas and semi-natural and wetland areas. Moreover those types of greenery open areas are located at the riverfronts in the city centre. It is a unique situation in comparison to Budapest in Prague. Budapest and Prague have concrete embankments developed in different types of build environment.

Another point that differs those 3 locations in linear type of development in Prague and Budapest whereas in Warsaw the only possible way to develop right river bank is creating nodes. Only a certain part of the left river bank is developed in a linear way. Budapest has been modernized by the development of whole districts (district XI, XIII), Prague as well was changing in a huge scale projects. Warsaw case, especially its right river bank situation, shows that small interventions and only low-cost and low-tech solutions implemented there can also stimulated people to return to the river.

The main differences between the case studies are in the amount of green spaces at the river frontline. Warsaw is the leader in the amount of forests and semi-natural, wetlands areas.

Warsaw should preserve its green river capital (its right riverbank) as it would help to create a resilient landscape within the city downtown. This is as a unique instance among other Eastern European capital cities. The structure of land development types shows that right river bank in Warsaw is a great and an exceptional city semi-natural landscape which should be preserved and protected. Semi-natural character of the river bed seems to eliminate the linear way of development of the river bank. Development based on creating certain points ensures the preservation of the great areas of natural habitats. On the other hand Budapest and Prague are examples of build riverbanks where the only greenery areas could be implemented in a scale of a city park, contrary to Warsaw where whole riverfront area could be treated almost as a separate green district. The result of the study is a conclusion that preserving the green character of the area is a better solution for the city than the traditional river regulation forms, as it could help eliminate the climate change effects by the nature means in the city downtown. The forthcoming evidence is the fact that cities, which lost their greenery along the riverbeds, try to bring them back what is clear in their policy management procedures. The first steps are converting often industrial used areas in to living residential estates. The next steps would be trying to create friendly climate for the inhabitants to live in by creating attractive green public spaces. Warsaw case study shows that green public space is already in the city centre. The only thing to do is ensure good quality outdoor infrastructure for the users.

The research showed that Eastern European cities have not developed long-term strategies concerning rivers' frontline yet. Warsaw is only by accident following the main direction taken by Western European cities in reference to the large-scale green waterfronts' areas. Prague and Budapest are at the beginning of their path to a sustainable land use at the river.

Green spaces' research was defined here rather narrowly based on Urban Atlas classification. However, this tool is used in research initiatives concerning similar issues [12]. Herein it was enough to show the dominant character of the water front. Comparative analysis with a different threshold value has been conducted using 1500 m distance from the riverbed. However, the differences in the results compared to 500 m were insignificant.

Table 3. Comparison of the green spaces located in chosen cities within 500m distance from each site of the riverbeds

Land use type [%]	Warsaw	Budapest	Prague
Forests	15,24	4,91	5,43
Other green areas	10,24	8,46	14,65
Semi-natural areas and wetlands	23,00	8,09	16,61
Total	52,93	23,87	40,64
Buildings	8,62	17,44	17,96

Source: by the author

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