Modern embankments of minor rivers on the example of the Belgorod region's cities

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Abstract. The article considers the problem of creating a comfortable recreational space in degraded riverside territories. The author analyzes the experience of the embankments’ reconstruction of the Belgorod region, identifies priority directions in the development of the territory improvement projects. The article provides examples of new attractive, comfortable, and functionally developed embankments in the Belgorod region’s cities. The creation of which was and is being carried out on previously degraded riverside territories, which contributes to improving the level and quality of the population’s life, as well as attracting visitors to the city.

1. Introduction
A city is a complex structure in which the hydrosphere, atmosphere, flora and fauna, relief, soils, etc. are currently undergoing significant changes due to poor environmental conditions. They affect the main indicators of the natural environment characteristic of a given region, making various changes, and generating natural elements that are not typical for this terrain or, on the contrary, destroy them. As a result, a whole range of environmental problems arise, one of which is the problem of minor rivers and riverside territories in cities. After all, the active development and building of riverside territories in many cities affect almost all components of the natural environment. Foreign experience shows how riverside territories, turned into parks and biotopes, contribute to the maintenance of the natural ecological environment [1].

Many Russian cities have watercourses of various sizes, profiles, and character on their territory. Most of them experience man-made impacts. There are often contradictions over the use of such territories [2]. If major rivers and lakes have a sufficiently large potential and a significant degree of stability and self-regulation to various types of impacts, then along with them there are small watercourses, that are completely dependent on the operational and urban planning policies of cities. At the same time, small rivers, lakes, and ponds play an important role in forming the structure, image and microclimate of a quarter, residential group, or urban area [3]. The riverside areas of such water reservoirs can become wonderful new recreational areas for residents and guests of the city.

Minor rivers are one of the main landscape components of great ecological significance. Water resources of minor rivers, as part of the total water resources, are important factors in the placement of productive forces and the socio-economic development of society [4].

Almost all minor rivers in cities have significant resource potential. On the riverside territories, the policy of improving recreational areas, green, walking and sports zones, places of mass recreation and tourism is currently actively developing [5]. Improving the aesthetic components of the urban
environment and creating its unique image can develop the tourism sphere, increase the level of the economy and incoming investment in the city and its facilities from the outside [6].

2. Materials and methods.  
The theoretical and methodological basis is an ecosystem approach focused on process management based on the biosphere compatibility principles [7]. The main principle of the ecosystem approach to environmental management is predetermined by the interconnection of processes and phenomena in nature. This makes it possible to identify the interest and need of participants in urban planning activities, draw up legal requirements for preventing and avoiding any harm to natural objects and the environment.

3. Results and discussions.  
Analysis of the riverside territories’ condition, as well as steps for their development and restoration, were carried out on the example of three rivers in the Belgorod region: Vezelka, Vorskla, Nezhegol. Several acute problems were found in all three territories: the lack of well-equipped public spaces along the rivers, connections between green spaces, and there were practically no approaches to the rivers. This is affected by the impact of degrading industrial zones, as well as parking and garages.

Since 2017 to 2020 these coastal zones were reconstructed as part of the federal program for the embankments’ improvement.

In 2017, the reconstruction of part of the Vezelka river embankment in Belgorod city was included in two federal programs at once: "Formation of a comfortable urban environment" and a project to organize public spaces for watching World Cup matches in 2018.

The chosen territory is located in the central part of the city. Important social, cultural and historical sites are located nearby: Victory Park, museum-diorama "Battle of Kursk. Belgorod direction", local lore museum, art museum, drama theatre named after M. S. Shchepkin, etc.

"Strelka" consulting bureau was engaged in the upgrading project’s development. The main objectives in developing this project were not only the creation of fan zones for the World Cup, but also the creation of a comprehensive improvement of the Victory Park’s land, taking into account the interests of those groups that visited it. Before the reconstruction, the embankment consisted of several separate and uncomfortable parts. As a result of the project implementation, these territories were merged into a single whole, and walking routes and bike tracks were created connecting different banks of the river. The embankment was divided into several thematic blocks:

1. The zone of mass public visiting with the focus on family and children’s recreation. The central section of the Victory Park has been allocated for it, as well as the territory near the children’s park "Kotofey".
2. The zone located near Belgorod State University, focused on students.
3. A calm recreation zone with aesthetically attractive landscapes, located near the museum-diorama’s territory.

Also, the following functional zones were identified in this project: 1- student embankment; 2-central embankment; 3- memorable embankment; 4- industrial embankment (figure 1).
In addition to these zones, taking into account the interests of citizens, special dog walking grounds, children’s and sports grounds were designed and equipped. In picturesque places located in close proximity to the water, "contact" zones that resemble fishing bridges were equipped. Along the river, where there was once a steep descent to the water reservoir, equipped seating areas have appeared, competently distributed in several tiers up the relief. Organizing this recreational area, the following principle was strictly adhered to: recreation and tourism objects should be designed as objects that are organically included in the natural landscape, but in no case changing it [8].

 Mandatory for implementation were: planting additional greenery (coniferous trees, various shrubs and herbs), creating bright species flowerbeds, cleaning water areas and installing a new drainage system (because in recent years, due to ground water, the territory of the Victory Park began to turn into a swamp). The improvement of the embankment in the Victory Park was completed before the 2018 FIFA World Cup.

 At the moment, the reconstruction of the Vezelka river embankment in Belgorod has already been completed. All conducted measures were able not only to transform the embankment and form a new community center, but also to have a great positive impact on the river’s state and coastal areas.

 In 2019, Graivoron city of the Belgorod region won the all-Russian competition “Towns and historical settlements” with the project of reconstruction of the Vorskla river embankment in the park “Petrovskaya steep”.

 The territory with an area of 4.6 Ha was improved in 4 months. During the renovation works, several asphalt rings (with a total length of more than 3 km) were laid, which are ski-roller, bicycle and walking routes. An amphitheater 53 m long and 13 m wide was installed above the river. The main structures installed in Petrovskaya steep correspond to the eco-trend. The amphitheater, playground, benches and even urns are made of natural materials.

 The Vorskla river embankment is divided into several functional zones: 1-walking zone, 2-beach, 3-festival zone, 4- entrance zone, 5- active recreation zone, 6- calm recreation zone, 7- islands, 8- forest park zone (figure 2).

 More than 1 400 different trees and shrubs were planted on the territory of the new embankment. In order to admire green spaces on the park’s territory all year round, experts planted more than 200 different tree species: linden, birch, spruce, pine, etc.
Figure 2. Functional zoning scheme of Vorskla river embankment in Graivoron.

The well-organized embankment of the Vorskla river in the park "Petrovskaya steep" has become a new public and recreational center of Graivoron.

In 2020, the project for the improvement of the Nezhegol river embankment in Shebekino won the all-Russian competition for the best projects for creating a comfortable urban environment in towns and historical settlements.

Shebekino has a complex functional structure due to the presence of a large number of industrial facilities, and storehouse and public utilities zones located dispersed throughout the city [9]. In the central part, there is a lot of badly organized zones for long or short term stay of citizens. The most common problems of riverside territories include: ecological, geological, degradation of part of natural territories, lack of a clear communication framework, divergence of interests of different user groups, incongruity of the functional organization of riverside territories with the modern context of the city [10].

The administration of Shebekino decided to put in order the central part of the city and the Nezhegol river embankment, thereby solving many of the urgent issues. Reconstruction of the coastal zone will be made from Likhachev St. to 50th anniversary of October St. This is the central part and the landmark of the city. The improvement will affect the territory with a length of 694 m and an area of about 3 ha, and the residents themselves chose a site for it. The project creators considered all the wishes of local residents. Trees and shoreline that exist now will be preserved as much as possible, but green spaces will be added. The main idea of the project according to the authors’ idea will be the creation of a public space surrounded by picturesque nature using a unique landscape.

The objectives of this project are: 1) creation of attractive urban spaces that contribute to improving the level and quality of life, as well as attracting visitors to the city; 2) development of the service industry by stimulating the development of small and medium-sized enterprises; 3) improvement of the positive image of the urban district.

Nezhegol river embankment is divided into the following functional zones: 1- entrance zone with cafes, 2- landscape park with walking areas and equipped recreation areas, 3- promenade with bike paths and viewing platforms, 4- mass event zone (festival park), 5- city beach, 6- boat pier, 7- park of generations, 8- youth cultural center square, 9- forest park, 10- arboretum (figure 3).
Figure 3. Functional zoning scheme of the Nezhegol river embankment.

Today, social and environmental factors of the formation of an architectural environment are of particular importance, which meet the tasks of "green" construction and are currently being actively developed all over the world [11]. In this regard, during the design and construction of the considered objects for the reconstruction of river embankments: the Vezelka river (Belgorod), the Nezhegol river (Shebekino) and the Voskla river (Graivoron), much attention was paid to the citizens’ opinion and their wishes for the improvement of territories.

All the studied embankments are located in an urban environment, but despite the differences in their location and the initial degree of improvement, it is possible to identify functional zones characteristic of all and compare them. The comparison results are shown in table 1.

| Functional zone                          | Belgorod | Shebekino | Graivoron |
|------------------------------------------|----------|-----------|-----------|
| Entrance zone                            | yes      | yes       | yes       |
| Transit zone                             | yes      | yes       | insufficient |
| Calm recreation zone with bike and walking paths | extended | insignificant | insignificant |
| Active recreation zone                    | yes      | yes       | yes       |
| Mass event zone                          | included in another zone | separate | separate |
| Beach zone                               | yes      | yes       | yes       |
| Water objects (bridges, piers, etc.)     | yes, but not enough | yes, but not enough | sufficiently |
| Accessibility (availability of parking, stops, etc.) | insufficient | good | good |
| Shoreline                                | extended | extended | extended |

4. Conclusion
Trends of development in many Russian cities are currently aimed at creating favorable conditions for the eco-reconstruction of urban spaces [5]. Without a competent approach to the organization of an ecologically friendly environment, without a rational arrangement and implementation of green zones in the planning schemes of cities and suburbs, there can be no "smart" and, most importantly, safe city for the human life [12].
Riverbanks are extremely valuable both ecologically and for the organization of recreational areas. Due to the large number of economic and residential developments near rivers, there are many conflicts over the use of coastal territories. Open public spaces are the most important element of the city's planning structure, as they primarily characterize the quality of the population’s life as a whole, reflect the level of development of social and cultural infrastructure, and form the overall city image.

The article provides examples of new attractive, comfortable, and functionally developed embankments in the Belgorod region’s cities. The creation of which was and is being carried out on previously degraded riverside territories, which contributes to improving the level and quality of the population’s life, as well as attracting visitors to the city.

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