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A.E. Semina¹, S.V. Maximova²¹Postgraduate student²Doctor of Technical Sciences, Professor, Perm National Research Polytechnic University,
29 Komsomolsky Pr., Perm, 614990, Russian Federation
e-mail: semina.ae@yandex.ru, svetlana-maximova@yandex.ru**ECOLOGICAL CORRIDORS' MORPHOLOGY
INSIDE THE URBAN STRUCTURE IN FORMING
THE ENVIRONMENTAL FRAME OF THE CITY**

Abstract: Ecological corridors are one of important parts of the city's ecological framework. Usually, the ecological corridor is a valley of small rivers or ravine that cross the city and occupy substantial areas. Small rivers and ravines are inappropriate territories for development; consequently growing city ignores these territories. As a result, ecological corridors become neglected and abandoned. Historical analysis of the city plans of Perm discovered that the interaction of the valleys of small rivers with the surrounding urban areas has historically changed. There are several periods of these changes: development of the city on both banks of a small river, extensive use for gardening, degradation. The urban status of small rivers' valleys is also changing. At the beginning it was the territory in the city's periphery (1797), nowadays it is the ecological resource inside the city with the preserved ecosystem which is exposed to strong anthropogenic impact (2017). The understanding of identity and diversity of the territories adjoined to these ecological corridors and different options for their use could be the possibility for transformation and changing of the situation. This paper describes the typology of the territories forming the ecological corridors, the typology of the surrounding and adjacent buildings, and types of their interaction. All of these are defined through the natural survey and the analysis of urban codes and plans. The recommendations for each morphotype of the river valley and ravines which are located in different options in the urban structure depend on the different scales of design, urban situation, and greenery area typology. The results of the morphological analysis of elementary residential planning units of the modern city can be used for the prediction of their future development.

Keywords: ecological corridor, landscape morphotype, river valley, ecological framework, areas interaction, urban structure.

In the history of urban planning there are three periods of forming ideas of natural environment integration into the city structure. The first period is characterized by regular geometrical forms of green spaces (Gorokhov, 1991). This period began with the development of cities. The city was considered on its own without taking into account the external environment (Vyatkina, 2012).

The period of formation of industrial centers in cities was the next period of shaping the idea of integrating natural environment into urban structure. This was a starting point for the city green systems development. Such systems linked green spaces inside the city with greenery around the city, together with creation of buffer zones, green belts, and green wedges to protect the city from industry influence (Lemes de Oliveira, 2104).

The last third period is the integrated approach to the design of a green spaces' network.

In some papers, the idea of creating holistic natural landscape-improvement systems was expressed (Glazychev, 1984; Gorodkov, 2000; Khromov, 1987; Pivkin, 1997; etc.). There are several definitions of the city green system. It varies in different countries: ecological network, national trust, nature environment development network, etc. For Russia the definitions "natural frame" or "ecological frame" are common.

The natural frame is a complex system of interconnected natural components. Such system gives analytical and systematized information about the quality and significance of natural and nature-like territorial complexes.

The ecological frame is a certain set and spatial combination of natural and cultural landscapes that ensure the ecological stability of the territory of the appropriate level.

Despite the difference in definitions, we can distinguish that the natural-ecological frame is a spatial structure, applying its functions according to the functions and significance of the elements. These elements can be of two types: area (large-scale and point) and linear (Gridnev, 2011).

Area elements are the points of ecological activity. They play the role of biodiversity safety and create conditions for recreation in the city structure. Linear elements are buffer zones or links between areas. As usual, linear natural elements are valleys of small rivers or beam-ravine system (Lagunov, 2014).

Moreover, there are several types of ecological frame territories depending on their location in the ecological frame structure such as key areas (having environmental value, specially protected natural territories), transit areas (ecological links between key areas, usually ecological corridors) and buffer areas (protective, usually having the status of security zones).

Currently, specially protected natural areas are legalized in Perm. The system of specially protected territories is the key to the formation of the natural frame.

The valley of the Kama River forms the landscape of the city of Perm. The main element of the left-bank part is a protruding ridge, from which streams flow, forming the hydrographic network of the city, i.e. a system of small rivers and streams (KCAP, 2010). As a rule, ravines are the valleys of small rivers and streams.

We can define three stages in the formation of relations between the city of Perm and the valleys of small rivers (Fig. 1): The city in the floodplain of the river. Perm was founded in the flood plain of the Yegoshikha River because of the construction of the Yegoshikhinsky Copper Smelting Plant. The rivers of Danilikha and Yegoshikha were perceived as resources on the periphery, they were like natural environment territories (inconveniences) which are limiting the growth of the city. At the second stage, after the city “stepped over” uncomfortable ravines, valleys of small rivers became for the city the natural environment territories within the urbanized ones. The valleys were given new functions. It was a stage of transformation of the valleys for garden plots and dachas, as well as recreation. Residents of the city realized the potential of these territories and, paying tribute to history, used slopes for building cottages with gardens for growing vegetables and fruits there.

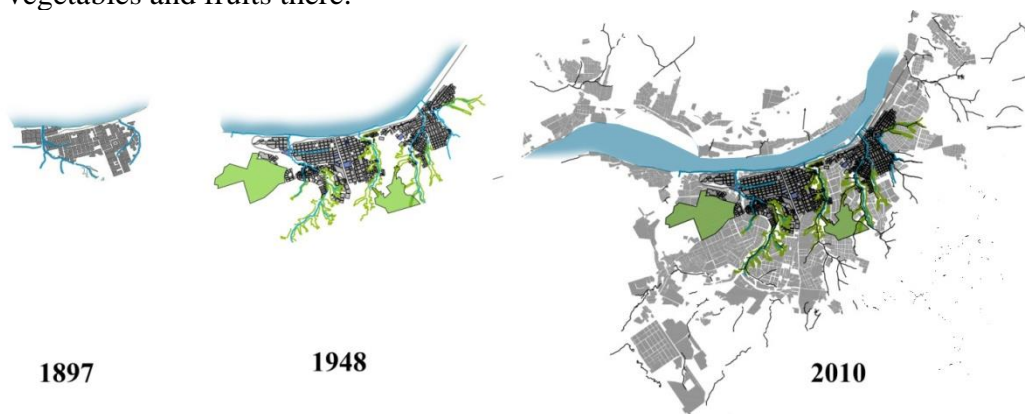


Figure 1. Structure of Perm in different periods. Gray – built area; blue – river; green – city forest

The next stage (which is still in process nowadays) is characterized by degradation of the territories of river valleys. The garden plots are abandoned, some fruit trees are partially preserved, but spontaneous overgrowth occurs more and more.

The ravine valleys have once again become unsuitable territories for the city (Baitelova, 2017). Because of the city growth and the development of the transport network, the city needs to overcome valleys. To travel from one area of the city to another, one needs to get across several ravines at once, through which road bridges are provided. There is no infrastructure for pedestrians, there are no officially constructed pedestrian bridges (not counting those made by volunteers). In addition, given the steep nature of the small river valleys slopes, people prefer not to descend into the valley, but cross the valley by car bridges, spending more time. As a consequence, the lack of daily use has resulted in neglecting the valleys of small rivers in the central part of the city.

The absence of legal consolidation of the boundaries of small rivers led to construction on the slopes, which negatively affects the ecological state and exposes the existence of a small river.



Figure 2. Relief type of the Yegoshikha river valley.
Height difference up to 30 meters, more in the left bank

Small rivers of Perm were not designated in official documents of the executive authorities until 2018. In the water register and the state cadastre of real estate, only large water objects were defined. However, urban activists have made it possible to include the territories of the river valleys in the rules of land use and development. The boundaries of regulation are now designated by the water protection zone of the river valley.

This is a great victory for the activists of the city of Perm. However, this approach does not take into account the nature of the relationship between the ravine and the surrounding territory.

Speaking about the morphology of valleys and ravines, it is necessary to note the peculiarity of coastal territories as linear objects, which consist of alternating different types of ownership, and accordingly different types of use of plots. This intersection was noted by Litvinov for the coastal territories of large rivers, but this functional imbalance (Litvinov, 2009) is also evident in the valleys of small rivers (Fig. 3).



Figure 3. Functional imbalance (cadastre map base).
Part of the Yegoshikha river.

The ravine system is characterized by the presence of an edge, which is a border area formed according to special principles. The edges define where the urbanized area ends and the valley begins, which requires special regulation.

For the river valley, there are several zones that form its landscape (Fig. 4):

1. Observation points.
2. Slopes.
3. The territory near the water.



Figure 4. The Yegoshikha river. Zones of river valley

In the strategic master plan of Perm (2010), the observation points are defined as capes. The cape is the extreme part of the plateau which goes into the valley, from which the widest view opens. Such observation points should have the strongest connection with the adjacent territory and serve as a popularizer of the recreational area of the ravine. This will allow to open valleys for visitors and develop a proper infrastructure.

As mentioned above, slopes can have different functions. These are either empty territories, or planted and overgrown with trees and bushes, or built-up. If the slope is low-grade, there is a threat of construction of high-rise buildings. Since access to the valley is better on this type of slope, anthropogenic pressure increases in such a place. (Kuznetsova, 2017).

The territory near the water is an ecological zone defined as the water protection area. This is the territory of flooding.

Morphology of river valleys is in close connection with adjacent territories. It could be built-up plots and free open spaces. The functions of the built-up areas include public, educational, residential and industrial buildings. Based on the field surveys, it can be concluded that nowadays for all types of built-up areas, the river valley is a back yard, which must be closed and hidden. As a rule, there are no entrances to the buildings from the side of the river valley. It happens quite often that the viewing points and edges of the valleys are closed by garages and secondary buildings. Such buildings in most cases are illegal or result from squatter development.

Public and residential buildings on the edge create opportunities for interaction between the adjacent built-up area and the recreational territory of the valley. However, there are no places where such interaction exists in Perm. Valleys are not considered by locals as a recreational territory where one can spend time.

Conclusion

Transformation of inconvenient areas of ecological corridors could begin with the identification of places for interaction between river valleys and adjacent territories, as well as observation points. Such places have the greatest potential for development in the near future.

Parts of ecological corridors should be included in the network of green areas of the city. River valleys may not have citywide significance, but also be places of recreation of district or micro district (local) value. Depending on the buildings on the edge, gullies are included in the green network of a block, district or city.

In the areas where the valley of the river adjoins undeveloped territories, and in itself is in a natural state and remains undeveloped, it needs additional regulation of activities in order to preserve biodiversity.

In the case of a built-up edge, first of all it is necessary to clearly define the limit of the edge. “Zone of responsibility” and natural area have to be designated and need to have limit of construction.

Identifying places for possible transit pedestrian flows and improving them could also positively influence the attitude of residents to these territories, and hence, after the development of these territories they will treat them as valuable for the city.

Such changes in attitude and status will entail a process of transformation, improvement of the ecological situation and environmental background in the city as a whole.

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