

# «Green infrastructure» of urbanized territories

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**Abstract.** Currently, there is a process of spatial concentration of the population and the spread of urban lifestyle, which inevitably leads to the expansion of the boundaries of cities and their sphere of influence, an increase in the diversity of activities. In this regard, the creation and maintenance of a comfortable urban environment of a megalopolis is becoming an increasingly urgent managerial task. The decisive factors in supporting urbanized territories in a comfortable state for living are the objects of "green" infrastructure. One of the important issues, at the same time, is the information support of the management system for the territories of land plots with green spaces.

## 1 Introduction

Urbanization as a process of spatial concentration of the urban population and the spread of the urban lifestyle inevitably leads to an increase in the diversity and complexity of infrastructures, the concentration and intensification of production, differentiation and an increase in the diversity of urban activities. In this regard, the creation and maintenance of a comfortable urban environment of a megalopolis is becoming an increasingly urgent managerial task [1]. Urbanization as a natural-historical process has led to the emergence of a wide range of problems, the analysis and evaluation of which becomes the main content of designing the infrastructure of a modern city. The decisive factors in supporting urbanized territories in a comfortable state for living are the objects of "green" infrastructure. "Green" infrastructure in general is a strategically planned network of natural territories with developed and managed innovative processes for creating a comfortable urban environment. One of the important issues, at the same time, is the information support of the management system for the territories of land plots with green spaces [2].

## 2 Materials and Methods

Mechanisms for the development of a comfortable urban environment in urbanized territories are currently supported by national projects and departmental projects of the government of the Russian Federation [3-5].

Let's consider the main terms and definitions from the regulatory and technical documentation on the essence of the issue under study. The formation of land plots is considered in the Land Code of the Russian Federation [6, Article 11.2.]. The concept of

public land plots is fixed in the Civil Code of the Russian Federation [7, Article 262]. In the Urban Planning Code, the term public use territories is disclosed [8]. In SP 42.13330.2016, the following concepts are considered: "natural object", "green zone", "green areas" [9]. The Housing Code of the Russian Federation [10, Article 36] establishes the right of ownership of common property in an apartment building (MCD), including the land plot where the MCD object is located, including elements of landscaping and landscaping.

Legislative acts of federal cities (Moscow, St. Petersburg and Sevastopol [11, article 65], [12]) and the accumulated experience of these cities in the field of preservation and accounting of green areas are of no small importance for the development of other regions of the Russian Federation. Table 1 presents a list and names of documents reflecting the policy of municipalities of the largest megacities of the Russian Federation regarding the conservation and development of green areas. As can be seen from the table, the law of St. Petersburg [11] introduces the concept of "territory of public green spaces", which does not contradict and is consistent with the above definitions of "public land" and "green areas".

**Table 1.**

| Разработанные документы  | Установленные приоритеты  |
|--|---|
| "About public green spaces". St. Petersburg <a href="http://docs.cntd.ru/document/8458668">http://docs.cntd.ru/document/8458668</a>                            | The list and borders of territories of green zones of general use are established [11].   |
| "On the protection of green spaces" the law of the city of Moscow. <a href="http://docs.cntd.ru/document/901734936">http://docs.cntd.ru/document/901734936</a> | The registration of green spaces is carried out in accordance with the procedure established by the Government of Moscow. For the purposes of accounting, a register of green spaces is created [12]. |
| The concept of the development of green public spaces of citywide significance "Green Novosibirsk".  | "Formation of a comfortable urban environment" [13] in Novosibirsk for 2018-2022  |

Thus, the object under consideration "territory of public green spaces" has all the characteristics of a real estate object, is subject to cadastral registration and registration of ownership rights in the EGRN [14].

As a result of the conducted research, the authors propose to make changes for the classification of types of permitted use of land plots in the section public land plots as an addition with the code 12.0.3. "Public green spaces". This type of permitted use uniquely and holistically characterizes the territories of green spaces of general use, which are territories (land plots) of general use. This classification is also necessary for the preservation and development of valuable natural territories, for the placement of recreation and recreation facilities, entertainment within urban areas.

The development of urbanized territories in our country is due to the current national project "Housing and the urban Environment" and activities within the framework of the federal project "Formation of a comfortable urban environment" [2]. In 2019, the methodology for forming the urban environment quality index was developed and approved. The list of indicators includes indicators: "The level of landscaping" and "The state of green spaces". A unified methodology has not yet been developed for calculating these indicators, so the analysis and generalization of experience, the choice of software is an urgent and timely task. According to the results of decryption and interpretation of satellite images of open access, such indicators as "The level of landscaping" and "The State of landscaping" are determined. The quantitative assessment of these indicators is made by calculating the vegetation index NDVI (Normalized Difference Vegetation Index), as the share of the territory with planted areas of increased biomass density in the total area of landscaping of

the city. The method of calculating the NDVI indicator is one of the research goals of this work. The features of the implementation and calculation of the NDVI indicator value in individual GIS (ArcGIS, SAGA, GRASS, ENVI, ERDAS IMAGINE) were analyzed. To analyze the changes in the NDVI index, Sentinel-2 L1C, Vegetation Indices satellite data were taken for two seasons, from 2018 to 2019. It was found that for the studied territory, the trend of changing the index values is the same from 0.45-0.55 in June to 0.58-0.6 in July. The obtained data can be used to calculate the threshold value of the calculated score of the indicator "state of green spaces». Assessment of the current level of comfort of the urban environment using the indicators "level of landscaping" and "state of green spaces", etc. it allows you to form and predict the development of a megapolis as a "single organism" capable of maintaining optimal parameters that ensure the normal functioning of each of its inhabitants in harmony with the urban environment. The orderly formation of a system of evaluation indicators of a comfortable urban environment, of course, increases the efficiency and attractiveness of investing investment resources in the development of "green" infrastructure facilities.

### **3 Results and Discussion**

The development of urbanized territories in our country is due to the current national project "Housing and the urban Environment" and activities within the framework of the federal project "Formation of a comfortable urban environment" [2]. In 2019, the methodology for forming the urban environment quality index was developed and approved. The list of indicators includes indicators: "The level of landscaping" and "The state of green spaces". A unified methodology has not yet been developed for calculating these indicators, so the analysis and generalization of experience, the choice of software is an urgent and timely task. According to the results of decryption and interpretation of satellite images of open access, such indicators as "The level of landscaping" and "The State of landscaping «are determined. The quantitative assessment of these indicators is made by calculating the vegetation index NDVI (Normalized Difference Vegetation Index), as the share of the territory with planted areas of increased biomass density in the total area of landscaping of the city [17]. The method of calculating the NDVI indicator is one of the research goals of this work. The features of the implementation and calculation of the NDVI indicator value in individual GIS (ArcGIS, SAGA, GRASS, ENVI, ERDAS IMAGINE) were analyzed. To analyze the changes in the NDVI index, Sentinel-2 L1C, Vegetation Indices satellite data were taken for two seasons, from 2018 to 2019. It was found that for the studied territory, the trend of changing the index values is the same from 0.45-0.55 in June to 0.58-0.6 in July. The obtained data can be used to calculate the threshold value of the calculated score of the indicator "state of green spaces". Thus, the most important factors in supporting urbanized territories in a comfortable state for living are the objects of "green" infrastructure. For objective technical and cadastral accounting of "green infrastructure" objects, there is a need for a more in-depth study of the classifier of types of permitted use of public territories. To date, there are no questions about the need for surveying for cadastral registration of land plots of public green spaces and entering information into the unified state register, but the indication of the type of permitted use should be carried out according to the results of the actual purpose of the object, to exclude errors in state cadastral accounting [18,19]. The established status, in relation to land plots of green spaces of general use, excludes the construction of any real estate objects not related to its maintenance within its borders.

### **4 Conclusions**

Objects of "green infrastructure" of various functional purposes should be included in the urban land use system as its main elements, in order to develop new approaches to regulating and planning the development of urban landscaping. During the operation of "green infrastructure" facilities, their effective accounting and inventory are of great importance, which, along with assessment and control, constitute a system of management measures, the result of which is the sustainable development of cities and improving the quality of life of people, a new value of real estate arises, the efficiency of using municipal resources increases, the investment attractiveness of territories increases. A technically competent and methodically prepared approach to the technical accounting of non-residential facilities, including infrastructure facilities, is digitalization, carried out on the basis of a technical inventory.

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