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## THE POSSIBILITY OF USING SPACE AND GIS TECHNOLOGIES TO CREATE A MAP OF THE GENERAL PLAN OF THE CITY OF VOLZHSK

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### Abstract

The projects of territorial planning, the most important of which is the general plan, are worked out with the aim of forming a long-term strategy for urban development, ensuring sustainable socio-economic, spatial and infrastructural development of the urban environment. Architectural documentation of general planning level is created for significant areas of the territory, which implies the use for this purpose of data of earth remote sensing with subsequent data presentation stage with the help of geographic information systems (GIS). A map of the general plan of the urban district of “The City of Volzhsk” in the Republic of Mari El has been presented in the proposed paper using satellite pictures and GIS Map Info Professional 10.0. The resulting map of the general plan of urban district is formed of 35 thematic layers, reflecting the current functional layout of the territory. In particular, on the map of the general plan there is a mapping of the current and future borders of the urban district, the elements of ecological framework and apartment block, the necessary planning objects, primarily the areas of municipal service, public and residential, public and business, the establishments of health service and social protection, industrial organizations. The main link of any map is the road network of the territory, which, in addition to the already mapped objects, is also presented on the map of the general plan of the urban district “The City of Volzhsk”.

**Keywords:** urban district, general plan, layer, space picture, space technologies

### 1. Introduction

An indispensable condition for sustainable and stable economic and social development of the urban district is the development of the documents of spatial planning and zoning. The main document of urban planning is the general plan the aim of development of which is the creation of architectural strategy for the territory development in the long term outlook and in accordance with federal and regional legislation [1]. The general plan for a period of 20 - 25 years determines the direction and the boundaries of the urban area, its functional zoning, the priorities of

development of engineering, transport and social infrastructures, architectural requirements for the preservation of historical and cultural heritage and especially protected natural territories, environmental and sanitary conditions in the city [2]. Creating a planning documentation of the level of the general plan of the urban district at this stage is possible with the use of space and geo information technologies. In the context of the current problem the space pictures represent a huge stratum of information and can be applied for visual specification of the position or the presence of objects of town-planning activities, territory zoning, assessment of the current condition and use of the area of the urban district (highways, wastelands, built-up areas, etc.) [ 3]. Along with the use of satellite images, the next stage of processing is the integration of the data into the GIS. The main part of the general plan is general planning maps, which is carried out in the complex GIS of a large number of layers. The maps of the general planning comprise the planned layout mapping of the capital construction of local significance, including: facilities of electricity, heat, gas and water supply of the population within the boundaries of the settlement, urban district; auto public roads, bridges and other engineering structures within the boundaries of the settlements included into the settlements in the urban district boundaries; other objects situation of which is necessary for exercise of powers of local self-government, bodies of local government of the urban district [4]. The most functional GIS packages for mapping are ArcGIS, MapInfo, Panorama, Easy Trace, etc. This paper on the example of the urban district “The City of Volzhsk” of the Republic of Mari-El represents mapping of the general plan using satellite images and MapInfo Professional 10.0 package. In the course of this work there were created 35 thematic layers which reflected the existing functioning of the territory of the urban district. The map of the general plan represents the components of ecological frame of the urban district, functional zones (residential, industrial, transport, and others.). The chart of the general plan of the urban district “The City of Volzhsk” in its current form and in GIS MapInfoProfessional 10.0. can be used to evaluate land use, including architectural activities, the level of development of engineering, transport and social infrastructures, etc.

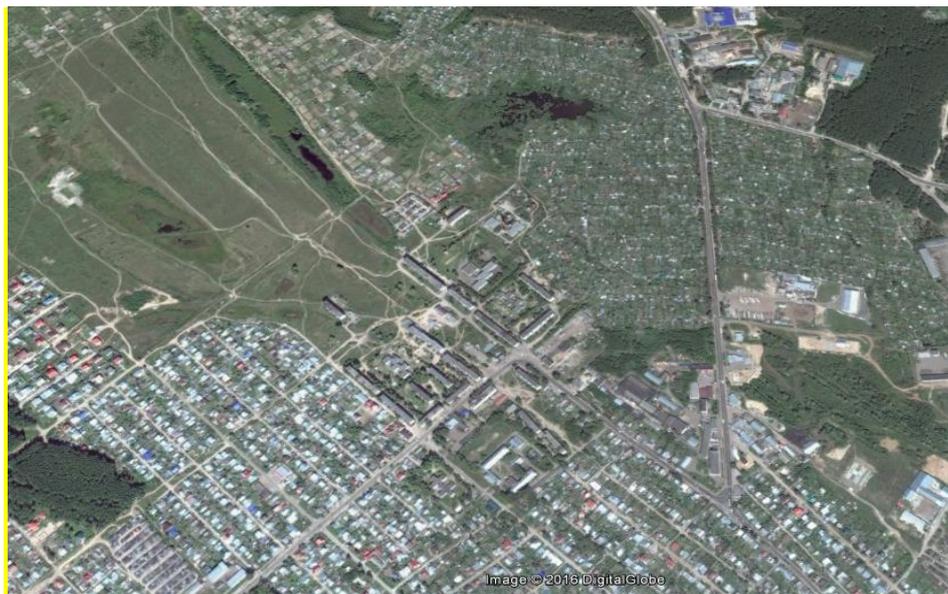
## **2. Methods**

Mapping the general plan of Volzhsk, as mentioned above, was carried out with the use of satellite images and GIS MapInfoProfessional 10.0. MapInfoProfessional is one of the most effective means for visualization and analysis of spatial data, intended for collecting, storing, editing, imaging and analyzing spatial data. Mapping the general plan of Volzhsk in MapInfoProfessional 10.0. involved the following stages:

1. Creating an underlayer and fixation of its coordinates. As the map basis, when charting the general plan there was used topographic- geodesic basis, and in case of its absence satellite image of high-resolution can be used.
2. Building a pictorial model of the city with the map of modern boundaries of the urban district and the following group of objects on it: residential, public and business, industrial, recreational, engineering and transport, infrastructural areas, etc.
3. Mapping the key objects in the short term (10 - 15 years), which are classified as the boundaries of the urban district and different urban areas. Implementation of this item is compulsory, because the general plan of the urban district is a project for the future.
4. Creating descriptive data to display all the main elements of the mapping.
5. Reporting and exporting of the map in the applied format.

### **3. Results**

Volzhsk is a city in Russia, an administrative center of the Volzhsk region of the Republic of Mari El, with a population of 54 600 people as of 2016 [5]. (Fig.1).

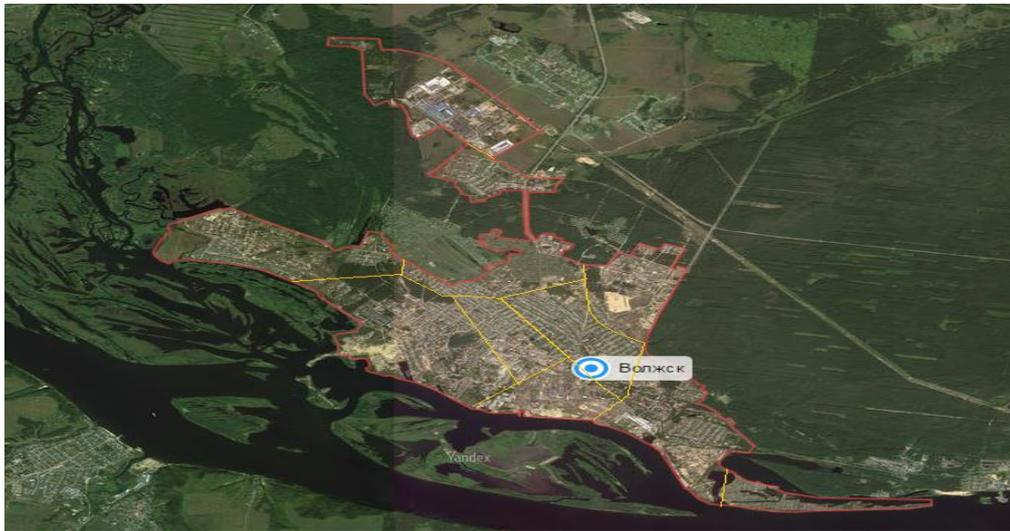


**Fig. 1 The city of Volzhsk on the satellite image (www.infokart.ru).**

It is the southernmost point of the republic at 101 km to the south from the city of Yoshkar-Ola and has contiguous borders with the Republics of Tatarstan and Chuvashia. The city has a close agglomeration connection with the Zelenodolsk region located at 12 km to the east and is strongly attached to the entire agglomeration of Kazan, despite the fact that they are in another region. The advantageous geographical position is determined by the presence of communication with other regions on the thoroughfares: auto-road Kazan - Yoshkar-Ola, the section of motorway passing through the Cheboksary hydroelectric power station and railway branch of the Gorky Railway Kazan - Green

Dol - Yoshkar Ola connecting Cheboksary with Kazan, , waterways on the river Volga. In the immediate vicinity from the city there are important transport highways of federal importance: the railway Moscow - Kazan-Ekaterinburg (Transsiberian), the highway Moscow - Cheboksary - Kazan-Ekaterinburg.

According to satellite images, the city is divided into 11 residential areas with the developed infrastructure: “Tsentralny”, “Zarya”, “Mashinostroitel”, “Druzhba”, “VDK”, “Severny”, “Gorgaz”, “Zapadny”, “Polevoy”, “Pribrezhny”, “Mamasevo” and two industrial districts – “Pribrezhny” and “Promuzel” (Figure 2).

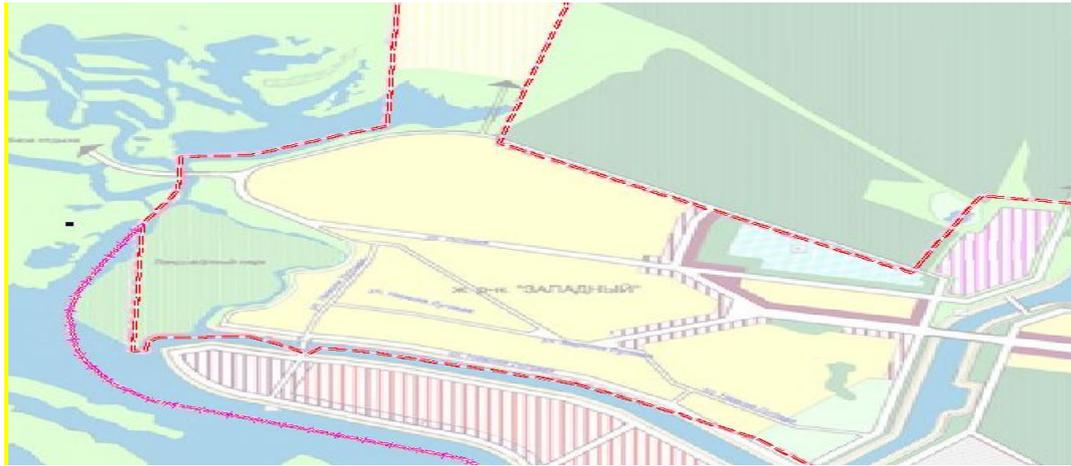


**Fig. 2 Zoning the city of Volzhsk on the satellite image (<https://yandex.ru/maps/>).**

It is a typical industrial city, the share of paper production in the economy of which is 29%, the share of mechanical engineering - 32%, the share of small and medium enterprises, the service sector - 39% [6]. In the productive assets of the city there are 31 budget-forming enterprises, 17 of them - large and medium-sized, 14 - small enterprises. Altogether, in the city there are about 100 large and small enterprises. All they are located in the industrial areas of the city - industrial areas “Pribrezhny” (within the boundaries of the district Tsentralny) and “Promuzel” (at the border with micro-district Mamasevo). The most important enterprises functioning in the city are JSC “Volzhsk hydrolysis-yeast factory”, “Mari pulp-and-paper plant”, JSC “Sovitalprod mash Plant”, “Volzhsk plant of building materials” Meat Processing Plant “Akashevsky” and others. It is important for the city of Volzhsk to consider the features of the placement of industrial facilities, residential areas and recreation areas in particular, as the city is drastically in need for recreation areas. The mentioned above determines the content and direction of territorial planning of the urban district “The City of Volzhsk”.

Familiarization with the territorial arrangement and the industrial potential of the city served as the basis for mapping the urban district of the general plan of “The City of Volzhsk”. After the preparation of the cover and fixation of raster image in the program MapInfoProfessional 10.0 all the basic elements of the master plan were mapped.

The first task consisted in applying modern and future boundaries of the urban district of “The city of Volzhsk”, marked on the map with red and pink circuits, respectively (Fig. 3).

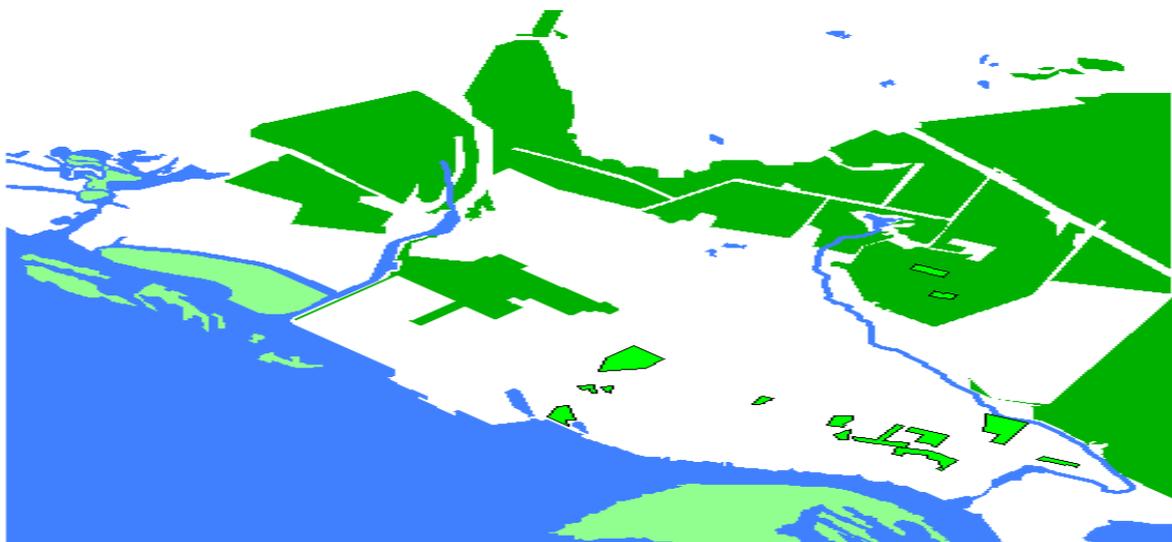


**Fig.3**The boundaries of the urban district “The City of Volzhsk” MapInfoProfessional 10.0.

After mapping the urban district boundaries, the elements of ecological framework of the territory were marked, in particular, water bodies and green spaces (Fig. 4). At the same time when plotting each new type of object, a new layer was created in the program MapInfoProfessional 10.0.

In view of the fact that the city is located on the left bank of the river Volga in the middle course, more efficient use of main waterway in the economic development of the city could be a promising factor in the strategic development and contribute to the attractiveness of the city [7].

The greenbelts, parks and public gardens, including the Central Park in the city, parks “Pobeda”, “Druzhba”, “Mashinostroitel”, public gardens “Ariada”, Oak grove are one of the main places for entertainment and leisure activities of the residents and visitors of the city.



**Fig. 4.** Water border and green spaces of the city district “The City of Volzhsk” MapInfo Professional

**10.0.**

Further the residential were plotted as the key elements of the urban development with consideration for both the projected residential sectors and forward-looking residential areas. In MapInfoProfessional there were shown high-rise residential areas in red polygon, private houses - yellow and low-rise residential areas -orange, appropriate crosshatching shows the areas in the perspective (Figures 5, 6.).



**Fig.5. Planned residential zones of the city district “The City of Volzhsk” MapInfo Professional 10.0.**



**Fig.6. Residential zones in the urban district “The City of Volzhsk” for the future MapInfo Professional 10.0.**

Subsequently, we continued the work on mapping all necessary planning objects, namely: the area of public service, the public and residential zones, the zone of institutions of health care and social protection, the social and business zone, the zone of city center, the industrial zone. The main link of any map in addition to the already charted objects is the road network of the territory, to display it, a separate layer has been created (Fig. 7). The total length of auto roads in the city is more than 126 km, including 112 km - with improved surfacing. The territories of the roads with hard surfacing is about 90%.

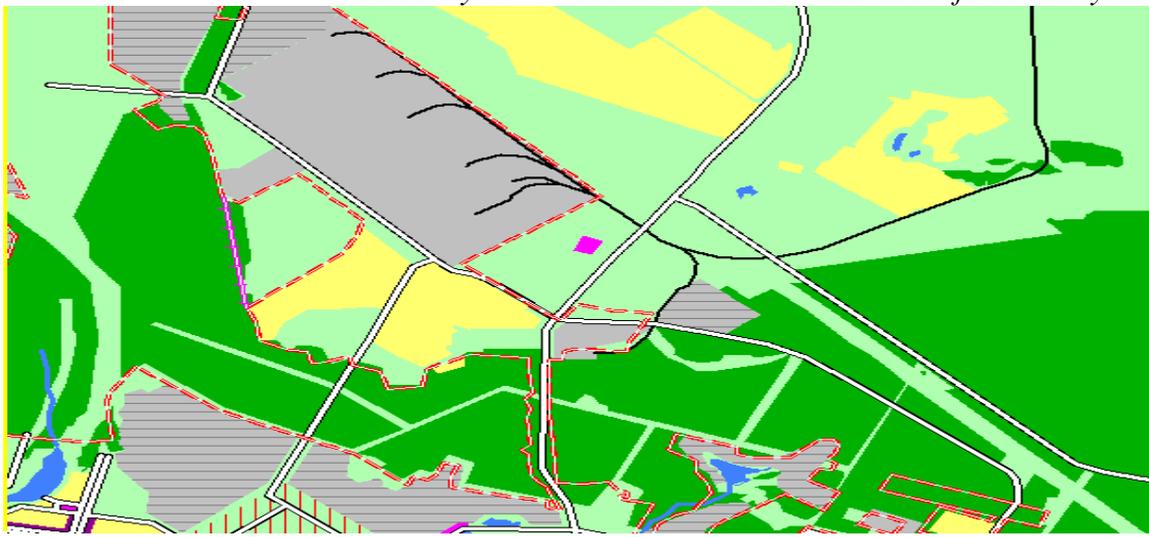


Fig. 7. Road network and other infrastructure of the city district “The City of Volzhsk” MapInfo Professional

### 10.0.

Then the work was continued on imaging point features, which were classified as railway stations, ports, hospitals, the objects of education, etc.

In total, when mapping the general plan of the urban district “Volga city” 35 layers were created, including raster layer, substrate, linear, areal, character and text objects (Fig. 8).

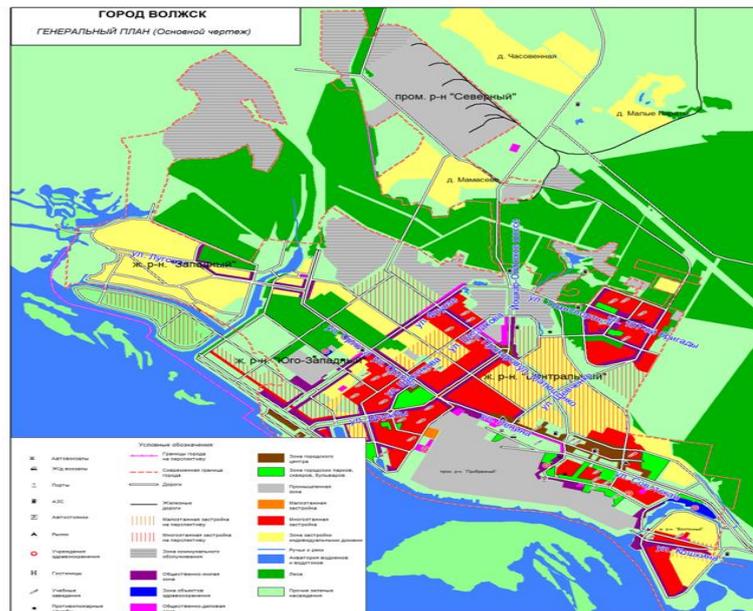


Fig. 8 The general plan of the urban district “The City of Volzhsk” MapInfo Professional 10.0.

## 4. Conclusion

In the process of this work from various aspects the authors studied the urban district “The City of Volzhsk” and GIS MapInfo Professional 10.0. Using satellite images the general plan of the area has been mapped. The map consists of 35 layers, reflects the current functional layout of the urban district with differentiation of residential, commercial, green, transportation and other areas.

## 5. Discussion

At the present stage, to visually clarify the position or the presence of the objects of town-planning activity, to create urban planning documentation, satellite images and geographic information systems are widely used. Using these mechanisms, the authors performed the work on mapping of the general plan of the urban district “The City of Volzhsk” in GIS MapInfoProfessional 10.0. The use of the project of the general plan of the territory and its cartographic part, in particular, serves as a basis for determining the interests of the population, the formation conditions of the activity, defines the requirements of town planning for the preservation of historical and cultural heritage, environmental and health well-being.

## Acknowledgements

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