

# Geoecological aspects of comprehensive development of Tomsk left-bank area

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**Abstract.** The article deals with the unique geoecological characteristics of the left bank of the river Tom' within Tomsk area (Russia). The authors suggest methodological approaches to land management in regions with intensive interaction of ecosystems and technogenic complexes. It proves the necessity to use the systems approach and estimating method to solve the tasks of urban development and land management. The authors make a conclusion about the most rational land use of the studied area in terms of ecologized land management.

## 1. Introduction

Nowadays the Russian scientific society is changing the paradigm of environmental perception. There comes the epoch of research based on systems approach and focusing on preserving favorable living environment as long as possible, which replaces the “technocentric” knowledge of the XXth century [1, 3]. These changes are a positive result of the global process of ecologization that has grown out of natural science and embraced all the aspects of the society ranging from urban planning to school education.

This process is manifested at a regional level in developing programs aiming at preserving and improving the environmental characteristics. The main principle of the process is the axiomatic necessity to protect natural areal complexes (NAC) and their constituent elements – unique landscapes under the conditions of growing industrial needs of the society.

Tomsk has been extending its boundaries for more than 400 years, and even more active for the last decade. At the moment it is possible to state the existence of Tomsk agglomeration. It needs a united systems development concept that would ensure the most effective use of NAC and the urban areas within its boundaries [7].

The use of the unique NAC as a site for urban development makes it necessary to take into account the whole complex of functional characteristics of the land. Comprehensive study of urban areas implies all-around consideration of interdependent influence of urban agglomerations on geoecological characteristics of local geo systems.

Land misuse caused by urbanization is the problem that can be solved by rational local land use and urban planning policy in particular areas. Taking into consideration the global concept of sustainable development the important task is to preserve undisturbed or slightly disturbed natural areas, their values increasing in the long-term.

In the frame of the development of sustainable land use planning, the fundamental approaches are those that ensure maximal optimization of resource use [4]. Complexity of urban development problems



makes it necessary to apply the systems approach to design choice and to the design scientific rationale mostly by means of geoecological methods.

## 2. Basic data

A lot of developed countries have a great experience in natural area conservation while developing urban and industrial areas. This issue is being actively discussed in Russia though without being provided with sufficient practical and regulatory framework. The undisturbed natural areas of Russia are an ecological buffer. Being basic living environment, local urban areas should be paid special attention to.

Tomsk land reserves are changed every year due to the urban boundary extension by incorporation the nearest rural settlements. Thus, there appeared recreation areas within the boundaries of the fully developed and built-up city.

At the moment, the most promising direction of Tomsk comprehensive development is Kirovskiy district, the left bank of the river Tom', in particular. It is planned by the analogy with Novosibirsk and other big cities situated on both banks of rivers. It should be noted that the documents (draft area plan and parcel plan) regulating functional use of the area have not been adopted yet. Thus, its future use has not been definitely determined. The future image of Tomsk as well as its long-term prosperity depends on what kind of engineering and planning decisions will be taken.

The right-bank area of Tomsk is being actively modernized. Typical urban districts of the 1980s gradually change its architectural and infrastructural image that meets modern requirements.

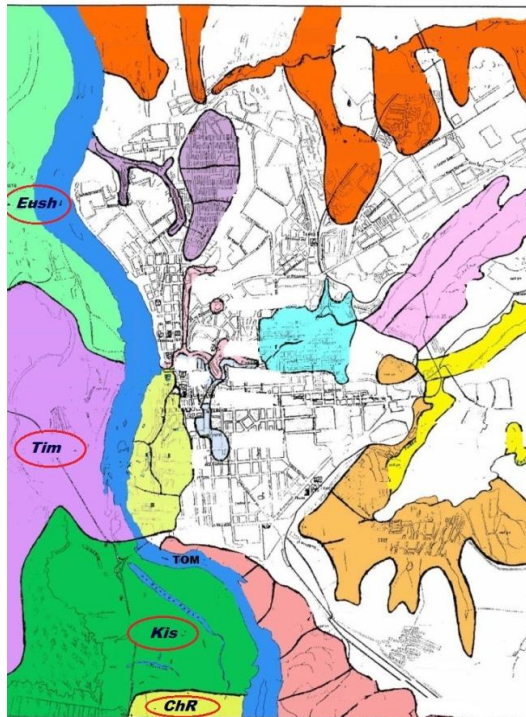
The objects of the present research are natural objects that have spatial and functional connections with the objects of engineering infrastructure situated in the Ob'-Tom' interfluvies near Tomsk. The aim of the work is to develop methodological approaches to the rational comprehensive development of Tomsk left-bank area in terms of underflooding threat.

The left-bank area of Tomsk is located in the Ob'-Tom' interfluvial plain. It is confined to the West Siberian folded margin platform, but at the same time has characteristics of a typical platform with its folded basement lying at low depth (up to 1 km). The platform cover embraces loose Mesozoic and Cenozoic sediments and consists of clay, sands and clay loams. This area is adjacent to the left-bank floodplain often flooded in spring and the terrace above the floodplain. All the flood plain lakes of the area are morphologically identical. Their origin is conditioned by flood waters of the river Tom'. The area basically consists of clay loams, from solid to liquid, the thickness of which is from 1.5 to 6.5 m. Also, sand loams ranging from solid to liquid are found, their thickness is up to 5.5 m. The area is well drained with a dense network of small rivers and lakes.

The combination of soil-formers makes grey forest soil and ashen-gray soil predominating in the area. The mother rocks are of different genesis: lacustrine, lacustrine-alluvial, alluvial and aeolian in places.

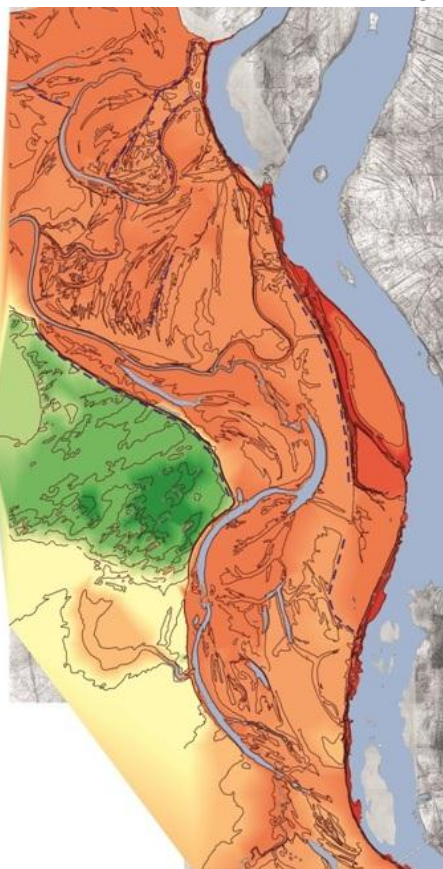
Ecological research conducted by Tomsk hydro geologists [2, 6] reveals a unique characteristic of the left-bank area: there are plenty of drinking water springs. Plicative tectonics and low dipping bedding of hydrogeological complexes and the above ground platform horizons condition lateral groundwater flow and springs in river valleys of the quaternary complexes. But the absence of folding or bench alluvial horizons that would work as a buffer in the places of the ground water discharge specifies high rate of surface water infiltration into deep soil horizons. This is also a water-collecting area. There are ground water wells of the first stage. They supply the city with drinking and domestic water from Palaeogene aquifer system. Nevertheless, the activity of Tomsk water intake led to strong landscape transformation.

Construction of anthropogenic objects within natural complexes with neglect of geoecological, social and economical risks doesn't meet the requirements of sustainable development of the region. Thus, the ecologized development of the left-bank area of Tomsk is undoubtful. The geoecological structure of the investigated area includes natural underground water outlets along the terrace of the flood-plain that comes out as springs identified in the road embankment near the bayou lakes. The largest concentrations of such springs are observed near settlements Timiryazev and Eushta, they form the left-bank spring mega zone (Figure 1) [6, 11].



12 – The left-bank landscape-spring mega-zone:  
**Eush** – Eushtinskaya;  
**Tim** – Timiryazevskaya;  
**Kis** – Kislovskaya;  
**ChR** – Chern-rechnskaya

**Figure 1.** Map of landscape and spring macro-zones of Tomsk.  
 ©Nazarov A and Vertman E 2004



**Symbols:**

— - horizontal

**Relief marks:**

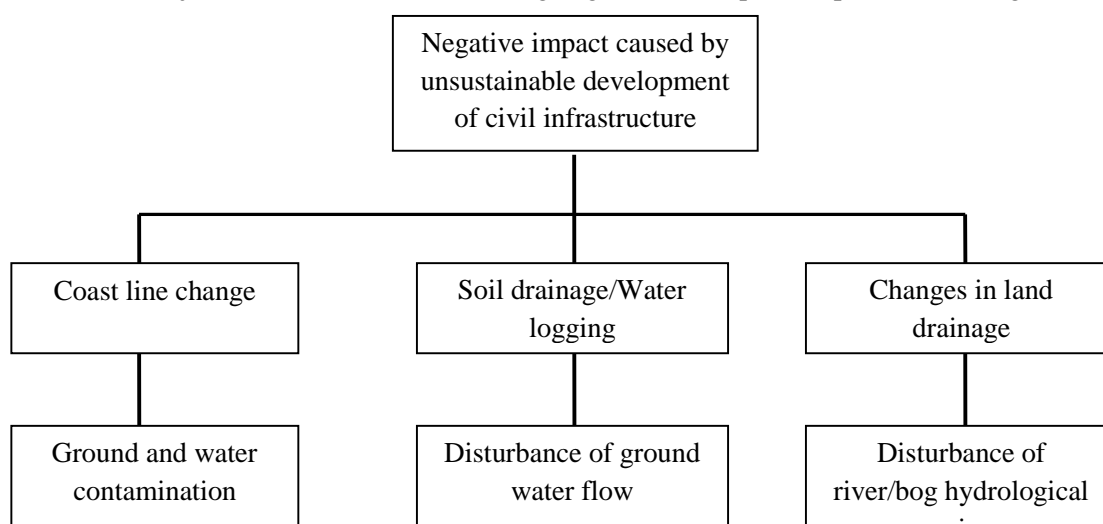
	70.000000
	77.500000
	85.000000
	92.500000
	100.000000

**Figure 2.** Map for the left-bank area prone to underflooding with sub-zones.

However, the left-bank area is not thoroughly investigated in terms of geoecology and geography. Our research of the unique geoecological features of the area resulted in compiling a map for area prone to flooding that manifest ground water-the river Tom' hydraulic connection (Figure 2) [8,9]. Flooding of the left-bank area is a negative process that leads to soil degradation due to erosion and suffusion processes, i.e. deterioration of engineering and geological conditions.

While developing the planning design of the left-bank area it is necessary to take into account the existing natural underflooding process and the technogenic underflooding attributed to the construction of water facilities engineering infrastructure. Thus, while developing the area it is necessary to apply the principle of sustainable and ecologized land use that implies continuous assessment and planning the whole "lifecycle" of anthropogenic objects. It will ensure further development of comfortable ecologized living environment [5, 10].

The left-bank area development will primarily influence the areas that are most attractive in terms of recreational and tourist activities in the valley of the river Tom'. Thus, planning design should include the whole complex of civil infrastructure (sewerage, water supply, waste disposal, traffic network etc.). While being designed and sited the objects of real estate are referred to land points therefore it is necessary to take into account the role of soil absorption capability and its buffer property. Potential environmental damage threatens the lands with the following functions: lands with water bodies, agricultural lands, special use zones, etc. [10]. Design and construction of civil infrastructure objects can result in the following negative consequences presented in Figure 3.



**Figure 3.** Basic negative consequences of unsustainable development of civil infrastructure on the left-bank area of Tomsk.

Civil infrastructure development will inevitably disturb the environment, thus, while developing the area it is necessary to apply ecologized approaches with regards to city development regulations. It is necessary to note that more and more local governments in Russian cities pay much attention to the problems of underflooding both of natural and technogenic genesis. The infiltration recharge value for the left-bank area of Tomsk is 95-197 mm/year. The technogenic factor leakage in water pipe systems can double this value.

### 3. Conclusions

1. The investigation of geoecological and geographical characteristics of Tomsk left-bank area allows identifying close interaction of these aspects with the technogenic factor. This interaction is manifested in the underflooding of the area caused by both natural and anthropogenic processes.

2. The research resulted in mapping for the left-bank area prone to underflooding. It is based on geoeological and geographical characteristics of the area.

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