

**PROBLEMS OF PROTECTION OF  
GEOMORPHOLOGICAL MONUMENTS IN THE  
STRUCTURE OF METROPOLITAN CITY**

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**ABSTRACT**

In Ukraine, there are several hundred natural geological monuments that, when destroyed, can not be restored and therefore require the most careful attitude. The geomorphological features of cities disappear due to the ever more anthropogenic load. Complicated relief is no longer an obstacle to construction due to the progress of construction technology. Outstanding features of the city's geomorphology can be preserved through the creation of complex programs for preserving monuments of different categories, which would be mutually supplemented and maintained with the help of protection zones. Detection and estimation of potential objects for initiation of security measures are based on historical and morphological analysis of elements of the city and the use of systematic, biomorphological, ecological, geographical analysis of cultivated dendroflora.

Lviv has a complex relief, due to which it was formed. Here we distinguish various geomorphological elements, which together make the Main European watershed. To the west the hills of Roztochia strand reaches, from the east - the ledge of Podillia plateau is observed. Several geomonuments of geomorphological origin are located within the limits of the almost million metropolitan area of Lviv: Mount High Castle (409.5 m above sea level), Lev Mount (389 m), Kortum Mount (372.5 m), limestone Chotovi Skeli (414 m) and Medova Pechera (Honey Cave).

In the modern structure of the city, the hills are part of the natural framework of the city's greenery system and make up its two wedges – the South-East and the North-West wedges. The most significant dominant point is High Castle Mount, which is part of a chain of planar erosion remnants and together with city center is a part of the UNESCO Conservation Zone. The top of the mountain is crocheted artificially from the walls of the medieval castle during the 1869-1900 with the cone-shaped hill in honor of the Union of Lublin, 36 m high. Over time, the hills were planted, and from the 19th century became the basis for the creation of landscape parks and walking alleys. Here the park "High Castle" with an area of 36.2 hectares is formed which is the main object of tourist excursions.

In modern Lviv planning, geological monuments are complemented with memorials of botanical, historical, garden and park art and forest parks. According

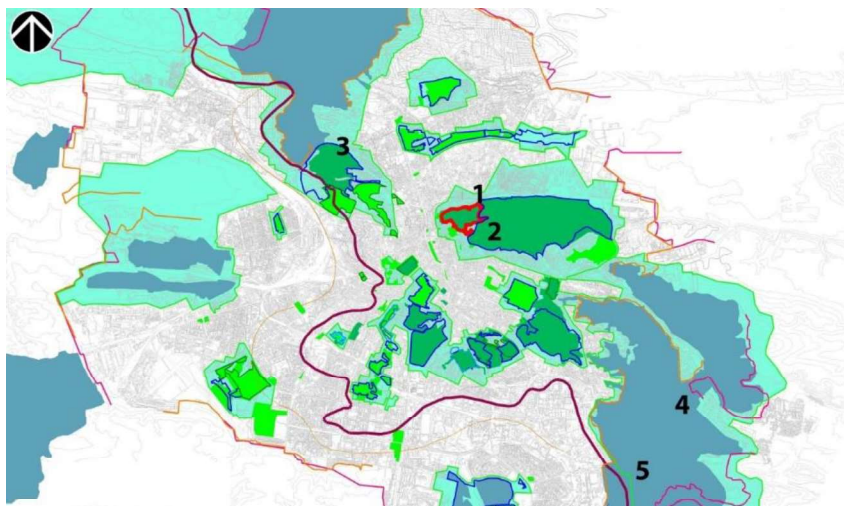
to the Law of Ukraine on Nature Conservation and National Parks "About the Nature Reserve Fund of Ukraine", which guarantees a balance between the territories designated for the protection of nature and development, the system of nature protection objects of Lviv has been developed.

**Keywords:** *city geomorphology, natural geological monuments, nature reserve fund of Ukraine*

## INTRODUCTION

The geographical location of Lviv contributed to its settlement from ancient times [1]. The terrains of the city are located at the junction of the lowlands of the Male Polissia with the hills of the Podillia Upland and Roztochya along which the line of the main European watershed passes. The lands of the city occupy the upper reaches of the Poltva River (the tributary of the Western Buh). The hills are surrounded by valleys from the east, south and west, of which the most distinctive is sideline horn of the Podillia Upland extending north-east of the modern center, with the mounts Budelnytsia, Zamkova, Lion (Sand), Snake, which is rapidly rising more than 100 m above the valley.

The geomorphological diversity of the territory of Lviv became the basis for the development of the natural face of the city, laid down in the modern General Plan of the city (Fig. 1) [2]. The High Castle is the most prominent spatial dominant in the Lviv landscape.



*Fig. 1. Geological monuments in the structure of the open spaces of the city of Lviv: 1 - Mount High Castle (409.5 m above sea level), 2 - Lev Mount (Lion Mount) (389 m), 3 - Kortum Mount (372.5 m), 4 - limestone Chotovi Skeli (414 m) and 5 - Medova Pechera (Honey Cave). The diagonal line passes on the main European watershed [source: 2].*

## **STUDY BOUNDARIES**

The purpose of the work is to create a concept for the development of the park Vysokyj Zamok - the monument of landscape garden art of local significance, which is part of the nature reserve fund of Ukraine as a national heritage. Since 1998, the park is part of the UNESCO World Heritage Area.

It is located on the hillside overlooking Lviv on the northwest of the city center. It covers the High Castle Mount and Prince Mount with its foot, covering an area of 36.2 hectares, surrounded by a wide protected zone. The park adjoins territories, diverse in function, landscape, planning organization and degree of anthropogenicity and pollution. In the city's territory, the park is fixed by the streets: from the east - Opryshkivska street; from the southeast and south - M. Krivonos street; from the southwest, east and north - Zamkova street.(The Castle Str.) The park lane has the same name as Vysoky Zamok, a part of the Lviv walking crossover, laid out on the hills above the Lviv lowland [3].

The High Castle in the east is adjacent to the territory of industrial purpose (in particular - the territory of the former balneological complex "Kiselki"), the territory of the Regional Landscape Park "Znesinnia", as well as the building area of the middle storey. From the south and southwest to the park, besides the residential development of the middle storey, territory of the Lviv Television Center (Knyazha Street) and the territory of the former monastery of the Sisters of Mercy with the church of St. Cazimir is adjoined. The entrance to the park is surrounded by the territory of secondary school No. 19 and the garden of the monastery of St. Onuphriy (Zamkova street). From the north, the park is surrounded by the railway with the Pidzamche railway station.

## **METHODOLOGY**

As the final result of the research was the creation of the concept of the development of the High Castle such basic requirements were formulated: to investigate and identify the role and significance of the territory of the High Castle in the architectural and planning structure of Lviv; to analyze and evaluate the state of the existing natural-landscape complexes on the territory of the High Castle; to explore and discover the nature and value of the components of the natural landscape and biodiversity of the High Castle area, to analyze and evaluate the use of the territory of the High Castle; to identify conflicts and critical interactions both in the park and within its surroundings.

## **RESULTS**

### **Analysis of the current use of the territory**

#### **A list of historical monuments**

In the 19th century, the hills with a formidable fortress once caused a lot of trouble to the city during windy days. The city was covered with clouds of sand and dust, and naked slopes during the rain turned into streams of swamps. There were various projects for the use of the hills up to the construction of several Dutch

windmills. It was only in the 1830 that the ravine between Kniazha Mount and High Castle Mount was filled up, a terrace was planned, which significantly changed the relief and the landscape, a park was built and trees were planted around the hills. The park was then characterized by a landscape style, in 1845 a cafe and a gardener's house were built. The hillside became a favorite place for numerous promenades of Lviv residents and guests of the city, and the tram branch was laid to the main entrance.

A number of historical monuments were preserved: part of the wall of the castle (located at the foot of the mound on the upper terrace); a stone sculpture "Lion of Lorentzovych" that once stood in the courtyard of the Town Hall and was moved onto the hill in 1874; the mound erected in 1841 to commemorate the three hundred years anniversary of the Lublin Union. It was projected without calculations and already in 1907 was subjected to strengthening; a grotto with lions built-in 1841 (originating from the old town hall, which collapsed on July 14, 1826); memorials in honor of the assault of the castle by the army of Bohdan Khmelnytskyj in 1648 and the defense of Lviv in 1675 from the Turkish troops.

#### **Condition of transport service.**

The main entrance and approach to the park are located on the south-eastern side at the converging of the streets of M. Kryvonos, Opryshkivska and Vysokyj Zamok. The entrance from the south, from Zamkova street can be interpreted as the main pedestrian entrance, which originates from the city center, from Porokhova tower (gunpowder tower) at the beginning of the chestnut avenue in Pidvalna street. From the north there are no approaches and there are no entrances to the park, except of the terrace at the foot of the hillside that is used by visitors spontaneously. In the area of the entrance to the High Castle, there are no public transport routes. Parking for the guests of the park is provided at the front of the main entrance to the park from M. Krivonos street and Opryshkivska Str.

#### **Functional use of the territory (the existing state).**

On the territory of the "Vysokyj Zamok" park there is a number of disharmonious objects, in particular, areas allocated for service. In 1957 a complex of buildings of the Lviv television center with a transmission complex and a TV tower on the upper terrace was built in the park. On the site of the old monastery gardens a school was built which completely closed the visual connections of the city with the High Castle from the southwest side. One of the largest restaurants "High Castle" and its affiliate is situated at the entrance to the park from M. Krivonos street and Opryshkivska street, as well as children's playgrounds, parking for guests of the park on the side of the main entrance, public toilets at restaurants. Chapel at the foot of the northern slopes above the wellspring of St. Mary in Zamkova street, a sculpture of the Mother of God near the chapel and concrete crosses (1990s), and now – the figures on the Road of Jesus Christ are located along the northern slope from the foot of the hillside to the lower terrace. Two underground warehouses on the slope of the hill from Opryshkivska street near the adjoining Zamkova street and parking lot in the northeast just opposite Opryshkivska street are located there too.

**Erosion on the hills.**

The slopes of the hills are subject to erosion degradation, but plane washouts dominate in this process. The intensity of plane washouts and flood processes significantly increases with the expanse of slope steepness. Almost everything concerning the sources of a powerful plane flushing is interconnected with anthropogenic activity, first of all with the trampling of the slope by human streams - recreators. Serpentine paths do not provide the needs of all visitors, especially children and young people, as a result of which part of the visitors of the park rises to the top of the mountain by a steep slope line. This led to the complete destruction of ground-covering vegetation and, in part, ground cover, and the development of high-intensity erosion in areas of such spontaneous climbs or descents. Over time, formed from rain and snow flows of the surface water hollows turn into ravines. To strengthen the slopes and stop the plane erosion processes, the tightening was done with the willows, the remains of which are still found in some places. Plane erosion has decreased somewhat after the built-up metal stairs on the piles between the middle and upper terraces of the northwest. The slopes, where the linear erosion predominates in the "High Castle" park, are more fragmentary. It is recommended to illuminate the lawns to provide access to sunlight for strengthening the greenswards. Curtain shrubs are planted, whose root system penetrates deeply into the array of slopes with the vertical structure of the roots. It is important with the help of engineering means to intercept water flows at the level of the terraces and to regulate descents from the terrace to the terrace in the concrete proposed places by engineering and architectural means.

**Condition of planting in the park**

A thorough inventory of High Castle Mount was carried out in 2007. Based on the collected data one can speak about the species (floristic) diversity of the tree-shrub vegetation of the park. In total, 3351 trees and 918 shrubs were recorded on the investigated area of the park (High Castle Mount and adjacent plots). Thus, the total number of species of woody-shrub vegetation of the park is 58. Of these, 7 species are conifers and 51 are deciduous; trees in the park make up 78.5%, shrubs - 21.5%.

Considering the long existence of the "High Castle" park (from 1835), it can be argued that the basis of parkland is: *Ulmus scabra* L. 164 особи (4.89%), *Aesculus hippocastanum* L. 517 (15.43%); *Carpinus betulus* L. 86 (2.57%); *Acer platanoides* L. 1392 (41.54%); *Acer pseudoplatanus* L. 226 (6.74%); *Tilia cordata* Mill. 224 (6.68%); *Robinia pseudoacacia* L. 85 (2.54%); *Fraxinus excelsior* L. 426 (12.71%) and other species (6.9%). Most of the park forms of trees is more than 100 years old. However, in the process of natural development of plants and natural regeneration different age groups of individual species appeared. A total of 10 samples are in the age group of over 150 years, which are growing here since the time of the laying of the park [4].

Taking into account the age structure of tree plantations, as well as negative anthropogenic influences (soil compaction by recreants, pollution of the environment, mechanical damage), a significant part of trees and shrubs have poor sanitary conditions. The most widespread damage found during the inventory is the

following: germination of mistletoe, dry branches, mechanical damage, freezing cracks, hollows, cramps, fungal diseases (core rot, trusses, various forms of cancer), stem entomo pests, nude roots. The number of damaged trees, depending on the species, is 60-40% [4].

The state of the city parks have an impact and effects of climate change. The level of groundwater is now considerably lower, and given that Lviv is located in the water shed, there is a particularly significant deterioration of the water regime, which adversely affects the development of the root system of plantings. Great damage for park plantings was caused by hurricanes, which almost every year pass over the city in summer, many trees are overthrown with the roots, and part of the trees are broken. Therefore, the planting of the "High Castle" park now contains a large number of damaged trees, which can become sources of damage to neighboring healthy trees.

#### **Landscape planning organization of plantations**

Shrub plantings in the park "High Castle" form the basis of the formation of the park environment. Combining with other components of the landscape i.e relief, architectural structures, elements of landscaping and taking into account the climate - plants determine the spatial structure and characteristic image of the object. Arrays and groves, groups of trees and shrubs, alley plantings, molded hedges, as well as solos can be identified among the main types of park vegetation.

By species composition, the arrays of the park "High Castle" are mixed (in the composition of several species), and depending on the vertical (tiered) structure - one-tier (crown tent is located approximately in one plane), since the shrub tier and growth are poorly formed. Somewhat smaller compositional elements are curtains - large groups of trees such as plantations of black pine on the cone itself, and a birch-poplar group near the ruins of the princely castle. All of this planting are of artificial origin, created at different times.

The most impressive is the chestnut alley which starts from the grotto with lions and passes around Zamkova mount, leading to the main park structures in the parterre part - the restaurant "High Castle" and the house of the gardener. It ends at the parking lot near M. Kryvonos street. The alley is composed of old age trees of bitter- chestnut ordinary (248 pcs.) The average height of them is 18.5 m, the average diameter is 0.52 m. On the other hand, there is an ash tree alley leading from the telecentre to the lower terrace, which is formed by cinis ordinary (186 pcs.). Average height of which is 21m. and average diameter is 45 cm.

#### **Interaction of natural and anthropogenic components of the territory of the "High Castle" park: types of conflicts**

The park is subject of constant anthropogenic pressure especially when Soviet doctrine of Lviv as an industrial city has changed on the vision of the city as creative and tourist one. The annual flow of tourists is about 3 million, and visits to the High Castle, from which panoramas on the city opens, are priority. Let us consider the types of conflicts.

1. Planning conflict - the impossibility of architectural and planning means to ensure a comfortable stay of people on this site due to the lack of accentuating of the entrances, the infrastructure of avant-zone of the main entrance (or entrances), the attractiveness of the alley road and pathway network, or, conversely, its unstructured and uncertain state, historical preservation of the formed architectural and planning structure, etc.

2. Spatial-visual conflict is caused by the degradation of direct and inverse visual links from the object to surrounding territories, panoramas, separate objects and, conversely, the perception of this object from separate points of view and view corridors; distortions by economic and other activities as objects of perception (its scale, silhouette) as well as surrounding historical landscapes (panoramas).

3. Functional conflict is incompatibility (due to overlapping or adjoining) of the opposite functions of zones, territories and individual objects (such as, for example, overlap of the sanitary protection zone of industrial objects, including the railways); the presence of separate economic and other non-park objects on its territory - a repeater together with a TV tower, a chapel with Jesus Christ road to it.

4. Anthropogenic conflict is caused by such actions of a person according to the natural environment, which have mostly selfish and self-interested antisocial character which is associated with the loss of the attractiveness of a natural object [7], the degradation of its elements and the destruction of the natural basis (trampled footpaths on the slopes that cause erosion, traces of arranging campfires, walking of dogs, unauthorized sampling of soil, driving of cars on the park's territory, acts of vandalism towards its natural and architectural elements) [5].

5. Natural conflict is founded in the irresistible force of nature, which destroys human-cultivated natural objects (self-seeding of trees that silence the growth of cultural plants and overlap species, erosion of the slopes, partly due to the lack of rainwater sewage, illness and dying of trees, for example, the spread of Macedonian converting moths which massively destroy the plantings of the age-old, priority chestnuts in the city, etc.

6. Transport-pedestrian conflicts arise at unauthorized crossing of trajectories of pedestrian and car traffic in intensive directions, lack of equipped parking lots and parking of cars in inappropriate places, lack of safe pedestrian approaches and public transport routes for access to the park, driving of cars through the park's alleys, etc.

#### **The concept of the planning organization of the park "High Castle".**

On the basis of a critical rethinking of the data obtained, the zoning of the territory of the "Vysokyj Zamok" park was developed, considering its status as the monument of landscape art. The project of maintenance and reconstruction of the park "High Castle" with consideration of construction of a suspended cableway for use of recreational possibilities of the park is developed. In the course of the project implementation, they coordinated with the developer the detailed plan of the neighboring area around the park territory of the city [6] (Fig. 2).



*Fig. 2. The concept of the master plan of the "High Castle" park in Lviv [6].*

In order to preserve the image of the High Castle as a legend of Lviv, it is necessary to fundamentally improve the maintenance of the park, the restoration of existing and the development of new elements that require funds. The combination of public, communal and private financial interests can be very profitable, especially in the tourist and recreational sector. The concept of an architectural and planning organization foresees the division of the territory into the landscape-territorial areas: A - Zamkova hora (Mount High Castle), B - Main (middle) terrace of the park, C - forest park array of western, northern and eastern slopes - the foot of the middle terraces and the High Castle Mount, D - the southern slopes that support the southern park terrace, E - the lower terrace of the park, F - the northern terrace of the park, G-1 - the gardens of the northern entrance to the park from the Opryshkivska street. The proposed structural division of the territory of the park allows it to effectively conduct monitoring, to store, develop and effectively plan work on objects, elements and the whole territory.

The general plan of the territory provides for the planning of the park as a whole and its separate objects and elements, the development of individual fragments illustrating the architectural, planning and space-spatial solutions of the park and territory within its protection zone. The main conceptual provisions for restoring the "High Castle" park are to overcome the identified conflicts.

## **CONCLUSION**

Much attention is paid to commutation of the "High Castle" park with other elements of the city's natural framework and the delineation of transport and pedestrian flows. In particular, a light pedestrian bridge over the Opryshkivska



street will link the main terrace of the park and the territory of the regional landscape park "Znesynnia", promising pedestrian bridges over the railway will connect the park with a city building area from the north i.e. Pidzamche district. The project provides for new means of transport for attracting more guests to the park and facilitating access for disabled visitors: a hangover road that runs practically from the center of the city (Pidvalna Str.) through the observation patio-belvedere terrace to the upper terrace. The arrangement of the elevator, going from the foot of the conus to the top of the hill through the bridge, is proposed. Due to the restoration of historical alley-serpentine there are comfortable connections on the vertical between different terraces of the park.

Now, it is necessary, on the basis of compositional analysis and inventory of plantations to reconstruct them, to restore the characteristic stylistic components of the park. The main design solutions reflect the architectural and spatial concept of the authors of the project and maximally reproduce the planning decisions of the parterres, laid since the formation of park compositions. The project envisages the reconstruction of floral parterres with the restoration of the composition of the late 19th - early twentieth century. On the main alley "Korso" a garden of small northern exedra-belvedere, the northern exedra-lion and the garden of the great northern exedra-belvedere with a gazebo were designed. In addition, the abovementioned serpentine and stairs go to the main terrace too. The project also includes new elements, such as: water museum (northern entrance), greenhouse-cafe (western entrance from B. Khmelnytsky Str.), museum "High Castle" with a model of the city (on the southern observation terrace), creation of the hotel complex near main entrance (M. Kryvonos street – Opryshkivska str.), gazebos on the main park alley. All this will make the park much more attractive and comfortable for rest and promenades.

The value of the park for the structure of the city of Lviv consists in creation of a unique landscape-historical complex as well the "High Castle" park in the planning structure, the natural framework, in the system of open territories and their protected zones, as well as in the system of visual connections of the city of Lviv. The domination of the terraces of the park over the city, together with the hillside, predetermines its exclusiveness for the city as a natural belvedere, the attraction for visiting throughout the year and the association of its silhouette as one of the city's business cards.

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