



ASDE-ECOREGIONS - OPERATIONAL EXPERIENCE

PRELIMINARY OF THE EUROZONE AND FOR THE BENEFIT OF STATE AND LOCAL ADMINISTRATION

I. INTRODUCTION

The inclusion of Bulgaria in the group of member states of the so-called Eurozone, in addition to the transition from the national currency - the Bulgarian lev - to the common European currency - the euro, also requires national governance in a much more direct connection with the common rules and regulations imposed by the European Commission and other European institutions.

In this regard, ASDE-ECOREGIONS begins publishing short materials related to the established operational capacity, in accordance with the introduced or upcoming mandatory European regulations, especially in the field of territorial planning, risk management, combating climate change, and the protection of natural and cultural-historical heritage.

In this short publication, we offer to the attention of the state and local administration, our comment and proposal, regarding the need for constant monitoring of the adopted mandatory indicators for the percentage of green areas, in accordance with the Law on Territorial Development and the related general development plans of the municipalities in Bulgaria. The development is also in accordance with the new Regulation (EU) 2025/912.

Our operational capacity is built on the basis of a number of projects under programs such as the 7th Framework Program, HORIZON 2020, INTERREG and ESA-PECS for Bulgaria - in this case - monitoring of green space indicators in development zones, implemented in the general development plans in each municipality.

II. STRATEGY

The main position of the expert team of ASDE-ECOREGIONS, when developing intelligent high-tech solutions, is that they should be maximally linked to real management practice, as well as to the operational capacity of the end user. On the other hand, we believe that there can be no sustainable and modern management of territory, resources, infrastructure and population without constant monitoring of mandatory priority indicators for the individual elements of territorial planning, such as the state of the natural environment, maintenance of environmentally friendly agriculture and, above all, sustainable management of the urban environment. For this type of monitoring to be meaningful, it must be linked to indicators that are monitored and complied with by local authorities, which leads us to the so-called general development plans of municipalities (GDPs / Master Plans), mandatory for municipalities in accordance with the Territory Act. As an integral part of this law, there is also the accompanying Regulation 7 on the rules and norms that should be observed when developing a GDP and subsequently its application. An important condition is that the monitoring of these indicators should not depend on the services dealing with the implementation of the GDP, but should be based on objective, independent and regularly received data, which should be analyzed on the basis of internationally accepted standards. In our opinion, this can be done on the basis of data received from satellite constellations, which should be supplemented with data from the ground. In this case, the most suitable is the European COPERNICUS program, which provides free data from the SENTINEL satellite group, which can be processed in accordance with the global ISO 19144 standard. With the help of external experts, an algorithm was established, partially including artificial intelligence for rapid processing of large data sets.

The main indicators that are set out in the law and the regulation and can be monitored are the indicators of the development zones, of which two are particularly important: percentage of built-up area for the respective zone; percentage of green areas for the respective zone.

As an example, we can present the results of an application for monitoring trends in green space indicators in the urbanized territories of the Municipality of Ruse. This application was developed within the framework of the project "NBSINFRA- 101121210 "Nature-Based solutions (NBS) to safeguard critical urban infrastructure against both natural and human-induced hazards, under the European Program HORIZON 2020. The development was carried out with the kind assistance of the Municipality of Ruse – Directorate "Economy, Investments, International Cooperation and Projects" and local experts.

EXAMPLE - MAP OF TRENDS IN THE STATE OF THE GREENING INDEX OF URBANIZED FUNCTIONAL AREAS UNDER THE MASTER PLAN OF RUSE MUNICIPALITY, FOR THE PERIOD 2017-2023.

(developed within the framework of the NBSINFRA project under the European HORIZON 2020 Program)

Preliminary information from the Master Plan of Ruse Municipality: The main types of functional (or development) zones in the General Development Plan (GDP) of Ruse Municipality are 8. They are:

- o **Residential areas** - with subcategories:
 - RI — low-rise development; Rm — mid-rise building; Rh — high-rise building; Rc — complex development - [Ruse Municipality](#)
- o **Production areas — with subtypes:**
 - Mostly a production area (Pm); Pure production area (Pp)
- o **Mixed multifunctional areas** - with subtypes: Mmf, Mmf 1, Mmf 2
- o **Public service areas** — e.g. "Ps" and "C" (mixed central zone)
- o **Recreational areas** — e.g. villa areas Rv, holiday, resort areas, etc. (recreation / rest areas)
- o **Sports and attractions areas** — sports areas, coastal areas, attractions, etc. (Sa)
- o **Green systems / landscaping** — greening areas, areas for cemetery parks and green areas, green systems (G,T)
- o **Nature conservation areas and protected areas** — areas covering protected areas, natural areas, areas with ecological/protection regime, etc. (N)

Other functional (or development) zones have been introduced separately, but they refer to non-urbanized territories, such as - "Agricultural" and "Forest territories (AT, FT), or territories with special purposes - "Special regime zones" (SZ) or "Transport and engineering infrastructure zones" (T, I).

Monitoring of trends in the percentage of green areas is mainly focused on the urbanized territories of the municipality of Ruse, because other types of territories - natural environment and agricultural areas require other monitoring methods. In addition, green areas in the urban environment are of fundamental importance for preserving the quality of habitation, the necessary standard of infrastructure, the health status of the capital's residents, as well as providing a major factor for risk prevention.

Table of quantitative indicators for the scope of the studied functional zones from the General Development Plan (GDP) of the Municipality of Ruse, as well as the various trends in the percentage of greening. GIS analyses, through an algorithm using partial artificial intelligence and based on data from the COPERNICUS Program and on-site data. Observation period – 2017 to 2023.

Master plan of Functional areas for municipality of Ruse – which data is total of all functional missing – white (1) zones		Functional areas with no noticeable trends (no change) – pale blue (2)	Functional areas with negative trends, but with indicators still above the minimum – yellow (3)	Functional areas with negative trends and indicators below the minimum percentage – red (4)	Functional areas with positive trends – green (5)
Number	n/a	1 952	236	205	58
Total area [ha]	n/a	6 172.54	1 573.56	610.47	70.20

Note: MUNICIPALITY OF RUSE - total area 570,624 km²; (according to the website of the Municipality of Ruse <https://obshtinaruse.bg/obsht-gradoustroystven-plan>)

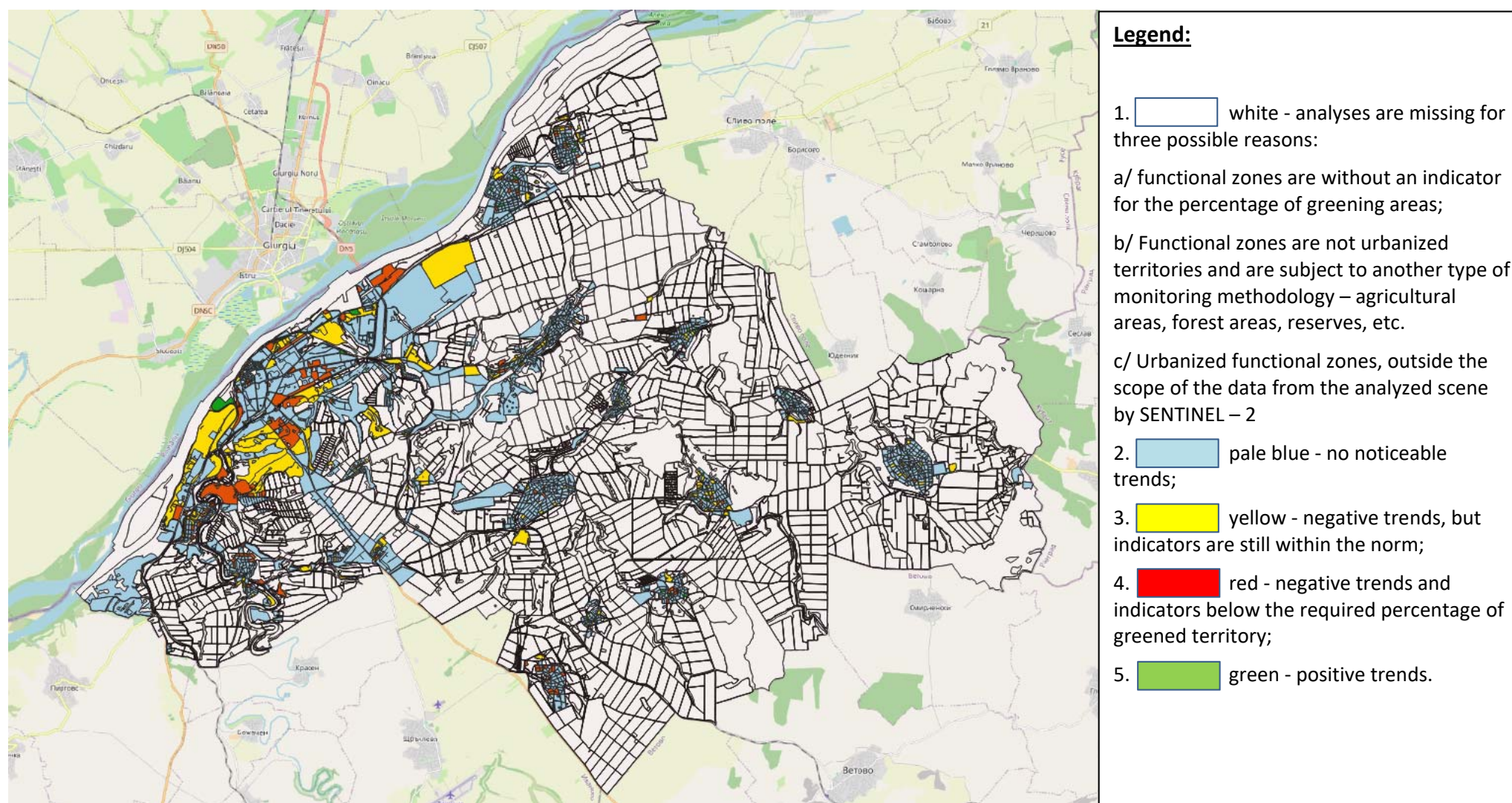
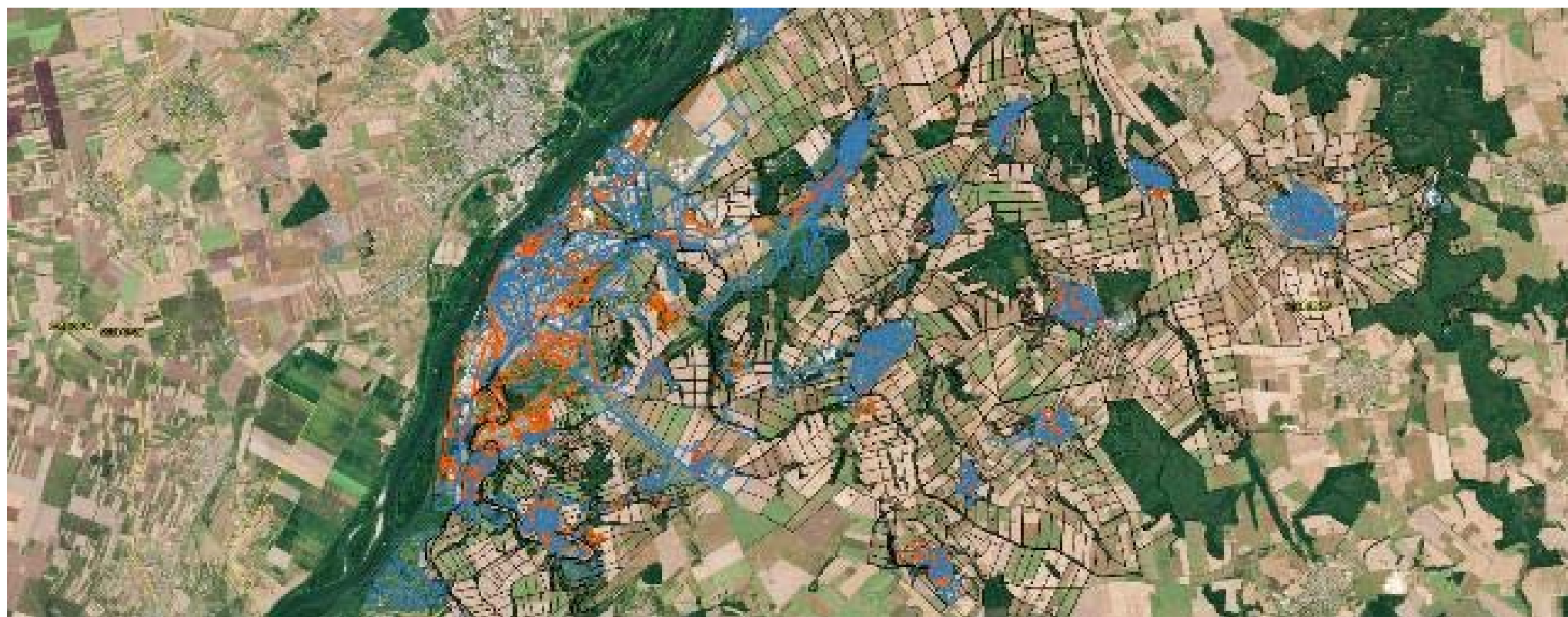


Fig.1. Map of trends in legally adopted indicators for green spaces in the development/functional zones of urbanized territories in the municipality of Ruse (period 2017-23) under the Master Plan for the Municipality of Ruse



Orange box: Negative trends observed in the normative percentage of green areas; Blue box: No negative trends observed

Fig. 2. Simplified map of potential trends in the percentage of mandatory green spaces in urbanized functional areas, based on satellite images from the Sentinel-2 satellite constellation

Important preliminary note: The presented map and data are an intermediate stage of development and should not be considered as a final product. In addition to completing the analysis of the satellite data, coordination with on-site data should be carried out, as well as discussions with experts from the capital administration in order to identify possible errors or possible other interpretations, as well as possible explanations for the changes that have occurred and trends noted.

Summary result (Note: Developmental/Functional urbanized areas of the type "Mixed Multifunctional" (Mmf) are excluded from the analysis):

- There is an overall decrease in mandatory green spaces in urbanized areas for the period 2017-23: 7%;
- There is a percentage of urbanized development zones with indicators for the percentage of green areas below the minimum percentage: 8%.

III. INPUT DATA FROM THE SENTINEL SATELLITE CONSTELLATION PROVIDED UNDER THE EC'S COPERNICUS PROGRAMME

This map is the result of applying the mechanism of regular monitoring of changes - CbM (Change by Monitoring), in accordance with the best European and global practice. Data from the SENTINEL satellite constellation, under the European COPERNICUS Program, were used. The analysis is combined - human expert analysis, with the application of artificial intelligence algorithms. Data from the optical sensor of the SENTINEL 2 satellite and products from the Copernicus Land Monitoring Service, for the period 2017-2023, were analyzed. The results show the trends of preservation, increase or decrease in the percentage of free greening area - one of the main sustainability indices, for the adopted functional zones under the General Development Plan of the Municipality of Ruse. Mainly urbanized territories were studied - territories corresponding to agricultural lands and territories that are forest massifs, reserves and natural environments were excluded from the presented analyses, as they are subject to analysis using a different type of methodology. Urbanized territories without a greening indicator were also not analyzed.

As the most visible and significant result for the sustainable management of the Municipality of Ruse, it should be declared the obvious reduction of the mandatory indicators for green spaces in urbanized territories of the broad center of the Municipality of Ruse, as well as partially in areas along the Rusenski Lom River. Since the lower reaches of the Rusenski Lom River, reaching the confluence with the Danube River, is part of the pilot area of the NBSINFRA project, below we present a more detailed analysis of the trends in the indicators for green spaces of urbanized development zones in this region. The detailed analyses are on an area of 35.36 hectares. Of course, upon request, we can make detailed analyses of each of the municipal development zones.

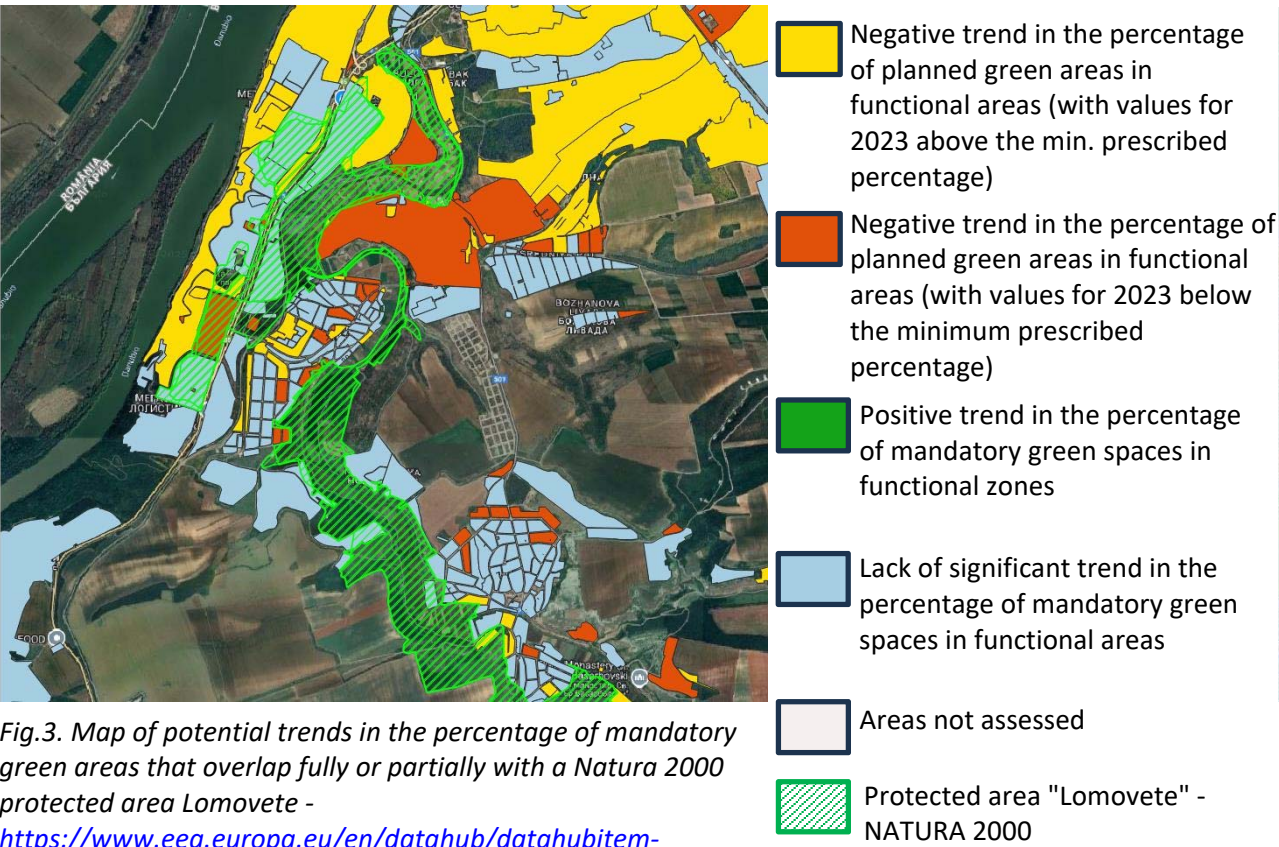


Fig.3. Map of potential trends in the percentage of mandatory green areas that overlap fully or partially with a Natura 2000 protected area Lomovete - <https://www.eea.europa.eu/en/datahub/datahubitem-view/6fc8ad2d-195d-40f4-bdec-576e7d1268e4>

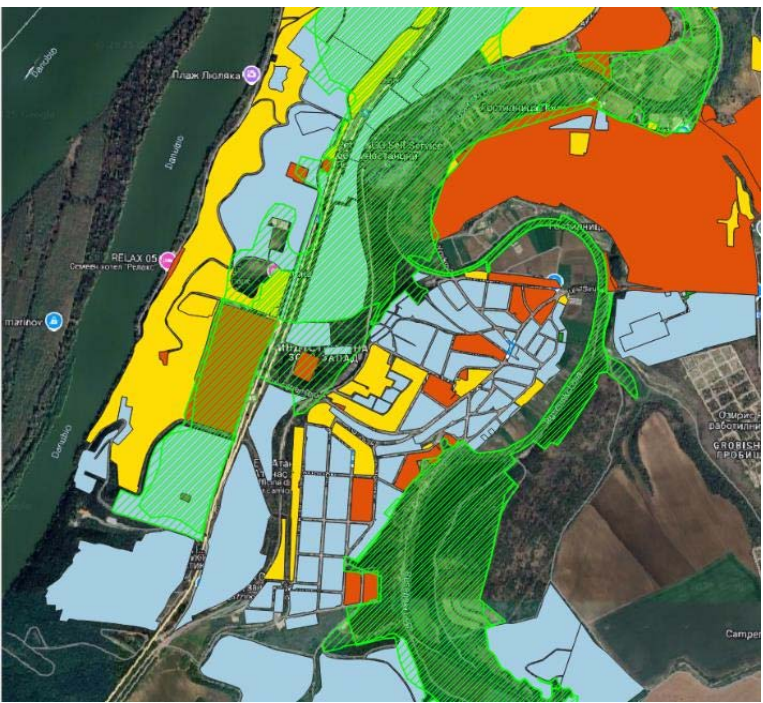


Fig.4. Functional areas with potential negative trends in the percentage of mandatory green areas falling within Natura 2000 "Lomovete"

The above two images are from the SENTINEL 2 satellite, with the boundaries of the development zone imposed.

	Type of functional areas	Number of functional areas	Affected parts of NATURA 2000 [ha]		Type of functional areas	Number of functional areas	Affected parts of NATURA 2000 [ha]
Negative trend above the minimum threshold (code 1)	Mostly a production area	4	1.22	Negative trend below the minimum threshold (code 2)	Villa area	1	0.26
	Forest Park	6	7.66		Low-rise residential development	6	4.09
	Villa area	1	1.99		Mostly a production area	1	0.03
	Mixed multifunctional zone	1	1.96		Mixed multifunctional zone	2	15.62
	Low-rise residential development	1	2.21		Public service area	1	0.30

The two tables above present the analyses for functional areas depicted in Fig. 3, with potential negative trends in the percentage of mandatory green areas falling within Natura 2000 "Lomovete". The indicators of the territory surveyed in detail in Fig. 4 are as follows: Total territory declared within the framework of NATURA 2000, for the entire OUP of the Municipality of Ruse – 4278 hectares. Total affected territory – 35, 36 hectares. Percentage of affected territory from NATURA 2000 – 0.8%.

We also present an example of Verification through monitoring of changes made to the General Development Plan of the Municipality of Ruse (GDP-Ruse) – The example is for analysis: Functional area (zone) with an observed potential negative trend in the indicator for mandatory green spaces. A visual assessment of a stratified random sample of functional areas was made, using the original Sentinel-2 satellite data used to determine the green spaces as a starting point. The results show a 90% accuracy in detecting negative trends in green spaces (Figure 4 below).



Fig.5. Examples of visual comparison of a pair of Sentinel2 images captured in 2017 and 2023, superimposed on the Master Plan of the Municipality of Ruse: The observation is on a functional area type: Mostly a production area, signature - (Pm). Graphs are also attached that visualize the trends for 2017 - 2023.



Fig.6. Generalized trend in the normative percentage of green areas in urbanized functional zones - type "Residential", signature - "R". The graph is based on satellite data (Sentinel-2) for the period 2017 - 2023.

The development is related to applied previous projects of ASDE-ECOREGIONS, implemented under the PECS Program of the European Space Agency, as well as under the European Program HORIZON 2020 - "HARMONIA". Partners in these developments are specialists from the Municipality of Ruse.

IV. INPUT DATA FROM SITE AND ADOPTED ALGORITHMS

The main source of information on the type of development/functional zones and indicators for green spaces is the Law on Territorial Development (LTD), REGULATION 7 on rules and regulations for the development of individual types of territories and development zones, and the general development plan (GDP) of the respective municipality. ASDE - ECOREGIONS has worked on trends in green space indicators for urbanized development zones, using data from published GDPs, for example, for the GDP of the Sofia Municipality, presented on the website of the Municipal Enterprise Sofia-Plan - <https://sofiaplan.bg/portfolio/oup-sofia/>; for the Municipality of Ruse, presented on the website of the GDP-Ruse - <https://obshtinaruse.bg/obsht-ustroystven-plan-na-gr-ruse-2020>. Unfortunately, there is no information on the number, individual and total area of the relevant development zones, according to the table of development regimes and the rules and norms of the individual types of territories (under REGULATION 7 of 22.12.2003). This does not allow us to make a comparison with the areas, according to the relevant data from the SENTINEL satellite constellation products of the Copernicus Territory Monitoring Services. For the needs of the analysis related to the Municipality of Ruse, an algorithm was prepared, combining the expert work of the expert, with the help of artificial intelligence. The number of development zones and their individual and total area are derived through this algorithm. In our opinion, it is necessary for the data to be checked and agreed upon by the experts from the Municipality of Ruse, in order to ensure relevance and reliability. This is also necessary due to the operational work of the planning mechanisms of the Ruse Municipality, responsible for territorial development, planning and building permits, where relevant updates and changes are made, as long as they are subject to the law and the adopted rules and regulations.

The image below presents a set of algorithm scripts developed using the object-oriented, high-level programming language PYTHON, applied to analyze trends in the development of green space indicators in urbanized development zones.

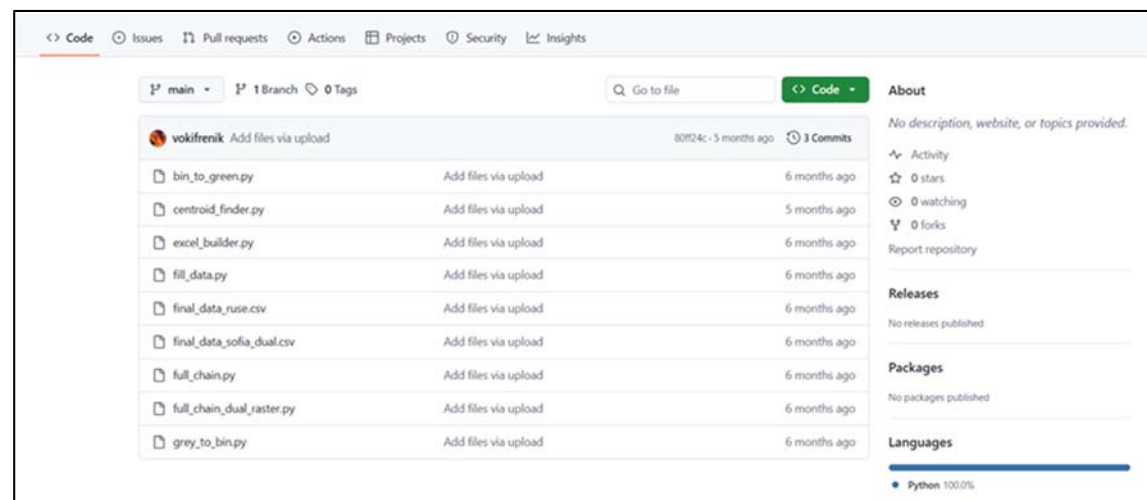


Fig.7 Set of scripts

PU:\Data_Zona_Analysis_extended_ID_2\id2_green.mxd — Features: Total: 451, Filtered: 451, Selected: 0																										
OBJECTID	NMEST_1	Zonall	Homesp	Shape_Leng	Shape_Area	площ	Zona_short	_2017count	_2017sum	_2017mean	_2019count	_2019sum	_2019mean	_2019count	_2019sum	_2019mean	_2020count	_2020sum	_2020mean	_2021count	_2021sum	_2021mean	_2022count	_2022sum	_2022mean	
1	1	гр.МАРТЕН	Висока зона	1	1064.90304037	50102.6916909	Ос	501	469	0.936127...	501	455	0.909106...	501	420	0.83823...	501	365	0.728463...	501	416	0.830533...	501	385	0.768463...	
2	7	гр.МАРТЕН	Зона за обществено обслуж.	1	3435.31092179	63261.2339015	Ос	11	1	0.090909...	11	0	0	11	0	0	11	0	0	11	0	0	11	0	0	
3	7	гр.МАРТЕН	Зона за обществено обслуж.	1	3435.31092179	63261.2339015	Ос	11	6	0.545454...	11	7	0.636363...	11	2	0.18181...	11	3	0.272727...	11	6	0.545454...	11	6	0.545454...	
4	7	гр.МАРТЕН	Зона за обществено обслуж.	1	3435.31092179	63261.2339015	Ос	17	4	0.235294...	17	1	0.0588235...	17	0	0	17	0	0	17	0	0	17	0	0	
5	7	гр.МАРТЕН	Зона за обществено обслуж.	1	3435.31092179	63261.2339015	Ос	10	5	0.277777...	10	5	0.277777...	10	0	0	10	0	0	10	0	0	10	0	0	
6	7	гр.МАРТЕН	Зона за обществено обслуж.	1	3435.31092179	63261.2339015	Ос	18	5	0.277777...	18	5	0.277777...	18	8	0.44444...	18	10	0.555555...	18	10	0.555555...	18	10	0.555555...	
7	7	гр.МАРТЕН	Зона за обществено обслуж.	1	3435.31092179	63261.2339015	Ос	19	14	0.736842...	19	12	0.631578...	19	16	0.84210...	19	14	0.736842...	19	16	0.84210...	19	16	0.84210...	
8	7	гр.МАРТЕН	Зона за обществено обслуж.	1	3435.31092179	63261.2339015	Ос	77	15	0.194805...	77	14	0.181818...	77	16	0.20779...	77	12	0.155844...	77	15	0.194805...	77	15	0.194805...	
9	7	гр.МАРТЕН	Зона за обществено обслуж.	1	3435.31092179	63261.2339015	Ос	102	30	0.294118...	102	35	0.343137...	102	20	0.19607...	102	2	0.019607...	102	16	0.156062...	102	16	0.156062...	
10	7	гр.МАРТЕН	Зона за обществено обслуж.	1	3435.31092179	63261.2339015	Ос	110	108	0.981818...	110	108	0.981818...	110	106	0.96363...	110	98	0.890909...	110	109	0.990909...	110	109	0.990909...	
11	7	гр.МАРТЕН	Зона за обществено обслуж.	1	3435.31092179	63261.2339015	Ос	117	67	0.572649...	117	55	0.470085...	117	52	0.44444...	117	39	0.333333...	117	63	0.539461...	117	63	0.539461...	
12	7	гр.МАРТЕН	Зона за обществено обслуж.	1	3435.31092179	63261.2339015	Ос	133	53	0.398496...	133	61	0.458646...	133	51	0.38345...	133	50	0.375939...	133	41	0.308270...	133	41	0.308270...	
13	8	гр.МАРТЕН	Зона за озеленяване	1	11014.5042719	404477.434016	Ос	22	19	0.863636...	22	15	0.681818...	22	15	0.68181...	22	2	0.090909...	22	4	0.181818...	22	4	0.181818...	
14	8	гр.МАРТЕН	Зона за озеленяване	1	11014.5042719	404477.434016	Ос	31	30	0.967741...	31	28	0.903225...	31	24	0.77419...	31	26	0.838709...	31	25	0.806451...	31	25	0.806451...	
15	9	гр.МАРТЕН	Зона за озеленяване	1	11014.5042719	404477.434016	Ос	31	25	0.806451...	31	24	0.77419...	31	20	0.64516...	31	23	0.741935...	31	24	0.774193...	31	24	0.774193...	
16	0	гр.МАРТЕН	Зона за озеленяване	1	11014.5042719	404477.434016	Ос	647	623	0.962905...	647	626	0.967542...	647	594	0.91900...	647	513	0.792090...	647	509	0.910555...	647	509	0.910555...	
17	8	гр.МАРТЕН	Зона за озеленяване	1	11014.5042719	404477.434016	Ос	738	728	0.986449...	738	729	0.987806...	738	724	0.98107...	738	649	0.879403...	738	729	0.987804...	738	729	0.987804...	
18	8	гр.МАРТЕН	Зона за озеленяване	1	11014.5042719	404477.434016	Ос	1238	1218	0.983844...	1238	1177	0.950726...	1238	1116	0.90145...	1238	1068	0.862681...	1238	1151	0.930725...	1238	1151	0.930725...	
19	0	гр.МАРТЕН	Зона за озеленяване	1	11014.5042719	404477.434016	Ос	2133	2020	0.951711...	2133	2040	0.960150...	2133	1990	0.93070...	2133	1654	0.775433...	2133	1969	0.923112...	2133	1969	0.923112...	
20	10	гр.МАРТЕН	Комплексно жилищно застро	1	612.740239155	20780.5154366	ЖК	206	54	0.262135...	206	44	0.213592...	206	44	0.21359...	206	26	0.126213...	206	36	0.174606...	206	36	0.174606...	
21	13	гр.МАРТЕН	Нискоетажно жилищно застро	1	62794.8040409	1671174.51561	ЖК	0	0	NULL	0	0	NULL	0	0	NULL	0	0	NULL	0	0	NULL	0	0	NULL	
22	13	гр.МАРТЕН	Нискоетажно жилищно застро	1	62794.8040409	1671174.51561	ЖК	1.0005252...	0.062380...	0.657392...	1.0005252...	0.060574...	0.0605065...	1.000525...	0.65115...	0.64564...	1.000525...	0.19002...	0.196660...	1.000525...	0.30550...	0.300002...	1.000525...	0.300002...		
23	13	гр.МАРТЕН	Нискоетажно жилищно застро	1	62794.8040409	1671174.51561	ЖК	1.2654296...	0.004705...	0.067001...	1.2654296...	0.160310...	0.1330066...	1.265429...	0.00970...	0.06700...	1.265429...	0	0	1.265429...	0	0	1.265429...	0	0	1.265429...
24	13	гр.МАРТЕН	Нискоетажно жилищно застро	1	62794.8040409	1671174.51561	ЖК	4	2	0.5	4	3	0.75	4	2	0.5	4	2	0.5	4	3	0.75	4	3	0.75	
25	13	гр.МАРТЕН	Нискоетажно жилищно застро	1	62794.8040409	1671174.51561	ЖК	4	0	0	4	0	0	4	0	0	4	0	0	4	0	0	4	0	0	
26	13	гр.МАРТЕН	Нискоетажно жилищно застро	1	62794.8040409	1671174.51561	ЖК	6	4	0.666666...	6	4	0.666666...	6	6	1	6	6	1	6	6	1	6	6	1	
27	13	гр.МАРТЕН	Нискоетажно жилищно застро	1	62794.8040409	1671174.51561	ЖК	6	1	0.166666...	6	0	0	6	0	0	6	0	0	6	0	0	6	0	0	
28	13	гр.МАРТЕН	Нискоетажно жилищно застро	1	62794.8040409	1671174.51561	ЖК	11	6	0.545454...	11	3	0.272727...	11	4	0.36363...	11	3	0.272727...	11	9	0.818181...	11	9	0.818181...	
29	13	гр.МАРТЕН	Нискоетажно жилищно застро	1	62794.8040409	1671174.51561	ЖК	27	26	0.962962...	27	22	0.814814...	27	24	0.88888...	27	12	0.444444...	27	21	0.777777...	27	21	0.777777...	
30	13	гр.МАРТЕН	Нискоетажно жилищно застро	1	62794.8040409	1671174.51561	ЖК	29	29	1	29	29	1	29	20	0.689655...	29	20	0.689655...	29	29	1	29	29	1	
31	13	гр.МАРТЕН	Нискоетажно жилищно застро	1	62794.8040409	1671174.51561	ЖК	36	25	0.694444...	36	18	0.5	36	23	0.63888...	36	10	0.277777...	36	14	0.388888...	36	14	0.388888...	
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Fig.8 Extract from a table with data from analyses of satellite images under the COPERNICUS – Sentinel-2 Programme for the period 2017-2023, showing trends in changes in the percentage of green areas in urbanized development zones, according to the Master Plan of the Municipality of Ruse

V. INCLUSION OF THE POTENTIAL OF ARTIFICIAL INTELLIGENCE IN THE DEVELOPMENT OF DATA ANALYSIS ALGORITHMS

In its developments, ASDE uses methods for the standardization of in situ data, according to the principles of the ISO 19178 standard. This is crucial for increasing the effectiveness of AI-based land monitoring systems that use remote sensing (RS) data. By providing a consistent framework for data collection, integration and interpretation, ASDE solutions aim to facilitate reliable interrelationship between in situ measurements and remote sensing data. This synergy enables more accurate environmental assessments, improved land use planning and timely detection of changes in urban areas and in contact areas with other land uses. This ultimately leads to better and more informed decisions in the field of sustainability and resource management. Through data standardization, ASDE contributes to the fact that different data sources can be seamlessly integrated, maximizing the potential of AI technologies in the monitoring and analysis of land dynamics.

VI. CONCLUSIONS

Some of the **basic principles for territorial development**, enshrined in the General Development Plan of the Municipality of Ruse (GDP-Ruse), as well as general principles of spatial planning that the plan follows, are:

- **Sustainable and integrated development** - The Plan is a strategic document that sets the guidelines for the social, economic and spatial development of the municipality, with the aim of ensuring balanced growth, sustainability and high quality of the environment and standard of living;
- **Clear territorial definition and zoning according to purpose** - The territory is divided into zonal categories - residential, mixed, industrial, public service areas, green systems, etc. This allows for a clear definition of the functions and regulations of each zone;
- **Compliance with legislation and regulations** - Ruse Urban Development Plan is implemented in accordance with national laws (e.g. Spatial Planning Act), as well as with additional rules/norms for spatial planning, which specify permissible parameters of development, purpose, protection, etc.;
- **Protection and integration of the natural environment and green systems** - The plan provides for zones for green systems, recreation and nature conservation areas, as well as regulations aimed at preserving natural, ecological and landscape qualities;
- **Flexibility and opportunities for gradual regulation and development** - The OUPO sets strategic guidelines, but the implementation of development measures is carried out through detailed development plans (DDP), which allows for phased and tailored development;
- **Preservation and integration of historical and cultural heritage** - The planning provides for special regimes for territories with cultural and historical value, in order to protect them during new development and construction;
- **Publicity, transparency and an orderly administrative process** - Through zoning, regulations and rules for development, predictability and transparency are guaranteed in investments, regulation, privatization and control over the territory.

In this regard, as well as a result of the analyses of trends in the mandatory indicators for green spaces, recorded in the Law on Territorial Development and in the Master Plan of the Municipality of Ruse, the following conclusions can be drawn:

- The application for monitoring trends in the percentage of green spaces promotes the enhancement of urban resilience and risk prevention through integrated decision support systems (DSS) and advanced modeling tools;
- The results are objective as objective data from the satellite segment are used, combined with local environmental data and local geospatial data to monitor trends in urban green spaces and monitor compliance with local regulations;
- Most functional areas have maintained and some have improved their percentage of urban green spaces. • However, a significant number show a downward trend, especially in certain parts of the wider center of the city of Ruse;
- Further review by local experts and general discussion is needed, as some of the observed trends could be due to: unpublished zoning changes, updates to parcel plans and noise in the processing of satellite data.

VII. NATIONAL MANDATORY REGULATORY REQUIREMENTS

As stated in Article 2 of the Law on Territorial Development (LTD), it "regulates public relations related to territorial development, investment design and construction in the Republic of Bulgaria, and determines the restrictions on ownership for development purposes" - <https://www.mrrb.bg/bg/zakon-za-ustrojstvo-na-teritoriyata-84665/>. In turn, each municipality is obliged to develop, approve and comply with the so-called General Development Plan, which should be the basis for municipal development for a long period of time - an average of 15-20 years. Of course, during this period, necessary changes may occur in the indicators and content of certain territories and development zones, but this should be done in accordance with the relevant legal order. Therefore, it is necessary to regularly monitor compliance with the municipal development plan, as well as the relevant indicators for sustainability of each of the development/functional zones.

These indicators are determined both by the LTD and by the accompanying Ordinance 7 on rules and regulations for the development of individual types of territories and development zones - <https://www.mrrb.bg/static/media/ups/articles/attachments/>

The proposed innovative application for monitoring indicators for the percentage of green areas in urbanized functional/developmental zones is a necessary tool for the national and local administration, in order to ensure objective control and preventive measures on changes and trends in compliance with key indicators of the legally envisaged development/functional territorial elements.

In the example shown, indicators for the percentage of green areas are included, but other important indicators can also be included, for example - percentage of built-up area, percentage of sealed area, trends in areas affected by landslide processes, etc.

As an example, the Table under Regulation 7 on rules and regulations for the development of individual types of territories and development zones is presented below, with the monitoring indicators - development parameters for the minimum green area for each development territorial category indicated in green. In our development, we have limited ourselves to urbanized development zones - column 4, with the cells in target color. In agreement with local specialists, we can display in tabular form the number of relevant development zones with negative trends in the percentage of green areas, so that they can be easily understood and illustrated for both the local administration and the citizens of the respective municipality.

LEGAL BASIS - TABLE OF ZONES WITH DEVELOPMENT REGIME AND MANDATORY PERCENTAGE OF GREEN AREAS (column in green), according to REGULATION 7 of December 22, 2003 on rules and regulations for the development of individual types of territories and development zones

	УСТРОЙСТВЕНА КАТЕГОРИЯ	УСТРОЙСТВЕНИ ПАРАМЕТРИ				ПРЕДНАЗНАЧЕНИЕ, ОСНОВНИ И ДОПЪЛВАЩИ ФУНКЦИИ, ОГРАНИЧЕНИЯ вижте на - https://www.mrrb.bg/static/media/ups/articles/attachments/	Индекс	Цвят	Площ/контур
		Макс. плътност на застр. в %	Макс. Кинт	Мин. озеленена площ %	Макс. Кота корниз в м				
	1	2	3	4	5	6	7	8	9
	УРБАНИЗИРАНИ ТЕРИТОРИИ								
	ГРУПА ЖИЛИЩНИ УСТРОЙСТВЕНИ ЗОНИ						Ж	кафяв	площ

1	Жилищна зона с преобладаващо високо-етажно застрояване	60	3,5	20	26 за жил. и общ. сгр.		Жг	кафяв	площ
2	Жилищна зона с преобладаващо комплексно застрояване	40	3,0	40	26 за жил. сгр. 32 за общ. сгр.		Жк	кафяв	площ
3	Жилищна зона с преобладаващо средноетажно застрояване	50 25 до 40	2,3 1,0 до 1,5	35 40 до 55	15 за жил. сгр. 20 за общ. сгр. 12 за жил. сгр. 15 за общ. сгр.		Жс	кафяв	площ
4	Жилищна зона с преобладаващо малкоетажно застрояване	40	1,3	40	10		Жм	кафяв	площ
5	Жилищна зона с малкоетажно застрояване в природна среда	20 до 30	0,6 до 0,9	70 до 60	7 до 10		Жм1	св.кафяв	площ
6	Жилищна зона с малкоетажно застрояване с допълнителни, специфични изисквания	30 25	1 0,8	60 60	10 8,5		Жм2	св.кафяв	площ
7	Жилищна зона с малкоетажно застрояване, с ограничителни параметри	10 до 15 20	0,1 до 0,3 0,5	80 до 80 70	кота било 7,5 кота било 8,5 7		Жм3	св.кафяв с вертикално зелено райе	площ
8	Вилна зона	25 20	0,8 0,6	60	8,5 7		Жв	Св. каки	площ
ГРУПА ЦЕНТРАЛНИ УСТРОЙСТВЕНИ ЗОНИ							Ц		
9	Зона на новия делови център			15			Ц1	Кереми-дено	площ
10	Зона на стария градски център	60 до 80	3,5 до 5	30 до 20			Ц2	Кереми-дено	площ
11	Зона централна със смесено застрояване	60	3,5	40			Ц3	Кереми-дено	площ
ГРУПА СМЕСЕНИ МНОГОФУНКЦИОНАЛНИ УСТРОЙСТВЕНИ ЗОНИ									
11 а	Смесена многофункционална зона за много високо строителство	60	3,5	40			Смфв	керемидено	
12	Смесена многофункционална зона	60	3,5	40			Смф	светло кереми-дено	площ
13	Смесена многофункционална зона с занижени параметри	40	2	40	26		Смф1	светло кереми-дено	площ
14	Смесена многофункционална зона предимно за околорадския район	40 60	1,2 1,2	40 30			Смф2	светло-кереми-дено	площ
ГРУПА УСТРОЙСТВЕНИ ЗОНИ ЗА ОБЩЕСТВЕНО-ОБСЛУЖВАЩИ ДЕЙНОСТИ							О	Червено	площ
15	Зона за общественообслужващи дейности	60 50	3 1,5	30 40	20 12		Оо	червено	площ
16	Зона за обществено-обслужващи дейности и озеленяване в градския район	30	1,2	50			Оз1	зелено с вертикално червено райе	площ
17	Зона за обществено-обслужващи дейности и озеленяване в околорадския район	20	0,8	60			Оз2	зелено с вертикално червено райе	площ
18	Линеен фронт на обекти за обществено обслужване							в цвета на съответната зона	червен контур
ГРУПА ПРОИЗВОДСТВЕНИ УСТРОЙСТВЕНИ ЗОНИ И ТЕРЕНИ ЗА СПЕЦИФИЧНИ ПРОИЗВОДСТВА							П		
19	Производствена зона	60	1,5	25			Пп	тъмно виолето	площ
20	Смесена производствена зона	55	1,5	30			Пс	светло виолето	площ
21	Зона за малки и средни производства и занаятчийски услуги	50	1,5	35			Пмс	розово-лилав	площ
22	Зона за високотехнологични производства	30	1,2	40			Птп	Розово-лилав с зелен щрих	площ
23	Терени за добив на полезни изкопаеми	10					Тди	сиво	площ
ТЕРЕНИ ЗА БАЗИ НА ГРАДСКОТО СТОПАНСТВО И ТЕХНИЧЕСКАТА ИНФРАСТРУКТУРА									
24	Терени за бази на зелената система						Тбз	кафяво-сиво	площ
25	Терени за транспортна инфраструктура						Тти	светло сиво	площ
26	Терени за инфраструктура на жп транспорта						Тжп	светло сиво с тъмно сив щрих	площ
27	Терени за бази на транспорта						Ттр	светло сиво	площ
28	(Изм. – ДВ, бр. 41 от 2007 г.) Терени за площни обекти на електроснабдяването и електронните съобщения						Тел	светло сиво	площ

29	Терени за площни обекти на ВиК						Твк	светло сиво	площ
30	Терени за площни обекти на снабдяване с петролни продукти, газ и топлоенергия						Тп	светло сиво	площ
31	Терени за сметища и инсталации за преработка на отпадъци						Тсм	светло сиво	площ
	УСТРОЙСТВЕНА ЗОНА И ТЕРЕНИ ЗА ОЗЕЛЕНЯВАНЕ							Зелено	площ
32	Зона на градски паркове и градини	1	0,06	85 (вкл. декор. водни площи)			Зп	зелено	площ
33	Терени на локални градини и озеленяване	2	0,02	80 (вкл. декор. водни площи)			Тго	зелено	площ
34	Терени за зелени връзки и озеленяване на улици, реки и дерета, открити канали и сервитути	0					Тзв	зелено	площ
35	Терени за специални зелени площи			60			Тзсп	светло зелено	площ с червен контур
36	Терени за гробищни паркове						Тгп	зелено с червен контур	площ с контур
37	Терени за декоративни разсадници						Тдр	светло зелено	площ
	ГРУПА УСТРОЙСТВЕНИ ЗОНИ И ТЕРЕНИ ЗА СПОРТ И АТРАКЦИИ								
38	Зона за спорт и атракции, предимно в градския район	20	0,3	40			Са1	синьо-зелено	площ
39	Зона за спорт и атракции, предимно в околорадския район	10	0,15	50			Са2	синьо-зелено	площ
40	Терени с конкретно предназначение за спорт и атракции	25	0,5	40			Тск	синьо-зелено	площ
	ДРУГИ ТЕРЕНИ								
41	Специални терени						Тсп	сиво-розово	площ
42	Терени на реки и други открити водни площи						Трк	синьо	площ
	ЗЕМЕДЕЛСКИ ТЕРИТОРИИ								
	ГРУПА ЗЕМЕДЕЛСКИ УСТРОЙСТВЕНИ ЗОНИ И ТЕРЕНИ						Сс		
43	Земеделска зона с разрешено застрояване						Сср	тъмно жълто	площ
44	Земеделска зона без право на застрояване						Ссб	светло жълто	площ
45	Земеделска зона със специфичен режим	1	0,02	20			Ссп	светло жълто-зелено	площ
46	Земеделска зона - трайни насаждения, разсадници и др.						Сст	светло жълто с зелено каре	площ
47	Терени за опитни полета на научни институти	5	0,05				Топ	жълто	площ
	ГОРСКИ ТЕРИТОРИИ								
	ГРУПА ГОРСКИ УСТРОЙСТВЕНИ ЗОНИ И ТЕРЕНИ								
48	Защитни гори и земи						Гз	тъмно зелено	площ
49	Рекреационни гори и земи – зелена зона						Гр	тъмно зелено	площ
50	Лесопаркове						Глп	тъмно зелено със св. зелен контур	площ с контур
51	Държавно ловно стопанство						Глс	тъмно зелено със св. зелен контур	площ с контур
52	Стопански гори						Гс	тъмно зелено	
53	Терени за горски разсадници						Тгр	тъмно зелено със св. зелен контур	площ с контур
	ЗАЩИТЕНИ ТЕРИТОРИИ								
	ГРУПА ТЕРИТОРИИ ЗА ЗАЩИТА НА КУЛТУРНО-СТОРИЧЕСКОТО НАСЛЕДСТВО								
54	Територия с концентрация на обекти на КИИ							оранжев контур върху основния режим	контур
55	Културно-исторически резерват							тънко черно каре върху основния режим	диагонал ен карианщ рих
56	Охранителна зона на културно-исторически резерват							тънък черен щрих върху основния режим	диагонал ен щрих
	ГРУПА ТЕРИТОРИИ ЗА ПРИРОДНА ЗАЩИТА						Р		
57	Природни резервати						Рзп	сиво зелено с синьо райе	площ с райе
58	Природни паркове						Рпп	сиво зелено	площ

59	Защитени местности и природни забележителности						Рдз	сиво зелено с тънък червен контур	площ с контур
	ОХРАНИТЕЛНИ ЗОНИ НА ВОДОИЗТОЧНИЦИ И НА КУРОРТИ					х.			
60	(Изм. - ДВ, бр. 98 от 2014 г., в сила от 28.11.2014 г.) Охранителен пояс "I" водоизт., вкл. на минерални извори							светло син контур върху осн. режим	контур
61	Оранителна зона "А" на курорт							розов контур върху осн. режим	контур
	НАРУШЕНИ ТЕРИТОРИИ ЗА ОЗДРАВЯВАНЕ,ВЪЗСТАНОВЯВАНЕ И УКРЕПВАНЕ НА ЗЕМНАТА ОСНОВА								Означ.с гра-ници и щрих върху осн. режим
62	Техногенно нарушени терени за биологично възстановяване						Ссб		Растр жълт
63	Техногенно нарушени терени за техническо укрепване						Тди		Растр зелен
64	Блата, мочурища и др. територии за оздравяване								
65	(Изм. - ДВ, бр. 98 от 2014 г., в сила от 28.11.2014 г.) Свлачища и срутища за укрепване								Черен контур
66	Сеизмично рискови зони								Червен контур
67	Суфозионен карст								Жълт контур

The Law of Development

The indicators in the relevant table from the Ruse Municipality's Master Plan are presented at the following website address:

(<https://obshtinaruse.bg/obsht-ustroystven-plan-na-gr-ruse-2020>)

POSSIBLE DISCUSSION ON FORECASTS AND OFFERS FOR REGULAR MONITORING AND SUPPORT BY ASDE-ECOREGIONS:

1. Following the market behavior of users of a particular product, they would probably be most interested in getting a product at extremely low shipping prices and, if possible, without subsequent data maintenance fees. We are ready to have a free trial period. It is possible to discuss a high one-time license price with a longer validity period, for example 3 or 5 years with free maintenance. More subscription options should be provided, similar to mobile operators. Higher interest can only be caused by a proven and obvious superiority of the platform over the competitors.
2. The option for self-maintenance and updating of the data and the possibility of integration, transfer (migration) or at least one-way data exchange with an existing GIS would be of interest, if this is considered possible. The interest of the municipalities is related to the provision of a free version for at least one year, possible reduction/optimization of the costs of mandatory insurance for non-threatened sites (those outside the risk zones), with possibilities for relevant amendments to the applicable laws and regulations.
3. This Annex supports REGULATION (EU) 2024/1991 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 24 June 2024 on nature restoration.
4. Other innovative applications are in development.

VIII. EUROPEAN REGULATION

The present study of trends in compliance with mandatory indicators for green areas in the planning zones of the Municipality of Ruse is in line with good European practice and, above all, with the requirements of the new **REGULATION (EU) 2024/1991 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL** on nature restoration. According to the uniform format of the national nature restoration plan (Regulation (EU) 2025/912): *“Member States shall identify urban eco-system areas in order to achieve the objectives of Article 8. Entire cities or smaller towns and suburbs may be identified directly on the basis of the latest available data from Eurostat. If the Member State decides to use a different approach for urban eco-system areas, it shall provide additional information.”* For Bulgaria, which has a Law on Territorial Planning and the accompanying ORDER 7 of December 22, 2003, which require each municipality to prepare and adopt a general development plan for the management of urbanized, agricultural and natural territories, it is appropriate and natural to implement a **system for regular monitoring of green space indicators, which are determined for the relevant development zones, and to regularly monitor trends.**

It is logical that this monitoring be carried out by an appropriate independent team of specialists based on objective data from European sources, such as the COPERNICUS Program and accepted standards, such as ISO 19144.

We are ready to share our experience and knowledge, which has been improved in continuous contact with European structures that provide independent, evidence-based knowledge and science, supporting EU policies for a positive impact on society.

ASDE-ECOREGIONS TEAM AND PARTNERS / 1998-2025