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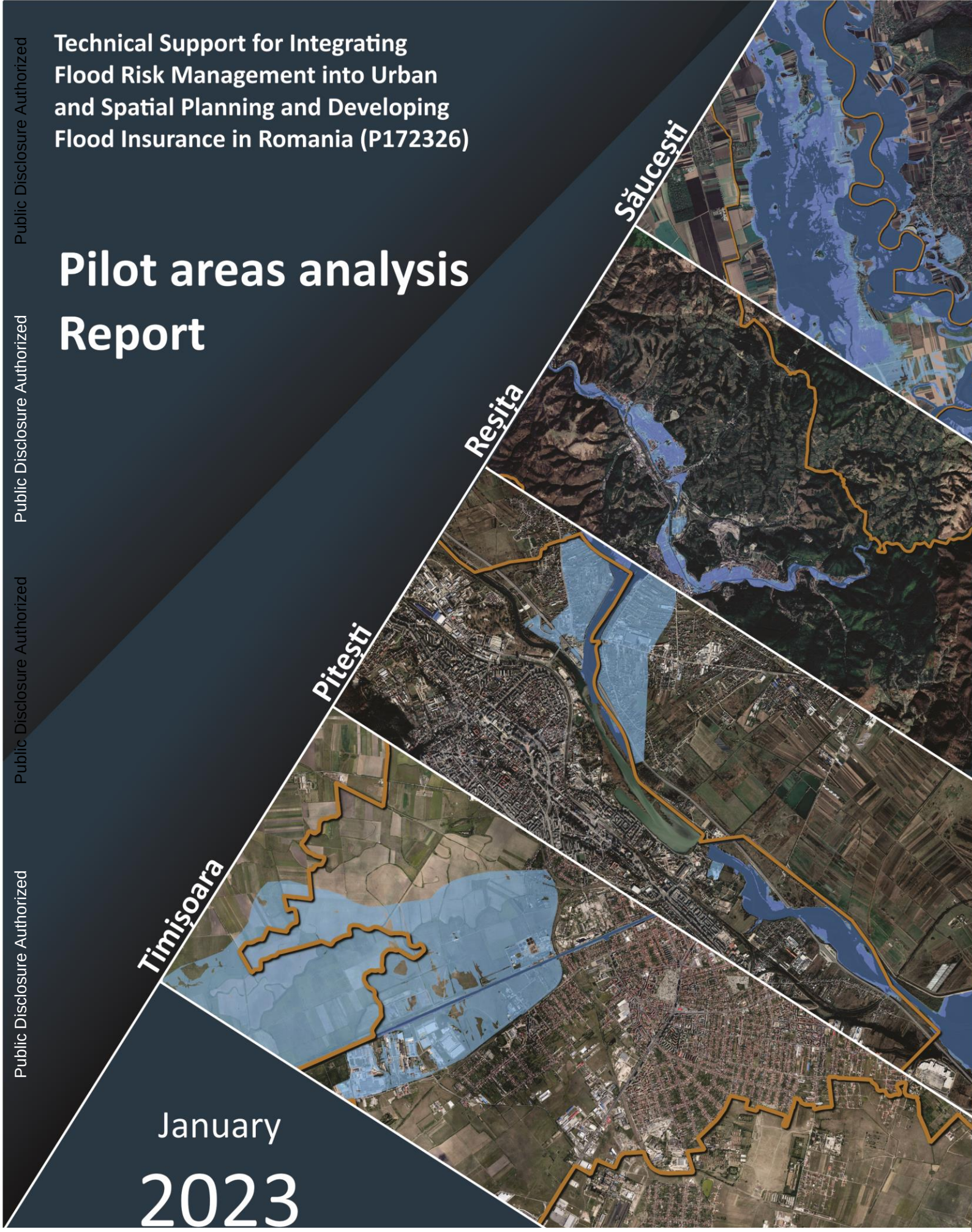
Technical Support for Integrating Flood Risk Management into Urban and Spatial Planning and Developing Flood Insurance in Romania (P172326)

# Pilot areas analysis Report




January

2023

Project funded by the European Union (EU) via the Structural Reform Support Programme
and implemented by the World Bank (WB) in cooperation with the European Commission's Directorate General for Reform Support (DG REFORM)

European Commission

MINISTERUL MEDIULUI, APELOR ȘI PĂDURILOR
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## Technical Support for Integrating Flood Risk Management into Urban and Spatial Planning and Developing Flood Insurance in Romania (P172326)

# Annex 5 to the Guideline for integrating Flood Risk Management into Spatial and Urban Planning

## Pilot areas analysis Report

**January 2023**

The project *Technical Support for Integrating Flood Risk Management into Urban and Spatial Planning and for the Development of the Flood Insurance Scheme* is funded by the European Union (EU) via the Structural Reform Support Programme and implemented by the World Bank (WB) in cooperation with the European Commission's Directorate General for Reform Support (DG REFORM)

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## Purpose

This report was delivered under the Administration Agreement signed between the European Commission on behalf of the European Union and the International Bank for Reconstruction and Development concerning the Part II Europe 2020 Programmatic Single-Donor Trust Fund on February 28, 2020. It corresponds to Addendum 5 of Annex 1 of the Output 4: Pilot areas analysis Report.

This report is the result of the work performed by a team of World Bank staff and experts led by Elena Daniela Ghiță (Water Resources Management Specialist, Task Team Leader), Amparo Samper Hiraldo (Senior Water Resources Management Specialist, Co-Task Team Leader) and Chris Fischer (Senior Water Resources Management Specialist, Co-Task Team Leader). Alexandru Cosmin Buteica (Environmental Specialist), Cosmin Feodorov (Project Management Analyst), Edmund Penning-Rowsell (Senior Urban Floods Expert), Laura-Elena Tucan (Spatial Urban Planning Expert), Maria Stoica (Urban Floods Risk Management Expert), Mary-Jeanne Adler (Senior Flood Risk Management Expert), Andreea Necșulescu (Senior Spatial Urban Planning Expert) and Ioan Bica (Senior Flood Risk Management Expert) provided valuable contributions. The team also benefited from the solid logistic support provided by Anastasia Gadja (Program Assistant) and Cristian Popa (Program Assistant) of the World Bank offices in Bucharest and the thoughtful guidance of Winston Yu, Manager, ECA Water Practice (SCAWA).

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## ABBREVIATIONS

| | |
|---|---|
| ANAR | National Administration Romanian Waters |
| APSFR | Areas of Potentially Significant Flood Risk |
| CIR | Fast Intervention Centers |
| CNPH | National Center for Hydrological Forecasts |
| FHRM | Flood Hazard Risk Maps |
| FHRM | Flood Risk Management |
| GD | Government Decision |
| GDP | Gross Domestic Product |
| GIS | Geographic Information System |
| GRP | Glass Reinforced Plastic |
| GoR | Government of Romania |
| FFPI | Potential Index for the manifestation of accelerated water runoff |
| IGSU | General Inspectorate of Emergency Situations |
| INHGA | National Institute of Hydrology and Water Management |
| LIDAR | Light Intensity Detection and Ranging |
| MEWF | Ministry of Environment, Water and Forests |
| MDPWA | Ministry of Development, Public Works and Administration |
| PATJ | County Territorial Development Plan |
| PATN | National Territorial Development Plan |
| PATZR | Regional Zonal Territorial Development Plan |
| PUD | Detailed Urban Plan |
| PUG | General Urban Plan |
| PUZ | Zonal Urban Plan |
| RBA | River Basin Administration |
| SPAU | Wastewater Pumping Station |
| SIDU | Integrated Urban Development Strategy |
| SP | Spatial Planning |
| WWTP | Waste Water Treatment Plant |



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# SECTION A: Introduction

## A.1. The context of the pilot areas analysis

Considering the context of Romania being a one of the European countries most at risk of floods and the impact of climate change which is expected to further exacerbate the frequency and magnitude of extreme flooding events, the European Commission has expressed an interest in ensuring that the World Bank provides technical assistance in the framework of the Trust Fund with the specific objective of supporting the Government of Romania (GoR) in enhancing its capacity in relation to flood risk management and urban and spatial planning, taking into account relevant international best practice. The Directorate-General for Structural Reform Support (DG REFORM) of the European Commission, has invited the World Bank to ensure additional support to the GoR to complement the advisory services activities carried out by the Bank under the RAS, which provides technical support to elaborate the Flood Hazard and Risk Maps and the Flood Risk Management Plans. Thus, **the project aims at increasing the awareness of public administrations charged with urban and spatial planning on the need for the integration of flood risk management** considerations into their practices, including by considering international best practice.

The project was designed in 4 major phases (*Figure 1*), as follows:

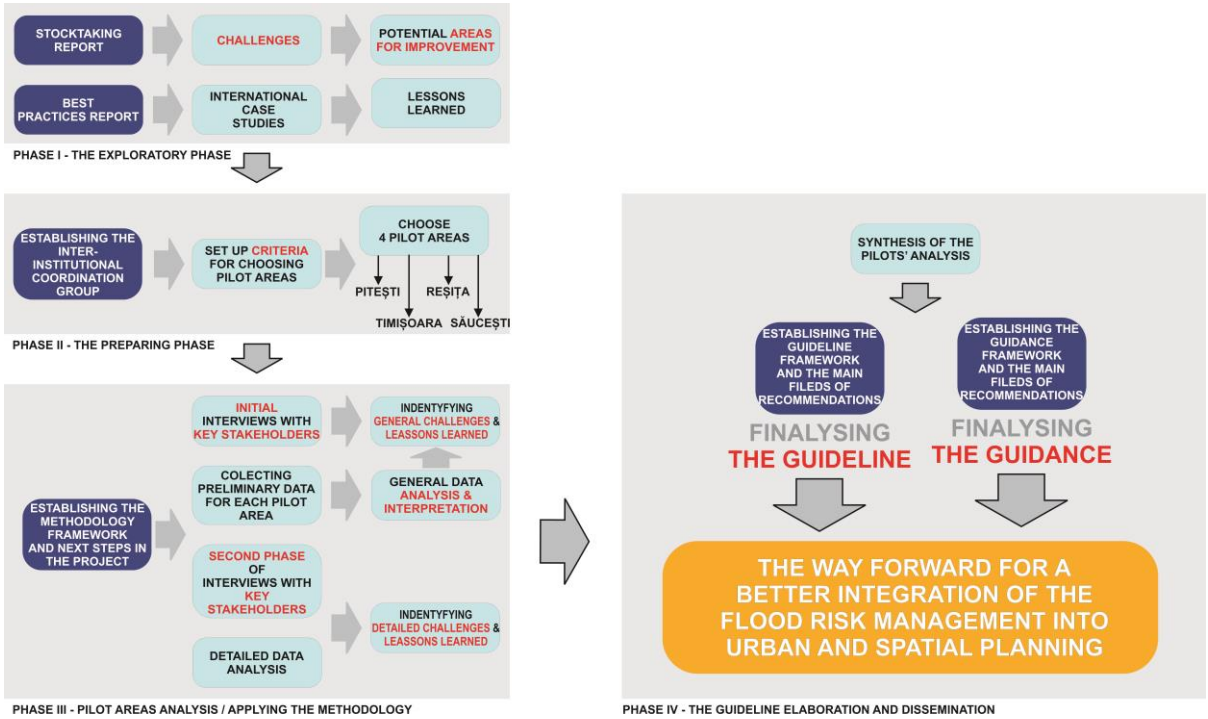


***Figure 1*** *– The SRSS project phases*
*Source: World Bank*

- **Phase I – The exploratory phase**. During this phase, two deliverables have been developed:
  - *Stocktaking Report*, which provides a description of the legal framework, the relevant tools, the relevant public institutions and stakeholders related to flood risk management and spatial and urban planning, and as well a long list of potential pilot areas to perform a more detailed analysis of how flood risk management aspects are considered into urban and spatial planning practices.
  - *Report on the best practices at European and international level*, which provides an analysis of how both fields are integrated in other countries, with relevance for the Government of Romania needs.


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- **Phase II – The preparing phase**. In this phase four pilots were selected based on a comprehensive set of criteria. For more details *ADDENDUM 3: Criteria for choosing pilot areas* can be consulted.

- **Phase III** – **Pilot Areas analysis**. This is the current phase for which this report is made. In this phase the methodology for pilots' analysis is established as can be consulted *in ADDENDUM 1: The Methodology for the development of the pilot areas analysis* and pilot analysis is made based in this methodology. This phase is needed for a more comprehensive analysis to capture different aspects of how the integration is considered at the local level.

- **Phase IV – The Guideline and Guidance elaboration and dissemination.** This *Guideline and the Guidance document on the Integration of Flood Risk Management into Urban and Spatial Planning Practices* will be based on the findings of the Stocktaking and preparatory phase and of four pilot activities.
  *The Guideline* will be used by relevant stakeholders identified in the Stocktaking Report and in the pilot analysis activity. It will be a step-by-step methodology for the integration process in the spatial and urban planning elaboration, approval and enforcement phases.
  *The Guidance* is a complementary document to the Guideline and it is meant to provide recommendation regarding legal framework improvement, policies and procedures, involvement of stakeholders in the integration process of flood risk management into urban and spatial planning.

## A.2. Objectives

The main objectives of the pilot area analysis are:

- Understanding the entire planning process (from the acquisition phase, to elaboration, implementation and enforcement phase);
- Identifying general approaches (valid for the entire country) versus specific approaches (particular to specific regions / administrative areas);
- Validation of the Stocktaking Report findings;
- Identifying the relevant stakeholders and their role in the integration process;
- Identifying challenges and potential areas of improvements in the integration process of flood risk management into urban and spatial planning.

## A.3. Summary of the Methodology for the development of the pilot areas analysis

During the project implementation, the main aspects of pilot's analysis approach have been discussed and agreed with the teams of the Ministry of Environment, Waters and Forests, National Administration "Romanian Waters" and Ministry of Development, Public Works and Administration, either during bi-lateral meetings or with the members of the Coordination Group of the project (a more extended team) and also suffered adaptations during the process. Thus, a *Methodology* was designed to approach the pilot area analysis.

The *Methodology for the development of the pilot areas analysis on the integration of flood risk management into urban and spatial planning practices* provides information regarding the purpose of the analysis, the selection of the pilot areas, the approaches and the tools to be used in the process, the relevant stakeholders to be considered etc. The methodology is a framework for the pilot areas analysis which should be followed in order to achieve the objectives presented above.

According to the methodology the following steps were followed for each pilot area analysis:

1. **Collect data** from open sources and from the relevant stakeholders (City Hall, RBA, Water Companies etc.);


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Data were collected for both fields of interest: flood risk management and spatial and urban planning and were focused on both existing situation and the forecasted one.

2. **Identify relevant stakeholders** in the process of flood risk management integration into urban and spatial planning.
   This analysis started from the Stocktaking Report findings and only stakeholders with direct role in the integration process were selected.
3. **Conduct interviews with the stakeholders** identified in step 2.
   A framework for each interview was established by consulting the Inter-Institutional Coordination Group and then following meetings were set-up;
4. **Identify and analyze the relevant flood risk management tools**;
   For each pilot current flood risk management tools used by different stakeholders were identified and analyzed. The correlation of these documents was a focus of the analysis.
5. **Identify and analyze the relevant urban and spatial planning tools**, from the list in *Figure 2*:
   The correlation between these documents was analyzed among with the integration of the flood risk management studies / tools in the spatial and urban planning plans;

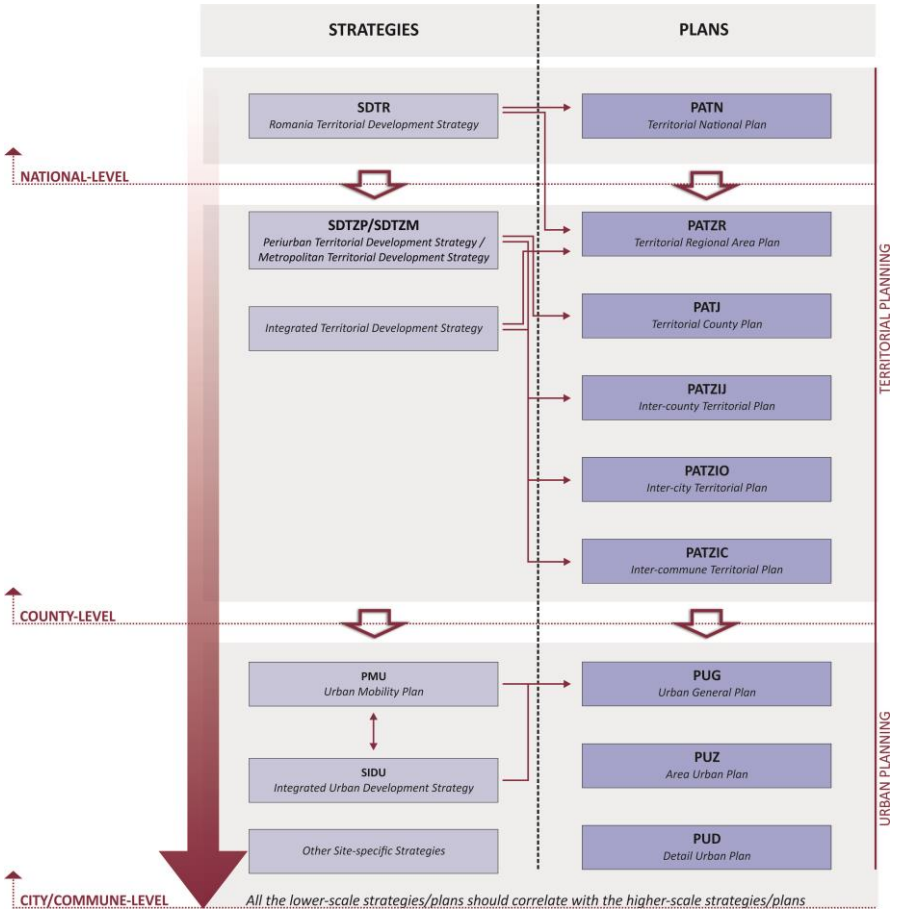


***Figure 2*** *– Spatial and urban planning tools and their relations*
*Source: World Bank*

6. **Identify main gaps and lessons learned** from the spatial and urban planning plans analysis;
7. **Identify main gaps and lessons learned** from the spatial and urban planning approval and enforcement process.


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A conclusion followed all these steps in order to establish the way forward for *the Guideline and Guidance document on the Integration of Flood Risk Management into Urban and Spatial Planning Practices.* Thus, the Guideline and Guidance are based on this Pilot Report analysis.

## A.4 Executive Summary

**This Report is an annex** to the *Guideline document on the Integration of Flood Risk Management into Urban and Spatial Planning Practices* and **should be read as an integrated part of it**. Moreover, The Pilot Area Analysis Report **substantiated the Guideline's approaches as it gives a full picture of the challenges and potential areas of improvement** for the integration process of flood risk management into Romanian urban and spatial planning plans.

This Report is an **exhaustive and comprehensive analysis** of the integration of flood risk management measures into urban and spatial planning by investigating all the phases of the process: from the collecting data phase to the elaboration, approval and enforcement phase. The process is studied by interviewing relevant stakeholders involved in different stages. Moreover, this Report is also analyzing the specific content of the urban and spatial planning plans, the relation between them and with the flood risk management issue.

Considering that the 4 pilots are representing different size of the urban areas, different typologies (urban-rural), different spatial locations, different flood sources that are affecting the areas, the results of the analysis reflect **multiple particularities of the challenges** that the integration of flood risk management into urban and spatial planning is currently facing.

This pilot analysis is organized in different sections, a section for each pilot. Thus, **Section B** is dedicated to **Timișoara pilot**, **Section C** is dedicated to **Pitești pilot**, **Section D** is dedicated **to Reșița pilot** and **Section E** is dedicated to **Săucești pilot**. All pilots are presented in parallel by using the same indicators: the pilot context (a general description: the territorial context, the geographical description, the demographic, economic and environment data), the flood risk management characteristics, the integration of hazard and flood risk maps and flood risk management measures into spatial and urban planning (the content of urban and spatial plans and the elaboration, approval and enforcement process).

After analyzing all the 4 pilots, broad conclusions are drawn about the integration of urban and spatial planning and flood risk management in **Section F**. All the conclusions from the individual studies of the pilots are correlated here in order to draw a holistic picture of the challenges that Romanian urban and rural areas are facing through the integration process of flood risk management into urban and spatial planning, from the elaboration and approval phase to the enforcement phase.

**The particular analysis of the 4 pilot areas**: Timișoara, Pitești, Reșița and Săucești **validated the findings of the preliminary research made in an earlier stage of this project, through the Stocktaking Report[1] as both reports revealed the same issues in the integration process.**

As a brief view of the report findings, **the main challenges** identified for all pilots are:

***Flood risk management:***

- **Hazard and risk maps are not made for all the river courses** and are only addressing to fluvial floods and flash floods;
- **Flood studies do not give specific measures**, only general approaches and some technical data;

[1] The Stocktaking Report stated the main important challenges and potential areas of improvement for the integration of flood risk management into urban and spatial planning. Its findings were substantiated by the legal framework analysis and by the interviews of specialist in these two fields.

- **The measures usually have a small-scale approach**;
- Proposed flood risk management measures are **usually only structural**;
- **In the support studies done for urban and spatial documents, to landslide risk is usually given more importance than to the flood risk;**
- **The land ownership** within the flood risk area is **one of the main problems** in the enforcement phase of the spatial and urban planning plans.

***Spatial planning plans:***

- **Multi-scale plans** (territorial plans, urban plans, territorial strategies, urban strategies etc.) **are not always properly correlated** mostly because of the outdated plans. This is because **the long-approval and non-integrated process of the spatial and urban planning plans**;
- **The lack of data or data provided in paper or non-editable** format and the lack of intercorrelation between various data bases is leading to inapplicable spatial and urban planning plans.
- **There are no metropolitan or peri-urban planning plans made for at least big cities**, in which FRM measures for the catchment area can be proposed.
- **Lack of** urban planners' **awareness** of the flood risks problematic and its implications;
- **Lack of integration** between different stakeholders' strategies, relevant plans, studies etc.
- The entire spatial and urban planning approach **is more strictly regulated than permissive** for decision making with a specific approach.

***The integration of Flood Risk Management into Urban and Spatial Planning:***

- **Flood risk (mainly from the fluvial source) is usually mentioned** in spatial or urban planning documentations, but **few measures are proposed** to prevent or reduce it; A **holistic approach is missing** in most of the plans; Nevertheless, nature-based solutions are very rare integrated in spatial and urban planning plans;
- **Other types of flood sources (pluvial, groundwater, sea water, artificial water-bearing infrastructure etc.) are usually not mentioned** in spatial or urban planning plans;
- **The unclear and uncorrelated provisions from the FRM and USP legal framework** concerning the **restrictions/ permissions in flood risk areas** as well the responsibilities for the enforcement / implementation phase in spatial and urban planning;
- **The land situated in flood risk areas is not used in anyway and different uses are not allowed related to the flood exceedance probabilities**;
- **The updated process of the general urban plans is not correlated with the timing of the updating the Hazard and Risk Maps** and the long approval process makes almost impossible to revise the plans.

Also, **main potential areas of improvement** resulted from all the pilot areas analysis are:

***Flood risk management:***

- **All watercourses and flood sources should be studied** and dedicated measures should be proposed, within specific site-locations; In this respect, **hazard and risk maps should be made for all river courses and for all flood sources**;
- **Flood risk studies should be site-specific** and integrated in the river basin's flood risk plan; A specific content for the necessary flood studies should be included in the legal framework covering both fields (flood risk management and spatial and urban planning);
- **Floods are not only a local problem**, so the solutions should start from the broad scale (regional river basins) and then go to the local scale (local rivers and creeks).

- **Combined non-structural measures should be proposed among with structural measures** because they can substantially reduce the flood risk;
- **A specific content for *Geotechnical and Hydrological Preliminary Study* and *Preliminary study on Environmental protection, Natural and Anthropogenic risks* should be provided** and the involvement of hydrological engineers in these studies should be mandatory by law;
- **Proper resources should be allocated in order to resolve the water cadaster and the areas within the water protected zones according to the Water Law 107/1996.**.

***Spatial planning plans:***

- **For a better correlation of multi-scales plans the approval process of the spatial and urban planning plans should be more efficient** so that it would last less long;
- **Using GIS** in the elaboration and enforcement process of spatial and urban planning plans **is fundamental** to ensure a proper management of the territory;
- Preparing **territorial plans for metropolitan or peri-urban areas can ensure a proper integration of the FRM measures** that are addressing to the catchment areas;
- **Dissemination process of flood risk management issues and measures** should be made for professionals and population in order to increase awareness and to ensure a proper integration into urban and spatial planning plans;
- **Spatial and urban planning approach needs to be more flexible and adaptable** to all the rapid changes from our society (economic, environmental, demographic, social etc.);
- **Coherent spatial development** can be done only **with the cooperation** of governmental institutions and clear communication between institutions and professional.

***The integration of Flood Risk Management into Urban and Spatial Planning:***

- **Flood mitigation can be based on nature-friendly solutions** and these should be included in territorial and urban planning practices and plans;
  Also, **Integration of flood risk management should be formalized at a large scale**, through territorial plans and strategies, **correlating them with urban and local plans** and detailed spatial plans through advocating specific measures;
- **Flood risk management measures should be dedicated and differentiated by types of flood sources** and should be properly integrated into urban and spatial planning;
- **The results of the flood studies should be included in the spatial and urban planning plans** in two ways: as interdictions and permissions and measures set into the Action Plans; **For the enforcement process** of urban planning plans, **specific actions should be proposed** in the Action Plan and detailed agenda of the implementations should be prepared;
  **An optimal integration** of Flood Risk Management into Urban and Spatial Planning can be done only through **an efficient interinstitutional cooperation**;
- **In the areas with flood risk less vulnerable developments should be proposed depending on the exceedance probabilities of floods;**
- **Proper tools that could generate more faster elaboration and approval process** (GIS data) should be adopted;
- **A specific multi-disciplinary Handbook should be made, through inter-institutional collaboration, to ensure step-by-step guidance is provided for urban planners, in the integration of flood risk management measures into urban and spatial planning.**

# SECTION B: Timișoara city pilot area, Timiș County

## B.1. General description

### B.1.1. Territorial context

Timișoara Municipality is the biggest city and the county seat of Timiș County, the most western county in Romania. The city is located in the central area of the county, 80 kilometers away from the Nădlac crossing point between Romania and Hungary and 45 kilometers away from Jimbolia crossing point between Romania and Serbia. Timișoara has developed along Bega River, which crosses its central area. The city is connected with the region through 2 main roads: E70 European Road and A1 highway.

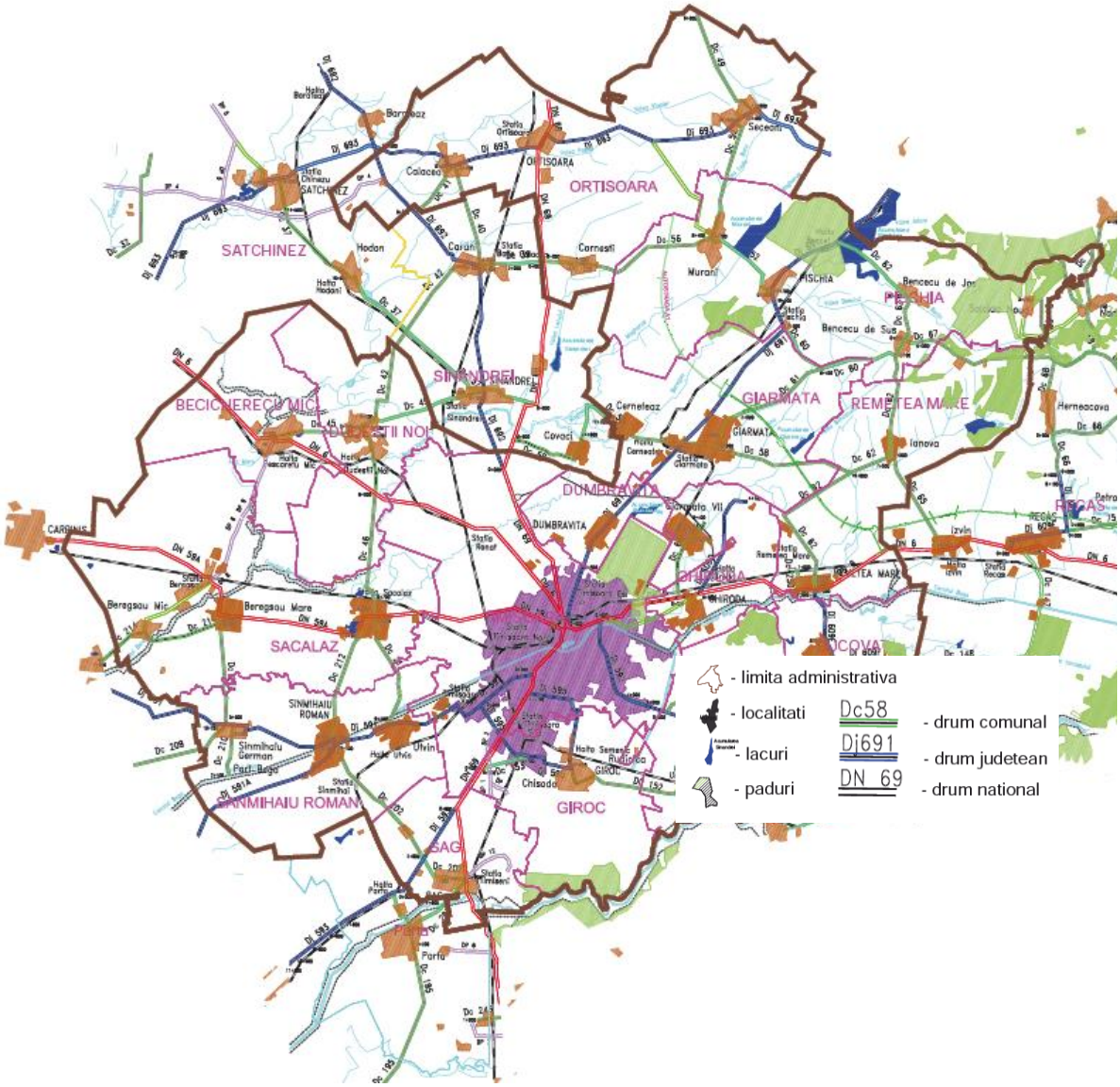


***Figure 3*** *– Timișoara metropolitan area*

*Source: Asociația de Dezvoltare Intercomunitară „Polul de Creștere Timișoara" [online]. Available at: https://adi-pct.ro/ (Accessed: 20.04.2022)*



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Being a 1st rank city and an important urban center in the western border area, Timișoara's administration established in 2009 a **metropolitan area** with a total surface of 108.031,00 ha, from which 12.926,83[2] ha represents the administrative territory of Timișoara. The metropolitan area (***Asociația pentru Dezvoltare Intercomunitară „Polul de Creștere Timișoara"***) includes other 19 commune administrations besides Timișoara: Becicherecu Mic, Biled, Bucovăţ, Ciacova, Dudeştii Noi, Dumbrăviţa, Fibiș, Ghiroda, Giarmata, Giroc, Moşniţa Nouă, Orţişoara, Pădureni, Pişchia, Remetea Mare, Săcălaz, Sînmihaiu Român, Şag and Șandra.

The territory of the municipality borders the following administrations:

- to the **north**: Sînandrei and Dumbrăvița commune;
- to the **north-west**: Dudeștii Noi commune;
- to the **west**: Săcălaz commune;
- to the **south-west**: Sînmihaiu Român commune;
- to the **south**: Șag and Giroc commune;
- to the **south-east**: Moșnița Nouă commune;
- to the **east**: Ghiroda commune.

Road accesibility is increased in the proximity of **A1 highway**, to the North-East, accessible by **E70 European Road**. The highway connects the city to the northern area (Arad-Oradea cities axis) and to the eastern area (Deva, Sebeș and Sibiu cities). E70 European Road is the main connection with Lugoj city, in the eastern area of Timișoara. Border accessibility is also high because of the proximity and easy connection with various crossing points with **Hungary** (Cenad – E70, Nădlac – A1 and Nădlac II – A1) and **Serbia** (Jimbolia – DN59A, Foeni – DJ593 and Moravița – E70).

Timișoara is connected to the neighboring administrative units by road and railway. The city is the terminal point of **M900** București-Caransebeș-Timișoara main rail line (with a length of 533 km), having a total of 3 train stations: Timișoara Nord, Timișoara Est and Timișoara Sud. Communications are provided by road traffic systems telecommunications. Moreover, Timișoara has also direct acces by air through its International Airport Traian Vuia.

[2] The Status of Timișoara Municipality (2020), p. 2



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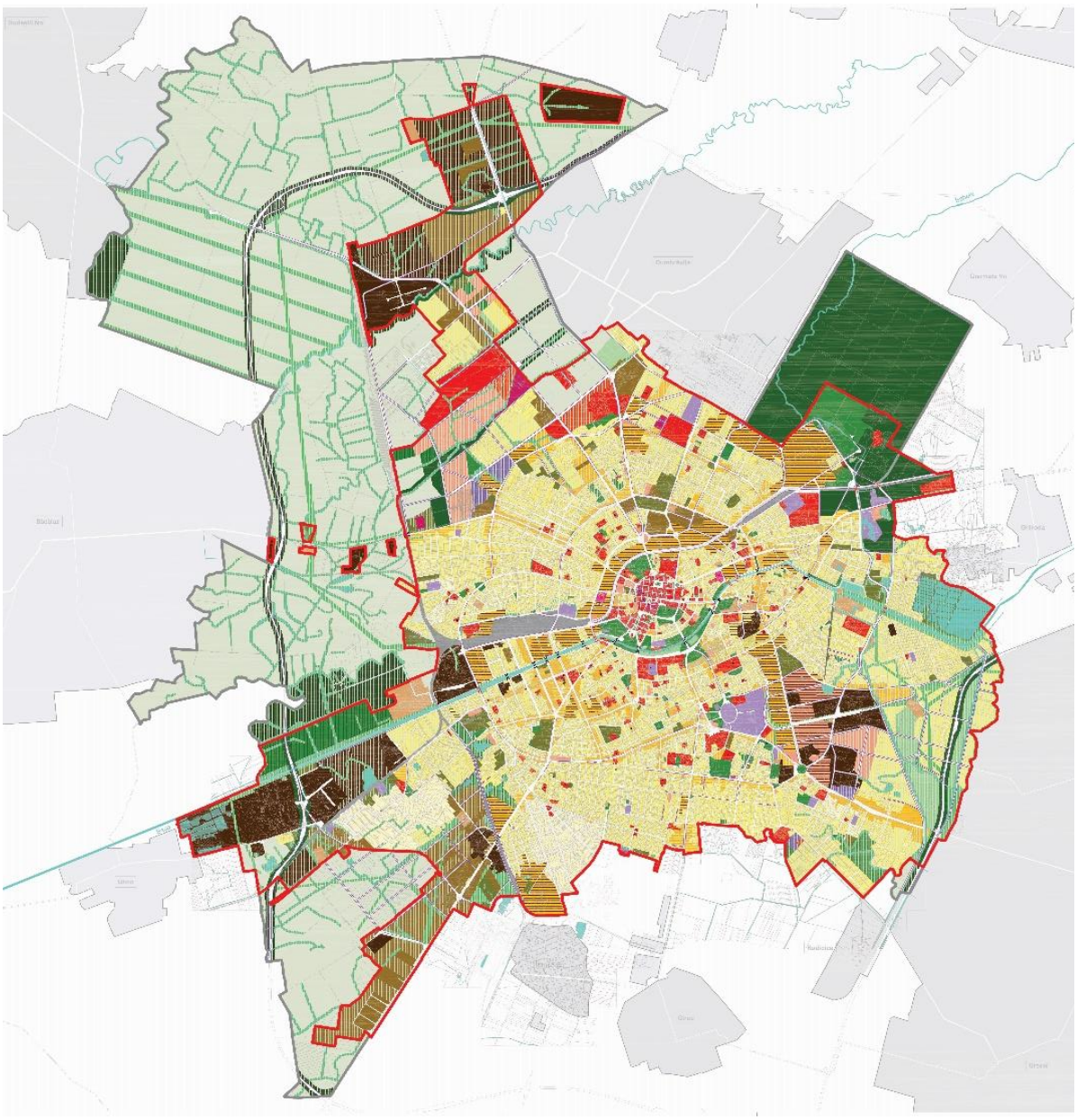

***Figure 4*** *– Timișoara Municipality*
*Source: Timișoara Municipality General Urban Plan*

## B.1.2. Geographical description

Timișoara is located in a low-altitude area, in **Timișoara Plain**, between Buziaș Plain and Vingăi Plain, with a medium height of 90 m. At a broader scale, the area (Banat Plain) is part of the Western Plain, the south-eastern segment of the Pannonian Plain. The geography of the area is populated with meanders, micro-depressions, alluvial deposits around the two rivers.

The range of altitudes is not broad, with variations of only 11 meters on the city's territory: the highest point is 95 m (Între Vii neighbourhood) and the lowest is 84 m (west of Mehala neighbourhood). The area is divided in 4 units:

- **The north-eastern unit**, around Giarmata Vii village. It is the highest of them, with altitudes over 100 m;
- **The eastern unit**, within Timișoara's city center. It is an alluvial plain, on both banks of Bega River, with altitudes between 90 and 95 m;


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- **The southern unit**, between Timișoara and Bega Rivers. The medium height is between 96 and 91 m;
- **The western and north-western unit**, around Mehala neighbourhood.

The image of the landscape is enriched by the two rivers that cross the area, **Bega** and **Timiș**, being part of the Timiș-Bega River basin. The interfluve also includes other smaller rivers which run dry during summer. Bega River is one of the main tributaries of Tisa River and it springs from Poiana Ruscă Mountains and it crosses the city. Timiș River's track is located 15 km south from Timișoara.

Timișoara has developed in a **moorland**, in the **interfluve of the two rivers**, hence the many floods that have affected the area along the history. Floods have caused great loss and hygiene problems in the city, which led to the regularization of the Bega River between 1728 and 1760. The **Bega Channel** has been developed along 2 centuries, between 1728 and 1916, with constant interventions taking place since then. The channel has a length of 115 km, starting at the entrance in Timișoara and ending at the river mouth. The landscape doesn't change much in the area of the river because of its small depth. Both riverbanks are densely built within the city territory.

The territory of Timișoara City has a total surface of 12.926,00 ha, from which 6.858,96 ha represent regulated built area, meaning 53.06% of the city's territory. 79.43% of this is urbanized, meaning 5445.86 ha, which include the central area, various activities, roads, railways, waterways and forests. The left 20.57% of the regulated built area is used for agriculture and animal husbandry units.

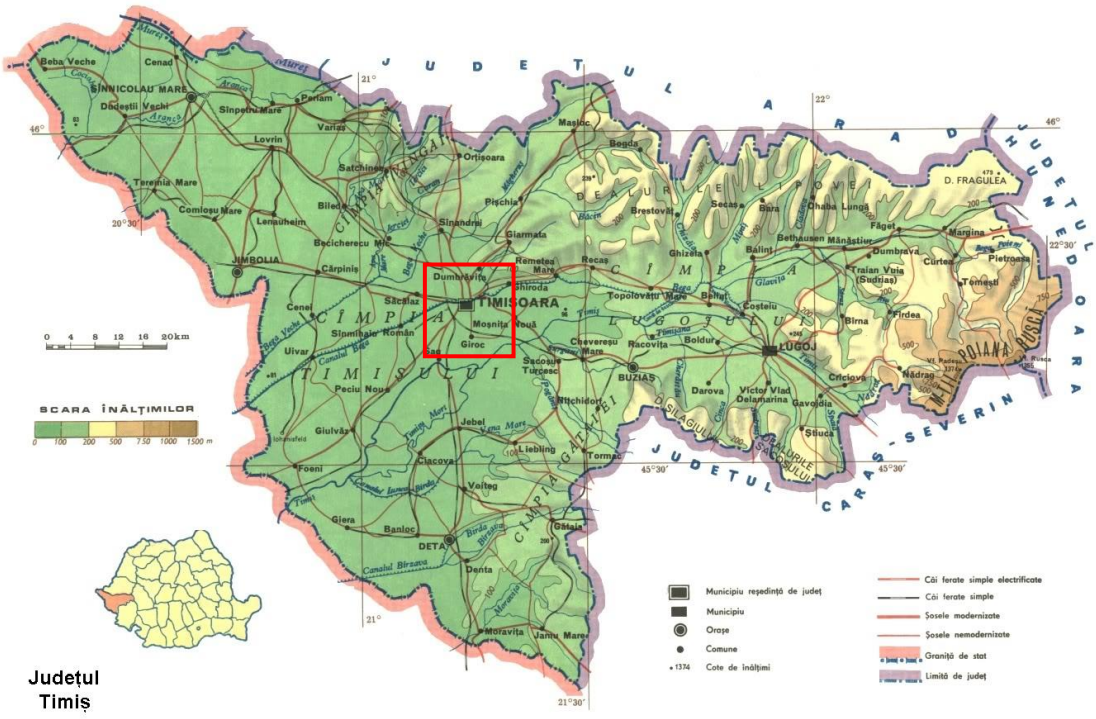


***Figure 5*** *– Location of Timișoara Municipality in Timiș County*
*Source: Harta Județului Timiș [online]. Available at: https://pe-harta.ro/timis/ (Accessed: 21.04.2022)*

Regarding **tectonics**, Timișoara Municipality is located in an area with east-west-oriented faults that have been generated by the Șanovița extinct volcano and by the mineralized water springs. Concerning **seismicity**, the area has a medium risk, with earthquakes that don't overcome 6 Richter degrees. Banat area is characterized by small-depth earthquakes (5-15 km), with horizontal and vertical movement, short-impulse and long return periods. Hence the tectonic dynamics, the area of the city and its thereabouts is populated with thermo-mineral springs.


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**Landslides** do not represent an environmental risk due to the flat geography of the area.

**Fluvial flood risk** is also reduced in Timișoara because of the flood prevention measures that have been implemented beginning with the 18th century. One of the main measures is the draining of the moorland in the 18th century and the construction of Bega Channel. Flood risk management is also improved by infrastructure like Coștei and Topolovăț hydrotechnical points and Giarmata and Dumbrăvița dams, which decrease flood risk on Behela River, one of Bega's tributaries.

### B.1.3. Demographic data

In 2021, Timișoara Municipality had a number of 318,296[3] inhabitants, according to the National Institute of Statistics. Comparing data from the 2002 Census (317,660 inhabitants) to the 2011 Census (319,279 inhabitants), resident population has grown with 5.3%[4].

However, in the last 8 years official data indicates that resident population has decreased in Timișoara, while the number of inhabitants in the metropolitan area has increased, showing a deurbanization trend – *„Nevertheless between 2005 and 2015, the city's population has decreased with 0.3%, population of the Growing Center has grown, overall, with 6.2%"*[5]. Nowithstanding the mild decline in population number, Timișoara is the fourth biggest urban agglomeration in Romania[6].

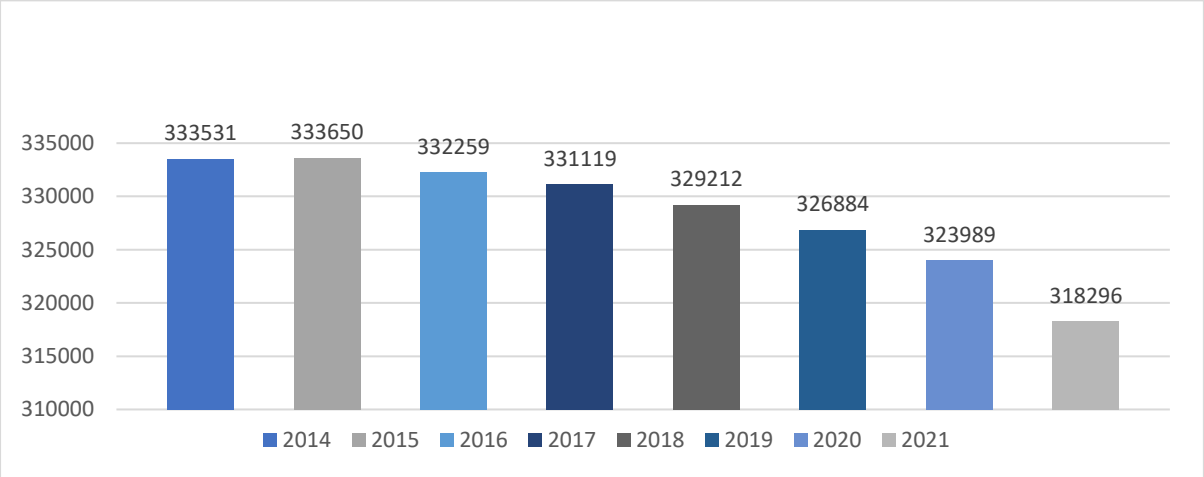


***Figure 6 –*** *The evolution of inhabitants number between 2014-2021 in Timișoara Municipality*
*Source: National Institute of Statistics [online]. Available at: https://insse.ro/cms/ (Accessed: 26.04.2022)*

The vitality of the city is maintained by population dynamics, with an increasing number of people moving to Timișoara for work or education. Therefore, the number of inhabitants who don't have an official residence (by personal documents) in Timișoara increases, due to significant **migration**. **Interior migration**[7] has increased in the past 8 years because of the multiple strengths and opportunities the city holds: excellent geographical position and accessibility, as it is close to the Hungarian and Serbian borders, but also close to the A1 highway; developing educational infrastructure, especially regarding universities; strong developing economy focused on both

[3] National Institute of Statistics, *POP108D – Populația după domiciliu la 1 iulie pe grupe de vârstă, sexe, județe și localități* [online]. Available at: https://insse.ro/cms/ (Accessed: 26.04.2022)
[4] Strategia de Dezvoltare Integrată a Polului de Creștere Timișoara 2015-2020 (2016), p. 9
[5] Banca Europeană pentru Reconstrucție și Dezvoltare (2015) *Planul de Mobilitate Urbană Durabilă pentru polul de creștere Timișoara*, Raport final, p. 15
[6] Strategia de Dezvoltare Integrată a Polului de Creștere Timișoara 2015-2020 (2016), p. 10
[7] National Institute of Statistics, *POP307A – Stabiliri cu domiciliul (inclusiv migrația internațională) pe județe și localități* [online]. Available at: https://insse.ro/cms/ (Accessed: 26.04.2022)


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production and consumption. However, data shows a dramatic fall in the number of people coming to Timișoara between 2019 and 2020, with 28.37%.

**Exterior migration**[8], on the other hand, has increased in the analysed time horizon, rising for 7 years, with a peak of 9332 people leaving Timișoara in 2019. Between 2019 and 2020 there has been a significant decrease, 8.34% less people leaving the city.

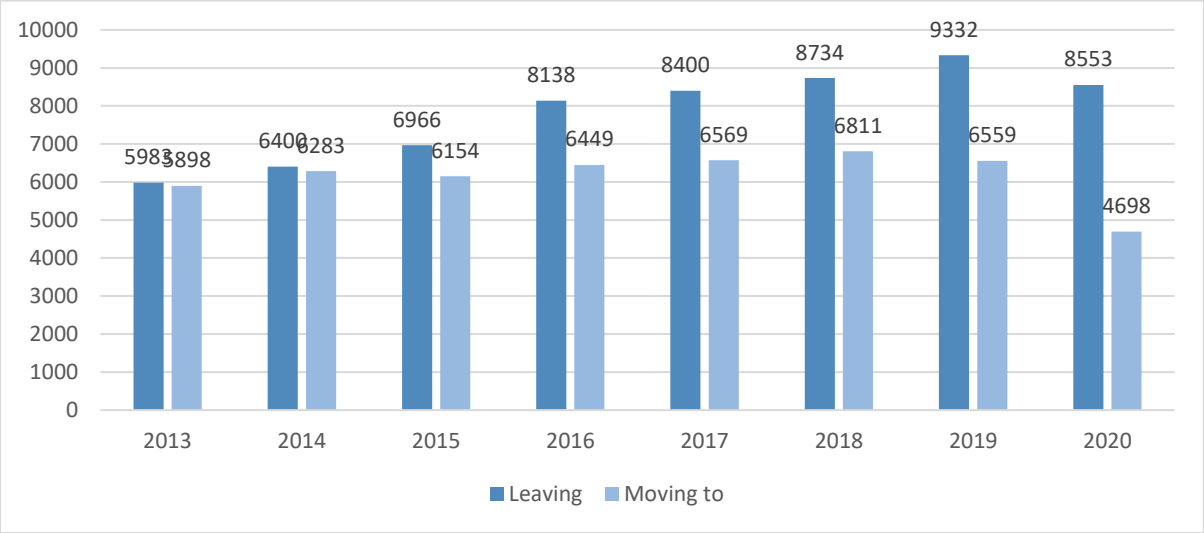


***Figure 7 –*** *The evolution of residents leaving and people moving to Timișoara between 2013-2020*
*Source: National Institute of Statistics [online]. Available at: https://insse.ro/cms/ (Accessed: 26.04.2022)*

The age structure[9] of the residents is balanced, most of them being aged between 35 and 44 years old. Statistical data shows an ageing trend in Timișoara's population, with more elders (60-69 years) than young people (0-29 years). An analysis of the 2014-2020 period shows that the birth rate is slowly but constantly decreasing. This phenomenon can have a negative effect on the available work force which is represented by residents.

[8] National Institute of Statistics, *POP308A – Plecări cu domiciliul (inclusiv migrația internațională) pe județe și localități* [online]. Available at: https://insse.ro/cms/ (Accessed: 26.04.2022)
[9] National Institute of Statistics, *POP108D – Populația după domiciliu la 1 iulie pe grupe de vârstă și vârste, sexe, județe și localități* [online]. Available at: https://insse.ro/cms/ (Accessed: 26.04.2022)


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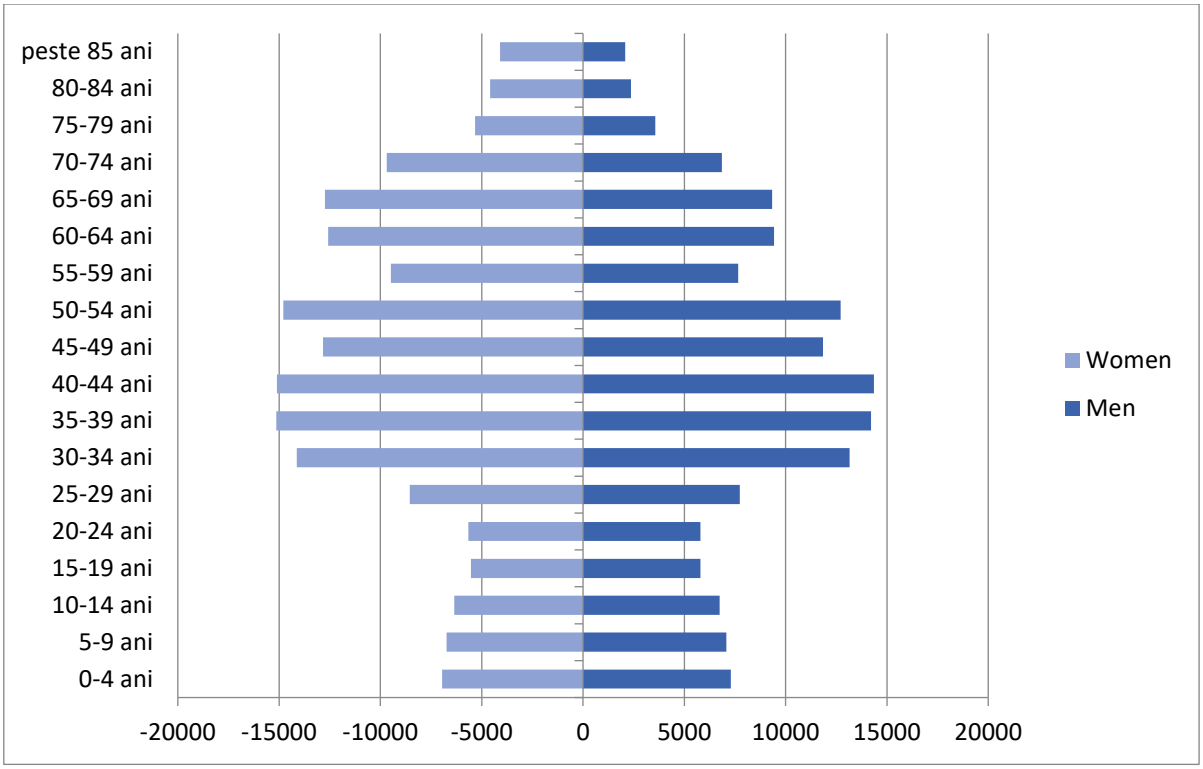


***Figure 8 –*** *Population structure by age groups (2021)*
*Source: National Institute of Statistics [online]. Available at: https://insse.ro/cms/ (Accessed: 26.04.2022)*

The **ethnic structure** of the city's population is diverse, with a strong multicultural heritage. The development of the city throughout history is marked by the diversity of ethnic groups from which the most numerous have been Germans, Hungarians, Serbians and Jews. In the past 20 years, since the beginning of the 21st century, there has been a decrease in ethnic diversity, with Romanians becoming the largest ethnic group in Timișoara.

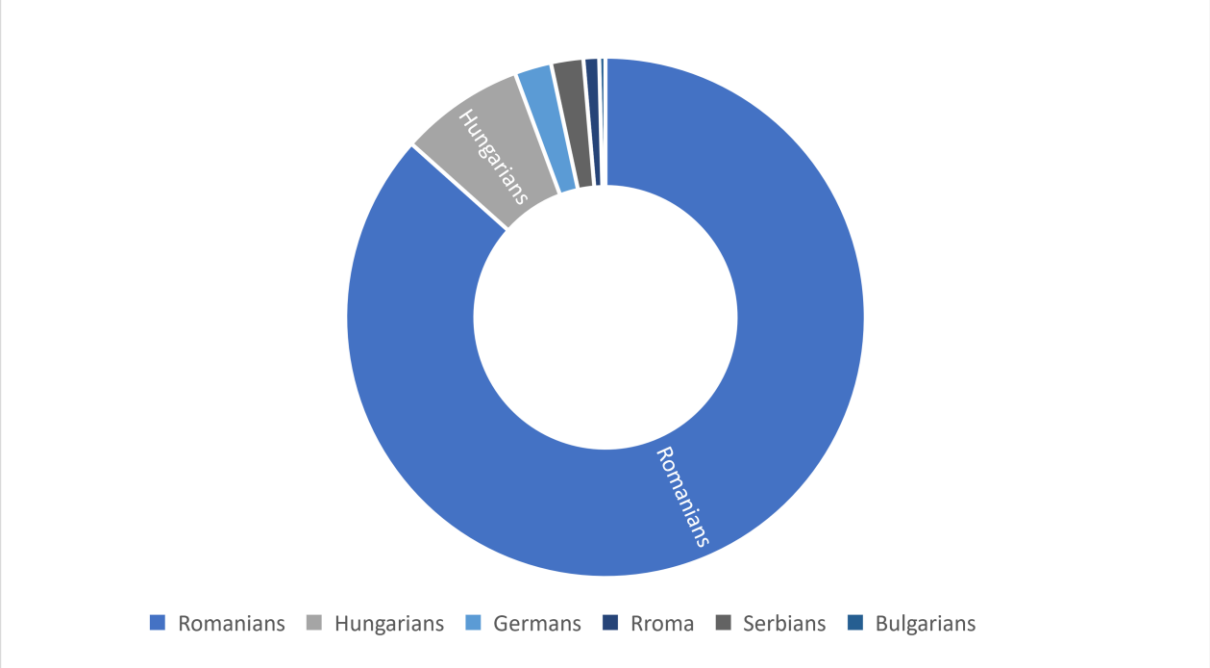


***Figure 9 –*** *Ethnic structure of Timișoara inhabitants in 2002*
*Source: 2002 Census, National Institute of Statistics*



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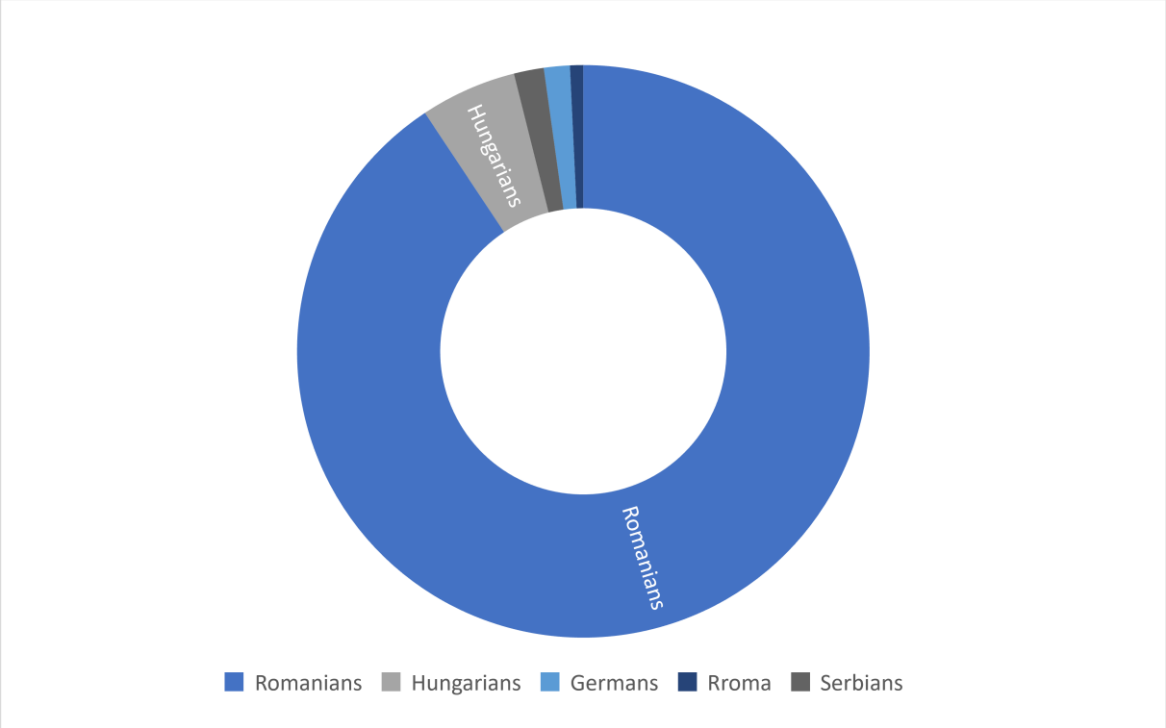


***Figure 10 –*** *Ethnic structure of Timișoara inhabitants in 2011*
*Source: 2002 Census, National Institute of Statistics*

| Year | Romanians | Hungarians | Germans | Jews | Serbians |
|---|---|---|---|---|---|
| **1880** | 3372 | 7497 | 19067 | no data | 1768 |
| **1900** | 4014 | 18624 | 27051 | no data | 1973 |
| **1930** | 24217 | 27652 | 27807 | 7171 | 2156 |
| **1948** | 58456 | 30630 | 16139 | 2713 | no data |
| **1966** | 109100 | 31016 | 25058 | 2590 | 4188 |
| **1992** | 274511 | 31785 | 13206 | 549 | 7748 |

***Table 1 –*** *Ethnic structure of Timișoara inhabitants in the 19th and 20th centuries*
*Source: Data sets of the census databases based on the work of Árpád E. Varga (1850-1992). Data series supplemented since 2002 [online]. Available at: https://nepszamlalas.adatbank.ro/ (Accessed: 26.04.2022)*

### B.1.4. Economic data

Timișoara is one of the most important western gateways to Romania. Located at the Hungarian and Serbian borders, it is also easy to access because of the flat geography and good connections to the national and european road, railway, airway and waterway infrastructure.

Timișoara Municipality's administrative territory has a total area of 12.926,83 ha, from which 53.06% is regulated built area. The latter includes a variety of land uses: central area (0.35%), institutions and services (5.04%), mixed-function area (7.47%), housing – both individual and collective (33.22%), economic activities (13.16%), cemeteries (3.20%), utilities infrastructure (2.29%), waterways (2.31%), green areas (6.64%) and roads (13.42%).

After Bucharest-Ilfov Development Region, the Western Development Region is the second growing area in Romania, regarding the number of inhabitants (in 2011): 24.96 billion lei, compared to 544.42 billion lei in Bucharest-Ilfov Region[10]. In a regional context, around the year 2015, Timiș County

[10] Timișoara Municipality General Urban Plan, p. II-20


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represented 48.5%[11] from the regional GDP. Timișoara is one of the strongest urban economies in Romania, an economy that is also supported by the communes in the metropolitan area, which, in 2012, were 21.4%[12] of the fiscal value of the growth pole. In the same year, the communes with the biggest fiscal value were Giroc, Ghiroda and Dumbrăvița. The economic trends show that the fiscal value coming from the periurban communes is constantly rising, having a more important contribution to the economic activity of Timișoara growth pole.

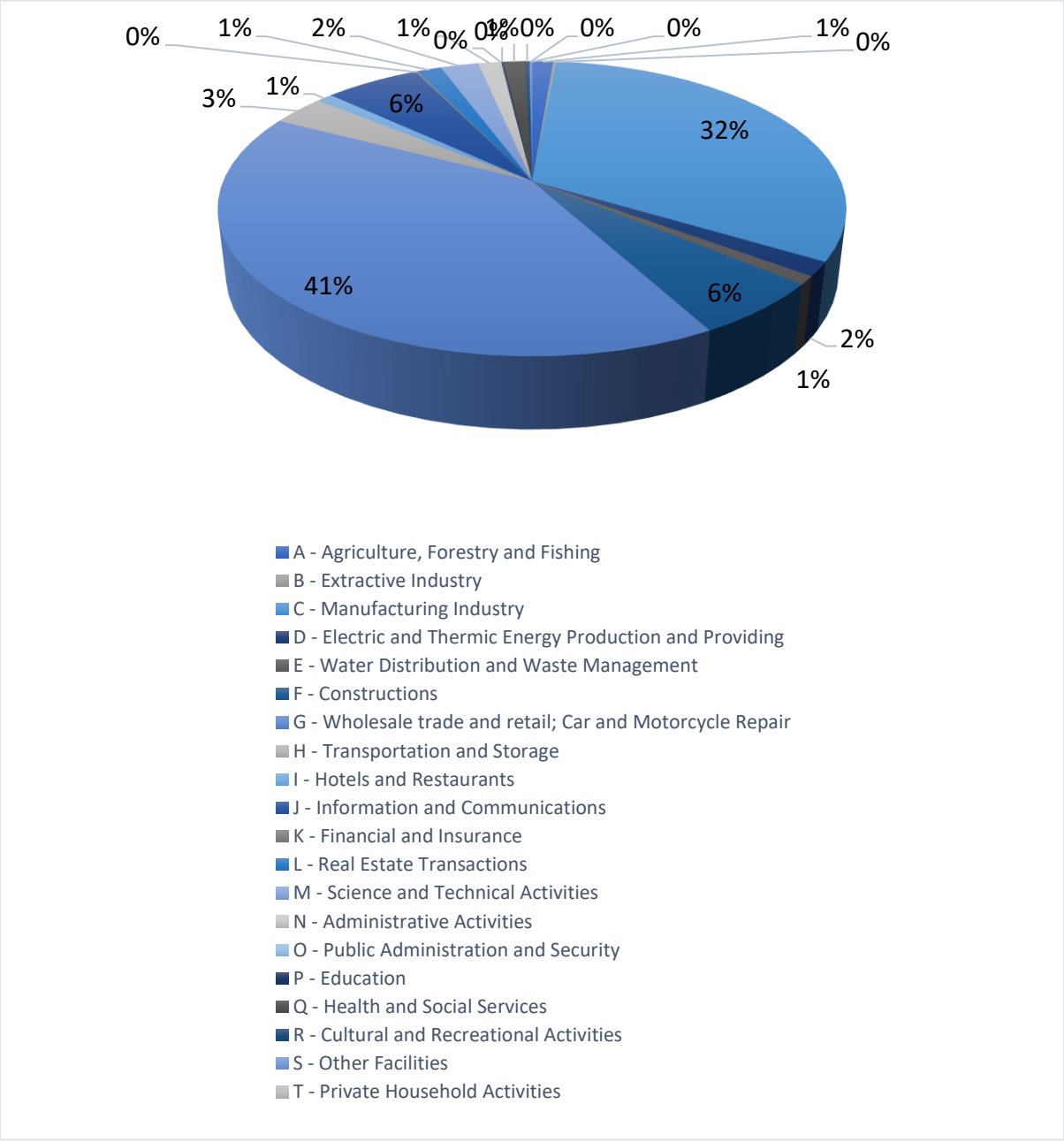


***Figure 11** – Total fiscal value of enterprises in Timișoara, by field of activity (CAEN)*
*Source: Lista firmelor din România – Timișoara, Județul Timiș [online]. Available at: https://membri.listafirme.ro/statistici-economice.asp#selectie (Accessed: 01.04.2022)*

From a numeric perspective, the local economy of Timișoara is mainly represented by **tertiary activities**. However, **secondary economic activities** represent the main investors in the city, having

[11] Strategia de Dezvoltare Integrată a Polului de Creștere Timișoara 2015-2020 (2016), p. 39
[12] Idem


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the biggest fiscal value and number of employees: tyre manufacturing, electronic equipment manufacturing, telecommunications, pig farms and meat production etc.

Data regarding total fiscal value of enterprises in Timișoara in 2020[13] shows a focus on *Wholesale trade and retail; Car and motorcycle repair (G)* activities, representing 41% of the total fiscal value of the city. Another significant economic activity is the *Manufacturing Industry (C)*, which is 32% of the total value. *Real Estate Transactions (L)* and *Administrative Activities (N)* are also relevant in the local economy, on the third place regarding the fiscal value of the enterprises (6%). This shows that Timișoara is an important economic center in the region, with both tertiary and secondary economic sectors having a contribution to a growing economy.

Therefore, Timișoara's economic profile is diverse, closely connected with the manufacturing industries like automobile components, textile and meat production, engineering and consultancy. Despite being dynamic and well-positioned in the region, the economy of the city is dependent on production activities and future innovation of the secondary sector.[14]

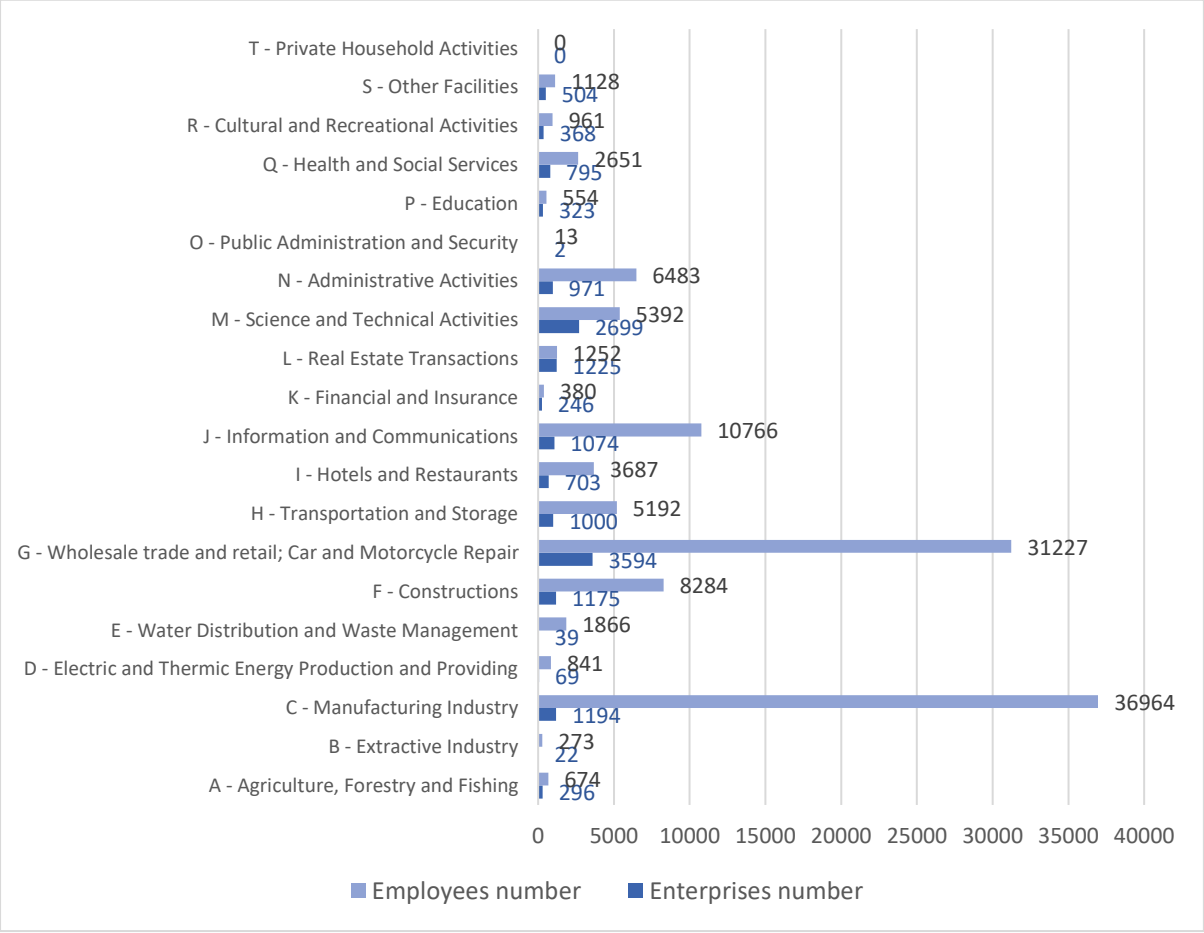


***Figure 12** – Total numbers of enterprises and employees in Timișoara, by field of activity (CAEN)*
*Source: Lista firmelor din România – Timișoara, Județul Timiș [online]. Available at: https://membri.listafirme.ro/statistici-economice.asp#selectie (Accessed: 01.04.2022)*

As mentioned before, production activities are dominant in Timișoara's economy: the greatest number of employees is found in the *Manufacturing Industry (C)*, while most of the enterprises are

[13] Lista firmelor din România – Timișoara, Județul Timiș [online]. Available at: https://membri.listafirme.ro/statistici-economice.asp#selectie (Accessed: 01.04.2022)
[14] Banca Europeană pentru Reconstrucție și Dezvoltare (2015) *Planul de Mobilitate Urbană Durabilă pentru polul de creștere Timișoara*, Raport final, p. 15


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concentrated in the commercial sector, *Wholesale trade and retail; Car and Motorcycle Repair (G)*. A significant number of people employed in the *Information and Communications (J)* reveals **a shift to the quaternary sector** in the local economy, as a consequence of innovation in business and technology. This shift is also powered by the development of higher education in the city and Timișoara becoming a university center for the western and central region of Romania.

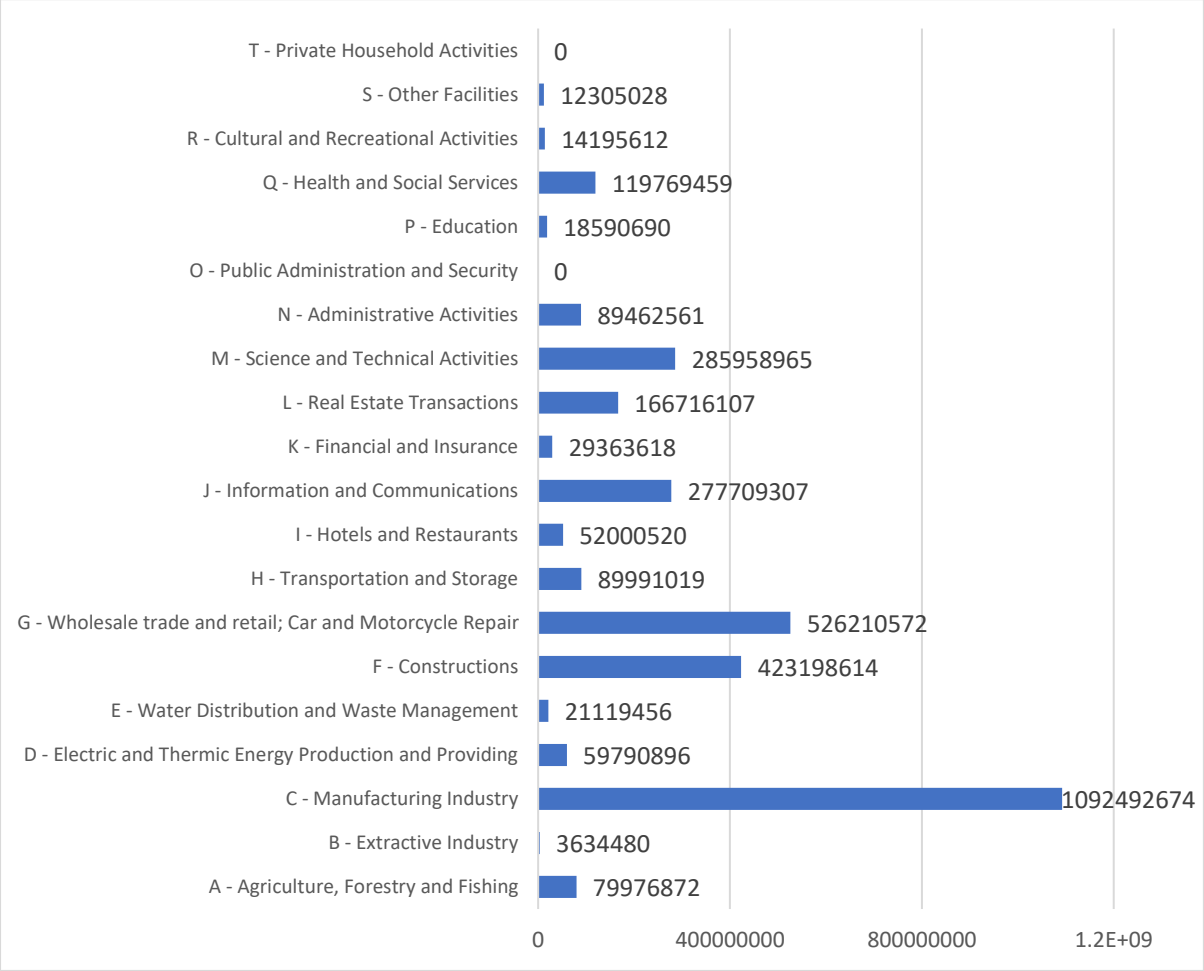


***Figure 13 –*** *Total net income in Timișoara, by field of activity (CAEN)*
*Source: Lista firmelor din România – Timișoaa, Județul Timiș [online]. Available at: https://membri.listafirme.ro/statistici-economice.asp#selectie (Accessed: 01.04.2022)*

Net income data in 2020 shows that the most profitable sector is production, *Manufacturing Industry (C)* generating double than *Wholesale trade and retail; Car and Motorcycle Repair (G)*. It is, however, important to mention the tertiary sector (*Constructions (F)*) and the quaternary sector which generate a significant income in the city. Income numbers in *Science and Technical Activities (M)* and *Information and Communications (J)* activities are proof that **Timișoara is a growing city with a dynamic economic and social life**.

The development of tertiary economic sector is a premise for the improvement of **touristic activities** in Timișoara: there is a growing variety of leisure and cultural activities and commercial areas. The geographical position and the proximity of European cities like Vienna, Belgrade or Budapest are also premises for development of tourism in Timișoara. Potential touristic sectors in the city are **domestic tourism** (historical landmarks, central area, Bega Channel area etc.), **cultural tourism** (museums, festivals), **archaeological tourism** (Timișoara Fortress, Roman and Dacian sites etc.) and **natural tourism** (parks, Pădurea Verde area and protected natural areas around Timișoara).


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The city has a strong cultural life, with multiple types of events and festivals taking place around the year: International Theater Festival, Saltimbancilor Festival, Wine Festival, Zilele Cartierului Cetate, Street Delivery Festival etc. **Cultural tourism** is also encouraged by the establishment of legal framework through community associations.

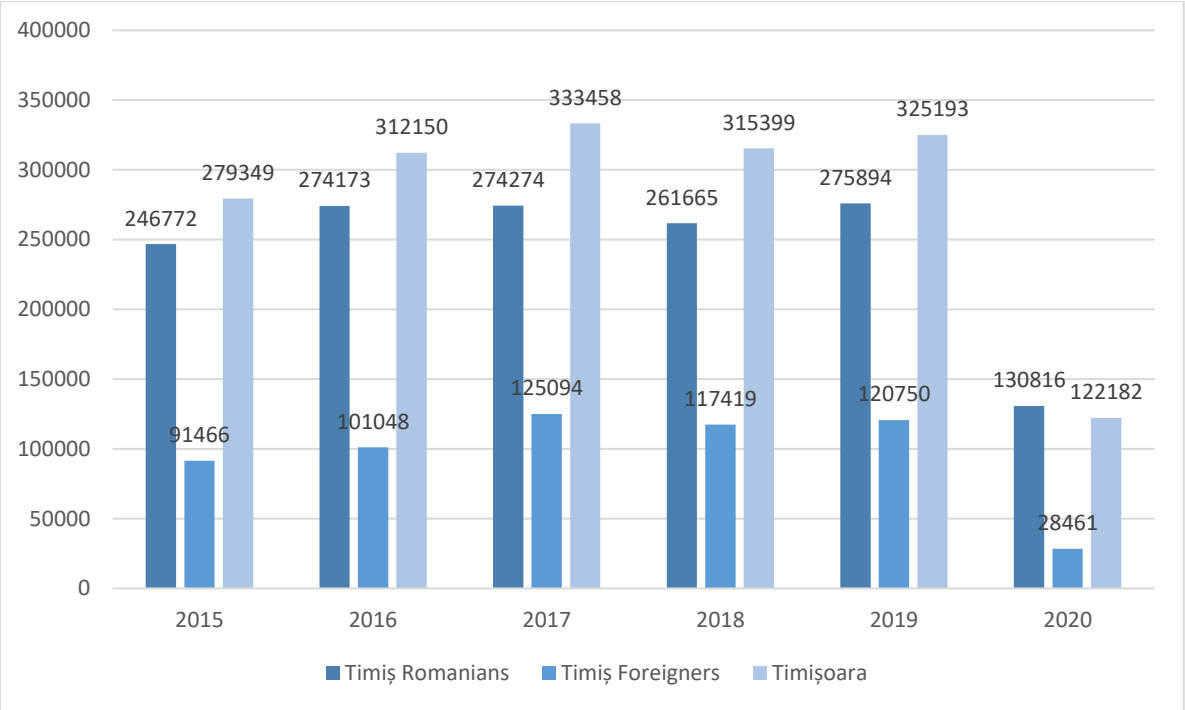


***Figure 14** – Tourist arrivals in Timiș County and Timișoara Municipality (2015-2021)*
*Source: National Institute of Statistics [online]. Available at: https://insse.ro/cms/ (Accessed: 17.05.2022)*

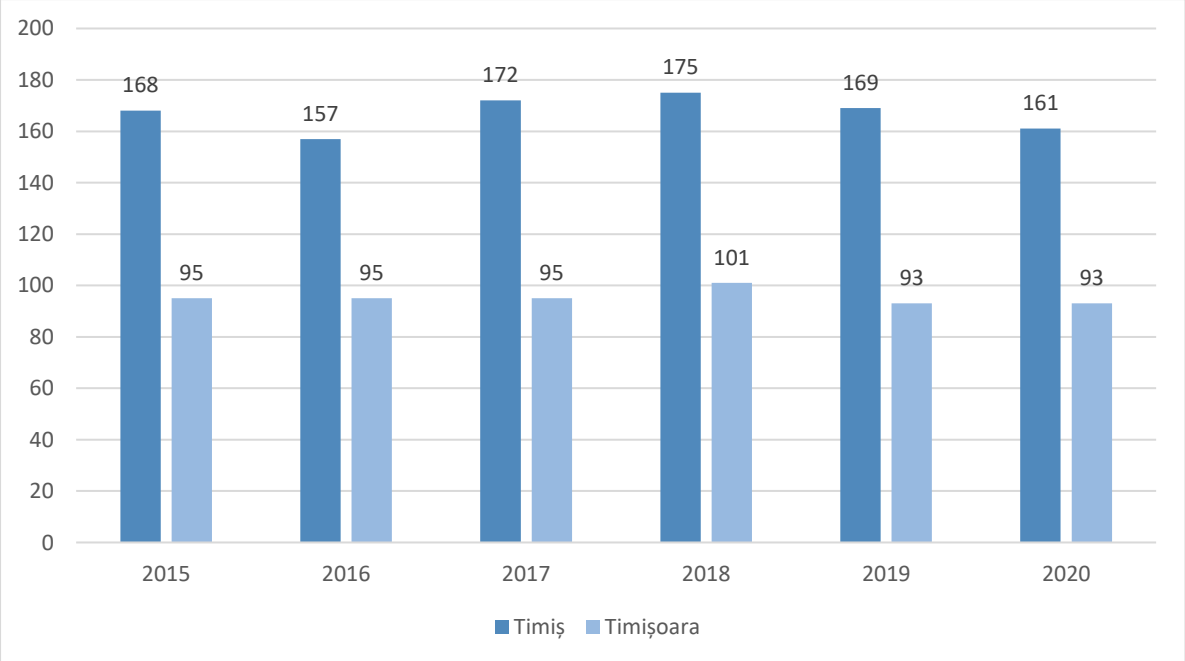


***Figure 15** – Accommodation structures in Timiș County and Timișoara Municipality (2015-2021)*
*Source: National Institute of Statistics [online]. Available at: https://insse.ro/cms/ (Accessed: 17.05.2022)*


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Both Timiș County and Timișoara Municipality data regarding tourist arrivals[15] show an increase, especially between 2015 and 2016, with a constant flow of international and national tourists between 2016 and 2019. The start of the COVID-19 Pandemic generated a dramatic fall in the touristic sector. Timișoara represents one of the main touristic attractions in the county, with more tourist arrivals than Timiș County records. However, there are significantly less accommodation structures[16] in Timișoara Municipality than there are at a county level. The number is constant, with a small decrease due to the pandemic.

## B.1.5. Environmental data

### B.1.5.1. Geology and soils

From the geological point of view, the silicon rocks predominate in Banat hydrographic area. Limestone rocks are found mainly in transverse strips and organic rocks occupy small areas. The mountain formations belong to the local lens and the Getic Canvas. In the plain area, there are sands, clays, red clay, loess, limestones, sandstones, marl, sandy marl and gravel.

The soils in Banat hydrographic area vary to the same extent as the landforms, namely:

- skeletal soils and high-rise podzols – on the high area of the mountains;
- podzols, brown or reddish-brown soils – in the hilly area;
- alluvial soils – in depressions;
- soils with excess water on the surface and in their mass – in the low plain;
- chernozem soils – on the high forms of the low plain.

### B.1.5.2. Flora, fauna and forests. Protected areas

From a geobotanical perspective, Timișoara is part of an oak forest area. Currently, with the exception of the wooded areas Green Forest, Bistra Forest, Giroc Forest, Șag, the territory fits into the anthropogenic forest-steppe that characterizes the entire Pannonian Plain. The landscape is diversified by the appearance of meadow vegetation, along the main rivers, in which softwood trees predominate: willows, poplars, alders.

Regarding dendrological parks, Bazoşu Nou Dendrological Park is a notable presence. It is a forest reserve with an area of 60.4 ha, located about 10 km south-east from Timișoara: the actual reserve has an area of 17.8 ha. The area around Timișoara Municipality is made of plains, forests and grasses.

Forest fauna includes mammals (insectivores and rodents) and numerous birds of great importance. In the forest-steppe and steppe areas shelter a large number of species of hunting interest (deer, hare, partridge, quail, pheasant).

Natura 2000 sites within the Banat hydrographic area include 14 S.P.A. sites (areas for special protection), according to GD 1284/2007, and 22 S.C.I. sites (areas of community importance), according to O.M. 776/2007.

- SPA sites: Teremia Mare – Tomnatic, Hunedoara Timişană, Pădurea Macedonia, Depresiunea Bozovici, Livezile Dolaţ, Lunca Bârzavei etc.;

[15] National Institute of Statistics, *TUR 104B – Sosiri ale turiștilor în structuri de primire turistică cu funcțiuni de cazare turistică, pe tipuri de structuri, tipuri de turiști pe macroregiuni, regiuni de dezvoltare și județe* and *TUR104E – Sosiri ale turiștilor în structuri de primire turistică pe tipuri de structuri, pe județe și localități*

[16] National Institute of Statistics, *TUR 101C Structuri de primire turistică cu funcțiuni de cazare turistică pe tipuri de structuri, județe și localități*



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- SCI sites: Pajiştea Cenad, Mlaştina Satchinez, Râul Timişului între Rusca şi Prisaca, Semenic – Cheile Caraşului, Cheile Nerei – Beuşniţa, Porţile de Fier, Cheile Rudăriei, Râul Cerna între Bozovici şi Moceriş, Cheile Teregovei etc.

The neighbourhood of Satchinez has a special ornithological potential: there are several rare species as small egrets, shovelers and yellow herons. The area is part of Satchinez Marsh Natura 2000 protected area (ROSCI0115).

According to Timiș Environmental Protection Agency, Timiș County holds a number of 45 natural protected areas (protected natural areas of national, international, community, county and local interest) whose limits are located entirely or partially on the territory of the county.

The register of protected areas drawn up by ANAR includes all categories of protected areas according to the requirements of Article 6 and Annex IV of the Water Framework Directive 2000/60/CE. The register (http://ananp.gov.ro/ariile-naturale-protejate-ale-romaniei/) includes the following categories of protected areas (see the map - *Figure 16*):

- **Protection areas for water abstractions for drinking water** – at the level of Banat Hydrographic Area, in 2013 were inventoried: 27 water abstractions from surface sources for drinking (of which 26 for population water supply and 1 for food industry water supply) and 289 underground water abstractions sources for drinking (of which 240 for population water supply and 49 for food industry water supply). The total volume of drinking water captured from surface sources was 126,458.88 $m^3$/year, and the one captured from underground sources was 33,670,987.20 $m^3$/year;
- **Areas for the protection of economically important aquatic species** – at the level of Banat Hydrographic Area in 2013, there were no significant catches for fish and no commercial fishing areas. As for the areas with fish species with economic potential, they are located on the watercourses and lakes in the mountains area with salmonid species (trout and grayling), with a total length of 1176.2 km (rivers);
- **Areas intended for the protection of habitats and species where water is an important factor** – in Banat Hydrographic Area, the natural protected areas related to the identified water were grouped into 30 sites with a total area of 147,812.27 ha. The length of the water bodies is approximately 25% of the total length of the water bodies, i.e., 1,884.92 km. In terms of natural lakes and accumulations, approximately 80.23% are natural protected areas that are related to water. As for groundwater bodies, out of the 6 groundwater bodies, 3 have been identified with probable dependence to terrestrial ecosystems from 7 sites of community importance;
- **Areas vulnerable to nitrates and nutrient-sensitive areas** – The Action Programme on the implementation of the Nitrates Directive has been applied without exception throughout Romania since June 2013. Romania has declared its entire territory as a nutrient-sensitive area.

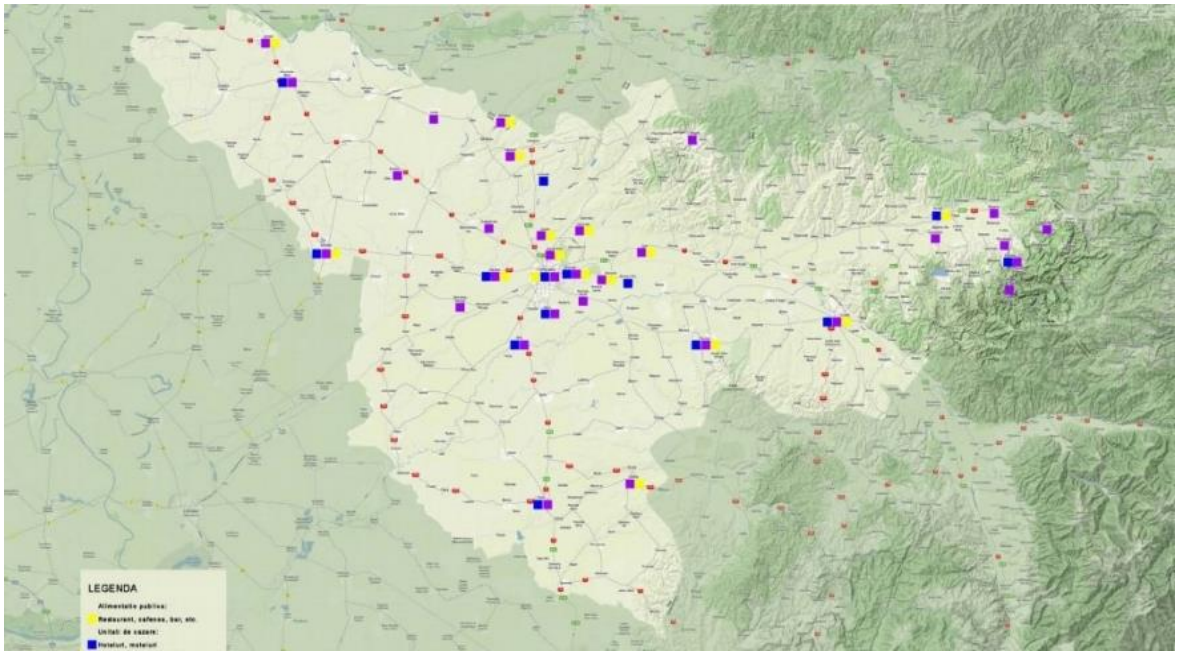


***Figure 16*** *– Natural protected areas in Timiș County*

*Source: "Spiritul Timişoarei - Timişoara Express", The 45 natural protected areas from Timiş County (Cele 45 arii naturale protejate din Judeţul Timiş, https://www.vechi.timisoaraexpress.ro/ghid-util/cele-45-arii-naturale-protejate-din-judetul-timis_17812) and Environment Protection Agency Timiş (https://atlas.anpm.ro/atlas#)*

### B.1.5.3. Climate and climate change impact

Over the last 20 years, climate change has become obvious and a reality, with its negative effects being felt both economically and socially. Starting from the EU goals for reducing greenhouse gas emissions (GES) until 2020, the Romanian National Strategy on Climate Change 2013-2020 was adopted, including the action plan which aimed to prevent and combat the effects of climate change (through actions aimed at reducing GES) and adapt appropriately and with minimal damage in the context created in the climate already[17].

At the local level, climate change „will influence ecosystems, human settlements and infrastructure" due to changes in temperature and precipitation that will lead to „extreme weather events such as heat waves, drought, flash floods and the like will be more frequent, with increased intensity and, consequently, with greater risks for significant damage associated with."[18]

For the 2021-2027 period, efforts at European level to combat climate change will intensify. In December 2019, EU leaders endorsed the goal of achieving a climate-neutral EU by 2050. In this context, a significant share of Cohesion Policy funds will be allocated to Policy Objective 2: A greener, carbon-free Europe, implementation of the Paris Agreement and investments in the energy transition, renewable energy and the fight against climate change[19].

In Romania, an increase in the number of extreme weather phenomena is observed, by rising number of warnings issued by the National Meteorological Agency regarding the occurrence of extreme weather phenomena[20], due to the increase in the annual average temperature.

[17] Summary of the National Climate Change Strategy 2013-2020
[18] National Climate Change Strategy 2013-2020
[19] The European Green Deal
[20] Annual report of the National Meteorological Administration [online]. Available at: http://www.meteoromania.ro/despre-noi/raport-anual/ (Accessed: 23.05.2022)

Timiș county's climate is temperate, with Mediterranean influences, characterised by hot summers and tender winters. The absolute maximum temperature was 42°C at Teremia Mare in 1952, and the absolute minimum at Timișoara, -35.5°C, on 29th of January 1963. The multiannual average temperature is 10,6 °C and the annual rainfall between 500-600 mm.

In Banat area, the general climatic features are marked by the diversity and irregularity of atmospheric processes. The dominant air masses, during spring and summer, are temperate ones, of oceanic origin, which bring significant precipitation. Frequently, even in winter, moist air masses arrive from the Atlantic, bringing heavy rain and snow. From September to February there are frequent penetrations of continental polar air masses, coming from the east. However, the influence of cyclones and hot air masses from the Adriatic and Mediterranean Seas is also strongly felt in Banat area, which in winter generates complete thaw, and in summer they bring periods of torrid heat.

Such atmospheric processes induced important precipitation, which together with snow melting creates important floods.

According to the annual average temperature projections famed in the application of regional climate models (EURO-CORDEX data), it is forecasted that in the 2021 – 2050 period, the average annual temperature recorded in Timişoara will increase by 1.0 °C compared to the reference range 1961–1990 (under the conditions of the average scenario of increasing the global concentration of greenhouse gases RCP 4.5)[21].

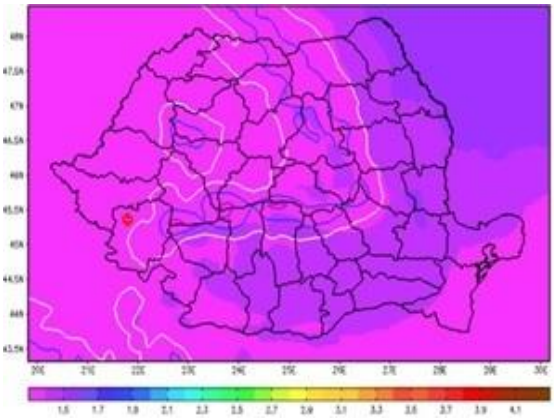

***Figure 17*** *– Annual temperature increase 2021 – 2050 (compared to the reference range 1961 – 1990)*

*Source: Information from ANPM, Climate Change Strategy, 2016 and https://www.meteoromania.ro/clima/scenarii-climatice/*

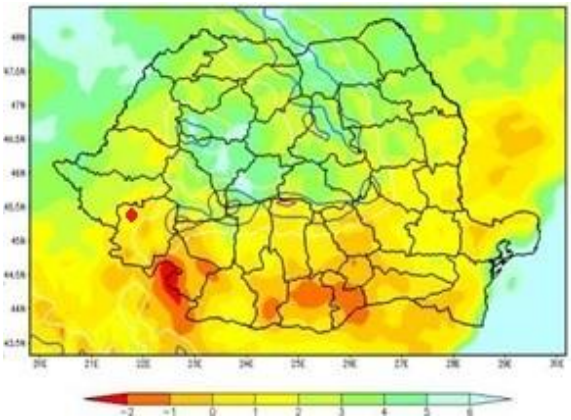

***Figure 18*** *– Increase in average annual precipitation 2021 – 2050 (compared to the reference range 1961 – 1990)*

*Source: Information from ANPM, Climate Change Strategy ANPM, 2016 and https://www.meteoromania.ro/clima/scenarii-climatice/*

Regarding the annual precipitation in the 2021-2050 period, according to similar forecasts (even though the trends are unclear), the trend shows an increase of the average annual amount of precipitation by 1-2% in Timiş County compared to the reference interval 1961-1990 for EURO-CORDEX global simulations.

One of the most significant consequences of air temperature rising is magnitude and frequency increase of extreme meteorological phenomena: heavy precipitation due to rise of humidity level in the atmosphere and rising frequency and intensity of floods. The total amount of seasonal

[21] Bojariu, Bîrsan, Cica, Velea, Burcea, Dumitrescu, Dascălu, Gothard, Dobrincu, Cărbunaru, Marin (2015) *Schimbările climatice – de la bazele fizice la riscuri și adaptare*, Bucharest: Editura Printech

precipitation has not increased, yet the maximum daily precipitation is on a rising trend, especially during autumn, winter and even during summer in the Bega river basin. During spring, the trend shows a decrease of maximum daily precipitation.

Climate change effects have been studied in Romania in order to understand the change in water dynamics regarding floods and flash floods in different river basins. In the carried studies were used two types of climate evolution simulations: a control simulation for the 1951-2000 period, to establish the reference climate regime, and a simulation based on the A1B evolution scenario of the greenhouse gases emission, for the 2001-2050 period[22]. A regionalization exercise has been carried out at national level in Romania to estimate the potential impact of the A1B climate change scenario on maximum fluvial flood flows with an annual probability of exceedance of 1%, comparing 2021-2050 to the reference period 1971-2000.

Three climate change classes have been established in the Romanian area for fluvial floods:

- Regions where the maximum flood flow will remain stationary (i.e., no change in the flood flows under climate change);
- Regions where there will be a moderate increase in flood flows (i.e., approx. 10%);
- Regions where there will be a significant increase in flood flows (i.e., approx. 20%).

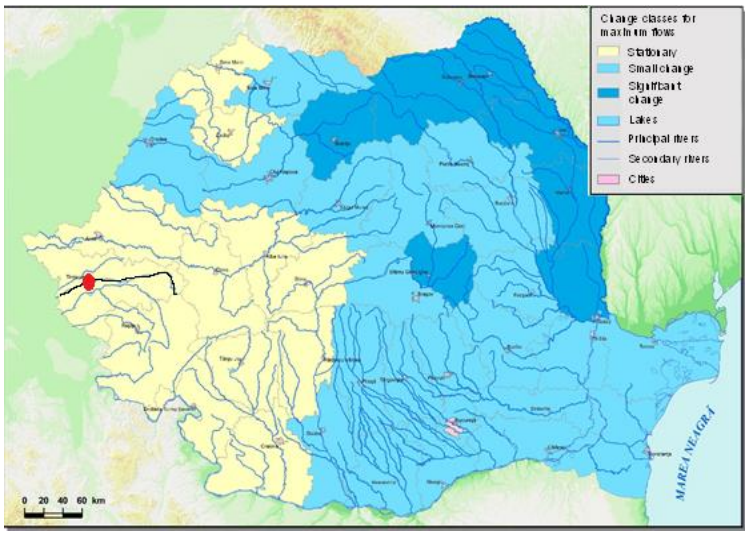


***Figure 19 –*** *Climate change classes: Regional changes of the maximum instantaneous 1% AEP flows for 2021-2050, compared to the reference period 1971-2000 in Romania (in black is Bega River, crossing Timișoara – red spot)*

*Source:* Metodology for Flood Hazard and Mapping[23]

In this scenario, Bega River basin is in a stationary scenario, with no increase of maximum discharges with different AEP.

Within EURO-CORDEX, a new generation of downscaled climate projections has become available for climate change impact studies in Europe. In work carried out by Alfieri et al., an ensemble of EURO-CORDEX RCP8.5 scenarios was used to drive a distributed hydrological model and to assess the projected changes in flood hazard in Europe through the current century. Changes in magnitude and

[22] Corbuş, Mic, Mătreaţă (2011) *Assessment of climate change impact on peak flow regime in the Mureş River basin*, XXVth Conference of the Danube Countries, Budapest, Hungary

[23]https://rowater.ro/despre-noi/dezvoltare-si-investitii-achizitii/proiecte-implementate-in-curs-de-implementare/proiecte-in-curs-de-implementare/proiectul-rofloods/



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frequency of extreme streamflow events were investigated by statistical distribution fitting and peak over threshold analysis[24]. A consistent method was proposed to evaluate the agreement of ensemble projections. Results indicate that the change in frequency of discharge extremes is likely to have a larger impact on the overall flood hazard as compared to the change in their magnitude. On average in Europe, flood peaks with a return period above 100 years are projected to double in frequency within three decades[25]. Therefore, even though the maximum discharges will not change on Bega, the flood frequency could be doubled in the future.

For urban and rural pluvial floods, as well as in some cases flash floods, rainfall intensity, duration and frequency (IDF) curves are used as the main input to either the hydrological or hydraulic model which is used to assess the flood hazard. In Romania there appears to have been relatively little work undertaken as to how climate change will affect sub-daily rainfall intensities. There is a trend in rainfall intensity in Romania with "extremely wet days", the amount of rainfall increasing by up to 9 mm/decade over the 1961 to 2013 period[26]. The analysis showed that generally Romania has become wetter especially in the northern regions, although the spatial distribution of the significant trends in different areas was found to be extremely irregular[27].

### B.1.5.4. Water resources

The territory of Timișoara has a rich hydrographic network, consisting of rivers, lakes and swamps. The average density of the water network is 0.38 km/ $km^2$.

The main watercourse is Bega River, the southernmost tributary of Tisza River. Springing from the Poiana Ruscă Mountains, Bega is channelled, being navigable from Timișoara to its mouth (115 km). In order to regularize the flow within limits that would allow it to be functional, a hydrotechnical node was built at Coşteiu, whose main role is that of controlling the flow, also ensuring the transfer of the water quantity from Timiș to Bega.

Bega Channel was designed for the access of barges weighing a maximum of 600-700 tones and an annual transport capacity of 3,000,000 wagons. In order to improve flood risk, the work was later completed with the hydrotechnical system from Topolovăţul Mic which, during periods of high water flows, directs the excess flow of Bega in Timiș River.

On the territory of Timișoara there are also numerous lakes, either natural, formed in the place of old meanders or in the detached areas (such as those near the Kuntz colony, near Giroc, the Snakes' Lake in the Green Forest etc.), either of anthropogenic origin (towards Fratelia, Freidorf, Moşniţa, Mehala, Ștrandul Tineretului etc.), notable because of their location on the line of contact with the peri-urban localities. The underwater fauna in the waters of the Bega Canal includes grayling, carp, chub etc., constituting a natural support for practicing recreational fishing.

Aquifers of Timișoara is found at a depth that varies between 0.5 and 4 m. The groundwaters are found at depths that vary from 4 to 9 m. Deep groundwater is located at a depth of 80 m and contains drinking water, ensuring the necessary requirements for urban consumption. There are also very deep groundwaters, captured in Unirii Square (hypothermal), then south of the Citadel and in the Fabric district (mesothermal), with therapeutic value, used for SPA purposes.

[24] Alfieri, Feyen, Dottori, Bianchi (2015) „Ensemble flood risk assessment in Europe under high end climate scenarios" in *Global Environmental Change*, Vol. 35, pp. 199-212
[25] Ibidem
[26] Croitoru, Piticar, Burada (2016) „Changes in precipitation extremes in Romania", *Quaternary International*, Vol. 415, pp. 325-335
[27] Ibidem


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## B.2. Flood risk management

### B.2.1. Floods Directive 2007/60/CE

As a Member State of UE, Romania transposed in 2010 into the national legislation the provisions of the EU Floods Directive 2007/60/CE on the assessment and management of flood risks[28].

The implementation of Floods Directive implies activities related to flood risk assessment and management developed in 3 distinct stages and repeated each 6 years. The 3 stages and their related activities are presented below:

- **Preliminary Flood Risk Assessment (PFRA)** – identification of significant flood events and designation of Areas of Potential Significant Flood Risk (APSFRs);
- **Flood Hazard and Risk Maps (FHRM)** – development of flood hazard and risk maps for each APSFR. Flood hazard maps may provide information on the extent of flooded areas, the depth of water and velocities, for floods that may occur in a certain period of time. The flood hazard maps are a result of hydrological and hydraulic modelling, based on a detailed mapping of the river and its floodplain. The risk maps are indicating the range of the flood risk, based on the combination of the flood hazard results and the information on exposed population and assets and their vulnerability.
- **Flood Risk Management Plans (FRMP)** – for each Unit of Management (in case of Romania, for each RBA and for the Danube River) such plan is elaborated. The core chapter of the plans is the one dedicated to the program of measures to reduce the flood risk considering the flood risk management objectives.

**First cycle of Floods Directive implementation in Romania**

In 2016, Romania finished the implementation of the first cycle of Floods Directive and the FRMPs have been approved by GD 972/2016[29].

During the PFRA stage, 39 significant flood events and 399 APSFRs have been identified at national level[30]. The criteria considered for identification of the significant flood events and the corresponding APSFRs are presented below[31]:

| Category criteria | Type of consequences | Threshold values |
|---|---|---|
| Consequences for human health | Number of losses of life | Minimum 10 deceased / missing persons |
| | Number of social objectives affected | Minimum 2 social objectives affected (town halls, schools, hospitals, etc.) |
| Consequences for economic activities | Number of economic objectives affected | Minimum 10 affected economic objectives |
| | Number of km of roads affected | Minimum 200 km of affected roads (DN, DJ, DC) |
| | Number of affected houses | Minimum 100 houses per event or minimum 30 for areas / localities that |

[28] https://eur-lex.europa.eu/legal-content/EN/NIM/?uri=CELEX:32007L0060
[29] https://legislatie.just.ro/Public/DetaliiDocumentAfis/186418
[30] http://www.mmediu.ro/app/webroot/uploads/files/2016-04-26_PMRI_Sinteza_Nationala.pdf
[31] Chendeș, Rădulescu, Rândașu, Ion, Achim, Preda (2014) „Aspecte metodologice privind realizarea hărților de risc la inundații raportate în cadrul Directivei 2007/60/EC", Hidrotehnica, v. 59 (10-11), pp. 14-27


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| Category criteria | Type of consequences | Threshold values |
|---|---|---|
| | | have been the subject of punctual events, of high intensity |
| Environmental consequences | Number of IPPC objectives affected | Minimum 1 affected IPPC objective |
| Consequences for cultural heritage | Number of cultural objectives affected – churches, monasteries | Minimum 1 affected cultural objective |

***Table 2** – Criteria considered to establish the flood risk*

*Source: Chendeș, Rădulescu, Rândașu, Ion, Achim, Preda (2014) „Aspecte metodologice privind realizarea hărților de risc la inundații raportate în cadrul Directivei 2007/60/EC", Hidrotehnica, v. 59 (10-11), pp. 14-27 and http://www.rowater.ro/dabanat/EPRI/1.%20EPRI.aspx*

For each APSFR along the inland rivers, only the fluvial source of flooding was considered when developing the flood hazard maps. Based on the water depth classes (below 0.5 m, between 0.5÷1.5 and above 1.5 m), the risk was qualitatively assessed as low, medium and high. For the Danube River the results from Danube FLOODRISK project were used[32].

Based on a national Catalogue of potential measures, measures to reduce risk at APSFR, RBA and national level have been proposed. A multi-criteria analysis with cost-benefit analysis elements has been applied to derive the programs of measures included in the FRMPs.

**Second cycle of Floods Directive implementation in Romania**

In 2019, Romania reported to European Commission the results of the PFRA stage of the 2nd cycle of Floods Directive implementation.

The criteria considered for identification of significant flood events and APSFRs have been developed further to integrate more aspects (pluvial source, future floods, susceptibility to flash-floods, climate change etc.). The methodology is described Chapter 4 of the PFRA Reports.[33]

During the PFRA stage, 54 significant flood events have been identified (32 fluvial sources and 22 pluvial sources) for the period 2010 – 2016 and 64 future floods at national level. As a consequence, 153 new APSFRs (136 from fluvial sources and 17 from pluvial sources) have been designated[34].

Currently, the FHRMs and FRMPs are under development, based on the new methodological framework.

Some of the flood hazard maps from cycle 1 will be revised and flood hazard maps for the new APSFRs defined in cycle 2 will be developed. Climate change will be considered for 1% AEP scenario. Quantitative risk maps will be developed for all 526 APSFRs and 1 scenario will be considered to integrate the climate change. [35]

[32]https://rowater.ro/despre-noi/descrierea-activitatii/managementul-situatiilor-de-urgenta/directiva-inundatii-2007-60-ce/harti-de-hazard-si-risc-la-inundatii/

[33] https://inundatii.ro/resurse/

[34]http://www.inhga.ro/documents/10184/469411/Brosura+EPRI+cl+II+RO.pdf/9074ad8e-8c3d-40cc-9194-56ec0c6fd705

[35]https://rowater.ro/despre-noi/dezvoltare-si-investitii-achizitii/proiecte-implementate-in-curs-de-implementare/proiecte-in-curs-de-implementare/proiectul-rofloods/

The FRMPs will include programs of measures containing national measures, a preparedness package, strategies for each APSFRs to reduce risk, a strategy at UoM level. Multi-criteria and cost-benefit analysis will be performed. [36]

The 2nd cycle FHRMs are to be reported to EC in September 2022 and the FRMPs in March 2023.

### B.2.2. Flood hazard and risk information for Timișoara Municipality

**Preliminary Flood Risk Assessment**

**During the cycle 1 of the Floods Directive implementation,** for Banat RBA 2 significant flood events were identified and 46 fluvial APSFRs.[37]

Timișoara Municipality has territories located in the catchments of 2 rivers designated as APSFRs: Bega (APSFR: r. Bega – av. loc. Topolovățul Mic, sect. îndig.) and Bega Veche (APSFRs: r. Bega Veche – av. loc. Sânandrei, sect. îndig and r. Bega Veche – av. loc. Săcălaz, sect. îndig). Bega river was designated APSFR based on the consequences of the floods from April 2000 and 2005 and Bega Veche river based on the consequences of the floods from February 1999.

**During the 2nd cycle of Floods Directive implementation,** 8 significant flood events (4 fluvial and 4 pluvial) have been identified during the period 2010 – 2016 and 9 future floods for Banat RBA. 22 new APSFRs from fluvial source and 4 from pluvial source were designated. Timișoara Municipality has been identified as pluvial APSFR after being affected by the significant flood event from June 14, 2016[38].

*Table 3* is detailing the sources, mechanisms and characteristics of flooding and the type of consequences of the APSFRs of interest for Timișoara Municipality.

| APSFR name | APSFR code | Length/ Surface (km/sq. km) | Flood source | Mechanism of flooding | Characteristics of flooding | Type of consequences |
|---|---|---|---|---|---|---|
| r. Bega - av. loc. Topolovățul Mic, sect. îndig. | RO1-05.01.....-02A | 77.47 | Fluvial | A21; A22; A23 | A35; A38 | B11; B12; B31; B41; B42; B43 |
| r. Bega Veche - loc. Sânandrei, sect. îndig. | RO1-05.01.021....-01A | 7.16 | Fluvial | A21; A22 | A35 | B11; B23; B31; B41; B42; B43; B44 |
| r. Bega Veche - av. loc. Săcălaz, sect. îndig. | RO1-05.01.021....-02A | 31.61 | Fluvial | A21; A22 | A34 | B11; B12; B41; B42; B43; B44 |

[36]https://rowater.ro/despre-noi/dezvoltare-si-investitii-achizitii/proiecte-implementate-in-curs-de-implementare/proiecte-in-curs-de-implementare/proiectul-rofloods/
[37]https://rowater.ro/despre-noi/descrierea-activitatii/managementul-situatiilor-de-urgenta/directiva-inundatii-2007-60-ce/epri/
[38] Ibidem


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| APSFR name | APSFR code | Length/ Surface (km/sq. km) | Flood source | Mechanism of flooding | Characteristics of flooding | Type of consequences |
|---|---|---|---|---|---|---|
| loc. Timișoara - inundatii din pluvial | RO1-05.01.....-155252-P-A | | Pluvial | A21 | A31 | B11; B23; B31; B41; B42; B43 |

***Table 3** – APSFRs – source, mechanisms and characteristics of flooding and type of consequences*

*Source: Floods Directive, Cycle 2 Preliminary Flood Risk Assessment Report for RBA Banat*

Legend[39]:

A21 - Natural Exceedance; A22 - Defence Exceedance; A23 - Defence or Infrastructural Failure

A31 - Flash Flood; A34 -Medium onset flood; A35 - Slow onset flood; A38 - Deep Flood

B11 - Human Health; B12 - Community; B23 - Pollution sources; B31 - Cultural assets; B41 - Property; B42 - Infrastructure; B43 - Rural Land Use; B44 - Economic Activity


***Figure 20** – Floods in Timișoara Municipality*

*Source: https://www.digi24.ro/regional/digi24-timisoara/timisoara-trafic-blocat-si-masini-sub-apa-dupa-o-ploaie-torentiala-429964*

*Source: https://www.radioresita.ro/actualitate/timisoara-s-a-transformat-intr-o-venetie*

For the period 2016 – 2020, the Synthesis Reports elaborated after flood events occur, mention that Timișoara Municipality has been affected by 1 event in June 2016 (*Table 4*).

| No. of the Synthesis Report | Municipality | Event starting date | Source of floods | Affected assets |
|---|---|---|---|---|
| 3424/29.07.2016 | Timisoara | 26.06.2016 | internal waters | 21.97 ha arable land |

***Table 4** – Flood events in the period 2016 - 2020*

*Source: ANAR, Summary tables containing the Synthesis Reports information*

**Flood Hazard and Risk Maps**

**During the cycle 1 of the Floods Directive implementation,** flood hazard and risk maps were developed for 3 AEPs (10%, 1% and 0.1%), using the methodology described in Chapter 2.6 of the FRMPs. The flood hazard pas are a result of a national program *Plan for Prevention, Protection and*

[39] https://cdr.eionet.europa.eu/help/Floods/Floods_2018/GuidanceDocuments/FD_ReportingGuidance.pdf



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*Mitigation of Flood Effects*, which was initiated before the Floods Directive to enter into force. The qualitative flood risk maps were developed by ANAR and INHGA[40].

In case of Timișoara Municipality, the fluvial flood hazard results from cycle 1 are shown in *Figure 21*. These results were shared with Timiș County Council in 2014 by MEWF.

During the 2nd cycle of Floods Directive implementation, the pluvial flood hazard and risk maps for 6 AEPs (33%, 10%, 1%, 1%+CC, 0.5% and 0.1%) for Timișoara Municipality will be published in September 2022. No revision of the fluvial flood hazard maps for Bega River and Bega Veche river will be done in this cycle. New flood risk maps will be done and published in September 2022.

[40]http://www.inhga.ro/documents/10184/121027/4+PMRI+Banat.pdf/3478b866-1a2c-4e55-9eb2-7892a664c534



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***Figure 21 –*** *Flood hazard areas in Timișoara Municipality*

*Source: World Bank by using the cycle 1 Flood Hazard results*



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## B.2.3 Flood risk management infrastructure

Timișoara Municipality is well protected against fluvial floods by a complex hydrotechnical system along Bega river and Timiș river. The water management scheme existing in the Bega River catchment in connection with Timiș river is shown in *Figure 22*[41].

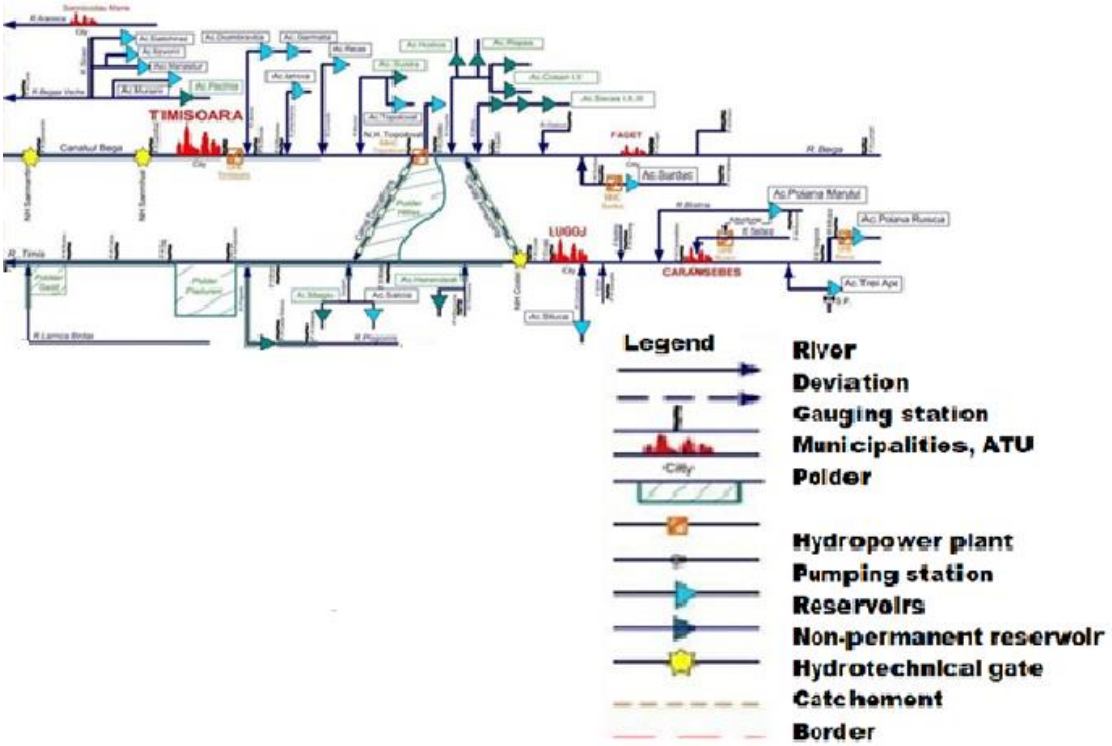


***Figure 22 –*** *The existing water management scheme in Bega River catchment in connection with Timiș river, with possible impact on the Timișoara growth pole*

*Source: Flood Risk Management Plan Banat River Basin Administration, RBA Banat*

Bega Channel, the river that passes in the middle of Timișoara Municipality is very well equipped with water management and flood mitigation infrastructure, as well as for drought risk management in the city and in agricultural land. The existing infrastructure and its characteristics are presented in the following *Tables (5, 6, 7, 8, 9, 10).*

| No. | Name | River | Cadastral code | County | UAT | Locality | Maximum discharge of deviate ($m^3/s$) | Owner |
|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| **BEGA RIVER BASIN** | | | | | | | | |
| 1 | NH Sânmartinu Maghiar | Bega | V-1 | TM | Uivar | Sânmartin Maghiar | 83,5 | RBA BANAT |
| 2 | NH Topolovăţ | Bega | V-1 | TM | Topolovăţ | Topolovăţ | 400 | RBA BANAT |
| 3 | NH Sânmihaiu Român | Bega | V-1 | TM | Sânmihaiu Român | Sânmihaiu Român | 83,5 | RBA BANAT |
| 4 | Bega – dam and | Bega | V-1 | TM | | Timișoara | 83,5 | S.C. COLTERM |

[41]http://www.inhga.ro/documents/10184/121027/4+PMRI+Banat.pdf/3478b866-1a2c-4e55-9eb2-7892a664c534#page=156&zoom=100,90,152



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| No. | Name | River | Cadastral code | County | UAT | Locality | Maximum discharge of deviate ($m^3/s$) | Owner |
|---|---|---|---|---|---|---|---|---|
| | inflow | | | | | | | S.A. Timişoara |
| **TIMIȘ RIVER BASIN** | | | | | | | | |
| 5 | NH Costei | Timiș | V-2 | TM | Costei | Costei | 40 | RBA BANAT |

***Table 5*** *– Hydrotechnical nodes (NH)*[42]

*Source: Flood Risk Management Plan for Banat River Basin Administration*

| Nr. crt. | Name | County | UAT | Deviate river | Cadaster Code | River flowing in | Cadaster Code | Lengh (m) | Owner |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **BEGA RIVER BASIN** | | | | | | | | | |
| 1 | Drainage Channel Bega – Timiș | TM | Topolovăț | Bega | V-1 | Timiș | V-2 | 5570 | RBA Banat |
| 2 | Channel for law flows Timiș – Bega | TM | Costei | Timiș | V-2 | Bega | V-1 | 9700 | RBA Banat |

***Table 6*** *– Deviations*[43]

*Source: Flood Risk Management Plan for Banat River Basin Administration*

| Dike code | Dike name | Location | Purpose or function of defense | Design AEP |
|---|---|---|---|---|
| V-1_MD_130+405-170+000_DL | Bega Dike to Timișoara MD | Timișoara Municipality / regulated built area; Sânmihaiu Român Commune / Sânmihaiu Român, Sânmihaiu German, Utvin localities; Uivar Commune / Răuți, Uivar, Pustiniș localities | Protection against fluvial floodings for urban and rural settlements and agricultural land | Q5%/47$m^3/s$ |
| V-1_MS_132+660-168+085_DL | Bega Dike to Timișoara MS | Timisoara Municipality / regulated built area; Sânmihaiu Român Commune / Sânmihaiu Român, Utvin localities; Peciu Nou Commune / Dinias, Peciu Nou localities; Uivar Commune / Sânmartinu Maghiar locality; | Protection against fluvial floodings for urban and rural settlements and agricultural land | Q5%/47$m^3/s$ |

[42] Ibidem

[43] Ibidem



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| Dike code | Dike name | Location | Purpose or function of defense | Design AEP |
|---|---|---|---|---|
| | | Otelec Commune / Otelec, Iohanesfeld localities | | |
| V-1_MS_107+550-127+365_DL | Bega Dike to Recaș – Timișoara MS | Recaș City / regulated unbuilt area; Bucovăț Commune/ Bazoșu Nou, Bucovăț; Mosnita Nouă Commune / Albina, Moșnița Veche, Moțnița Nouă; Timișoara Municipality / regulated built area | Protection against fluvial floodings for urban and rural settlements and agricultural land | Q2%/72m$^3$/s |

***Table 7*** *– Bega flood protection dikes within Timișoara growth center*[44]
*Source: Flood Risk Management Plan for Banat River Basin Administration*

Trei Ape Reservoir on Timiș River has a power production role and flood mitigation for the mountainous part of the catchment. It is not impacting the water dynamics in downstream part of the Timiş river, in cross sections of flow deviation to Bega or on Hitiaș Polder.

| Name of dam/ reservoir | River | Cadaster Code | County | Dam height (m) | NNR volume | Attenuation volume (mil. m$^3$) |
|---|---|---|---|---|---|---|
| Sustra | Lipari | V-1.16b.1 | TM | 8.50 | 0.92 | 0.86 |
| Topolovăț | Mociur | V-1.16b | TM | 9.50 | 4.20 | 3.875 |
| Ianova | Gherteamoș | V-1.19 | TM | 8.75 | 5.50 | 4.82 |
| Giarmata | Behela | V-1.20 | TM | 10.50 | 1.34 | 0.74 |
| Dumbrăvița | Behela | V-1.20 | TM | 5.00 | 1.32 | 1.22 |
| Satchinez | Sisco | V-1.21.4.3 | TM | 6.30 | 3.35 | 3.09 |
| Murani | Măgheruș | V-1.21.2 | TM | 7.65 | 6.24 | 4.77 |
| Surduc | Gladna | V-1.10 | TM | 34.00 | 24.225 | 25.775 |

***Table 8*** *– Permanent reservoirs for flood protection with a possible impact on Timișoara area*[45]
*Source: Flood Risk Management Plan for Banat River Basin Administration*

| Name of dam / reservoir | River | Cadaster Code | County | Type of dam | Dam height (m) | Total Volume (attenuation volume) (mil.m$^3$) |
|---|---|---|---|---|---|---|
| Iosifalău | Iosifalău | V-1.16a | TM | PO | 9.15 | 0.99 |
| Coșarii II | Chizdia | V-1.16 | TM | PO | 7.60 | 2.00 |
| Coșarii I | Chizdia | V-1.16 | TM | PO | 6.60 | 0.325 |
| Repas | Repaș | V-1.16.1 | TM | PO | 7.60 | 1.60 |
| Hodoș | Hodoș | V-1.16.2 | TM | PO | 6.60 | 0.875 |

[44] Ibidem
[45] Ibidem


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| Name of dam / reservoir | River | Cadaster Code | County | Type of dam | Dam height (m) | Total Volume (attenuation volume) (mil.m³) |
|---|---|---|---|---|---|---|
| Recaș | Curasita | V-1.18.1 | TM | PO | 8.50 | 0.52 |
| Pischia | Bega Veche | V-1.21 | TM | PO | 10.40 | 13.30 |
| Mănăștiur | Apa Mare (Rat) | V-1.21.4 | AR | PO | 8.00 | 10.15 |
| Izvorin | Slatina (Izvorin) | V-1.21.4.2 | AR | PO | 8.05 | 6.64 |
| Secas I | Miniș | V-1.14 | TM | PO | 5.67 | 0.482 |
| Secas II | Miniș | V-1.14 | TM | PO | 5.59 | 0.495 |
| Secas III | Miniș | V-1.14 | TM | PO | 6.43 | 0.559 |

***Table 9** – Frontal reservoirs/polders with a role in flood protection with a possible impact on Timișoara area*[46]

*Source: Flood Risk Management Plan for Banat River Basin Administration*

| Name of dam / reservoir | River | Cadaster Code | County | Length (m) | Dam height (m) | Surface (ha) | Total Volume (attenuation volume) (mil. m³) |
|---|---|---|---|---|---|---|---|
| Hitias Polder | Timiş-Bega | Timis-Bega | TM | 11310 | 5 | 1430 | 20 |
| Gad Polder | Timiş – Lanca Birda | Timis, V-2– Lanca Birda-V-2.36 | TM | 4500 | 5 | 420 | 20,5 |
| Pădureni-Polder | Timiş | V-2 | TM | 8640 | 8 | 1120 | 35 |

***Table 10** – Polders with a role in flood protection with a possible impact on Timișoara area*[47]

*Source: Flood Risk Management Plan for Banat River Basin Administration*

### B.2.4. Sewerage network

Timișoara Municipality has a unitary system for collecting sewage (domestic waters) and pluvial waters. The collected water is discharged in the wastewater treatment plant, which can treat up to 3,000 l/s (maximum treatment capacity).

#### B.2.4.1. Collecting domestic waters

Collection of the domestic waters is done in a centralized manner: the operator of the sewerage system is the Regional Operator AQUATIM SA. The sewerage network has a total length of 547.36 km, and the water network has a total length of 642 km[48].

[46] Ibidem
[47] Ibidem
[48] Water Permit for Timișoara Municipality General Urban Plan, 08.01.2016



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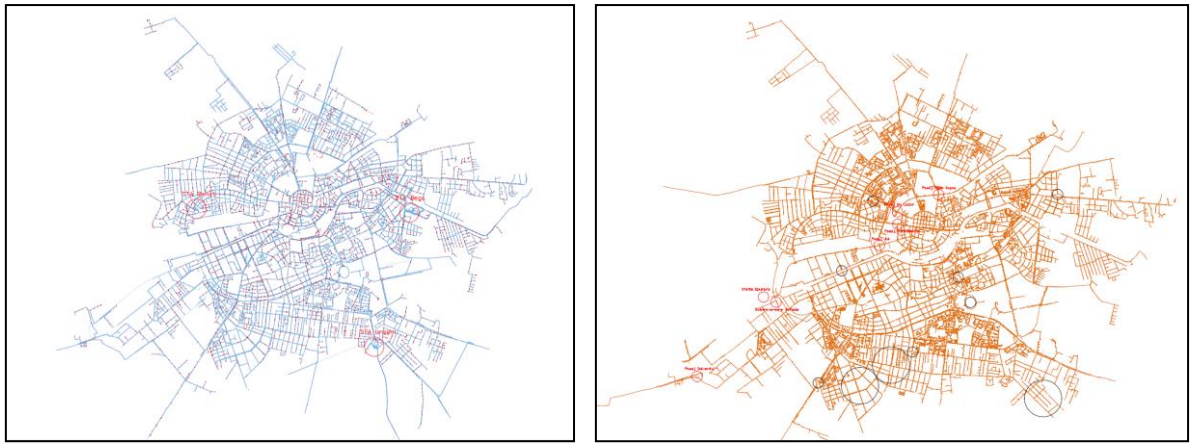

***Figure 23 –*** *Water and sewerage network of Timișoara Municipality*
*Source: Processed by World Bank, using data provided by AQUATIM SA*

The regional operator, in partnership with the local and county authorities, is implementing a project co-financed by the Cohesion Fund of the European Union: „Extension and modernization of the system water supply and sewerage in Timiș County", which includes investment for expansion and rehabilitation of water distribution and sewerage system. Timișoara Municipality has foreseen[49] the following feasibility studies:

- extension of water – sewerage networks: Nera, Dundrea, Bachus, Prof. Alex Streets, Cisman, Gr. Alexandrescu, Aurora, Pictor Zaicu, Teiului, Centura, Nicoregti, Letea, Ceferiștilor, Viitorului, Ovidiu Cotruș, Anton Katrein, Bela Lugosi, Freidorf Industrial Park – Paul Morand, Wilhelm Tell;
- extension of the water-sewerage networks on the streets: l. Bulbuca, Olarilor, losif Sirbu, Bv. South, Victor Gaga, Florin Medelet, Caras, Al. Indrieș, Torac, Popa Anca (Behela), T. Bucurescu, D. Zamfirescu, Dafinului, Azaleelor, D. Dinicu, Sanzienelor, Violetelor, Anemonelor, Crăițelor, Orhideelor, J. J. Ehler, Neajlov.

| Connection degree | | | | | |
|---|---|---|---|---|---|
| Timișoara | **2016** | **2017** | **2018** | **2019** | **2020** |
| | 98.8 | 99.8 | 99.8 | 99.8 | 99.9 |

***Table 11*** *– Connection degree of the population to the sewerage network in Timișoara (2015-2020)*
*Source: Technical data provided by AQUATIM SA*

### B.2.4.2. Sections with problems and streets without networks[50]

In the past years, the Water Company Aquatim has been investing heavily in adapting to climate change and solving the sections where flooding problems occur during heavy rains.

In the last five years, Aquatim has invested about 10 million lei, from its own funds, in a set of measures meant to equip Timișoara sewerage system and make it resilient for torrential storms: „Aquatim has intervened in areas known to be vulnerable to heavy rains and has equipped sewerage with systems that allow it to function normally in exceptional situations. The principle was to ensure, locally, enough space for the temporary collection and storage of a large volume of water, to be redirected, where possible, or later released into the network, after the peak of the rainfall has passed.", explains Aquatim's representative.

[49] According to AQUATIM address no. 8419/13.03.2015
[50] Technical data provided by AQUATIM SA


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A landmark in torrential storms was the rainfall on 2nd of August 2016, when there were 68 liters / $m^2$ for 90 minutes in all neighborhoods of Timișoara. „Positioning the flooded areas on the map by removing the sewer in the rain of August 2016 gives us a good picture of the risk areas. We can see, at a review of the measures taken by Aquatim since then – remedial works, but also modernization solutions, that we intervened in sensitive points, such as railway crossings: Calea Șagului bridge area, Bujorilor streets, Emile Zola, Freidorf Industrial Park etc. ", Aquatim's representative mention.

Four railway passages from Timișoara have been equipped with systems that ensure the efficient evacuation of rainwater accumulated from the low areas, in heavy downpours. Solutions proposed and implemented by Aquatim are as it follows:

- Rehabilitation of the sewer collector on Jiul Street (Aquatim, 2016) completed the extensive modernization works of the CFR passage, carried out by the local administration. The rainwater management solution in the passage area was realized through the investment of the mayor's office, according to an idea proposed by the water company. A pumping station was located underground on Jiul Street, which discharges directly into Bega the water collected by the sewer at torrential rains, after the separation of hydrocarbons and suspensions.
- The solution developed by Aquatim for the Popa Șapcă passage (2017) consisted of a buffer basin, with a gradual subsequent release into the sewer. The ensemble comprises two large parallel tubes, 48 meters long and 2 meters in diameter, located on Aristide Demetriade Street and an automated pumping group.
- The sewerage in the area of Brediceanu and Gheorghe Lazăr passages was modernized in 2020, by Aquatim. At the first passage, a pumping station was built, with the discharge of the peak flow into the collector channel. The risk area was isolated by a discharge network of about 50 m and manholes and reassurance chambers. For the Gheorghe Lazăr passage, a more complex solution was chosen, which includes a discharge network of over 250 meters, a dam solenoid valve, cleaning chambers, emptying and calming, a spillway and a decanter and an automated pumping station. Excess rainwater is discharged in a controlled manner into the sewer on the Circumvallation Road.
- On Emile Zola Street in Timișoara, another hot spot on the sewer flood map, a new sewer collector was introduced, with a diameter of 1,400 mm, mounted parallel to the existing one, to double the collecting area when needed. A pump set ensures subsequent discharge into the network.
- The sewerage capacity in the Calea Șagului Bridge area – the regulated built area of Timișoara has extended, and the risk of flooding the area under the bridge has been reduced by modernizing the sewerage network in the area and introducing a pumping station with discharge into the main collector. Discharges cross the railway lines.
- The sewerage network was completed with wastewater pumping stations and rehabilitated on sections, on Nicolae Stoica de Hațeg, Dimitrie Dinicu, Salciei and Aleea Cascadei streets, while in the Freidorf Industrial Park a sewerage network was built exclusively for rainwater, which is pumped and discharged into Bega River.

In addition to the externally contracted rehabilitation works, the water company implemented, with its own maintenance teams, local remedial measures, such as repairs in the Dan Păltinișan Street as well as the installation of anti-discharge valves on Gladiolelor Street 1st of December 1918 Street.

Timișoara treatment plant is located on the northern bank of Bega. The wastewater collected from the southern part of the city must therefore „pass" through the Bega canal to reach the treatment plant. There are two sub-crossings of Bega, through siphon-type hydraulic systems, based on the principle of communicating vessels. Both were designed in order to ensure their self-cleaning, but this

only happens at high flows, during heavy rains. Their regular maintenance is therefore essential for the proper functioning of the sewer. „Preventive maintenance, cleaning and regular inspection of sewer sections is always important. However, if we talk about the overflow siphons, which connect the sewer in the southern part of the city to the treatment plant, the impact is crucial" said Aquatim's representative.

Three recent major maintenance works complete the set of measures designed to ensure the efficient operation of the sewer under all conditions. It is the unclogging of the siphon chambers for both South collectors and the complete unclogging of the 2,000 mm diameter pipe, of the overflow siphon, corresponding to the new collector from the south.

The former overflow siphon of the southern sewer collector, on Baba Novac Street, was completely rehabilitated, hydraulically and structurally, through an Aquatim investment, in 2019. The old one dated from 1912, from the beginning of the sewer and here it is 25% -30% of the wastewater collected from the southern half of the city transits. Aquatim's future plans also include equipping the new south-facing overflow siphon with an excess rainwater pumping station in Bega.

### B.2.4.3. Treatment of wastewater

The wastewater treatment plant (WWTP) of Timișoara Municipality is located on Pastorilor Street, in the south-east of Timișoara, along the dam, on the right bank of the Bega Channel, outside the regulated built area, at around 30 km up the border with Serbia, on a total surface of 21.6 ha.

In 2002, through ISPA program, there was an investment in a new mechanical-biological and tertiary wastewater treatment plant with a capacity of 2,400 l/s (average flow) and 3,000 l/s (maximum flow) and it is dimensioned for 440,000 L.E. It includes the following steps: nitrification-denitrification and chemical step to reduce phosphorus. The stormwater line includes: overflow threshold and rainwater pumping station, coarse screens with mechanical cleaning with a distance between bars of 100 mm, 4 water storage tanks for the first peak of stormwater.

If, after the storage of the first peak of stormwater in the old primary settling tanks with a capacity of 10,800 $m^3$, the storage capacity is exceeded, a flow up to 21,000 l/s (calculation flow at the maximum capacity of rainwater pumps) can be discharged into the Bega Channel. The water from the first rain basins is reintroduced gradually into the treatment circuit when the conditions allow it[51].

In 2021, the WWTP Timișoara treated 40,886,907 $m^3$ of wastewater, and 1,503,999 $m^3$ were discharged directly into the Bega Channel during heavy rainfall.

| Month | Jan | Febr | Mar | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. of days | 2 | 2 | 1 | 0 | 2 | 0 | 6 | 1 | 1 | 0 | 2 | 2 |
| Total | 19 | | | | | | | | | | | |

***Table 12** – Number of days when the bypass was used (2021)*
*Source: Technical data provided by AQUATIM SA*

### B.2.4.4. Deficiencies of the wastewater treatment plant

No deficiencies were recorded.

[51] Water Permit for Timișoara Municipality General Urban Plan, 08.01.2016


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### B.2.4.5. The stormwater system

The stormwater from the existing urban area of Timișoara Municipality is collected together with the domestic flow in the mixed sewerage system. For the metropolitan urban area of Timișoara, the stormwater is discharged as it follows:

- rainwater from the road area is taken through the adjacent marginal gutters, directed through drainage slopes, and discharged to the nearest surface emissary. Under the conditions imposed by its administrator, before being discharged, the waters with possible impurities are passed through sludge and hydrocarbon separators. The waters discharge into the emissary is done by the limits imposed by H.G. 352/2005 – NTPA 001/2005;
- rainwater from the construction area with other functions is collected from the concrete platforms of the incinerators through ditches or pipes buried and passed through hydrocarbon separators, then discharged into street ditches or directly into outlets;
- rainwater from residential areas, considered conventionally clean, is retained on the premises of each property or discharged into the road gutter (emissary).

A total rainwater flow of 373,418 l/s is calculated taking into account the area of the basin corresponding to the proposed urban area with a surface of 7,859.96 ha.

The level of the outlets, both for domestic and stormwater drainage, should be correlated with the level corresponding to the maximum calculation flow in the standard class.

## B.2.5. Flood Risk Management Tools

**The National Strategy on Flood Risk Management has as specific objective on long term: to protect localities against floods of 1% to 0.01% AEP**, depending on the rank of the locality. Timișoara is a rank I locality. This implies for the defense structures to be designed for at least 0.2% AEP floods.

**Flood Risk Management Plans**

In line with the flood risk management objectives, the cycle 1 FRMP of Banat RBA (2016) contains proposal of measures to reduce the fluvial flood risk along Bega river and Bega Veche river APSFRs *(Table 13)*[52]

| APSFR name | EC measure code | Name of the measure | Implementation status |
|---|---|---|---|
| r. Bega - av. loc. Topolovăţul Mic, sect. indig. | M31 | Maintaining the forest area in the Bega river basin for 2484.17 ha | - |
| | M35 | Securing the Sanmihaiul Roman Hydrotechnical Node: repair and rehabilitation of dam and hydrotechnical constructions, hydromechanical equipment, maneuvering devices, following the drying of the lock and the rehabilitation of the lock, landscape arrangements | repair and rehabilitation of dam 62%, repair and rehabilitation of hydromechanical equipment 57% |

[52]http://www.inhga.ro/documents/10184/121027/4+PMRI+Banat.pdf/3478b866-1a2c-4e55-9eb2-7892a664c534#page=156&zoom=100,90,152

| APSFR name | EC measure code | Name of the measure | Implementation status |
|---|---|---|---|
| | M33 | Consolidation and reprofiling of the Bega - Timis channel on the sector Topolovat - confluence with Timis river: riverbed reprofiling L = 6.0 km, consolidation of the riverbed for 12.0 km, complete terraced dikes | 100% |
| | M33 | Improvements on Bega river and tributaries in the Timisoara-Balint sector: riverbed regularization and recalibration on Bega river for a length of 33 km, stage I (1.6 km of dikes with local materials, existing embankments for 15.2 km, synthetic sheet piles on 2.5 km, concrete wall for 1.8 km) | technical and economic indicators are under the approval process. A technical study is needed after the approval of the technical and economic indicators |
| | M33 | Improvements on Bega river and tributaries in the Timisoara-Balint sector: regularization of tributaries Lipari, Mociur, Curasita, Gherteamos, Behela, stage II (46.58 km regularization of tributary riverbeds, 6.15 km dikes along local tributaries, 3.6 km elevation of existing dikes along tributaries) | technical and economic indicators are under the approval process. A technical study is needed after the approval of the technical and economic indicators |
| r. Bega Veche -loc. Sanandrei, sect. indig. | M33 | New dike on the Cerneteaz area for 4.01 km | - |
| | M31 | Improving the management of forests in the floodplains of Bega Veche river related for 206.69 ha | - |
| | M31 | Maintaining the surface of the forests in the Bega Veche river basin for 10567.62 ha | - |
| | M35 | Maintenance of the existing works in the Bega Veche river basin: mechanical mowing for 60 ha, manual mowing for 1000x100 sq m | 100% |
| | M35 | Maintenance of Bega Veche watercourse and tributaries: mechanical mowing for 20 ha, manual mowing for 200x100 sqm, deforestation for 60x100 sqm | 100% |
| | M35 | Dikes elevation: dike elevation left bank + right bank in Sanandrei area for 5.355 km | - |
| r. Bega Veche - av. loc. Sacalaz, sect. indig. | M35 | Maintenance of existing works in the Bega Veche river basin, maintenance of Bega Veche dikes: mechanical mowing for 620 ha, manual mowing for 5800x100 sq m | 100% |



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| APSFR name | EC measure code | Name of the measure | Implementation status |
|---|---|---|---|
| | M35 | Maintenance of Bega Veche watercourse and tributaries, mechanical mowing for 120 ha,<br>manual mowing for 1200x100 sq m,<br>deforestation for 60x100 sq m | 100% |
| | M35 | Sacalaz area support wall elevation for 12.365 km | - |

***Table 13** – Measures proposed in cycle 1 FRMP of Banat RBA*
*Source: Flood Risk Management Plan for Banat River Basin Administration*

An integrated project was proposed in cycle 1 FRMP of interest for Timișoara Municipality: The complex arrangement of the Bega river in order to defend against floods Timișoara and the riparian areas

Under the 2nd cycle FRMPs, for the 3 fluvial APSFRs and for the pluvial APSFR – Timișoara, a strategy will be developed to reduce the flood risk at APSFR level.

**The River Basin Management Plan of Banat RBA (2022)** indicates as water bodies along the APSFRs of interest for Timișoara Municipality the following (*Table 14)*[53]:

| Water Body name | Water Body Code | Category | Status/ Potential (S/P) | Water body typology code | Class of the ecological status/ potential | Chemical status |
|---|---|---|---|---|---|---|
| Bega - cf. Chizdia - cf. Behela | RORW5 -1_B3 | RW | P | RO11CAPM | 2 | 2 |
| Bega - cf. Behela - frontiera | RORW5 -1_B4 | RW | P | RO11CAA | 2 | 3 |
| Bega Veche (Beregsau,Niraj) - av. cf. Valea Dosului + afluenti | RORW5 - 1 - 21_B1A | RW | P | RO18CAPM | 3 | 2 |

***Table 14** – Water bodies of interest for Timișoara Municipality*
*Source: Updated River Basin Management Plan of Banat RBA 2022-2027*

Legend:
RW - natural river / CAPM river / artificial river
LW - reservoirs
S/ P – ecological status/ ecological potential
Water body typology code: Natural rivers: RO01-RO19; Strongly modified rivers: RO01CAPM-RO19CAPM; Artificial rivers: RO01CAA-RO19CAA; Reservoirs: ROLA01-ROLA07
Classes of the ecological status/ potential: 1- very good ecological condition/ 2- good ecological status/ / maximum and good potential/ 3- moderate ecological status / moderate potential; 4- poor ecological status / potentially weak

[53]http://banat.rowater.ro/wp-content/uploads/2022/03/Anexele-Planului-de-Management-Actualizat-al-Spatiului-Hidrografic-Banat-2022-2027.pdf


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When elaborating the strategies at APSFR level, the characterization of the water body should be considered.

Currently, part of **Timișoara Municipality Flood Defence Plan against floods, ice and accidental pollution (2018-2021)**[54] is published on the municipality website. Only parts of the document are presented (i.e., prevention, response and recovery measures), but not the evacuation route.

### B.2.6. Areas developed in floodplain

Built areas that are directly affected by floods or where floods might have an indirect impact have been identified using flood hazard and risk maps developed in the first cycle by the Government of Romania for the EU Floods Directive.

Inside Timișoara's regulated built area, Bega Channel is the main course of water and the only potential flood generator. **Flood risk is reduced in the regulated built area** because of the regularization that was implemented during the XIXth and XXth centuries. The area that is most frequently exposed to flood risk is reduced: both banks of the river in the central area where there the main land use is leisure activities like parks, sport areas, terraces, restaurants and and small-scale commerce. In the **central area**, the Local Committee for Emergency Situations[55] identifies the following flood risk points:

- Former Bier Haus S.A. Terrace area;
- Flora Terrace – Yacht Club;
- Former Boss Terrace;
- River Deck Terrace;
- Former Hercules, actual Entrance Terrace;
- Riviere Terrace;
- Dark Terrace;
- Vaporul Terrace.

The riverbanks situated in the periphery of the city (both western and eastern peripheries) are used for residential, educational and industrial areas. In this case, the flood risk area covers a large surface, but the frequency of this type of floods is reduced, with a 1000-years occurence. According to the Local Committee for Emergency Situations, peripheral urban areas exposed to flood risk are:

- Ghiroda Nouă – residential neighbourhood;
- Plopi – residential neighbourhood;
- Hydrotechnical Plant – Enel;
- Water Plant – Aquatim;
- Wastewater treatment plant – Aquatim;
- Pool area – Pădurea Verde;
- National Highway – Pădurea Verde;
- Kuncz – residential neighbourhood.

**Flood risk is greater outside Timișoara's boundaries**, along adjacent rivers like **Beregsău River**, in the north of the city, and other important rivers in the area like **Timiș River**, in the south of the city. Outside Timișoara, to the east, the track of Bega River is not regularized, which determines a greater flood risk than inside the city.

[54] https://www.primariatm.ro/transparenta/strategii-si-planuri/plan-local-de-aparare/
[55] Data provided by Timișoara City Hall (21.02.2022)


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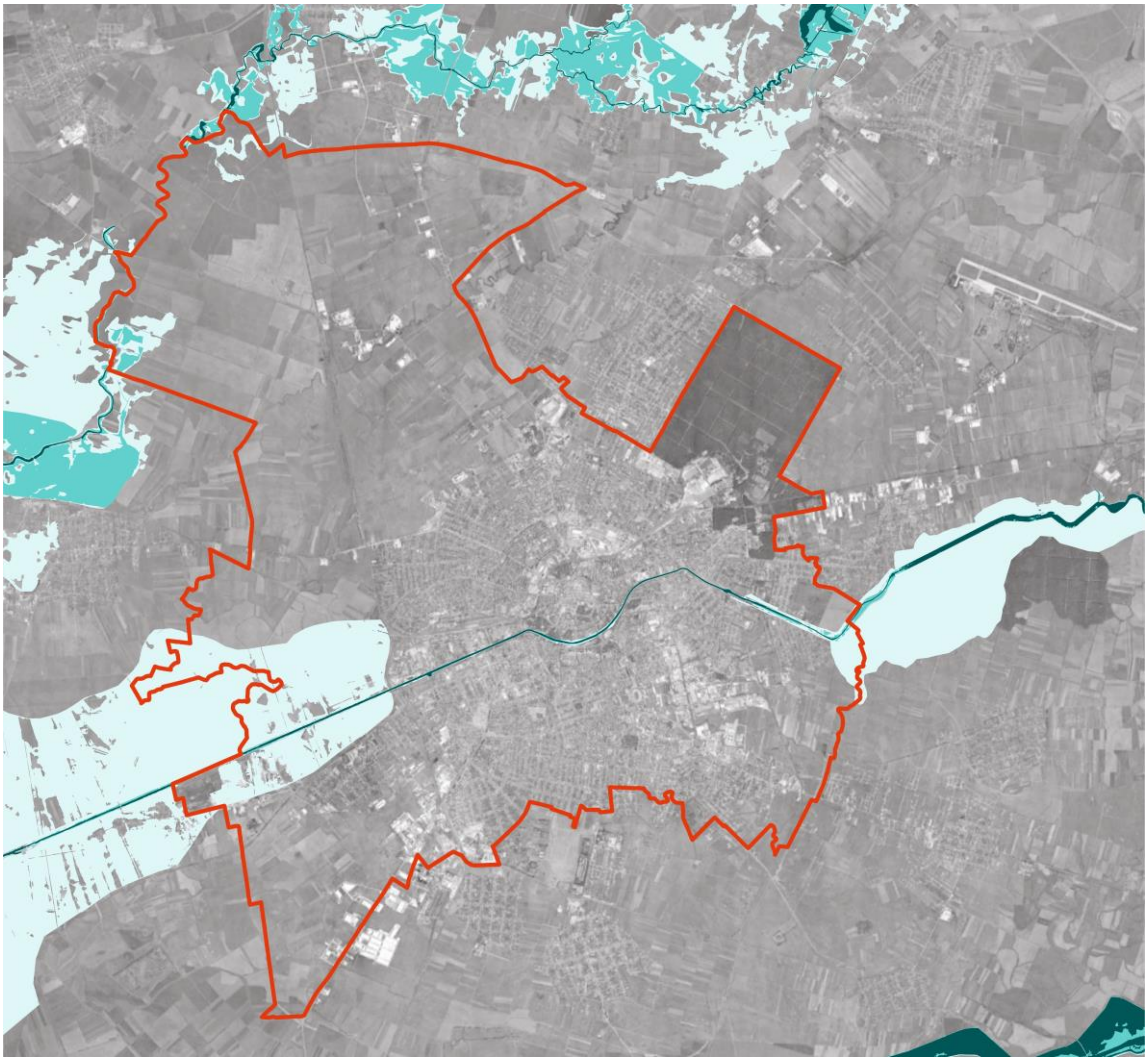

***Figure 24 –*** *Hazard and flood risk map on Bega Channel and adjacent rivers – administrative territory of Timișoara Municipality*

*Source: World's Bank processing of Google Earth Satellite View image*

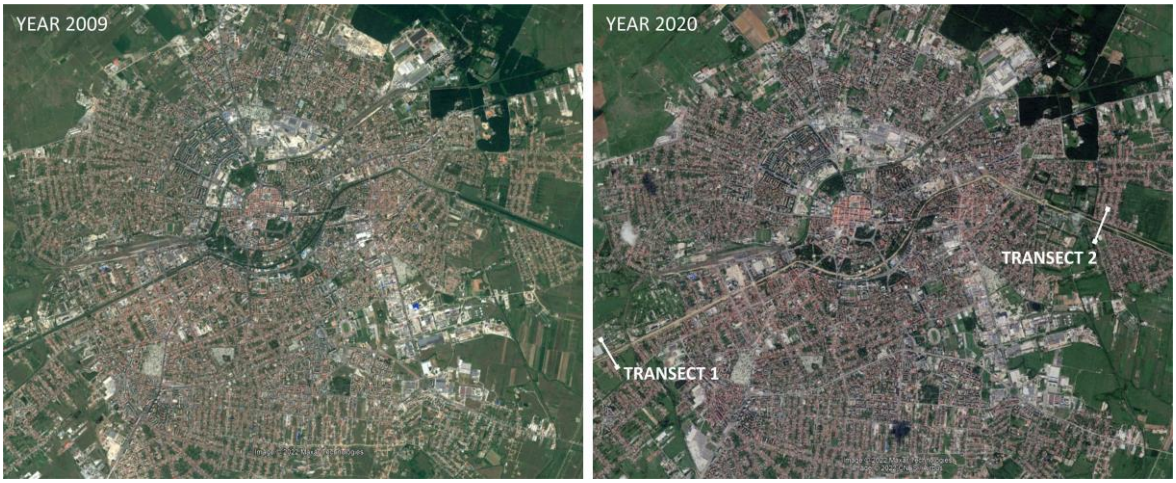


***Figure 25 –*** *Comparison between satellite images of Timișoara Municipality (2009, 2020)*

*Source: World's Bank processing of Google Earth Satellite View image*



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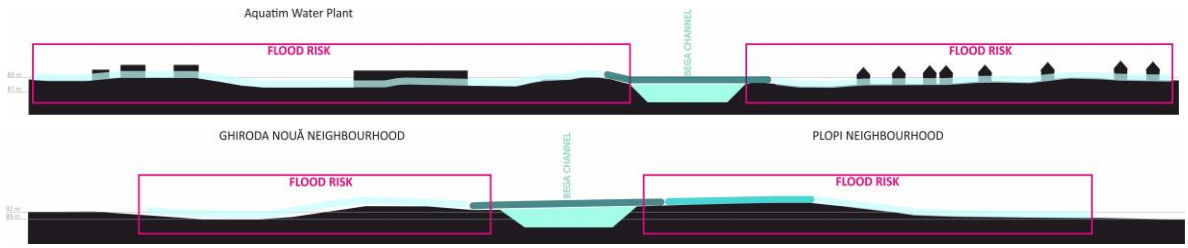


***Figure 26** – Transects of Bega Channel's floodplain in Timișoara Municipality*
*Source: World Bank*

A comparison between the urban development in Timișoara in 2009 and in 2020 shows little spatial expansion but densification in the peripheries, especially in the industrial and logistics areas. The peripheral neighborhoods that are situated in flood risk areas have continued their development, becoming denser (Plopi and Ghiroda Nouă neighbourhoods).

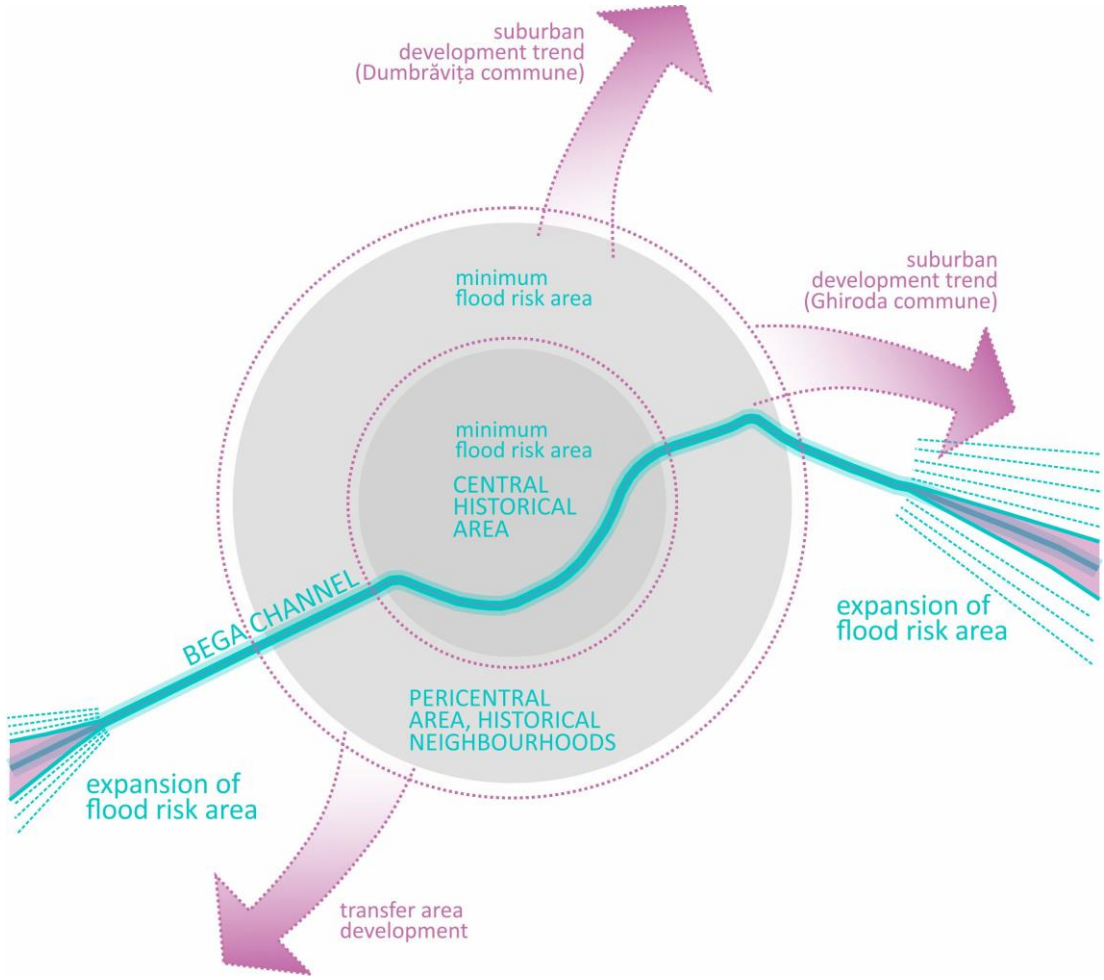


***Figure 27** – Development trends in Bega Channel's area in Timișoara Municipality*
*Source: World Bank*

The transects presented above (Transect 1 and Transect 2) show peripheries that are more exposed to flood risk than the central area where the river has standard flood prevention infrastructure: embankments and levees. The analyzed areas have a reduced flood risk, where the flood occurrence is minimum (1000 years) and **the built-up area is not dense** and is represented by residential neighborhoods or industrial and civil engineering infrastructure.


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Spatial development trend analysis shows three main development axes in the peri-urban area, **outside of Timișoara's regulated built area**: Ghiroda Commune, along DN 6 national road, Dumbrăvița Commune and DN 59 national road. These axes have different profiles, oriented either towards a suburban profile (Dumbrăvița), either towards highly accessible transfer and industrial areas (Ghiroda-DN 6, DN59). The development usually follows accessibility in connection with the main roads (national and international links) and the city gateways.

Two of these are developed in flood risk areas: Dumbrăvița industrial area and the residential area of Ghiroda Commune and Ghiroda Nouă residential neighbourhood. The two points are exposed to high flood risk (10-year and 100-years occurrence) which has been identified on the banks of Bega River, with an extended flood risk which is low (1000-years occurrence) but which could affect a much greater area.



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## B.3. Integration of hazard and flood risk maps and flood risk management measures into spatial and urban planning

### B.3.1. Spatial and urban planning plans analysis

#### B.3.1.1. Timiș County Economic and Social Development Strategy 2021-2027

The strategy for economic and social development of Timiș County is part of the Operational Program for Administrative Capacity, SIPOCA 704, funded by the European Social Fund, which aims to improve public administration's activity by using innovative technologies, especially in underdeveloped regions. The Strategy stands on four pillars: **Health and Welfare**, **Economy and Society**, **Infrastructure and Environment**, **Leadership and Strategy**. Regarding infrastructure and environment, the Strategy includes overcoming economic issues through infrastructure development, accelerating green agendas, mitigating climate change and **strengthening the critical risk infrastructure in order to mitigate territorial vulnerabilities**. Following the European Green Deal, Timiș County Economic and Social Development Strategy 2021-2027 has four important goals: **Clean Energy**, **Sustainable Industry**, **Construction and Rennovation**, **Sustainable Mobility**.

As water dynamics are concerned, Timiș County Economic and Social Development Strategy 2021-2027 identifies flood risk as a main cause for restrictions in the development of urban planning. Regarding the geographical position of the county, most of its territory is located in a low plain crossed by four important rivers (Mureș, Timiș, Bega and Bârzava). Even though much of the flood risk has been diminished by construction of hydrotechnical flood prevention infrastructure, climate change brings an increasing precipitation intensity, therefore a greater flash flood risk. As a priority measure, the Strategy lists the **implementation of flood mitigation projects proposed by the Management of Flood Risk Plan for Banat hydrographic area**[56].

Pluvial flood risk is still important in the county, especially in cities and towns of villages where most of the housing is not connected to the sewerage system. The infrastructure is managed by Timiș Water-Sewerage Intercommunitary Development Association (ADI Timiș), which holds 78 administrative units from the total of 99.

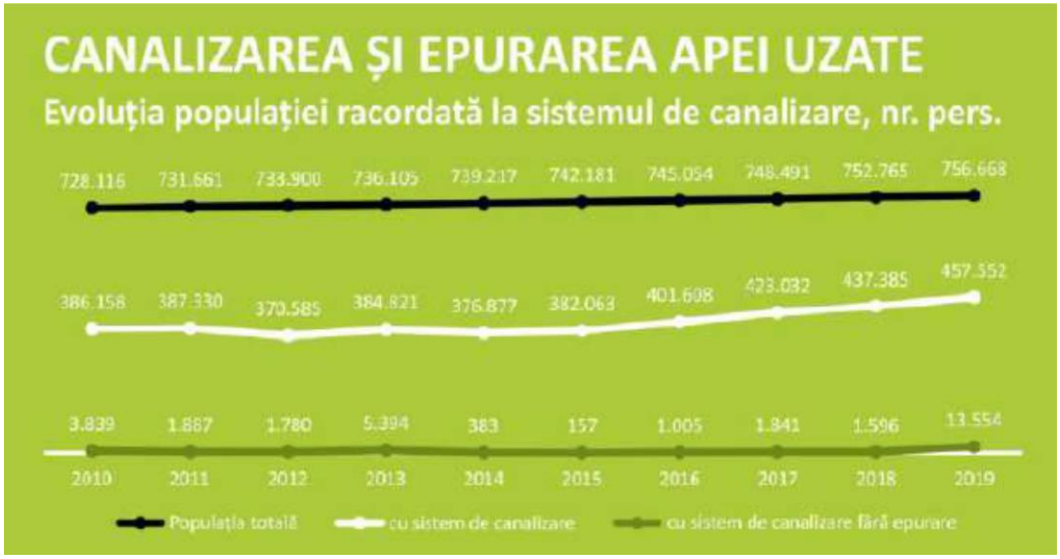


***Figure 28** – Development of water and sewerage infrastructure in Timiș County 2010-2019*
*Source: Timiș County Economic and Social Development Strategy 2021-2027, p. 70*

[56] *Flood Risk Management Plan Banat River Basin Administration*, RBA Banat


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Regarding water and sewerage infrastructure, the rural area is underdeveloped, with approximately 50.5% of the administrative units not having water and sewerage infrastructure. However, there has been an increase in the total length of the sewerage infrastructure in the last 10 years, with approximately 18% and also greater growth between 2016 and 2019[57]. Some of the administrative units have been funded through the National Plan of Local Development, 1st and 2nd phase: Lugoj Municipality, Făget, Gătaia and Jimbolia Cities and 43 communes.

### B.3.1.2. Timiș Territorial County Plan

The necessity of a territorial county plan is given by the constant challenges that appear in the urban and rural communities and that need to be approached in an integrated manner. Timiș Territorial County Plan (Timiș PATJ) aims to adapt planning practices to new European legislation, international, regional and metropolitan cooperation, new growing urban centers and environmental challenges. Thus, the main goals of Timiș PATJ are:

- sustainable development of urban centers, especially Timișoara to become an investment and cultural attractor in south-western Europe;
- enhance Timiș County as part of the European transport mobility system;
- sustainable use of the county's resources in order to enrich the economic sectors;
- sustainable development of natural and built heritage;
- development of regional and international tourism in the county.

Timiș County is located in Romania's western area, in the border area, having two countries as neighbors: Hungary (to the north-west) and Serbia (to the south and west). Aldo, Timiș County is part of the historic province of Banat. A third of the county's limits are international borders, administrative or even natural, as Mureș River is both an international (Romania-Hungary) and intranational (Timișoara-Arad counties) limit. Timiș is one of the four counties to form the Western Development Region, along with Hunedoara, Arad and Caraș-Severin counties, and also part of the Dunăre-Criș-Mureș-Tisa Euroregion, which has a population of 6 million inhabitants, on a 77.100 km$^2$ area.

The geography of the county is divided into two main geologic regions which reflect in the landscape: the Pannonian Depression, with low altitudes, in the central, western and southern area (85% of the territory), and the Getic Field, to the east, in the Poiana Ruscă Mountains area. The mountainous area includes settlements that are vulnerable due to the difficult access to resources, social equipment and lack of risk prevention measures: Nădrag, Pietroasa and Tomești communes[58]. Between the two main geological areas, there are the Banat Hills, a geographical transition area, with altitudes between 200 and 400 m.

Regarding sustainable development and environment, PATJ Timiș aims to protect, preserve and enhance the natural environment by:

- Protection of termal resources with tourist potential and sustainable development of minerals;
- Protection and preservation of biodiversity;
- Protection and improvement of environmental factors;
- Prevention, protection and reduction of anthropic and technological hazards risk;
- Sustainable water management by flood risk defense and enhancement of water potential and distribution;
- Use of renewable energy sources;
- Development and implementation of an integrated waste management system.

[57] Timiș County Economic and Social Development Strategy 2021-2027, p. 67
[58] Timiș Territorial County Plan, Vol. II, p. 29


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The four river basins that can be found in Timiș County are Mureș, Aranca, Bega and Timiș River Basins. Timiș, Aranca and Bega are part of the greater river basin of Danube, while Mureș is part of Tisa's River Basin. The hydrographic system is also composed of multiple lakes, both natural and anthropogenic (reservoirs): relict lakes, meander lakes, cenotes, thermal lakes, fish farms, leisure lakes and reservoirs for flood mitigation (Surduc and Murani Reservoir).

Situated in a **low plains area with alluvial deposits, in the Timiș-Bega-Bârzava rivers sector**, in the rivers' floodplains, Timișoara Municipality is at the intersection of **Timiș-Bega Plain** and **Timișoara Plain**. Timiș River springs in Semenic Mountains (Caraș-Severin County) and Bega River springs in Poiana Ruscă Mountains, both rivers crossing Timiș County and going further in Serbia. On their tracks, they collect multiple creeks and torrents, around Lugoj City coming closer to each other and having a common riverbed.

The main **natural risks** identified in Timiș County are floods, drought, thunderstorms, landslides and earthquakes. The map below shows the gradient of natural risks which decreases from east to west, as the medium height of the territory also decreases, from mountainous (Poiana Ruscă Mountains) to plain area (the Pannonian Depression). There can also be seen a series of existing flood prevention infrastructure which serves the main river courses.

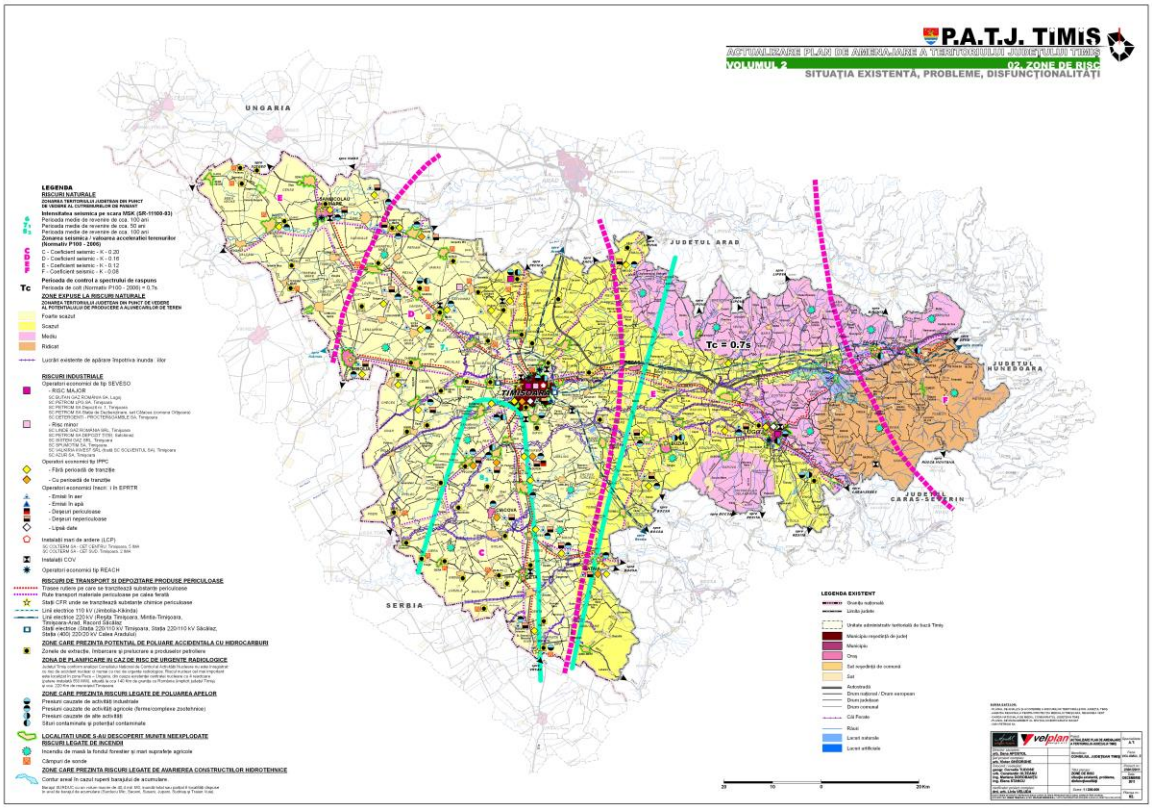


***Figure 29 –*** *Existing situation and Identified Problems*
*Source: Timiș Territorial County Plan*

**Flood risk** has gained greater importance in Timiș County after the 2005 floods when the river flows in Banat region have exceeded the normal quantities. The phenomenon has been analysed, listed and certain causes have been identified: significant quantities of precipitations overlapping snow melting, damage of dams, deforestation, lack of gutters and drain infrastructure in rural areas, defective sewerage systems, housing and other unfit constructions located in floodplain, inadequate emergency situation practices.


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**Flash flood risk is minimum in the central sector and downstream of Bega** due to flood mitigation interventions like construction of dams, regularizations (in Timișoara, for example) and connection channels with Timiș River which not only prevent floods, but also have a role in irrigations and water supply. However, the spring sector of the river is constantly supplied with additonal water flow by the creeks that come from the high hills slopes on the right bank, especially at the end of winter, when snow melts. This phenomenon has caused the great floods that took place in 2005 in the area, as the configuration of the upstream sector, with high slopes on the right bank of Bega River, represents a **flood risk for the territory on the left bank**. The high speed of adjacent water streams also generates an **erosion phenomenon** that deeply affects the river banks. Flood risk is also high in the central sector of Timiș River, west from Timișoara, hence the flattening of the terrain, sedimentation processes and eutrophication of the river.

The Territorial County Plan suggests three kinds of approaches in flood mitigation measures: prevention measures, operational measures and restoration measures.

Proposed **prevention measures**:

- Prohibition of building practices in flood risk areas;
- Structural measures of bridges and footbridges;
- Identification of flood risk areas and implementation of flood mitigation measures in spatial and urban plans;
- Alarm systems for floods;
- Maintenance of existing flood prevention infrastructure;
- Raising awareness about flood risk and prevention.

Proposed **operational measures**:

- Detection of flooding and flash flooding probabilities;
- Forecast of the flood area and its evolution;
- Warning of authorities and population about flood propagation, duration and intensity;
- Response actions of authorities and population;
- Resource supply (material, economic and human) at a county level for operational interventions.

Proposed **restoration measures**:

- Re-enabling of damaged utilities infrastructure;
- Restoration of roads and other transport infrastructure;
- Restoration of social centers and population support;
- Report of the flood.

Moreover, the **National Flood Management Strategy** includes two types of measures, structural and non-structural. Structural measures refer to hydrotechnical flood defense infrastructure as permanent reservoirs, non-permanent reservoirs, dams, regularization and rehabilitation of water courses. The non-structural ones are soft measures, focused on prevention and legal framework:

- Development of warning and forecast informational systems;
- Rules and regulations for the exploitation of reservoirs;
- Management of flood risk areas through: zoning of the riverbed, development of flood risk maps, restrictions regarding building in floodplain and planning of floodplain land;
- Development of a legal framework for all scale institutions (local, basinal, regional and national) in order to set responsibilities;
- Development or update of flood management plans, flash flood scenarios and cooperation systems;
- Raising awareness activities for decision makers;

- Development of suitable economic tools for post-flood restoration.

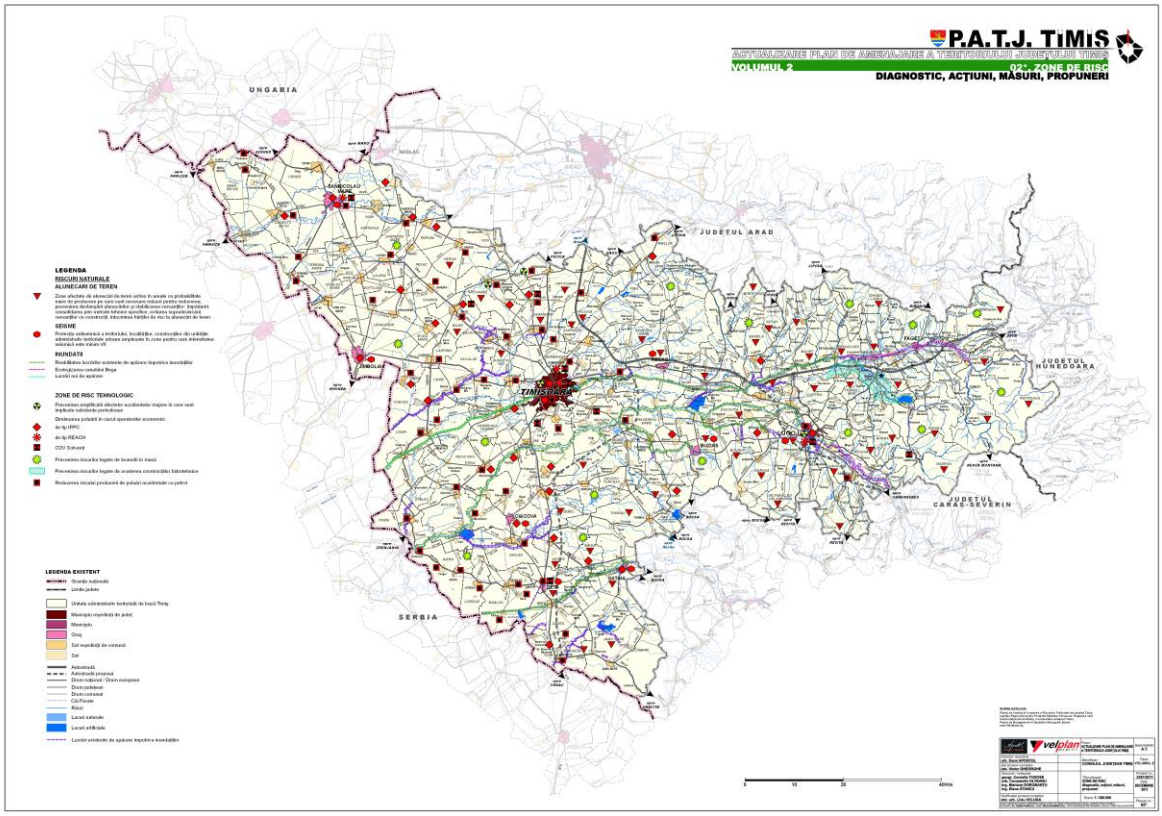


***Figure 30** – Diagnosis and Proposed Measures*
*Source: Timiș Territorial County Plan*

Timiș County has a **medium risk of drought** because of the vegetation type (steppe) that covers 50% of the territory.

**Thunderstorms** are a common phenomenon in the county during summer and spring, with sudden intensification of precipitation and wind. This type of weather can threaten constructions and human lives 61ndust additional manifestations as thunders and hail.

**Landslide risk** ranges from low to medium in Timiș County because of the flat geography of the area. The western part of the territory, in the area of Poiana Ruscă Mountains, is exposed to a higher landslide risk than in the rest of the county.

Timiș County is the second most active area regarding **seismicity**, after Vrancea area. There are four seismic sectors in the county: Banloc-Timișoara-Jimbolia, Băile Herculane-Orșova, Arad-Mașloc-Sânnicolau Mare and Moldova Nouă-Oravița. Timișoara is part of an area prone to earthquakes that can reach **7 degrees on Mercalli scale**. Earthquakes in the area are small-depth (5-15 km), with few preshocks and high numbers of aftershocks.

### B.3.1.3. Integrated Development Strategy of Timișoara Growth Center 2015-2020[59]

Following Timiș County's strategy, the integrated development follows **five strategic goals**: growing economic competitiveness and innovation capacity, development of mobility and accessibility through

[59] Strategia de Dezvoltare Integrată a Polului de Creștere Timișoara 2015-2020



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intelligent and integrated management of infrastructure, intercultural and cohesive social environment, ecological and attractive habitat, inclusive and transparent administration.

The Strategy makes a diagnosis of the situation of spatial an urban development in Timișoara and its metropolitan area, recording the need for integrated planning through **inter-administrative cooperation** and a **coherent vision for the growth center**. The proposed priority areas for urban development are Timișoara's center, the historic suburbs and the airport area, between Calea Aradului and Calea Lugojului, as an international and national gateway to the city. Proposed projects do include waterways in and beyond the city, prioritizing the management and image of the water front of Bega Channel.

### B.3.1.4. Timișoara Municipality Green Spaces Development Strategy

The Green Spaces Development Strategy features an Action Plan for Green Spaces Conservation[60] which aims to **create an ecological, confortable and attractive habitat**. Some of the main measures regarding green spaces which have been proposed through the Plan are:

- Maintenance and good management of existing green areas;
- Rehabilitation of public urban infrastructure on the banks of Bega Channel through remodelling of the parks located on the banks of the river;
- Thorough regulation of land use in green areas located in Timișoara regulated built area and in its outskirts;
- Remodelling and modernization of several urban parks (Rozelor, Justiției, Alpinet, Grădina Botanică Timișoara);
- Extension of green spaces area, especially on degraded and abandoned properties;
- Development of green curtains and street plantations for aesthetic reasons and most of all for air pollution reduction.

The Green Spaces Strategy also proposes new imposed areas of green space depending on land use (i.e., 10% green space in the central area). The requested percentage of green area is determined by a score calculated using different indicators, as it is presented in the below figure:

[60] Ciupa, Cădariu, Nica, Burtic, Carp (2011) Timișoara Municipality Green Spaces Development Strategy, Chapter XI

| No. | Scored elements | Unit | No. of allocated points |
|---|---|---|---|
| **1.** | **Surfaces with vegetation** | | 1 |
| | Lawn, grass lawns | 1 $m^2$ | 10-20 |
| | Existing trees | 1 piece | 10 or 15 |
| | New trees proposed for planting | 1 piece | 5 |
| | Hedge | 1 lm | 5 |
| | Shrubs, including vines and roses | 1 piece (per 1 $m^2$ / shrub) | 2-4 |
| | Flowering plants (perennial, annual, biennial, bulbous) | 1 $m^2$ | 3 |
| **2.** | **Surfaces with water** | 1 $m^2$ | 3 |
| 3. | **Paved surfaces** | | |
| | Asphalt | 1 $m^2$ | -1 |
| | Concrete | 1 $m^2$ | -0,8 |
| | Pavement | 1 $m^2$ | -0,5 |
| | Grassy tiles | 1 $m^2$ | 0,2 |
| **4.** | **Grassy terraces** | 1 $m^2$ | 0,8 |
| **5.** | **Green walls, green facades, green roofs** | 1 $m^2$ | 0,5 |
| 6. | **Flower bowls** | 1 $m^2$ | 0,2 |

***Table 15 –*** *Green space score calculation*
*Source: The Green Spaces Development Strategy*

### B.3.1.5. Timișoara Municipality General Urban Plan (PUG Timișoara)

According to the M*ethodology Guide on the elaboration and the framework content of the General Urban Plan*, approved by Order no. 13N/10.03.1999, the **General Urban Plan is the main tool of operational planning and has a directorial, strategic and regulatory character**. Thus, the purpose of the PUG is:

- establishing the directions, priorities and regulations for spatial planning and urban development of localities;
- ensure the rational and balanced land use, necessary for urban functions;
- areas susceptible to natural hazards will be marked and specified (landslides, floods, geological inhomogeneities, vulnerable existing built-up area);
- to highlight the valuable built-up area and to specify the way of its capitalization for the benefit of the commune;
- to ensure an increase in the quality of life, especially when it comes to housing and services;
- to ensure the basis of the realization of some investments of public utility;
- to ensure the regulatory support for the issuance of town planning certificates and building permits;
- to ensure the correlation of the collective interests with the individual ones in the land use.

Also, the **objectives** pursued by the General Urban Plan are:

- optimizing the relations between the localities and their administrative and county territory;
- capitalizing on the natural, economic and human potential;
- different routes development and organization;
- establishing and delimiting the regulated built-up area;
- establishing and delimiting buildable areas;
- establishing and delimiting areas with a temporary or permanent construction ban;


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- establishing and delimiting the protected areas and their protection zones;
- modernization and development of the water, sewer, electricity, gas and telecommunications networks;
- highlighting the land holdings in the regulated built-up area;
- setting public utility objectives;
- establishing the land use and the conditions of conformity and construction.

After approval in accordance with the existing law, the General Urban Plan becomes an act of authority belonging to the Local Public Administration's authority.

Timișoara is a **first rank city**[61], meaning it has a favorable position in the territory regarding national and European context, along the main transportation axes and it is a center of development and attractivity. According to the Order no. 233/2016 for the approval of the *Methodological Norms for the application of Law no. 350/2001 regarding the spatial planning and urbanism and for the elaboration and updating of urban planning documents*, the required preliminary studies for a first rank settlement are as it follows:

1. Analytical studies:
   - Preliminary Study regarding the updating of the Topographic Support;
   - Preliminary Study regarding geotechnical and Hydrological Preliminary Study;
   - Preliminary Study regarding peri-urban relations;
   - Preliminary Study regarding organization of roads and transport;
   - Preliminary study on Environmental protection, Natural and Anthropogenic risks;
   - Historical preliminary study / Landscape preliminary study;
   - Preliminary study regarding the identification of property types;
   - Preliminary study regarding the utility network;
2. Advisory studies:
   - Preliminary study on stakeholder analysis and social surveys;
3. Prospective studies:
   - Preliminary study regarding the economic activities' evolution;
   - Preliminary study regarding socio-demographic evolution;
   - Preliminary study regarding urban mobility and transport;
   - Preliminary study regarding the impact of climate change;

None of the preliminary studies mentioned above has been provided but the preliminary analysis is included in the written part of the General Urban Plan. Flood risk is analysed in *Chapter II.8. Risk areas* which present the main natural risks Timișoara is exposed to: earthquakes and floods.

Even though there are multiple existing structural measures that have lowered fluvial flood risk in Timișoara, the pluvial flood risk is still high and it is closely connected to **clogging and lack of maintenance of municipal sewerage system**. The fluvial flood risk had been decreased due to the connection between Bega and Timiș rivers, through infrastructure like Coștei and Topolovăț hydrotechnical nodes and Timiș-Bega supply channels: potential overflow on Bega Channel is redirected to Timiș River, in accordance to data provided by Remetea Mare hydrometric station. The flow is also supplied by Behela River which converges with Bega Channel in Crișan neighbourhood in eastern Timișoara. On Behela River there is also a permanent reservoir, Dumbrăvița. Moreover, the channel has a levee network which has a total length of 2,350 m: between Podul Tinereții and Podul

[61] The Law no. 351/2001 for the approval of the National Territorial Plan – Section IV – The localities network





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Traian, on the right bank (350 m), between pedestrian bridge (Gelu Street) and Podul Modoș, on the right bank (800 m) and left bank (1200 m).[62]

In Timișoara's regulated built area, RBA Banat data doesn't identify significant flood risk areas, due to previous channeling of Bega River and other structural flood mitigation measures which adjust the flow. There is a single exception: **flood risk in „Flora Terrace" area**, that is on Bega Channel's right riverbank and **floods that may occur in low-height areas of Timișoara due to heavy and long-drawn storms which would overlap spontaneous melting snows**.

Proposed measures for flood mitigation concern the rehabilitation of existing infrastructure and construction of new infrastructure. Banat Water Agency is responsible for the two proposed projects of flood infrastructure rehabilitation: **„Securing Coștei hydrotechnical node"** and **„Securing Sânmihaiu Român hydrotechnical node"**. There are also proposed measures for flood mitigation in peripheral neighborhoods of Timișoara which are located in the floodplain of smaller rivers but where flood risk is significant. **Behela River**'s riverbed has been rectified and **Giarmata and Dumbrăvița dams** have been built. Following the same approach, **Subuleasa Stream**'s track has been rectified, for flood mitigation in the south-eastern industrial area (Calea Buziașului).

Regarding green infrastructure in Timișoara, the General Urban Plan and the Green Spaces Strategy[63] include a series of proposed measures which aim to increase and rehabilitate green areas in order to improve air and water quality, image of public space and which can also diminish flood risk. The measures are located on the entire territory of the city but mainly along the watercourse system and on connection corridors between residential and leisure areas. The most significant general measures which are also relevant for flood mitigation are as it follows[64]:

- Maintenance, protection and revitalization of existing green areas;
- Inventory of unbuilt properties and their owners in order to ask them to fence and sanitize them;
- Inventory of public domain terrains in order to create green spaces and curtains;
- Identifying and implementation of economic mechanisms to encourage legal and independent owners to create and manage green areas, forestry and other kinds of plantations.

[62] PUG Timișoara, p. II-45
[63] Ciupa, Cădariu, Nica, Burtic, Carp (2011) Timișoara Municipality Green Spaces Development Strategy
[64] PUG Timișoara, p. III-97


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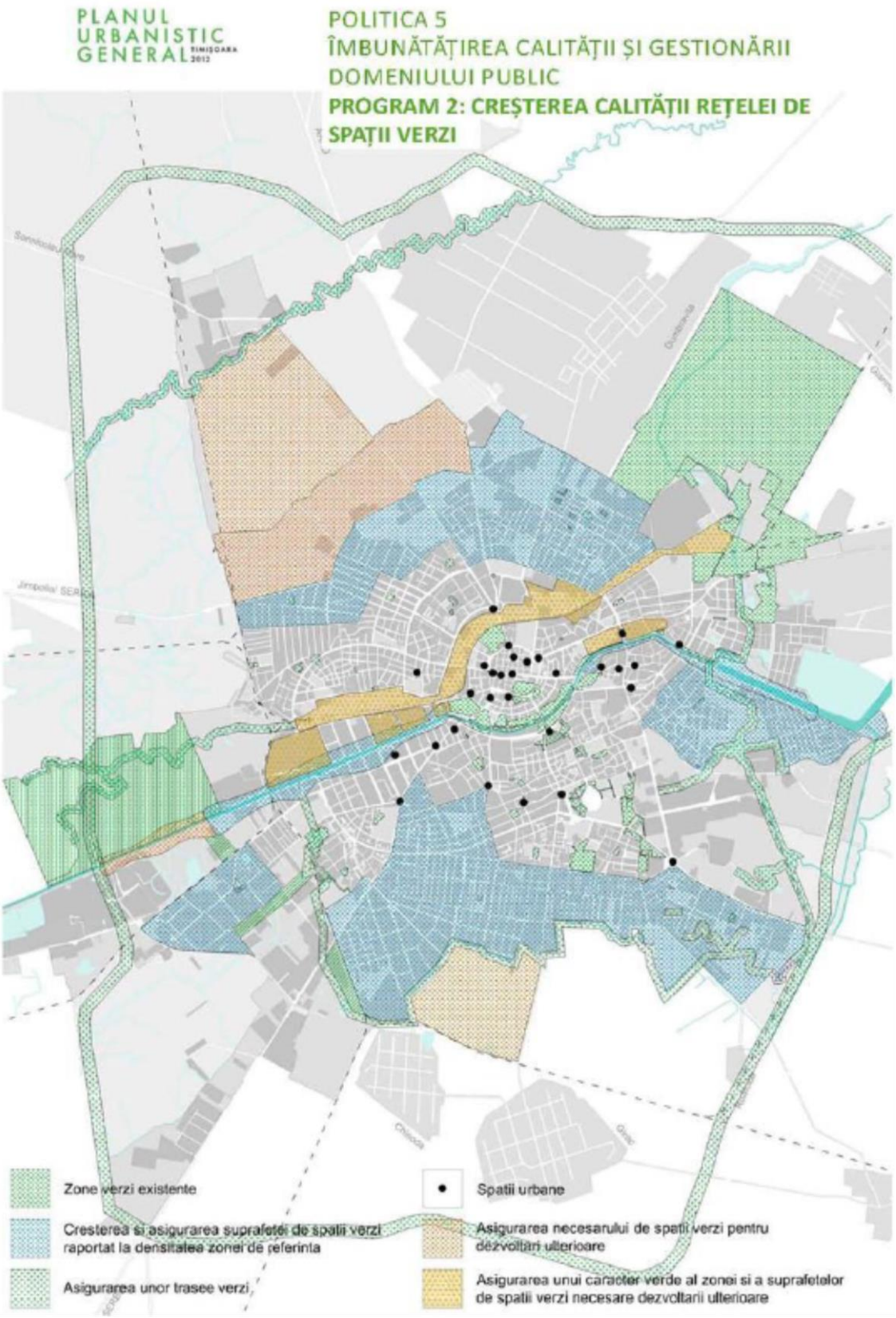


***Figure 31 –*** *Improvement of quality and management of public domain: Increasing the quality of green spaces network*

*Source: Timișoara General Urban Plan*



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Analyzing in parallel the General Urban Plan's provisions map, the improvement of quality and management of public domain: increasing the quality of green space network map and the flood hazard and risk map of Timișoara Municipality, it is observed that the General Urban Plan's provisions map proposes afforestation in flood risk zones and to arrange several green areas protection and ecological corridors among the river banks which can also play a role in flood protection.

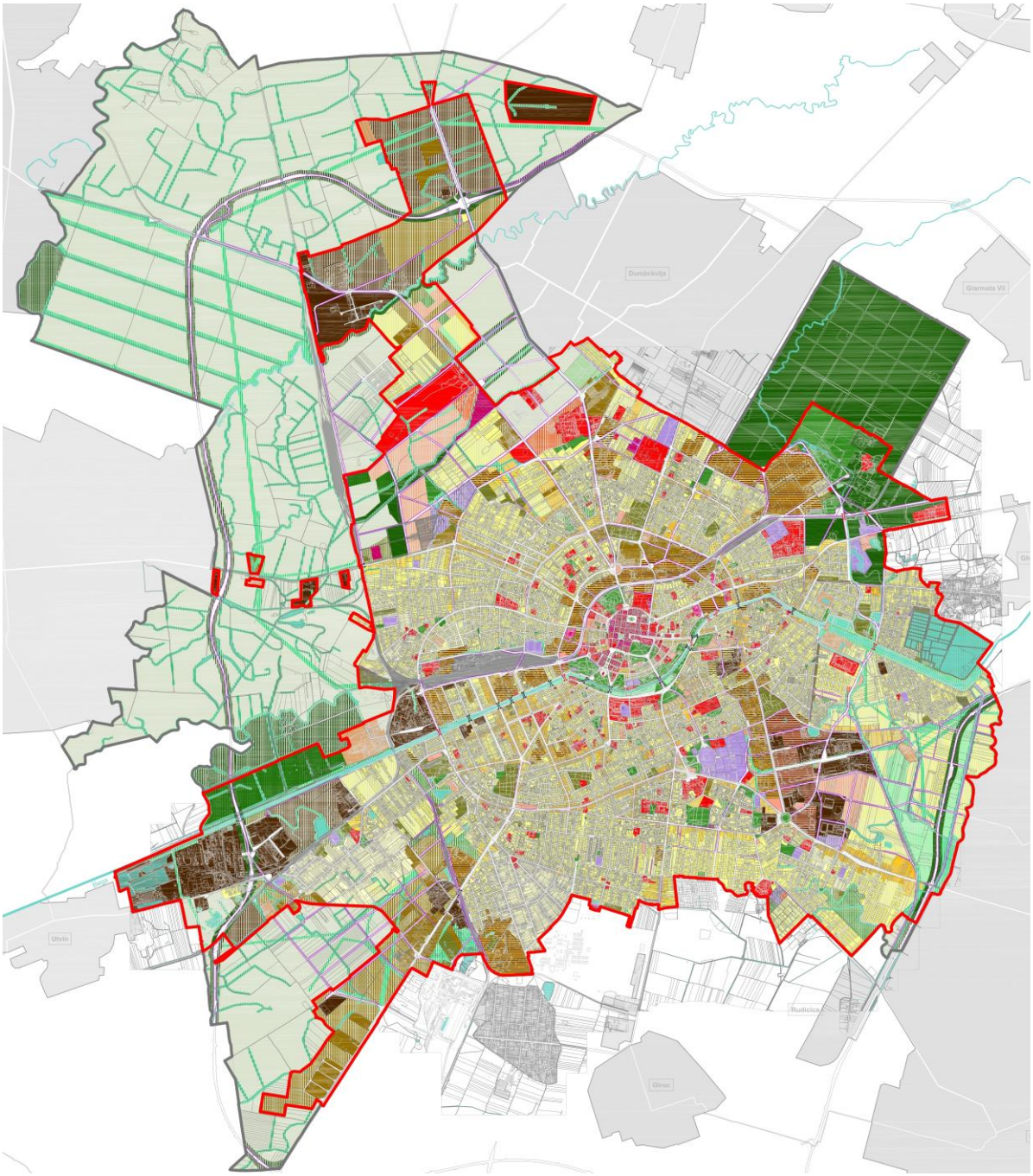

***Figure 32** – The General Urban Plan's provisions*
*Source: Timișoara General Urban Plan*

In the case of the Timișoara Municipality, the action plan related to the PUG was made available, but among the listed projects there are no proposals for flood prevention or protection.



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### B.3.1.6. Conclusions

The territorial and urban spatial development plans, regardless the scale, are correlated and derive from one another. In the floods matter, the Timiș County Plan focuses more on the mountainous area of the county, where flood risk is significant due to degraded or absent hydrotechnical infrastructure. As the scale grows larger, approaching the urban level, fluvial **floods become less important** because of the lower flood risk that the urban area is exposed to. But the pluvial risk become more important due to the past pluvial floods events that occurred in the city. Even if this risk is not expressed very clear in the local planning documents, there are some dedicated measures to reduce the effects of intensive rainfalls events.

In Timișoara Municipality, Bega Channel has been regularized beginning with the 18$^{th}$ century, with successive measures like drainage of the moorland, construction of the channel, two hydrotechnical points outside of the city, in Coștei and Topolovăț and also two dams, Giarmata and Dumbrăvița.

#### Main gaps

There are numerous documents which approach territorial and urban planning of Timișoara Municipality and the adjacent territory. They are correlated when it comes to flood risk approach because they present general problems and measures. However, regarding site-specific measures, they are either absent, either not correlated between the different scales. The correlation cannot be done in the existing procedure context: **the development and approval of these documents require long periods of time**. A relevant example is Timișoara Municipality PUG which started 10 years ago but it has not yet been approved, facing the risk of becoming outdated in comparison with the present local context and site data.

Local development plans only address fluvial flood risk from a local and structural perspective, not taking into consideration the broader scale of the territory. For example, Timiș Territorial County Plan includes measures for the spring area of Bega Channel, but it does not address the rest of the catchment area. **Neither territorial or urban development plans have a multi-scale approach**, discussing either the local- or the large-scale hydrography and flood risk. Flood risk is mentioned in large-scale territorial documentations like Timiș County Territorial Plan or Timiș County Economic and Social Development Strategy 2021-2027, mainly including structural measures. However, at a **metropolitan level, flood risk and flood mitigation are not discussed**, neither the territorial flood risk.

Even though Timișoara's central area is not exposed to significant fluvial flood risk, due to the existing infrastructure, the peripheral eastern neighborhoods are part of medium risk area and both banks of Bega Channel in the historical center are exposed to highly-occurring floods. These areas are **not mapped in any urban or territorial spatial plans of Timișoara or Timiș County** and there are no proposals for fluvial flood mitigation in Timișoara. Fluvial flood risk in Timișoara is also generated by the presence of **smaller rivers located in the proximity of the city**, which are part of the catchment area, but which are **not analysed in any documentation**.

Of greater importance in Timișoara Municipality is the **pluvial flood risk which is not addressed in any of the multiple existing territorial and urban spatial or strategic plans**. Compared to fluvial flood risk, pluvial flood risk in Timișoara has not yet been reduced through any type of proposed measure. Small-scale, urban development plans like the PUG only present minimal information on flood risk. The analysed documentation **does not include very specific sustainable or green measures for flood mitigation, only general approaches.**

### Lessons learned

Timișoara PUG identifies a series of flood risk areas in central Timișoara, on the banks of Bega Channel. The written part of the documentation should be site-specific, being correlated with the spatialization part, by mapping these areas. The lack of spatialization also applies to territorial and urban spatial development plans (Urban Development Integrated Strategy 2015-2023, Asociația de Dezvoltare Intercomunitară „Polul de Creștere Timișoara", Timișoara Municipality PUG) where **flood risk areas and flood mitigation measures should be integrated in the drawn pieces of the documentation**, for further localization and thorough mapping.

There are multiple territorial and urban spatial plans which address the development of Timișoara area and they should integrate flood risk of all types (fluvial, pluvial, groundwater etc.) by analyzing, mapping it and proposing mitigation measures both in written and spatial parts of documentations. The **multi-scale correlation** of the documentations is necessary in order to have an integrated approach: floods are not only a local problem, but also a basinal issue. At all territorial scales, existing flood management infrastructure should be rehabilitated and adapted to sustainable and nature-based solutions, by synchronizing large-scale to urban-scale interventions. Flood mitigation measures in the urban areas should be **site-specific**, creating a balance between the needs of the inhabitants and a risk-resilient city.

Flood risk on Bega Channel and in Timișoara can be improved by developing existing green infrastructure located on both banks and by going further to analyzing small rivers in the area (Behela, Beregsău Rivers). Spatial data is also necessary and it should be integrated in spatial development plans, at all territory scales.

## B.3.2. Spatial and urban planning plans elaboration, approval and enforcement

The following chapter is based on interviews conducted with the local institutional stakeholders: **Timișoara Municipality**, **Banat Regional Basin Administration** (RBA Banat) and **Inspectorate for Emergency Situations** (IGSU Timiș). The interviews took place through meetings and questionnaires sent by e-mails.

### Main gaps

#### *The municipalities meeting*

The meeting with **Timișoara Municipality** took place on 24$^{th}$ of November 2021 (24.11.2021) and it included 3 main subjects: historical floods, General Urban Plan's status and integration of flood hazard prevention in future planning practices.

**Main gaps regarding local flood risk**

Timișoara is exposed to pluvial flood risk generated by intensive rain events and melting snows. The risk is generated by degraded irrigation channels for agriculture use but the current state of the infrastructure is not assessed in a report or any kind of documentation. The lack of data is caused by multiple ownership of the channels – some are owned by Timișoara Municipality, while others are owned by ANIF. The institutions do not share an integrated management of the infrastructure. The land ownership is not clear and investors are taking advantage on this uncertain situation.

**Main gaps regarding spatial and urban planning**

The Timișoara PUG in force is the one developed in 2002 and it is outdated. An updated version has been in progress for the last 10 years and it recently entered the final phase of approval. The development of the PUG is encountering challenges as: lack of available data, conflicts regarding land ownership and land use in private-owned land, lack of integrated approach

in planning practices, lack of legal framework, outdating of strategies (e.g., Timișoara Green Areas Strategy) and plans due to long period of PUG approval procedure.

The absence of an updated PUG generated the need for derogatory Urban Zoning Plans (PUZ) which can respond to fast and dynamic urban change but do not follow a coherent vision of city development. The approval steps of these documentations are not centralized through laws, so there is no standard protocol to be followed by urban planners. The PUG cannot follow the pace of the PUZ dynamics in order to integrate or assess them in the complete plan.

**Main gaps regarding the integration of flood hazard and risk maps and flood risk management measures to reduce the flood risk into spatial and urban planning**

There are no spatial plans regarding flood risk management in Timișoara, nor any integrated plan or strategy for the metropolitan or river basin area. There is still reluctance from the municipality to non-structural measures and their implications (compensatory measures).

The PUG does not feature flood mitigation measures for building design. Regarding draining channels and other municipal infrastructure, the developers of the PUG are encountering obstacles in the approval of blue-green infrastructure measures by central institutions like Environmental Protection Agency or Water Company.

### *National Romanian Waters and Rivers Basin Administrations meeting*

The meeting with the three River Basin Administrations involved in the project (Argeș-Vedea, Banat and Siret River Basin Administrations) took place on 9th of February 2022 (09.02.2022). The meeting featured three topics: spatial and urban planning in the absence of risk maps and flood studies, integration of FRM (flood risk management), RBM (river basinal management) and environmental aspects in spatial and urban planning and interinstitutional cooperation. The fourth topic, permits and authorizations, was not discussed in the meeting due to the lack of time, but RBAs responded by e-mail to several questions related to this topic.

**This Section, *SECTION B: Timișoara city pilot area, Timiș County* is presenting the main gaps and lessons learned revealed from the meeting with all the 3 RBA (Argeș-Vedea, Banat and Siret River Basin Administrations) for the three topics mentioned above: spatial and urban planning in the absence of risk maps and flood studies, integration of FRM (flood risk management), RBM (river basinal management) and environmental aspects in spatial and urban planning and interinstitutional cooperation.**

**Main gaps regarding spatial and urban planning for all the 3 catchment areas: Argeș-Vedea, Banat and Siret**

First of all, the main problem identified is regarding the flood studies and their developers and their process of PUGs integration. During the PUGs approval phase, a flood study is requested for all the watercourses within the locality although this study is not included in the spatial and urban planning legal framework. Also, for PUG's approval, a water management documentation is drafted according to the framework content which is approved only by the order of the Minister of Environment, Waters and Forests and not by the Ministry of Development, Public Works and Administration. This documentation is different from the spatial planning documentation and only some parts of the PUG's documentation are included in the water management documentation.

Another gap regarding these studies is that they are done in the same way all over the country, for all uses – PUG, bridge, other use, containing the flows at various calculation probabilities, the corresponding levels, the depths of flow, technical data that allowing beneficiaries and specialists to see if the investment meets the requirements from the point of view of floods. This is a condition for

obtaining the Water Management permit. In addition, the flood studies do not give specific or detailed measures, only technical data regarding the flood issue.

The non-correlation specified in the Strategy approved by GD 846/2010 between the STAS 4273/1983 and the perspective of defense against floods and the perspective of development led to contradictions between RBAs and engineers. Thus, RBAs do not allow buildings to be developed in certain areas, although they could be built according to the provisions of STAS. But in National Administration Romanian Waters – Technical Economic Committee's meetings regarding the promotion of the National Flood Risk Management Strategy on medium and long term, approved by GD 846/2010, these provisions of the strategy prevail and the importance classes from STAS 4273/1983 remained only indicative. An update of the Romanian standards of design was tried a few years ago a couple of times but it was concluded that the standards are not mandatory so the process was interrupted. The standards represent now an assurance to the engineer and investor that the quality in constructions from Law 10 is respected.

In addition to all these, in the feasibility studies, for regularization works, dikes, etc. are used both calculation and verification flows, although the second ones must be used only for dams, and whilst hydraulic models are no recommended for the flood study, every company prepare this in his own way.

**Main gaps regarding the integration of flood hazard and risk maps and flood risk management measures to reduce the flood risk into spatial and urban planning for all the 3 catchment areas: Argeș-Vedea, Banat and Siret**

Regarding the integration of flood risk management measures in the PUG, only the general ones are taken over, specific measures not being included/proposed unless the water authority has a project already promoted that can be carried out up to a certain term. There are urban planners who do not have enough information or specialization necessary to propose flood risk management measures. Urban planners have the legal obligation to include these measures, but they only discuss these measures, they do not propose such measures and do not propose investments to reduce the risk of floods.

Cycle 1 maps problem (they addressed only the flood risk from the river, although all flood risks must be discussed before starting the PUG) will be resolved partially by the Cycle 2 maps by analyzing also the flood risk from the heavy precipitations (will still remain unanalyzed other types of flood risks). Also, for small non-cadastral torrents, small non-cadastral watercourses flood studies must be made. Engineers and urban planners collaborate with the RBAs asking about them before the beginning of the PUG. This reflects a good and intense collaboration between the two parts. The only pressure is that many times the mayors want to build at any cost in the floodplain.

The PUG's action plan is not discussed with the RBAs (not being the subject of the approval), but it must include the elements that the RBAs consider necessary through the specialized studies: dams, dikes, other measures for the management of floods.

**Main gaps regarding the interinstitutional cooperation for all the 3 catchment areas: Argeș-Vedea, Banat and Siret**

Major infrastructure projects are usually addressing mainly to the principal purpose of the project and are not integrating flood risk management measures (i.e.: the highways projects).

### *County Inspectorate for Emergency Situations meeting*

The **County Inspectorate for Emergency Situations** (**IGSU Timiș**) was interviewed through an official address on 17th of February 2022 (17.02.2022). The interview included 4 questions regarding integration of flood risk mitigation in emergency situations plans.

**Main gaps regarding integration of flood hazard and risk maps and flood risk management measures to reduce the flood risk into spatial and urban planning**

Integration of flood hazard and risk management measures is done by including the Flood Defense Plan and the risk maps in the PUG. The plan must be developed by each local administration and then approved by emergency-specialized central institutions. According to IGSU Timiș, the content of the Flood Defense Plan is integrated in the PUG through GIS plans, risk receptors map, blue corridors for flood mitigation, sewer system and pumping stations map.

The risk areas are not provided by the IGSU Timiș, nor any other data regarding critical infrastructure like evacuation roads, evacuation areas or meeting points. These liabilities are not featured in the current laws.

**Main gaps regarding interinstitutional cooperation**

IGSU Timiș does not have the authority to verify the content of the PUGs in order to assure the coherence of emergency strategies throughout the county.

**Main gaps regarding permits and authorizations**

The Flood Defense Plan is developed by each municipality or commune and it has to be verified and approved by Timiș Water Management System representative, then by IGSU Timiș and the president of Emergency Situations Committee (Prefect of Timiș County). However, the integration of the plan in the PUG is not later verified by the IGSU.

## Lessons learned

### *The municipalities meeting*

**Lessons learned regarding local flood risk**

Flood risk can be approached by small-scale measures as rehabilitation of deteriorated infrastructure (e.g., drainage channels located in the agricultural area) and green infrastructure systems to collect pluvial water before it arrives in ground ponds.

**Lessons learned regarding spatial and urban planning**

In the absence of other integrated planning instruments like the PUG, other in force strategic documents should be used for flood risk management – a good example is Timișoara Green Areas Strategy. The PUG can be funded from both national and local budget.

**Lessons learned regarding integration of flood hazard and risk maps and flood risk management measures to reduce the flood risk into spatial and urban planning**

Flood risk management integration in spatial and urban planning should be done through the development of a green infrastructure system. Flood mitigation can be based on nature-friendly solutions and should be included in territorial and urban planning practices and plans. Good examples of nature-based measures for reducing flood risk are: green corridors, blue-green grids in the city, minimum percentage of permeable and planted area per plot and diversification of plant species in the city.

Integration of flood risk management should be done at a big scale, through territorial plans and strategies, correlating them with urban and local plans and detailed spatial plans through specific measures.

*National Romanian Waters and Rivers Basin Administrations meeting*

**Lessons learned regarding spatial and urban planning for all the 3 catchment areas: Argeș-Vedea, Banat and Siret**

It is not necessary to have a procedure of quality check of the flood studies based on hydraulic models because of the already too many existing procedures which delay by months the certain studies. Certified developers know the content of a flood study; they show the flows, levels and floodable areas in certain critical sections of the rivers. It is recommended not to build in flood risk area. However, if important objectives are proposed, measures to protect these objectives from flood risk should be adopted.

The results of the flood studies should be included in the spatial and urban planning plans in two ways: as interdictions and permissions and measures into the Action Plan. In order to build in an urban area, historically developed in the floodplain, different studies/chapters in the Flood Study will be made for each objective. There are areas where there are older buildings, among which are spaces for urban development. In this case, it is not possible to ban construction between existing constructions. The solution is to do defense works, in order to remove the entire area from flooding. Where there are floodable areas without constructions, and are proposed by the mayors for development, the municipality must be advised not to build in these areas.

**Lessons learned regarding integration of flood hazard and risk maps and flood risk management measures to reduce the flood risk into spatial and urban planning for all the 3 catchment areas: Argeș-Vedea, Banat and Siret**

There are hazard and risk maps for most of the large rivers, but there are still small rivers and other types of flood risks not studied in these maps. Therefore, flood studies can identify floodplains from other sources and can propose measures to reduce all types of flood risk. There are at least 2 types of important floods: one is the flooding from rivers and another is the source of flooding from the rainwater source, because the sewerage network is insufficient or there are not enough green measures, including changing the destination of the land, etc., for a better management of the rainwater

Regardless the nature of the investment, whether it is a proposed construction or a territorial or urban plan, flood risk studies should be site-specific and integrated in the river basin's flood risk plan. Formal studies and uniformization of flood risk approach is an impediment in the coherent regional and urban development.

**Lessons learned regarding the interinstitutional cooperation**

Within the RBAs, there is good communication and RBA Banat cooperates with other local administrations in the county. The dialogue between the RBA and local administrations is constant and the involvement in flood risk management is carried according to the current laws. The RBA should provide technical flood risk data and counseling for both the urban planners and municipalities in order to do planning in an integrated manner and to mitigate flood risk.

*County Inspectorate for Emergency Situations meeting*

**Lessons learned regarding integration of flood hazard and risk maps and flood risk management measures to reduce the flood risk into spatial and urban planning**

It should be part of IGSU's responsibility to provide data regarding flood risk areas, emergency areas, emergency routes and Fast Intervention Centers to urban planners and municipalities. Flood Defense Plans should follow common guidelines issued by the IGSU Timiș in order to have a coherent emergency strategy at both territorial and urban scale.

**Lessons learned regarding interinstitutional cooperation**

The County Inspectorate for Emergency Situations should work in cooperation with other institutions concerned with water management and hazard. Moreover, there should be permanent communication between IGSU, the local administration and the urban planners who develop the PUG in order to obtain coherent territorial and urban development for Timiș County and Timișoara Municipality.



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# SECTION C: Pitești city pilot area, Argeș County

## C.1. General description

### C.1.1. Territorial context

Pitești Municipality is located in Argeș County, along the Argeș River and the European Road E81 (on the Sibiu-Constanța route). The territory of the city borders:

- in North and North-West with Mărăcineni, Budeasa and Bascov Communes;
- in West with Babana and Moșoaia Communes;
- in South with Albota and Bradu Commune;
- in East with Ștefănești City.

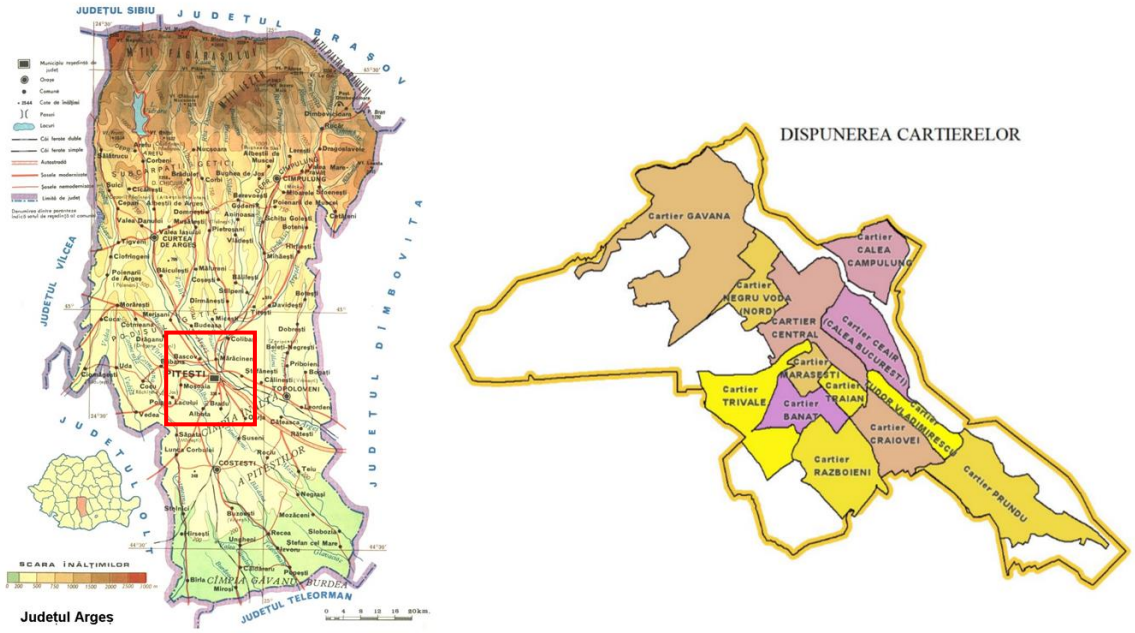


***Figure 33 –*** *Location in Argeș County (left). The component neighborhoods of Pitești Municipality (right)*

*Source: Harta Județului Argeș [online]. Available at: https://pe-harta.ro/arges/ (Accessed: 01.04.2022) (left), Pitești General Urban Plan – in progress (right)*

The administrative territory of the city includes 13 neighborhoods. Due to the fact that Pitești is the capital of Argeș County, it has an increased accessibility comparing to the rest of the territory and many road connections with other important cities of the country. The main roads that serve Pitești city are:

- highway A1 (E81), which connects Sibiu and Bucharest Municipalities;
- national road DN7, which connects Bucharest Municipality and Nădlac City;
- national road DN7C, which connects Pitești Municipality and Cârțișoara Commune;
- national road DN73, which connects Pitești and Brașov Municipalities;
- national road DN65, which connects Pitești and Craiova Municipalities;
- national road DN65A, which connects Pitești and Turnu Măgurele Municipalities;
- national road DN67B, which connects Pitești and Târgu Jiu Municipalities;
- county road DJ659, which connects Pitești Municipality and Dâmbovița County;
- county road DJ703E, which connects Pitești Municipality and western area of the Argeș County;
- county road DJ741, which connects Pitești Municipality and Mioveni City;



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- communal roads DC155, DC154, DC154A, DC156, DC156A, DC161, DC162, DC163, DC163A, DC165, DC173, DC173A, DC177, DC179, DC210, DC211, Dc211A, DC212, DC212A, DC212B, DC214, DC219A, DC220, DC223, DC276, DC75, DC76, DC77, DC78, DC79, DC81, DC82, DC85.

The high number of roads that cross Pitești Municipality prove its importance in the connectivity network of the country. Pitești Municipality was one of the first cities to be connected with the capital, Bucharest, by rail, in the 19th Century and through a highway in the 20th Century.

In a European context, European road E81 (A1 highway) and Pitești Municipality are part of the Rhine-Danube Core Network Corridor (TEN-T) which links Central and South-Eastern Europe. The railway that crosses Pitești (Arad-Sibiu-Brașov-Pitești-București) is also part of the rail network of the same European corridor.

The relations of the Municipality in the territory are:

- with other cities and communes in the peri-urban area of Pitești, through the existing roads and railway;
- with other important municipalities through roads and rail, for the following purposes: commuting for work and education, transportation of consumer goods, marketing of agri-food products.

### C.1.2. Geographical description

Pitești Municipality is located on the right bank of Argeș River, at the intersection of the Getic Plateau and the Romanian Plain. The terrain of the city is made of hills that rise from the river meadow to the west in terrace steps. The Argeș riverside has widths that vary up to 1 m on both sides, with asymmetric development (the left side has a bigger extension than the right side).

The hydrographic network of Pitești Municipality is comprised of Argeș River, Râul Doamnei River (which represents a natural border between Pitești Municipality and Ștefănești City), Bascov Stream (which represents a natural border between Pitești Municipality and Bascov Commune), Valea Rea Stream, Trivale Stream, Geamăna Mică Stream, Geamăna Mare Stream, Prundu Lake (which is a concrete dam that has the role of protection against floods, water suppliance for industrial platforms and irrigation systems, belonging to ANAR-RBA Argeş-Vedea, is also part of the city's public water system delivering).

Lithology varies over limited areas and consists of Quaternary alluvial deposits with cross-stratification characteristic of fluvial systems. The lower and medium terraces are generally stable and only limited areas are affected by floods in the periods of excessive rainfall and by bankside erosion due to the torrential nature of the watercourses in the area.

Pitești territory is at low **landslide risk**, the areas where this risk is increased are the ones with steep slope, the ones adjacent to Argeș River, to Râul Doamnei River and to Bascov Stream.

Pitești territory is not exposed to great pluvial flood risk, but the highest flood risk is triggered by intensive rainfall in short time, and by the overlapping Pitești territory with fluvial floods, which is complemented by the high technological flood risk, because it is situated downstream of big reservoirs.

The entire Pitești Municipality territory has an area of 4094,32 ha, with 2725 ha regulated built area (66,55% of the total area). The city is divided in 13 neighborhoods of which 12 are on the right side of Argeș River and one on the left side. The neighborhoods are located in different geographical areas, as it follows:


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- on the meadow terrace, next to the Argeș River: neighborhoods Calea București, Calea Câmpulung, Tudor Vladimirescu and Prundu;
- on the first terrace of the river: neighborhoods Negru Vodu and Centru;
- on the second terrace of the river: neighborhoods Găvana, Mărășești, Traian, Banatului and Craiovei;
- on the third terrace of the river: neighborhoods Trivale and Războieni.

### C.1.3. Demographic data

According to the National Institute of Statistics, Pitești Municipality had 171.190 inhabitants on January 1, 2021[65].

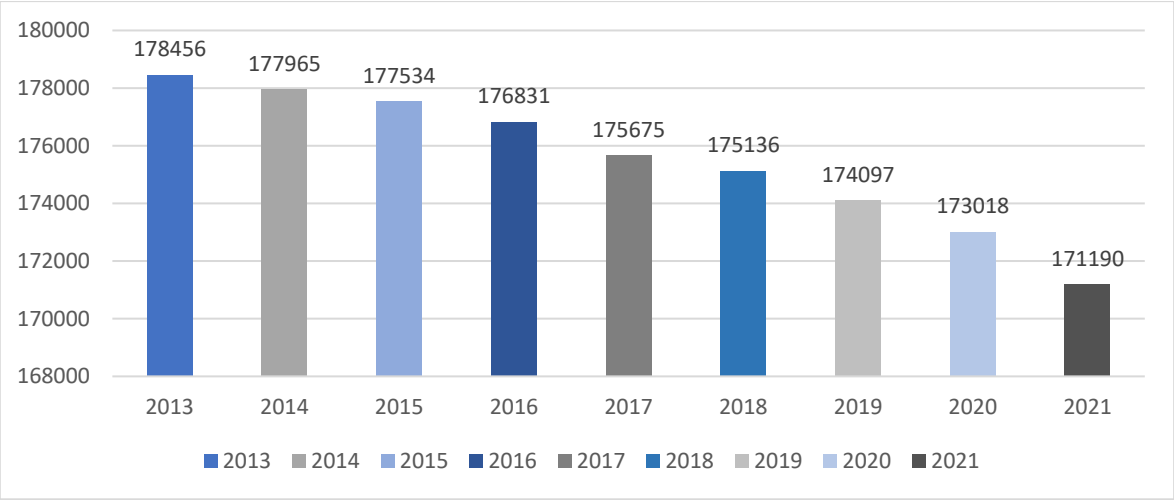


***Figure 34 –*** *The evolution of inhabitants number between 2014-2021 – at the level of the entire Municipality*

*Source: National Institute of Statistics [online]. Available at: https://insse.ro/cms/ (Accessed: 02.04.2022)*

As it can be seen from the previous graphs, in the period 2013-2021 the number of inhabitants in Pitești dropped from 178,456 to 171,190 persons. This decline in population was caused by the large number of people who moved to the metropolitan area of the municipality, where they built their houses, but also by thousands of people who moved to Bucharest due to job changes.

[65] National Institute of Statistics, *POP108D – Populația după domiciliu la 1 iulie pe grupe de vârstă, sexe, județe și localități* [online]. Available at: https://insse.ro/cms/ (Accessed: 1.04.2022)



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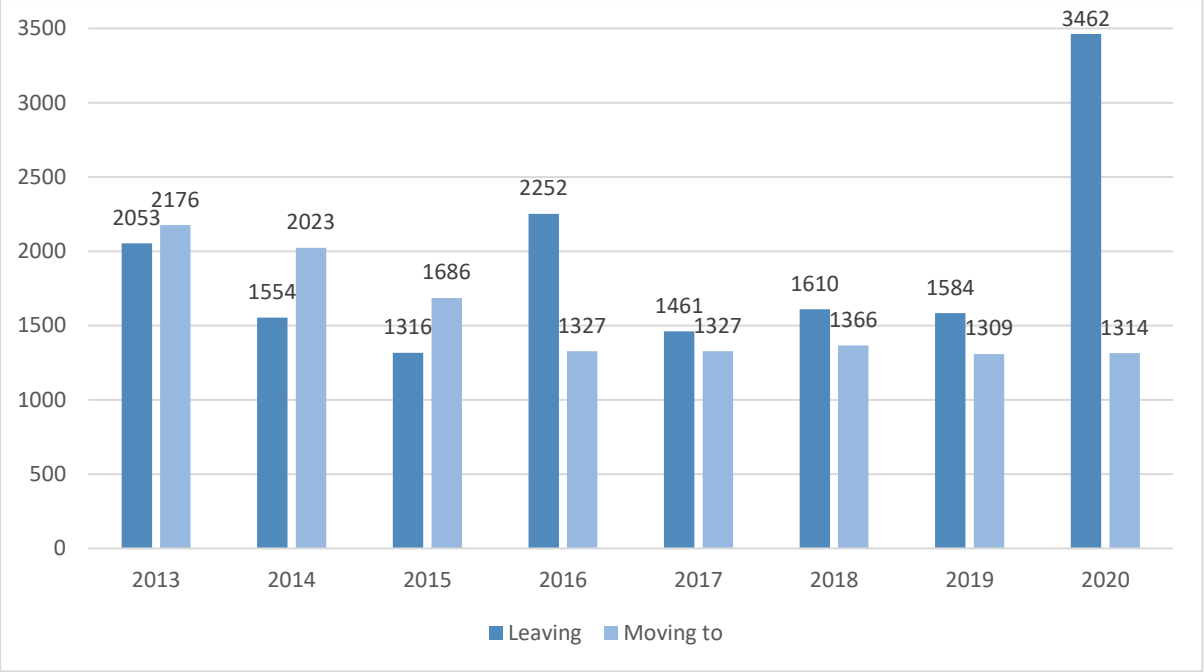


***Figure 35** – The evolution of residents leaving and people moving to Pitești between 2013-2020*
*Source: National Institute of Statistics [online]. Available at: https://insse.ro/cms/ (Accessed: 02.04.2022)*

The previous graph shows how the number of departures from home decreased from 2013 to 2015, until 2016 followed an increase in this number, then stagnated until 2020 when there was a large increase in this number, from 1,584 to 3,462 people who left the city of Pitești in 2019, respectively in 2020.

Regarding the age groups and structure of the local population[66], most of the residents are aged between 30 and 54 years old, while the number of younger people (under 30 years old) is bigger than the number of elders (between 75 and 85 years old and over).

The analysis of the 2011-2021 period shows that there is a slight increase in the number of births between 2011 and 2017 and then, a decrease in the number of births from 2017 to 2020.

[66] National Institute of Statistics, *POP108D – Populația după domiciliu la 1 iulie pe grupe de vârstă și vârste, sexe, județe și localități* [online]. Available at: https://insse.ro/cms/ (Accessed: 02.04.2022)



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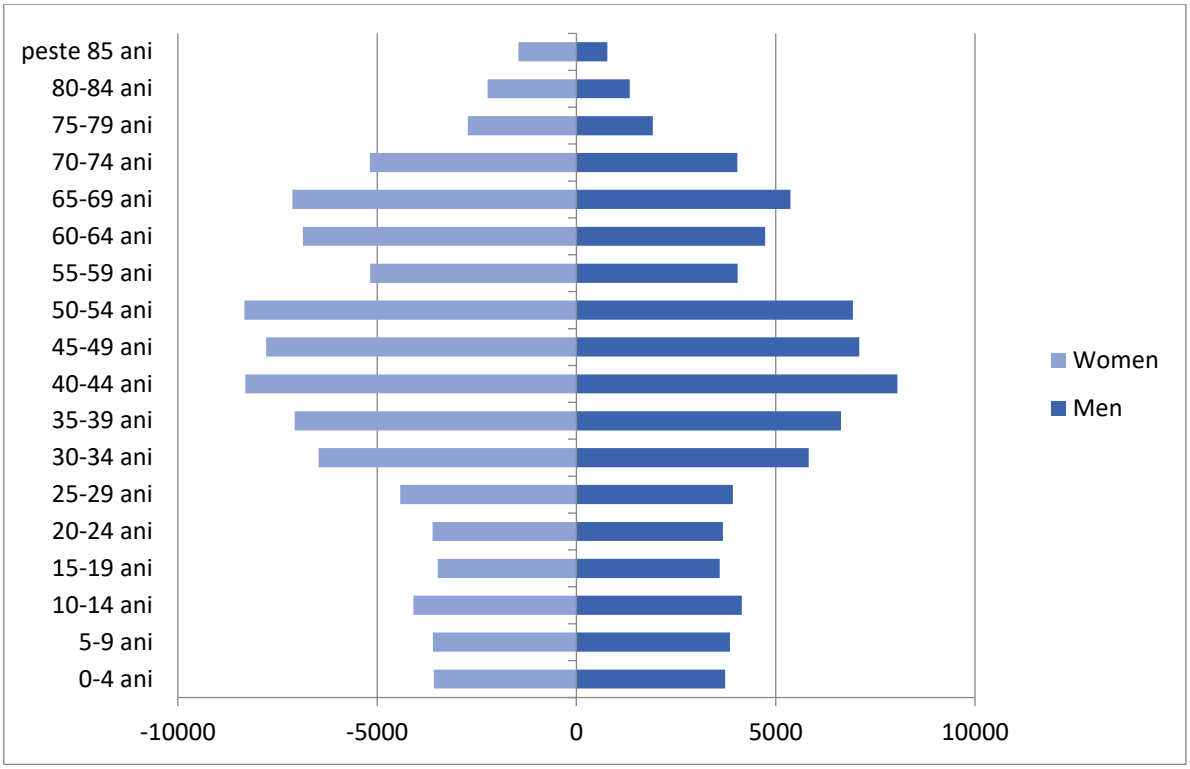


***Figure 36** – Population structure by age groups (2021)*

*Source: National Institute of Statistics [online]. Available at: https://insse.ro/cms/ (Accessed: 02.04.2022)*

The population from the communes and from the cities in the peri-urban area of Pitești Municipality has grown while the population of Pitești has decreased. This phenomenon is due to the urbanization of rural areas.

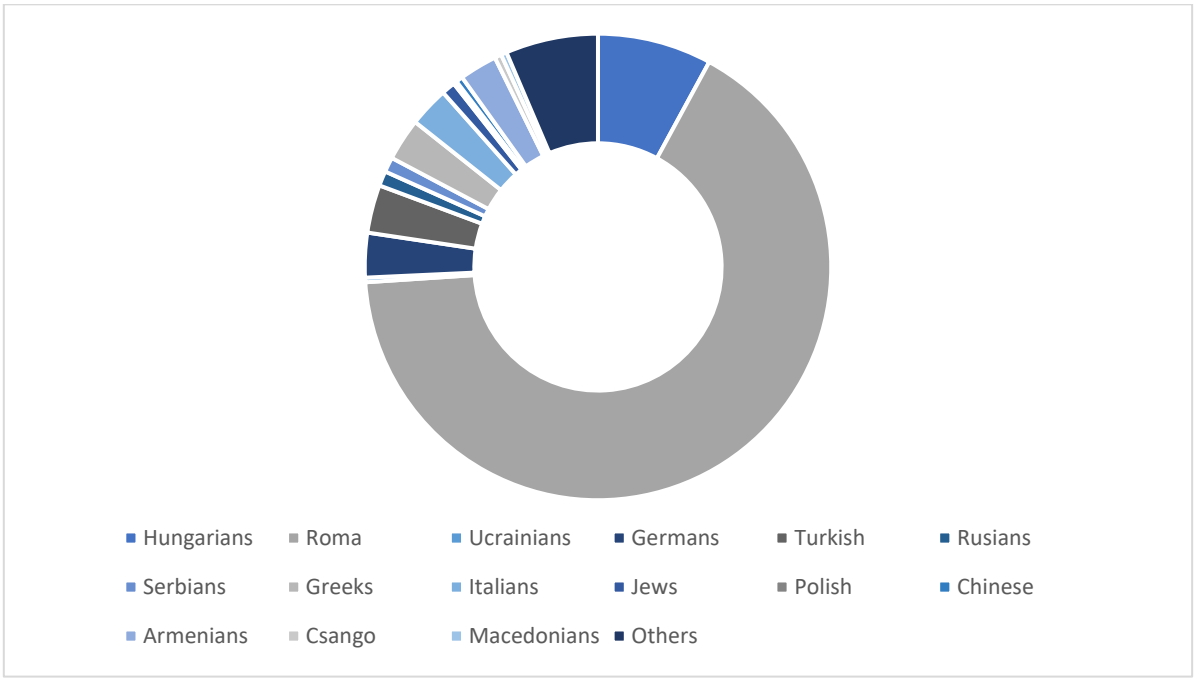


***Figure 37** – Ethnic structure of Pitești inhabitants in 2011*

*Source: 2011 Census – 8. Populația stabilă după etnie – Județe, municipii, orașe, comune, National Institute of Statistics [online]. Available at: https://www.recensamantromania.ro/rpl-2011/rezultate-2011/ (Accessed: 2.04.2022)*



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The ethnic structure of the city is mainly made up of Romanians. Other ethnicities like Hungarians, Germans, Turkish, Italians, Roma or Serbians are evidence of the past multiculturalism that was typical to the area.

The Census of 1930[67] recorded that 88% of the inhabitants of Pitești municipality were Romanians, 3% Jews, 2.50% Hungarians, 2.20% Roma, 1.40% Germans, 0.6% Greeks and 0.30% each Russians, Bulgarians, Armenians and Serbians, Croats and Slovenians (the last three grouped together).

### C.1.4. Economic data

The economic activities identified in Pitești municipality are predominant from the secondary sector (represented by constructions, followed by water distribution, waste management and production and distribution of electricity, thermal energy and natural gas) and the tertiary economic sector (represented by food and non-food trades, transport of people and goods and tourism).

The primary economic sector of the municipality is represented by agricultural activities and raising domestic animals and birds both in personal households and in commercial companies and also by mineral exploitation. Agricultural companies represent less than 2% of the total economic agents.

Gathered data[68] shows that in 2020 the most important activity sector, using the total fiscal value index, is *Wholesale trade and retail; Car and motorcycle repair (G)*, representing 55% of the total fiscal value in Pitești, followed by Manufacturing Industry (C) representing 16% and Transportation and Storage (H) representing 11%, Constructions (F) is the fourth contributor to the local economy, being 8% of the local fiscal value.

[67] Populația statornică în 1930, Institutul Central de Statistică, pp. 16-17
[68] Lista firmelor din România – Pitești, Județul Argeș [online]. Available at: https://membri.listafirme.ro/statistici-economice.asp#selectie (Accessed: 02.04.2022)


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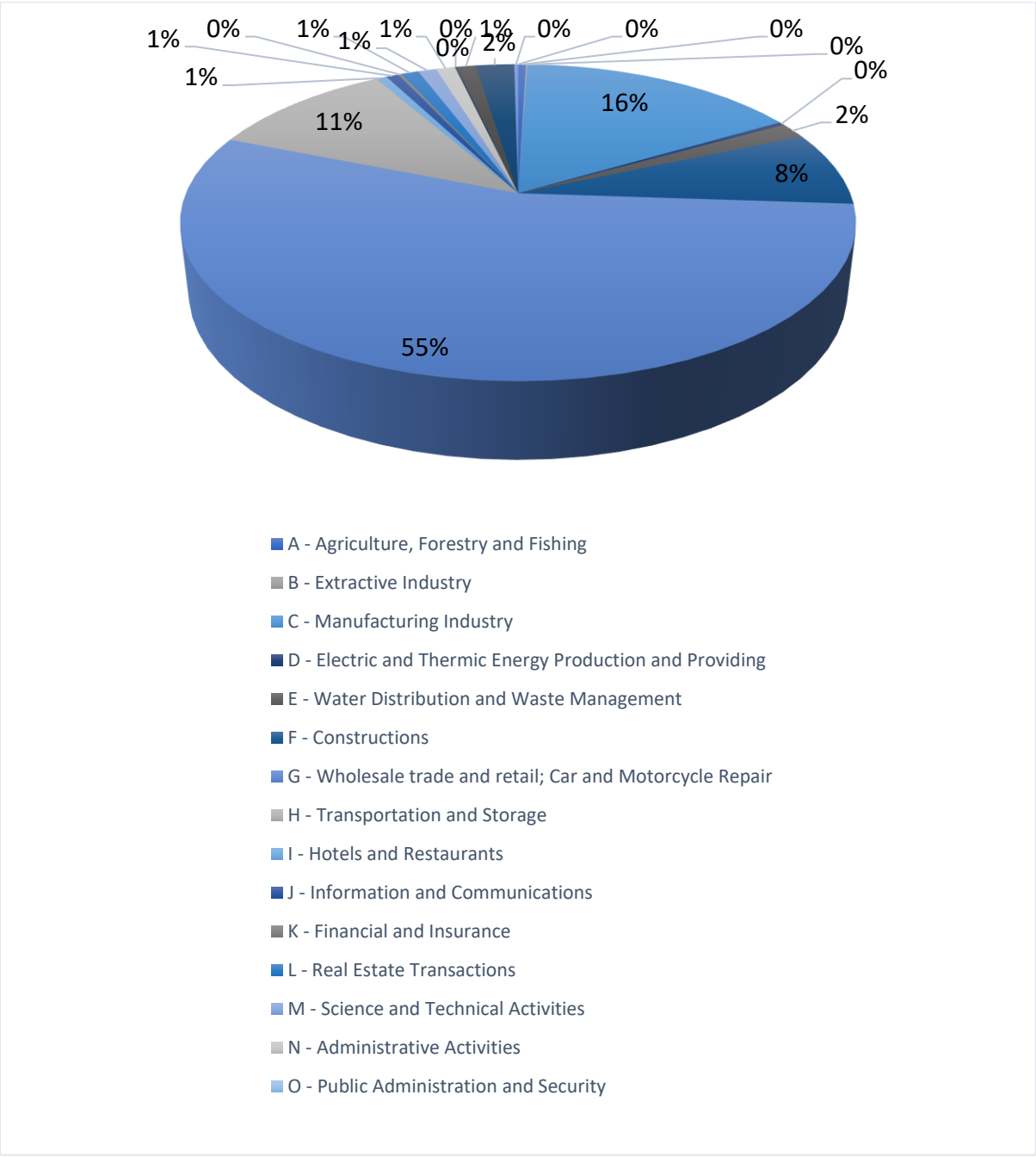


***Figure 38** – Total fiscal value of enterprises in Pitești, by field of activity (CAEN)*

*Source: Lista firmelor din România – Pitești, Județul Argeș [online]. Available at: https://membri.listafirme.ro/statistici-economice.asp#selectie (Accessed: 02.04.2022)*



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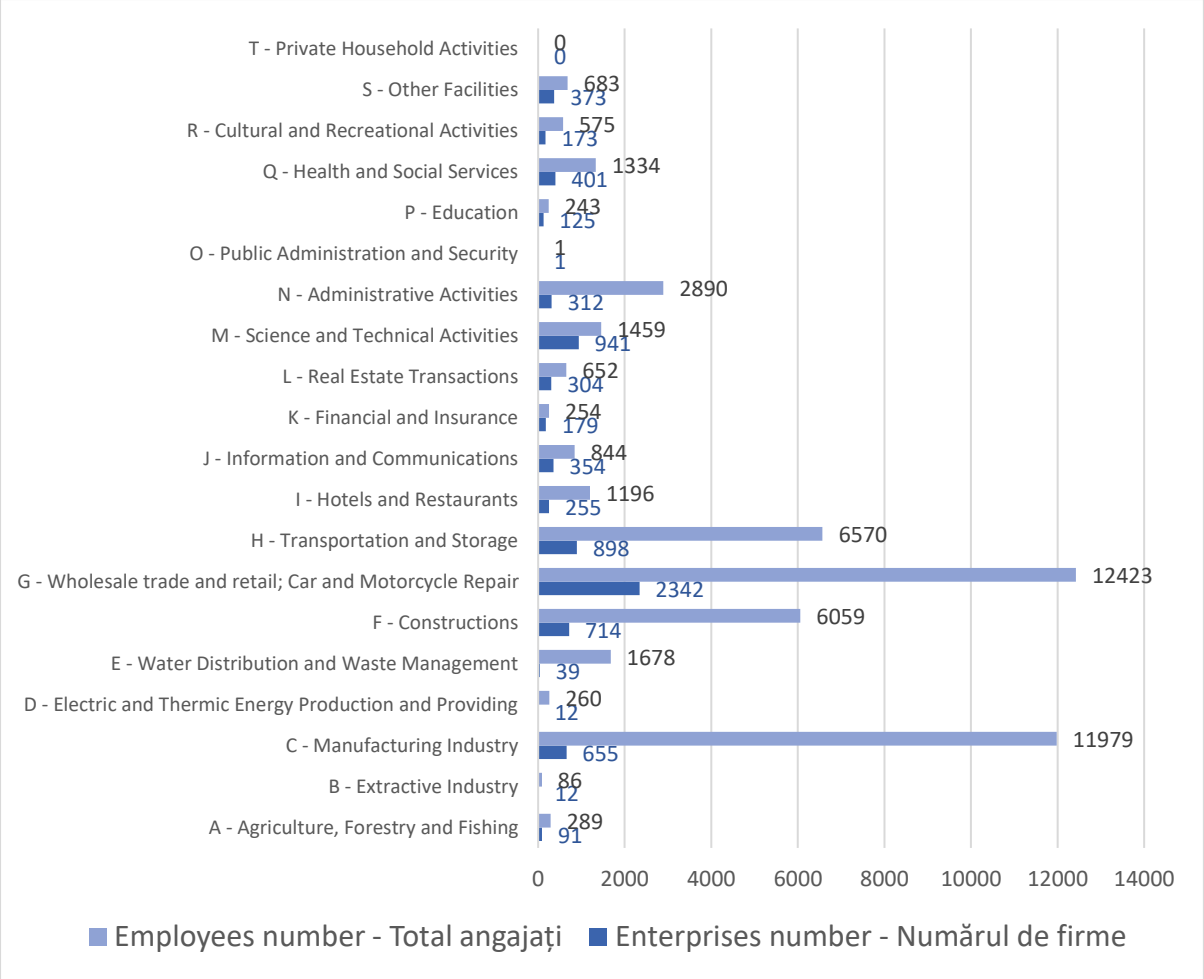


***Figure 39 –*** *Total numbers of enterprises and employees in Pitești, by field of activity (CAEN)*
*Source: Lista firmelor din România – Pitești, Județul Argeș [online]. Available at: https://membri.listafirme.ro/statistici-economice.asp#selectie (Accessed: 02.04.2022)*

The workforce statistics indicate that in 2020 Wholesale trade and retail; Car and motorcycle repair (G) has the highest number of employees (12,423 people working in this field). Manufacturing Industry (C) ranks second in terms of number of employees, totaling a number of 1,1979 employees. These two areas are far from the third place in the ranking of the number of employees, the latter totaling 6,570 employees, represented by Transportation and Storage (H). The number of unemployed has fluctuated over time, decreasing between 2015 and 2018 from 923 to 449 unemployed, then by 2020 increasing to 946 unemployed, and finally, in 2021 reaching again 573 unemployed.

Regarding the number of enterprises and employees in Pitești in 2020, classified by activity sectors, Wholesale trade and retail; Car and motorcycle repair (G) has also the greatest number of enterprises, along with Transport and Storage (H), Constructions (F) and Manufacturing Industry (C) sectors.


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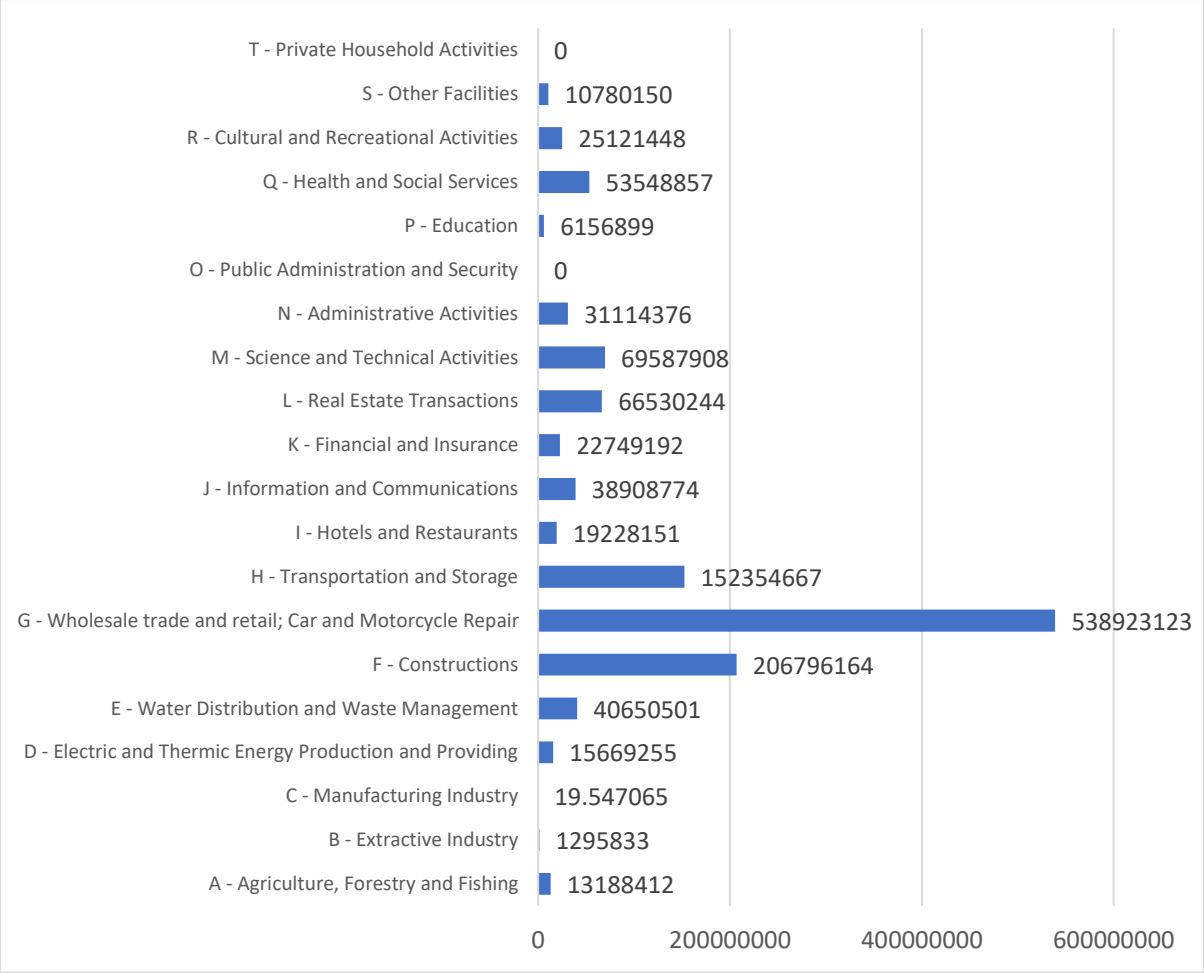


***Figure 40** – Total net income in Pitești, by field of activity (CAEN)*

*Source: Lista firmelor din România – Pitești, Județul Argeș [online]. Available at: https://membri.listafirme.ro/statistici-economice.asp#selectie (Accessed: 02.04.2022)*

Wholesale trade and retail; Car and motorcycle repair (G) is the most stable activity sector in Pitești, not only having the greatest fiscal value and being the biggest employer, but also having the greatest total net income in the local economy. The Constructions (F) and Transport and Storage (H) are also profitable sectors. This shows the micro-economic profile of Pitești.

## C.1.5. Environmental data

### C.1.5.1. Geology and soils

From the geological point of view, the area is part of the great Subcarpathian structural unit „Getic Depression". From a geomorphological point of view, the area fits in the High Plain of Pitești and in the eastern part of the Cotmeana Platform. Located at the confluence of Arges River with Doamnei River, the city has developed on the eastern terminal area of the Cotmeana Platform, where the Argeș River has dug on the right bank several terraces:

- The highest terrace, with a relative altitude between 100 and 110 m from the level of Argeș River, is positioned above the Trivale district;
- The high terrace, with a relative altitude between 60 and 65 m from the level of the Argeș River. On this terrace there are the Trivale neighbourhood, Războieni, the „Sf. Gheorghe" Cemetery and the „Nicolae Dobrin" Stadium;



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- The upper terrace, with a relative altitude between 40 and 45 m, compared to the level of the Arges River. On this terrace have developed the neighborhoods: Craiova, Traian, Banat, Marasesti and Găvana;
- The low terrace or the lower terrace, with a relative altitude between 20-25 m from the level of the Arges River. On this terrace were developed the neighbourhoods: Prundu, Centru and Negru Vodă.
- The meadow area includes a warehouses street and the neighborhoods Eremia Grigorescu, Calea Bucureşti, Popa Şapcă, Tudor Vladimirescu. Argeş meadow area is situated at the geographical limits of $44^0$.868940, $24^0$.896105.

In general, on all terraces, the load-bearing capacity is good, with an average value of 250 to 300 Kpa for clays and 350 to 400 Kpa for gravel. Analyzing the executed drillings and the water from the wells, it results that there are two aquifer layers, the first of which has a free level, being quartered at the base of the gravel layer, occupying only the lower areas of the gravel and giving rise to places or arms of underground rivers. The second aquifer layer is found in the sands of the geological foundation and is below the elevation of 10-25 m deep.

The prevailing soils in the Arges River Basin are differentiated according to the altitude, namely:
- prepodzols (EP) – areas over 2.200 m altitude;
- podzols (PD) – areas up to 1,200 m altitude;
- podzols (PD), districambosoil (DC), preluvosoils (EL) – areas at around 1.000 m altitude;
- preluvosoils (EL) and lusosoils (LV), eutricambosoils (EC) – areas at 500 m altitude.

No mineral resources can be found in Piteşti floodplain, that can be exploited, except for some poorly mineralized waters. The northern area of the platforms presents very favorable natural conditions for the cultivation of trees and vine. The southern area of the Pitesti Plain is intensively cultivated with cereals and technical plants as rape, sun flower and beetroot crops. Throughout the peri-urban area, animal farms and vegetable crops are also particularly important agricultural activities.

### C.1.5.2. Flora, fauna and forests. Protected areas

In Piteşti Municipality, the protected flora is represented by: yew, tulip tree, laurel tree, magnolia, Gingko biloba, pond cypress, edible chestnut, walnut, Japanese acacia tree, cedar, mammoth tree, Judah's tree. Regarding the fauna, it should be noted that due to the anthropogenic influence, the number of species has been reduced. It is notable, however, the presence of the following: squirrel, wild boar, deer, fox.

The Trivale Forest is the main green area of Piteşti. Part of this forest has been designed under the name of Trivale Park since 1900. The park is part of a secular oak forest and it is becoming one of the favorite places for walks of the inhabitants. The forest where Trivale Park has been arranged is mostly preserved today, bordering two districts of the city. The access to this area is easy, reachable right from the center of Pitesti, going through Trivale Street and passing the Trivale hermitage. There is also an alley that crosses the forest, the Hunter's Horn Complex, and further on to the Zoo. The forest is under the administration of Piteşti Forest District and has an area of about 750 ha, out of the total area of 1808.9 ha (the difference in area is found on the territory of the communes Bascov, Moşoaia and Băbana). In accordance with Judgment no. 18/1994 of the Arges County Council, an area of 484.3 ha of this forest is declared a forest reserve, thus becoming a **protected area of local interest**. Therefore, the conservation of the existing natural heritage is taken into account in order to be able to continue to fulfill the role of protection of the environmental factors, but also of the landscape and recreational one.

From the forestry point of view, the Trivale Forest is included in the forest unit of the Middle Arges. It covers the low hills, with an altitude between 290 and 430 meters, on the

terraces on the right side of the Arges and Bascov rivers, starting from Valea Ursului, to the south of Piteşti. The prevailing slope is slightly sloping, which makes erosion weak, even where the land has been cleared. Trivale Forest is located at the limit between the beech and oak subarea, here being also the southern limit of birch, this location generating a varied vegetation, which allows the coexistence of species characteristic to the mountain area with those characteristics of hill and plain areas. The flora includes 764 taxa, divided into 95 families, and 21 species with different protection regimes. Also, the fauna present in the Trivale Forest is rich in taxa, with different protection regimes, registering 12 species of mammals, 87 species of birds, 2 species of reptiles, 12 species of amphibians and numerous species of invertebrates.

Other green areas in Pitești Municipality that have a role in rainfall infiltration:

- **Lunca Argesului Park***,* inaugurated in 2013, is the largest park in the country arranged with European funds. It stretches over 24 hectares and is an extension of the Green Belt of Piteşti Municipality, started with the Ştrand Park, then connected with the Tudor Vladimirescu area. Lunca Argesului Park will be connected to Ştrand and the leisure base in Tudor Vladimirescu district through a pedestrian alley and a bike track that will pass under the Arges bridge.
- **Ștrand Park** is one of the city attractions located on the Argeș River waterfront. It includes places of leisure and sports (boating, karts racing, football fields, tennis and an artificial ice rink).
- **Expo Parc** is a city park, located in Calea Bucureşti neighborhood, which complies with the European security, ecological and aesthetic norms of public parks arrangement. The park holds about 200 large trees and 1500 shrubs and a vegetation specific to all seasons (with alternative flowering periods). It also has spaces created for all age categories: playgrounds for children, places for chess players, sports fields, spaces for dogs and uses alternative energy production systems (solar panels with photovoltaic cells).
- **Prundu Park** is a park for relaxation, mainly used by the inhabitants of the neighborhood. It also has outdoor fitness equipment.
- **Lumina Park**, named so because there was the former cinema „Lumina". The park is the largest in Găvana neighborhood. The 1907 Park is located exactly in the center of Pitești, between Argeș County Museum and Military Circle, being an oasis of greenery in the heart of the city.

Other protected areas of interest for Piteşti Municipality are Natura 2000 sites „Argeș Middle Floodplain" (ROSCI0106) and „Argeș Reservoirs" (ROSPA0062). Not far from the city, upstream Argeş county, there is also the Natura 2000 site „Făgăraș Mountains" (ROSCI0122), a touristic attraction.

The City of Piteşti is a transit place for tourist destinations located in the surroundings: Făgăraș Mountains, Transfăgărășan, Bucegi, the Rucăr-Bran Corridor, the Olt Valley and built heritage like „Liviu Rebreanu" Memorial House in Ştefăneşti, the Florica Villa in Ştefăneşti, the Goleşti Museum Complex, the „Tutana" Church in Băiculeşti, the Dendrological Park in Mihăeşti. Considering these, the city also offers transit tourism. However, the touristic function of Pitești is poorly developed.

### C.1.5.3. Climate and climate change impact

Located in the southern part of the country, Argeș river basin has a temperate climate – continental, with a pronounced vertical distribution, as it follows:

- the annual rainfall records values between 1000 and 1400 mm on the peaks of the mountains;
- between 600 – 800 mm in the Subcarpathian, hilly and Piedmont areas;
- below 550 mm in the plain area.


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The highest daily average values of air temperature are recorded during summer (July – August) surpassing 30°C as a result of the arrival of tropical air, and the lowest values are recorded in winter (-7°C in January), being a consequence of the arrival of arctic or continental cold air. The monthly average values reach 11°C in the plain area. The multiannual average values of the air temperature register a slight increase from N to S.

As shown in the ***Figure 17*** *– Annual temperature increase 2021 – 2050 (compared to the reference range 1961 – 1990)* (*B.1.5.3. Climate and climate change impact),* it is forecasted that in the period 2021 – 2050 the average annual temperature recorded in Pitești will increase by 1.0 °C compared to the reference range 1961–1990[69]. Regarding the annual precipitation (***Figure 18*** *– Increase in average annual precipitation 2021 – 2050 (compared to the reference range 1961 – 1990)– B.1.5.3. Climate and climate change impact)*, in the period 2021 – 2050, it is forecasted an increase of the average annual amount of precipitation by 1.7 ÷ 1.9 % in Argeş County compared to the reference interval 1961 – 1990.

In Argeș river basin, one of the most significant consequences of the increase in air temperatures is the increase in the magnitude and frequency of negative events related to the extreme precipitation generated by the increase in the humidity level of the atmosphere. This induces an increase in the frequency and intensity of floods. Even the total amount of the seasonal precipitation is slightly increased, the maximum daily precipitation is on an increasing trend during autumn, winter, and even summer, in Argeş river basin. During spring, the trend shows a decrease in the maximum daily precipitation.

As shown in the ***Figure 18*** *– Increase in average annual precipitation 2021 – 2050 (compared to the reference range 1961 – 1990)* (*B.1.5.3. Climate and climate change impact),* Argeș river basin is located in an area that suffers small-changes with regards to the value of the peak flow. Considering Alfieri' study[70], even if the maximum discharges will be affected by small changes (10%) on Argeş river, the flood frequency could be double increased.

### C.1.5.4. Water resources

| No. | River | Gauging station | F ($km^2$) | H (m) | Hydrological parameters | | |
|---|---|---|---|---|---|---|---|
| | | | | | Qmma (mc/s) | Qmax 1% (mc/s) | R (kg/s) |
| 1 | Doamnei | Bahna Rusului | 355 | 1,508 | 9.25 | 350 | 0.94 |
| 2 | Argeș | Malu Spart | 3,799 | 751 | 38.60 | 2,090 | 40.70 |
| 3 | Argeș | Budești | 9,299 | 389 | 50.30 | 1,910 | 55.80 |

***Table 16*** *– Main hydrometric stations on Argeș River and hydrological parameters features (the mean multiannual discharge, Qmma, 1% maximum annual exceedance probability (AEP)-Qmax1% and mean annual sediment transport – R)*

*Source: Flood Directive, Cycle 1 FRMP Report for Argeş-Vedea UoM (RBA)*

From the hydrographic point of view, Pitești Municipality is located in the north-western part of Argeș River Basin, on its right bank, between Bascov Reservoir and Goleşti Reservoir. Arges River (L=350 km, F=12,550 $km^2$) springs upstream of Vidraru Reservoir, under the crest of Făgăraş Mountains, from confluences of the two rivers Capra and Buda, rivers that currently flow into the Vidraru Reservoir.

[69] Bojariu, Bîrsan, Cica, Velea, Burcea, Dumitrescu, Dascălu, Gothard, Dobrincu, Cărbunaru, Marin (2015) *Schimbările climatice – de la bazele fizice la riscuri și adaptare*, Bucharest: Editura Printech

[70] Alfieri, Feyen, Dottori, Bianchi (2015) „Ensemble flood risk assessment in Europe under high end climate scenarios" in Global Environmental Change, Vol. 35, pp. 199-212

The main tributaries impacting Piteşti urban area, in the order of formation of the hydrographic basin, are: Vâlsan (L=79 km, F=348 km$^2$), Râul Doamnei, which also has the highest flow contribution (L=107 km, F=1,836 km$^2$) and Râul Târgului (L=72 km, F=1,096 km$^2$). The main hydrological characteristics of Argeş and its main tributaries are presented below.



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## C.2. Flood risk management

### C.2.1. Flood hazard and risk information for Pitești Municipality

**Preliminary Flood Risk Assessment**

**During the cycle 1 of the Floods Directive implementation,** for Argeș - Vedea RBA 4 significant flood events were identified and 29 fluvial APSFRs.[71]

Pitești Municipality has territories located in the catchments of 2 rivers designated as APSFRs: Argeș (APSFR: r. Argeș - av. loc. Pitești) and Râul Doamnei (APSFRs: r. Râul Doamnei - av. loc. Sboghițești). Argeș river and Râul Doamnei river were designated APSFR based on the consequences of the floods from July 1975.

**During the 2nd cycle of Floods Directive implementation,** 3 significant flood events (2 fluvial and 1 pluvial) have been identified during the period 2010 – 2016 and 1 future flood for Argeș - Vedea RBA. 4 new APSFRs from fluvial source and 1 from pluvial source were designated. 3 of the new fluvial APSFRs are of interest for Pitești Municipality: r. Argeș - av. confl. Arefu - loc. Pitești, r. Bascov - av. confl. Valea Cânepii și r. Budeasa - av. confl. Valea Salciei. The new APSFR on Argeș river and on Bascov rivers were identified after the significant floods from July 2014. Budeasa river was identified as future flood. Pitești Municipality has been identified as pluvial APSFR after being affected by the significant flood event from May 04, 2014[72].

*Table 17* is detailing the sources, mechanisms and characteristics of flooding and the type of consequences of the APSFRs of interest for Pitești Municipality.

| APSFR name | APSFR code | Length/ Surface (km/sq. km) | Flood source | Mechanism of flooding | Characteristics of flooding | Type of consequences |
|---|---|---|---|---|---|---|
| r. Argeș - av. confl. Arefu - loc. Pitești | RO4-10.01.....-02A | 67.70 | fluvial | A21; A22 | A35 | B11; B12; B22; B31; B41; B42; B43; B44 |
| r. Argeș - av. loc. Pitești | RO4-10.01.....-01A | 229.09 | fluvial | A21; A22 | A35 | B11; B12; B41; B42; B43; B44 |
| r. Râul Doamnei - av. loc. Sboghițești | RO4-10.01.017....-01A | 64.06 | fluvial | A21; A23 | A34; A38 | B11; B12; B41; B42; B43; B44 |
| r. Bascov - av. confl. Valea Cânepii | RO4-10.01.016....-01A | 10.23 | fluvial | A21 | A33 | B11; B12; B23; B41; B42; B43; B44 |

[71]https://rowater.ro/despre-noi/descrierea-activitatii/managementul-situatiilor-de-urgenta/directiva-inundatii-2007-60-ce/epri/

[72]https://rowater.ro/despre-noi/descrierea-activitatii/managementul-situatiilor-de-urgenta/directiva-inundatii-2007-60-ce/epri/



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| APSFR name | APSFR code | Length/ Surface (km/sq. km) | Flood source | Mechanism of flooding | Characteristics of flooding | Type of consequences |
|---|---|---|---|---|---|---|
| r. Budeasa - av. confl. Valea Salciei | RO4-10.01.017.11...-01A | 10.85 | fluvial | A21 | A33 | B11; B22; B23; B41; B42; B43; B44 |
| loc. Pitești - inundatii din pluvial | RO4-10.01.....-13178-P-A | | pluvial, water bearing infrastructure | A24 | A33 | B11; B12; B22; B23; B31; B41; B42; B43; B44 |

***Table 17** – APSFRs – source, mechanisms and characteristics of flooding and type of consequences*
*Source: Floods Directive, Cycle 2 Preliminary Flood Risk Assessment Report for Argeș-Vedea RBA*

Legend[73]:
A21 - Natural Exceedance; A22 - Defence Exceedance; A23 - Defence or Infrastructural Failure; A24 - Blockage / Restriction
A33 - Other rapid onset; A34 -Medium onset flood; A35 - Slow onset flood; A38 - Deep Flood
B11 - Human Health; B12 - Community; B22 - Protected Areas; B23 - Pollution sources; B31 - Cultural assets; B41 - Property; B42 - Infrastructure; B43 - Rural Land Use; B44 - Economic Activity

For the period 2016 – 2020, the Synthesis Reports elaborated after flood events occur, mention that Pitești Municipality has been affected by 2 events in July 2019 and June 2020 (*Table 18).*

| No. of the Synthesis Report | Municipality | Event starting date | Cause of floods | Affected assets |
|---|---|---|---|---|
| 17191/21.08.2019 | Pitești | 01.07.2019 | runoff from the slopes | 19 m drainage channel |
| 11214/13.07.2020 | Pitești | 09.06.2020 | Turcești river | 1 culvert |

***Table 18** – Flood events in the period 2016 - 2020*
*Source: ANAR, Summary tables containing the Synthesis Reports information*

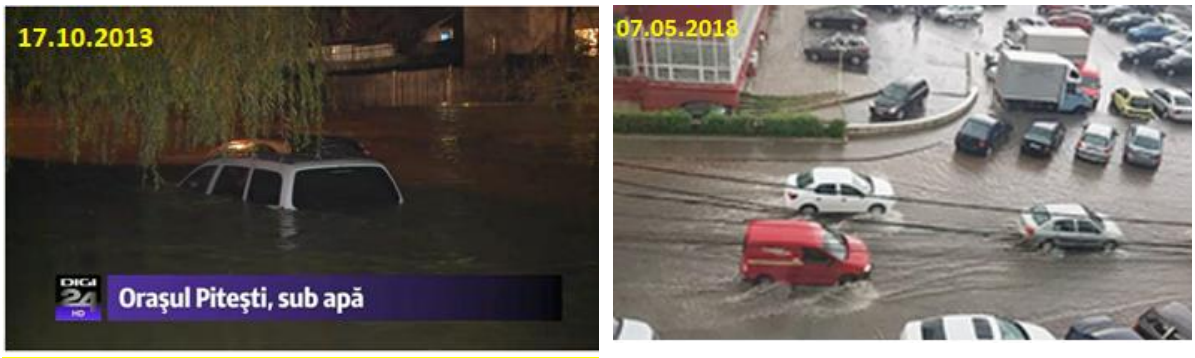


***Figure 41** – Floods in Pitești Municipality*

*Source: https://www.digi24.ro/stiri/actualitate/evenimente/video-pitestiul-sub-ape-ploaia-torentiala-care-a-cazut-timp-de-sase-ore-a-inundat-jumatate-din-oras-135821;*

*Source: https://m.ziare.com/pitesti/stiri-actualitate/strazi-inundate-in-pitesti-7269531*

[73] https://cdr.eionet.europa.eu/help/Floods/Floods_2018/GuidanceDocuments/FD_ReportingGuidance.pdf


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**Flood Hazard and Risk Maps**

**During the cycle 1 of the Floods Directive implementation,** flood hazard and risk maps were developed for 3 AEPs (10%, 1% and 0.1%) (in case of Argeş, two more AEPs (0.5% and 0.2%) were mapped), using the methodology described in Chapter 2.6 of the FRMPs. The flood hazard pas are a result of a national program *Plan for Prevention, Protection and Mitigation of Flood Effects*, which was initiated before the Floods Directive to enter into force. The qualitative flood risk maps were developed by ANAR and INHGA[74].

In case of Pitești Municipality, the fluvial flood hazard results for 2 APSFRs from cycle 1 are shown in *Figure 42*. These results were shared with Argeș County Council in 2014 by MEWF.

During the 2nd cycle of Floods Directive implementation, the pluvial flood hazard and risk maps for 6 AEPs (33%, 10%, 1%, 1%+CC, 0.5% and 0.1%) for Pitești Municipality will be published in September 2022.

For Bascov and Budeasa rivers flood hazard results from *Plan for Prevention, Protection and Mitigation of Flood Effects* project will be used. For the Arges river APSFRs, some river sectors will suffer changes as new flood hazard modelling will be performed. For Râul Doamnei river, the old hazard maps will not be revised. All APSFRs will have new risk maps. The maps will be published as well in September 2022.

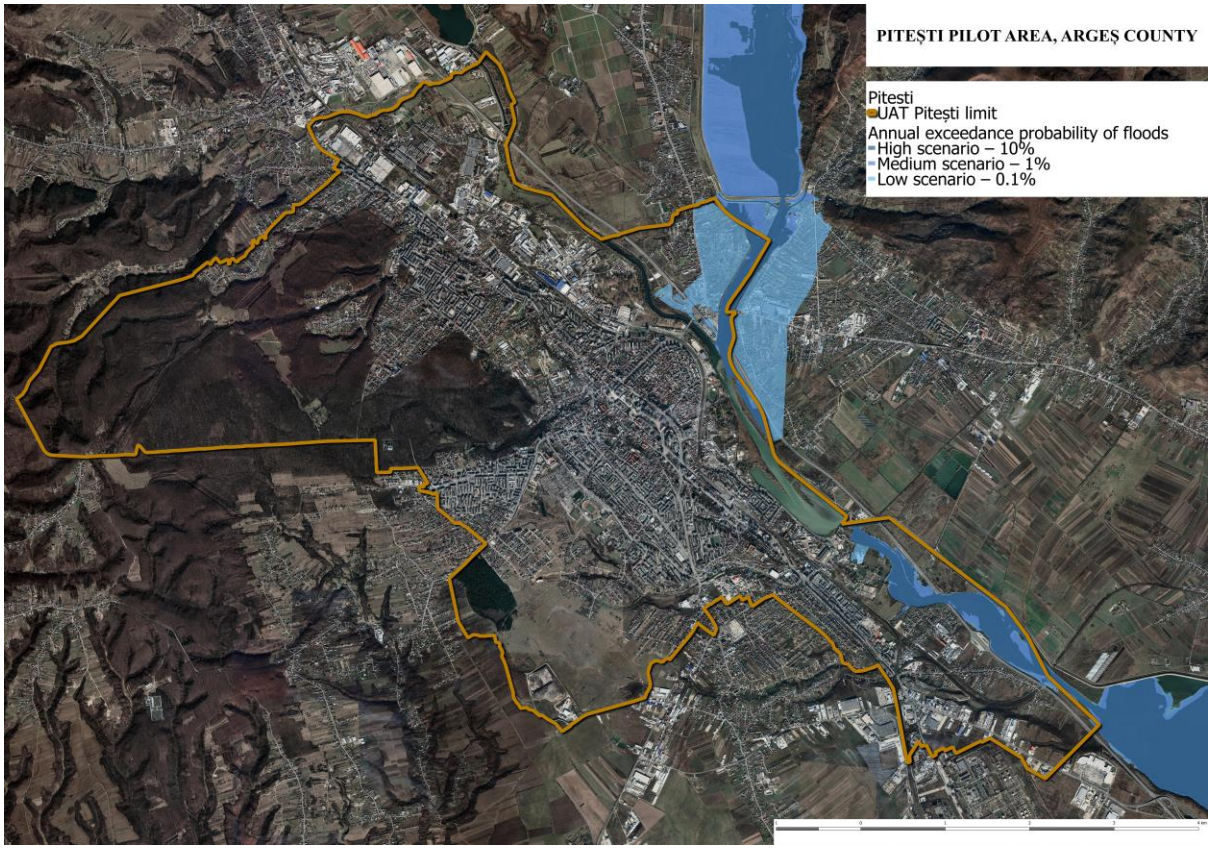


***Figure 42 –*** *Flood hazard areas in Pitești Municipality*
*Source: World Bank by using cycle 1 Flood Hazard Results*

[74]http://www.inhga.ro/documents/10184/121027/7+PMRI+Arges-Vedea.pdf/3a2701a9-2fc7-4308-8f44-b505c86f985f



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## C.2.2. Flood risk management infrastructure

Pitești Municipality is well protected against fluvial floods by a complex hydrotechnical system along Argeș river. The water management scheme existing in the Argeș river is presented in *Figure 43*[75].

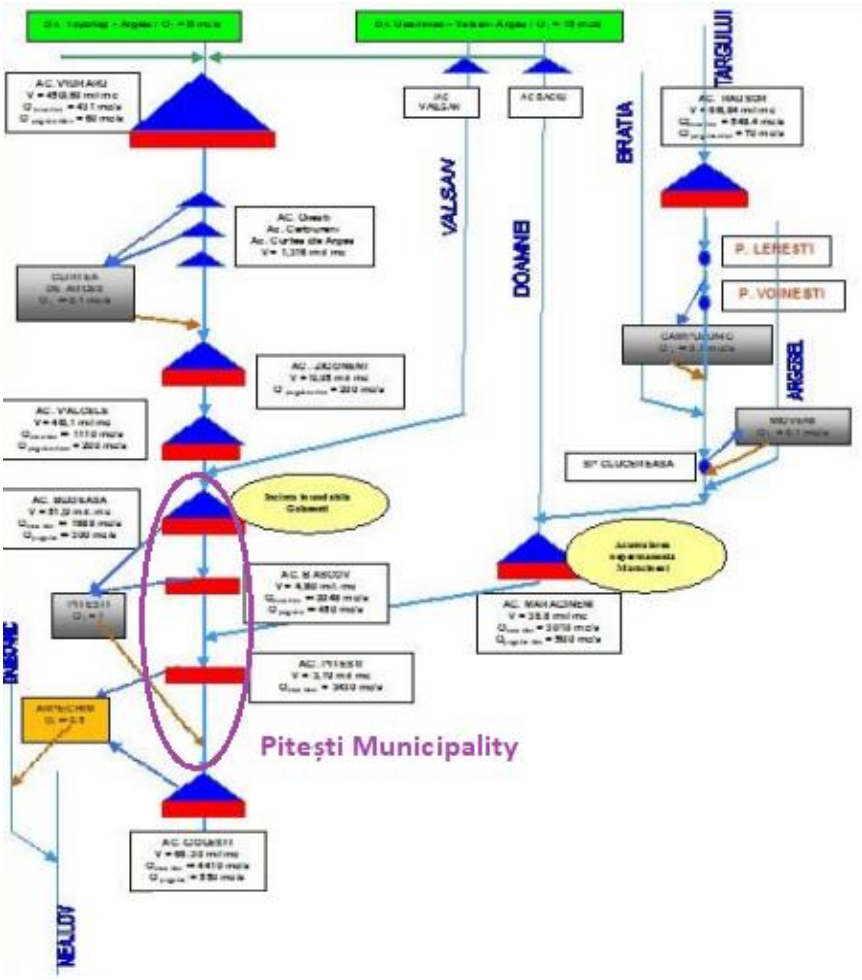


***Figure 43 –*** *The existing water management scheme in Argeș catchment with possible impact on the Pitești Municipality*

*Source: Flood Risk Management Plan for Argeș-Vedea River Basin Administration*

Argeș river, the river that passes Pitești Municipality is very well equipped with water management and flood mitigation infrastructure, as well as for drought risk management in the city and in agricultural land. The existing infrastructure and its characteristics are presented in the following *Tables (19, 20, 21).*

| Dike code | Dike Name | Location | Purpose or function of defense | Design AEP |
|---|---|---|---|---|
| VII10.01.17 | Dike Maracineni Polder | Maracineni | Protection against fluvial floodings; of localities agriculture land | Q1%/1320m$^3$/s |

[75]http://www.inhga.ro/documents/10184/121027/7+PMRI+Arges-Vedea.pdf/3a2701a9-2fc7-4308-8f44-b505c86f985f



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| Dike code | Dike Name | Location | Purpose or function of defense | Design AEP |
|---|---|---|---|---|
| VII10.01.17.MD | Dike on Doamnei River downstream the Mărăcineni Dam | Pitesti, Ștefănești, Mărăcineni | Protection against fluvial floodings; of localitiesagriculture land | Q1%/920m$^3$/s |
| VII10.01.17.MS | Dike on Doamnei River downstream the Mărăcineni Dam MS | Pitesti, Ștefănești, Mărăcineni | Protection against fluvial floodings; of localitiesagriculture land | Q1%/920m$^3$/s |

***Table 19*** *– Defense dams for protection of Pitești growth center*[76]

*Source: Flood Risk Management Plan for Argeș-Vedea River Basin Administration*

Vidraru Reservoir on Argeș has a power production role and flood attenuation for the mountainous part of the river basin.

| Name of dam/ reservoir | River | Cadaster Code | County | Dam height (m) | NNR volume | Attenuation volume (mil. M$^3$) |
|---|---|---|---|---|---|---|
| Vidraru | Argeș | VII-10.1 | Argeș | 450.62 | 475.22 | **25.00** |
| Oeşti | Argeș | VII-10.1 | Argeș | 0.14 | 0.23 | 0.90 |
| Cerbureni | Argeș | VII-10.1 | Argeș | 0.35 | 0.49 | 0.14 |
| Curtea de Argeș | Argeș | VII-10.1 | Argeș | 0.31 | 0.49 | 0.18 |
| Zigoneni | Argeș | VII-10.1 | Argeș | 9.05 | 9.05 | 0.00 |
| Vâlcele | Argeș | VII-10.1 | Argeș | 37.80 | 46.10 | 8.30 |
| Budeasa | Argeș | VII-10.1 | Argeș | 25.90 | 51.10 | **25.20** |
| Bascov | Argeș | VII-10.1 | Argeș | 2.29 | 4.80 | 2.51 |
| Piteşti | Argeș | VII-10.1 | Argeș | 1.06 | 3.3519 | 2.28 |
| Goleşti | Argeș | VII-10.1 | Argeș | 44.9 | 66.30 | **21.40** |

***Table 20*** *– Permanent reservoirs for flood mitigation with a possible impact on Pitești area*[77]

*Source: Flood Risk Management Plan for Argeș-Vedea River Basin Administration*

| Name dam/ reservoir | River | Cadaster Code | County | Type of dam | Dam height (m) | Total Volume (attenuation volume) (mil.m$^3$) |
|---|---|---|---|---|---|---|
| Mărăcineni | Doamnei | VII 10.01.17 | AG | SS | 30,5 | 38,5 |

***Table 21*** *– Frontal reservoirs/polders with a role in flood mitigation with a possible impact on Pitești area*[78]

*Source: Flood Risk Management Plan for Argeș-Vedea River Basin Administration*

[76]http://www.inhga.ro/documents/10184/121027/7+PMRI+Arges-Vedea.pdf/3a2701a9-2fc7-4308-8f44-b505c86f985f

[77] Ibidem

[78] Ibidem



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## C.2.3. Sewerage network

In Pitești urban agglomeration, there is a combined system for collecting sewerage (domestic waters) and for pluvial waters. It is considered that 60% of the system is unitary, and 40% is separative[79]. This agglomeration includes the localities: Piteşti, Ştefăneşti (Valea Mare-Podgoria, Viişoara, Izvorani, Ştefăneştii Noi, Ştefăneşti), Bascov (Bascov, Valea Ursului, Glâmbocu, Mica, Prislopu Mic and Schiau), Albota (Albota and Gura Văii), Merişani (Dobrogostea, Vărzaru and Borleşti), Moşoaia (Smeura, Hintesşti and Dealu Viilor), Bradu (Bradu and Geamăna) and Mărăcineni (Mărăcineni and Argeşelu). The equivalent population is 256,200[80]. The operator of the sewerage system is the Regional Operator SC APACANAL 2000 SA.

### C.2.3.1. Collection of domestic water

The existing sewerage system serves 162,845 inhabitants out of 167,518 inhabitants from Pitești Municipality, which represents a percentage of 97.2% of the population. The combined sewerage network has a total length of 254.1 km.

The unitary system is represented by the collectors from the old area of the city, the neighborhoods Craiova, Razboieni, Exercitiu, Banat and Smeurei. The separative system is found in the new area of the city (Prundu, Tivale, Zona Nord, Găvana neighbourhoods) and on the following streets: Eremia Grigorescu, Câmpineanu, Calea București, Gârlei, Nicolae Bălcescu, Popa Șapca, Tudor Vladimirescu and in the north industrial area.

Of the total length of the sewerage network, 57.5% consists of street canals with reduced diameters 20, 25, 30 cm. The sewer system is made of simple concrete and concrete pipes reinforced for large sections of over 100/150 cm. In the case of large sectors, the ovoid section is used, imposed by the smaller width and ensuring minimum speeds larger in dry weather.

The main collectors that ensure the transport of wastewater to WWTP Pitesti are the following:

- ZIN industrial water sewerage collector (Ov 50/75 cm, L = 1,500 m);
- sewerage collector A block area SC Rolast – WWTP Pitesti (Ov 80/120 cm, Ov 150/100 cm, Ov
- 135/90 cm, Ov 345/230 cm; L = 3,200 m);
- industrial zone collector (Ov 60/90 cm, Ov 80/120 cm, Dn 400 mm; L = 5,275 m);
- Trivale B sewerage collector (Ov 90/60 cm, Ov 150/100 cm, Dn 500 mm; L = 4,500 m);
- Războieni sewerage collector (Ov 120/80 cm, Ov 150/200 cm, Ov 180/120 cm, Ov 250/300 cm;
- Dn 500mm; L = 10,500 m);
- collector channel Craiovei (Ov 90/60 cm, Ov 150/100 cm; L = 1,900 m);
- collector channel Prundu Bananai – WWTP Pitesti (Dn 500 mm; L = 2,000 m);
- intermediate SPAU sewerage collector – WWTP Pitesti (Ov 105/70 cm, L = 1,500 m);
- Ana IMEP sewerage collector – Viilor bridge (Dn = 200 – 250 mm);
- Ștefănești sewerage collector – collector A (Dn = 250 mm);
- sewerage collector Calea Câmpulung area (Dn = 250 – 315 mm); also takes over sewage from the Mărăcineni sewerage system.

The main pumping stations in Pitești sewerage system are Târgul din Vale intermediate pumping station – made of 2 grill lines (coarse screen and fine screen), 1 longitudinal desanding, 2 + 1 electric pumps (Q = 500 l / s, H = 1 mCA) – and METEO I rainwater pumping station located in the Târgul din

[79] Address 10784/03.12.2021 from SC APACANAL 2000 SA

[80] Master Plan on the Rehabilitation, modernization and extension of water supply and sewerage systems in Arges County (2017) Revised version

Vale area equipped with 3 electric pumps (Q = 3 mc / s, H = 10 mCA). On the route of the sewerage networks are installed other 8 wastewater pumping stations.

Within the Regional Project „Extension and rehabilitation of water and wastewater infrastructure from Argeș County" financed by SOP Environment 2007-2013, for the Pitești sewerage system is provided the extension of the sewerage network (approx. 7 km, 6 waste water pumping stations). The stormwater network has a total length of 82.6 km[81]. The list of extension works proposed for the sewerage network in Pitești for 2022 includes the following streets[82]: N. Balcescu Street, Stadionului Alley, Octavian Goga Street, Rudolf Schweitzer Street 8, Depozitelor Street-Colonie ACH, Gârlei Street.

### C.2.3.2. Sections with problems and streets without networks

The areas frequently put under pression when extreme torrential rains occur are the separative systems from the metropolitan area (Mărăcineni, Albota, Moșoaia, Ștefănești, Bascov, Merișani, Bradu) and some parts from Pitești Municipality, the areas where the discharge of the sewerage is not done gravitationally, but by pumping stations. In Pitești, in the periods with increased hydrological volume, the frequently flooded streets are: Gârlei Street / Valea Rea, Mihai Lungeanu Street, Calea Bascov Street, Mircea Eliade intersection with Nicolae Bălcescu Boulevard, 1 Decembrie 1918 intersection with Nicolae Bălcescu Boulevard, Găvenii Street and industrial areas like Argintex and Grosmetchin, Podul Viilor area, Petrochimiștilor Boulevard, Basarabia Street and the intersection with Craiovei Street, Vasile Pârvan and Ion Minculescu Streets[83].

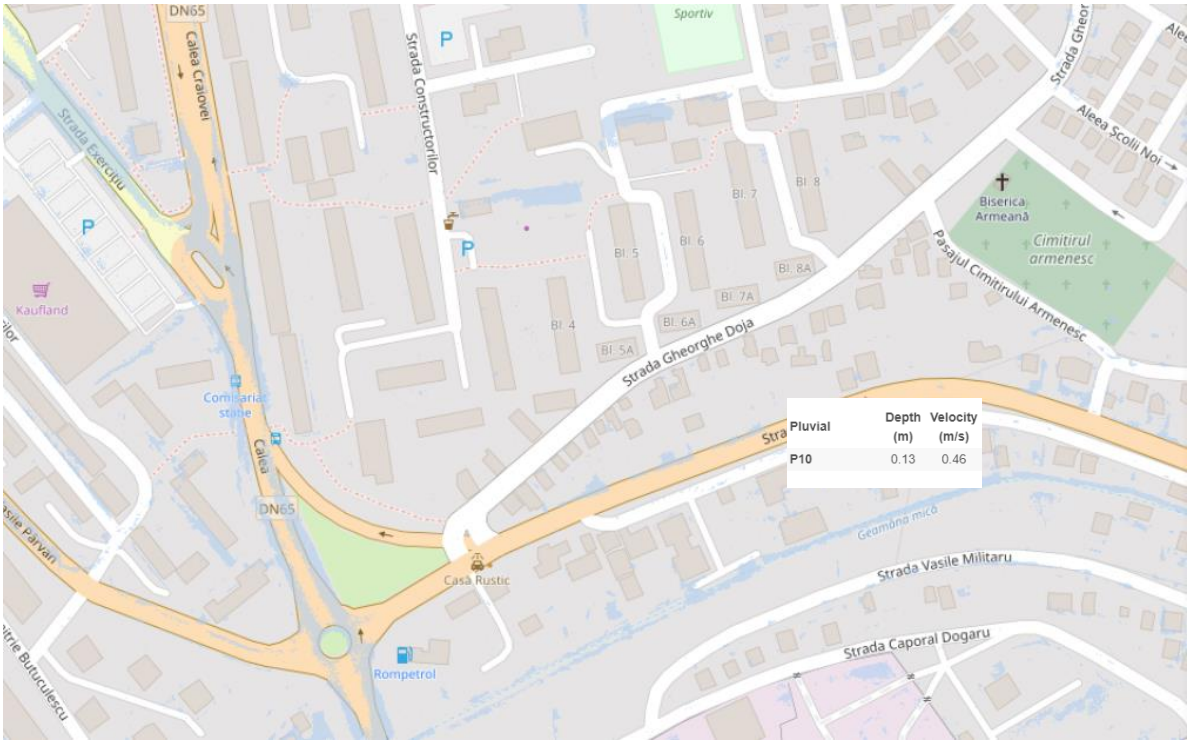


***Figure 44** – Basarabia Street, intersection with Craiovei Street, 1 in 10 years flood event*
*Source: World Bank RO-FLOODS database*

[81] Master Plan on the Rehabilitation, modernization and extension of water supply and sewerage systems in Arges County (2017) Revised version
[82] List of extensions for 2022 provided by SC APACANAL 2000, Investment Department
[83] Address 10784/03.12.2021 from SC APACANAL 2000 SA


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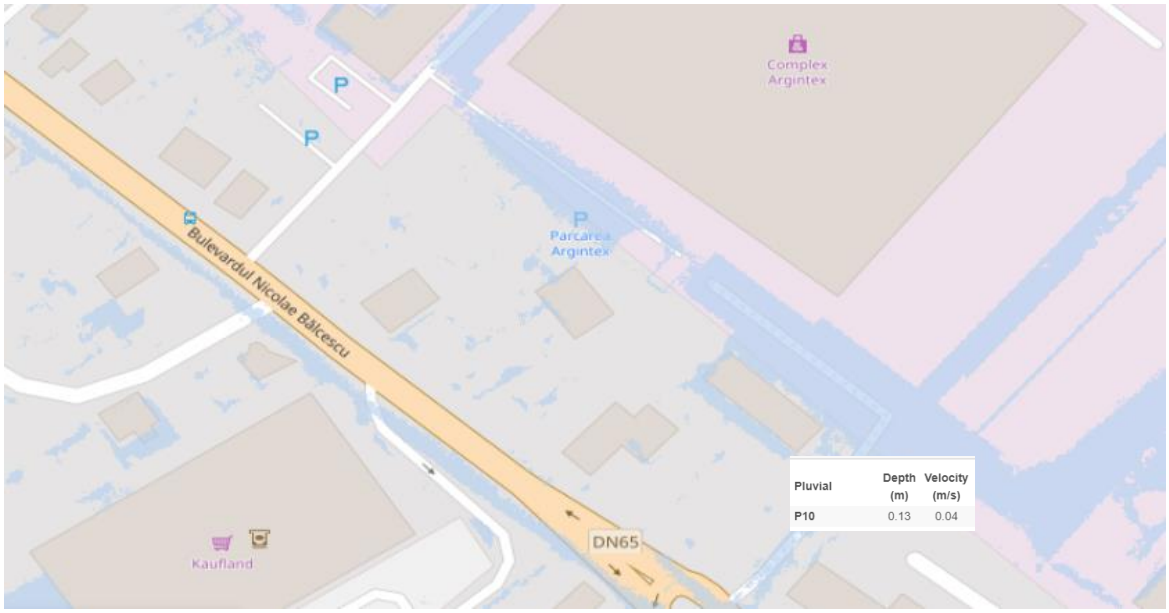


***Figure 45 –*** *Nicolae Bălcescu Boulevard, intersection with Argintex complex, 1 in 10 years flood event*

*Source: World Bank RO-FLOODS database*

The General Inspectorate of Emergency Situations has a database with the data and addresses of the locations flooded in the last 15 years (2006-2020) from Pitești, Argeș County. These points are marked in shapefiles and can be found in the figure below.

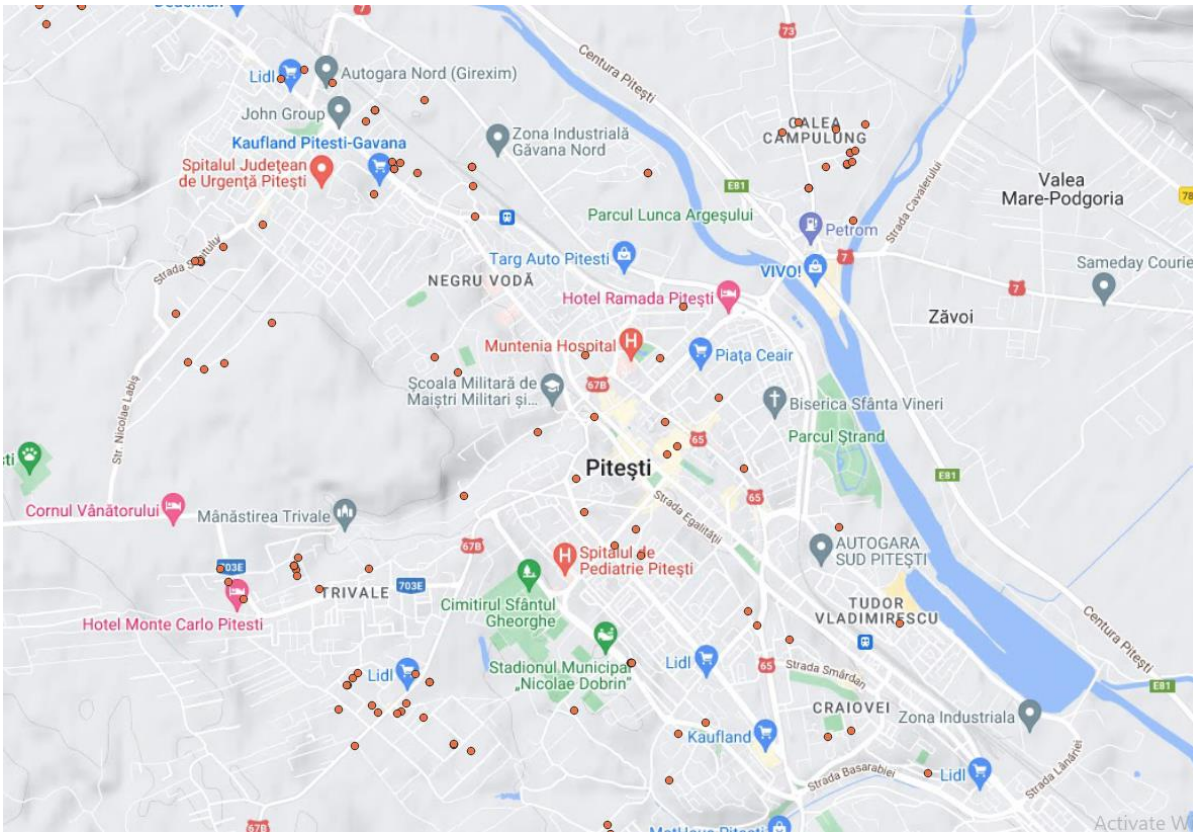


***Figure 46 –*** *Points where urban floods occurred in Pitești Municipality and IGSU had to intervene between 2006 and 2020*

*Source: IGSU*



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### C.2.3.3. Treatment of wastewater

Pitești wastewater treatment plant is mechanical biological with advanced treatment and was dimensioned for the equivalent population 320,000 $Q_{uz\ day\ max}$ = 72,100 m3/ day, $Q_{uz\ or\ max}$ = 4,100 m3 / h and $Q_{uz\ or\ min}$ = 740 m3 / h (flow rate dimensioning of the roughing step Q = 8,200 m3 / h; biological stage sizing flow Q = 4,100 m3 / h), MTS load = 20,800 kg / day, CBO5 load = 17,800 kg / day, nitrogen load total = 3,600 kg / day and phosphorus load = 1,000 kg / day[84].

The general plan of the Pitești Wastewater Treatment Plant, on which are the main technological objects that ensure the current treatment chain, is presented in the following figure. The effluent is discharged in Argeș River, downstream of Pitesti reservoir.

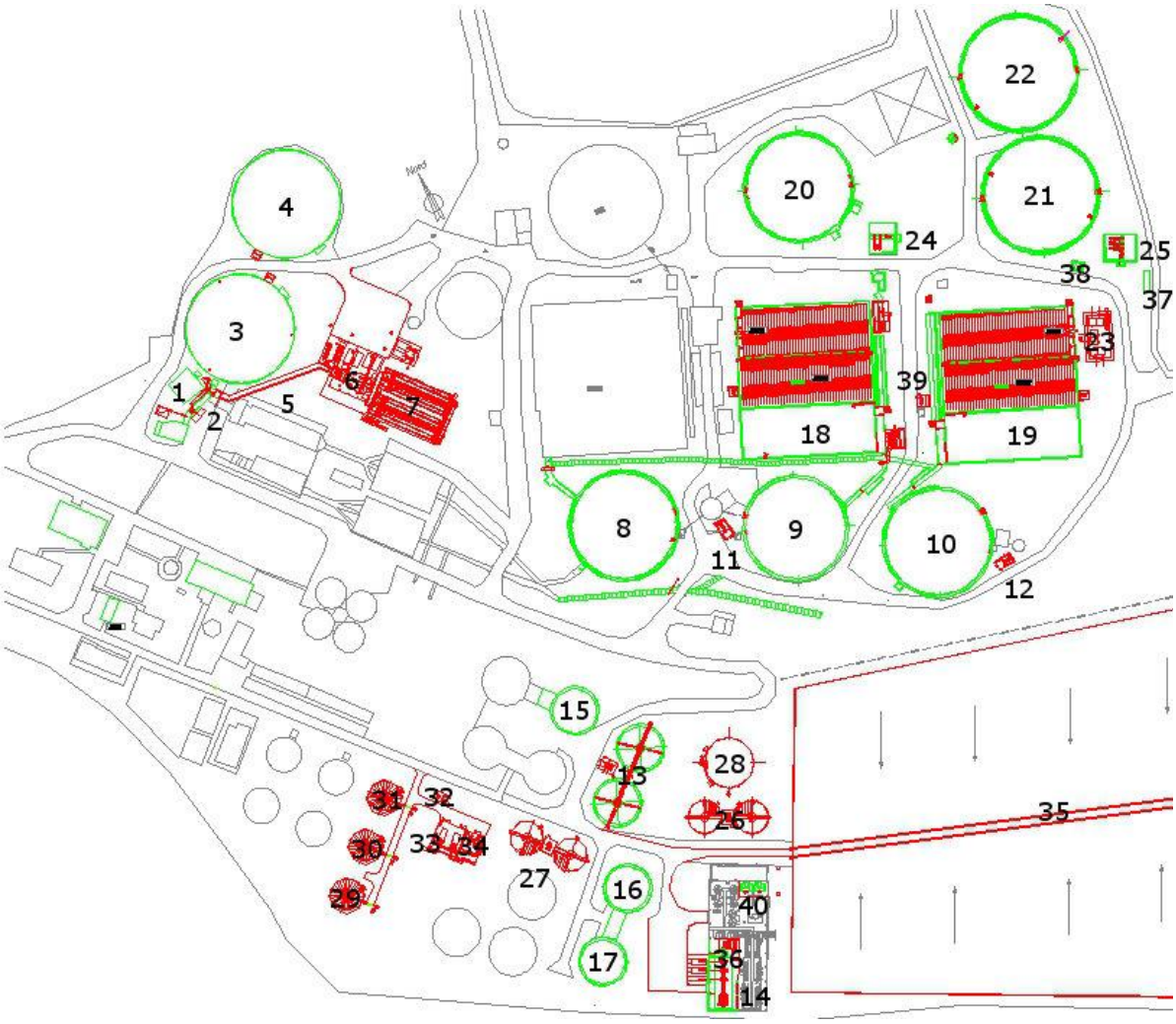


***Figure 47 –*** *General plan of Pitești WWTP*

*Source: Master Plan on the Rehabilitation, modernization and extension of water supply and sewerage systems in Arges County (2017) Revised version*

### C.2.3.4. Deficiencies of the wastewater treatment plant

The works completed under the ISPA measure no. 2003 / RO / 16 / P / PE / 026 „Rehabilitation of the wastewater treatment plant, the sewerage and water supply network in Pitești Municipality, Argeș County, Romania" ensured the rehabilitation and improvement of the Wastewater Treatment Plant Pitești. The quality of the effluent is in accordance with the Romanian legislation in force (NTPA

[84] Master Plan on the Rehabilitation, modernization and extension of water supply and sewerage systems in Arges County (2017) Revised version



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011/2002, assessed and supplemented by GD 352/2005) and with Directive 91/271 / EEC on urban wastewater treatment as amended by Directive 98/15 / EEC. In SOP Environment Programme, it was proposed to supplement the facilities included on the sludge line with a dehydration station for sludge with press filters (including lime preparation-dosing installation).

#### C.2.3.5. The stormwater system

The rainwater network has a total length of 82.6 km and the concept of the rainwater network reflects the existence of natural valleys (Bascov, Trivale, Valea Rea, Găvana, Turcești, Geamăna), where water collected rainwater is discharged. From the lower part of the city the pluvial water flows gravitationally in Argeș River (flow rates less than 10 $m^3/s$) through a collector (Dn = 2.5 m, L = 1.37 km) and by pumping (for flows higher than 10 $m^3/s$).

### C.2.4. Flood Risk Management Tools

**The National Strategy on Flood Risk Management has as specific objective on long term: to protect localities against floods of 1% to 0.01% AEP**, depending on the rank of the locality. Pitești is a rank II locality. This implies for the defense structures to be designed for at least 0.2% AEP floods.

**Flood Risk Management Plans**

In line with the flood risk management objectives, the cycle 1 FRMP of Argeș-Vedea RBA (2016) contains proposal of measures to reduce the fluvial flood risk along Argeș river and Râul Doamnei APSFRs (T*able 22*)[85]:

| APSFR name | EC measure code | Name of the measure | Implementation status |
|---|---|---|---|
| r. Argeş - av. loc. Piteşti | M31 | Improving the management of forests in the floodplains of the Argeș River for 2696.3 ha | - |
| | M31 | Maintaining the surface of the forests in the Argeș river basin for 71015.2 ha | - |
| | M31 | Maintaining forests in the perimeter areas of the accumulation lakes 60 ha Goleşti reservoir on Argeș river | - |
| | M33 | Restoration of the attenuation volume of the Prundu reservoir on Argeș river, Piteşti locality, Argeș county (V = 60.000 m3) | Done |
| | M35 | Securing the Budeasa dam on Argeș river, Argeș county. Estimated capacities: Rehabilitation of electrical, hydromechanical installations, etc. | In 2019, PT was completed |
| | M35 | Securing the Bascov dam on Argeș river, Argeș county. Estimated capacities: Rehabilitation of electrical, hydromechanical installations, etc. | SF prepared, but needs updating |

[85]https://cdr.eionet.europa.eu/help/Floods/Floods_2018/GuidanceDocuments/FD_ReportingGuidance.pdf
[85]http://www.inhga.ro/documents/10184/121027/7+PMRI+Arges-Vedea.pdf/3a2701a9-2fc7-4308-8f44-b505c86f985f


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| APSFR name | EC measure code | Name of the measure | Implementation status |
|---|---|---|---|
| | M35 | Securing the Prundu dam on Argeș river, Argeș county. Estimated capacities: Rehabilitation of electrical, hydromechanical installations, etc. | SF prepared, but needs updating |
| | M35 | Maintenance and repair of hydromechanical equipment and related installations<br>hydrotechnical construction:<br>- Pitesti on Argeș river | Done |
| r. Râul Doamnei - av. loc. Sboghiţeşti | M31 | Maintaining the forest area in the Râul Doamnei river basin for 46500.5 ha | - |
| | M35 | Securing the Mărăcineni Dam - left bank of the Râul Doamnei river, Arges county. Estimated capacities: bank protections on 528 m | SF prepared, approved by Ministerial Order, but no funds were allocated |
| r. Bascov | | Regularization of Bascov river, upstream confluence with the river Argeș, Argeș county. Estimated capacities:<br>Riverbed arrangement = 25500 m, riverbank defenses for 2130 m | Investment objective in progress |

***Table 22** – Measures proposed in cycle 1 FRMP of Argeș-Vedea RBA*
*Source: Flood Risk Management Plan for Argeș-Vedea River Basin Administration*

An integrated project was proposed in cycle 1 FRMP of interest for Pitești Municipality: *The complex arrangement of the rivers Argeș, Râul Târgului and Râul Doamnei for defense against floods of riparian localities.*

Under the 2nd cycle FRMPs, for all the fluvial APSFRs and for the pluvial APSFR – Pitești, a strategy will be developed to reduce the flood risk at APSFR level.

**The River Basin Management Plan of Argeș - Vedea RBA (2022)** indicates as water bodies along the APSFRs of interest for Pitești Municipality the following (*Table 23*)[86]:

[86] https://arges-vedea.rowater.ro/despre-noi/descrierea-activitatii/managementul-european-integrat-resurse-de-apa/planurile-de-management-ale-bazinelor-hidrografice/prezentari/#1656579009895-7a0f4afe-78c7


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| Water Body name | Water Body Code | Category | Status/ Potential (S/P) | Water body typology code | Class of the ecological status/ potential | Chemical status |
|---|---|---|---|---|---|---|
| Argeș: sector amonte conf. Vâlsan - intrare Ac. Prundu (am. conf. Râul Doamnei) | ROLW10-1_B3 | LW | P | ROLA06 | 2 | 2 |
| Argeș: Sector intrare Ac. Prundu (Pitești) - aval Ac. Golești | 4 ROLW10-1_B4 | LW | P | ROLA07 | 3 | 2 |
| Canal Bascov | RORW10-1_B2_F | RW | P | RO05CAA | 2 | 2 |
| Canal Prundu | RORW10 -1_B2_G | RW | P | RO10*CAA | 2 | 2 |
| Râul Doamnei : Localitatea Slatina - av. Ac. Mărăcineni | RORW10-1-17_B3A | RW | S | RO05 | 3 | 2 |
| Râul Doamnei : av. Ac. Mărăcineni - confluență Argeș | RORW10 - 1 - 17_B4 | RW | S | RO05 | 3 | 2 |
| Bascov | RORW10-1-16_B1 | RW | S | RO04 | 4 | 2 |
| Budeasa | RORW10-1-17-11_B1 | RW | S | RO18 | 3 | 2 |

***Table 23*** *– Water bodies of interest for Pitești Municipality*
*Source: Updated River Basin Management Plan for Argeș-Vedea RBA 2022 - 2027*

Legend:
RW - natural river / CAPM river / artificial river
LW - reservoirs


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S/ P – ecological status/ ecological potential
Water body typology code: Natural rivers: RO01-RO19; Strongly modified rivers: RO01CAPM-RO19CAPM; Artificial rivers: RO01CAA-RO19CAA; Reservoirs: ROLA01-ROLA07
Classes of the ecological status/ potential: 1- very good ecological condition/ 2- good ecological status/ / maximum and good potential/ 3- moderate ecological status / moderate potential; 4- poor ecological status / potentially weak

When elaborating the strategies at APSFR level, the characterization of the water body should be considered.

Currently, **Pitești Municipality Flood Defence Plan against floods, ice and accidental pollution**[87] is not published on the municipality website.

## C.2.5. Areas developed in floodplain

Analyzing the flood risk map overlapping the neighborhood boarders it is observed that only 2 out of 13 neghbourhoods are affected by flood: Calea Câmpulung and Prundu. The report will further approach these two city areas given that the rest of the city is considered safe according to the hazard and flood risk map.


***Figure 48 –*** *Flood risk map overlapping the satellite images and neighbourhoods*
*Source: World's Bank processing of Google Earth Satellite View image*

**Calea Câmpulung Neighbourhood**

Following the analysis of the risk maps, it is observed how the east and the south of the regulated built area are under the threat of floods. This is due to the location of the neighbourhood on the western side of Râul Doamnei River.

[87] https://www.primariapitesti.ro/cautare?keyword=inundatii&Search=


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Analyzing the urban documents approved and in progress, it is observed that all the territory of the neighbourhood is regulated to be built, not taking into account the low risk of floods.

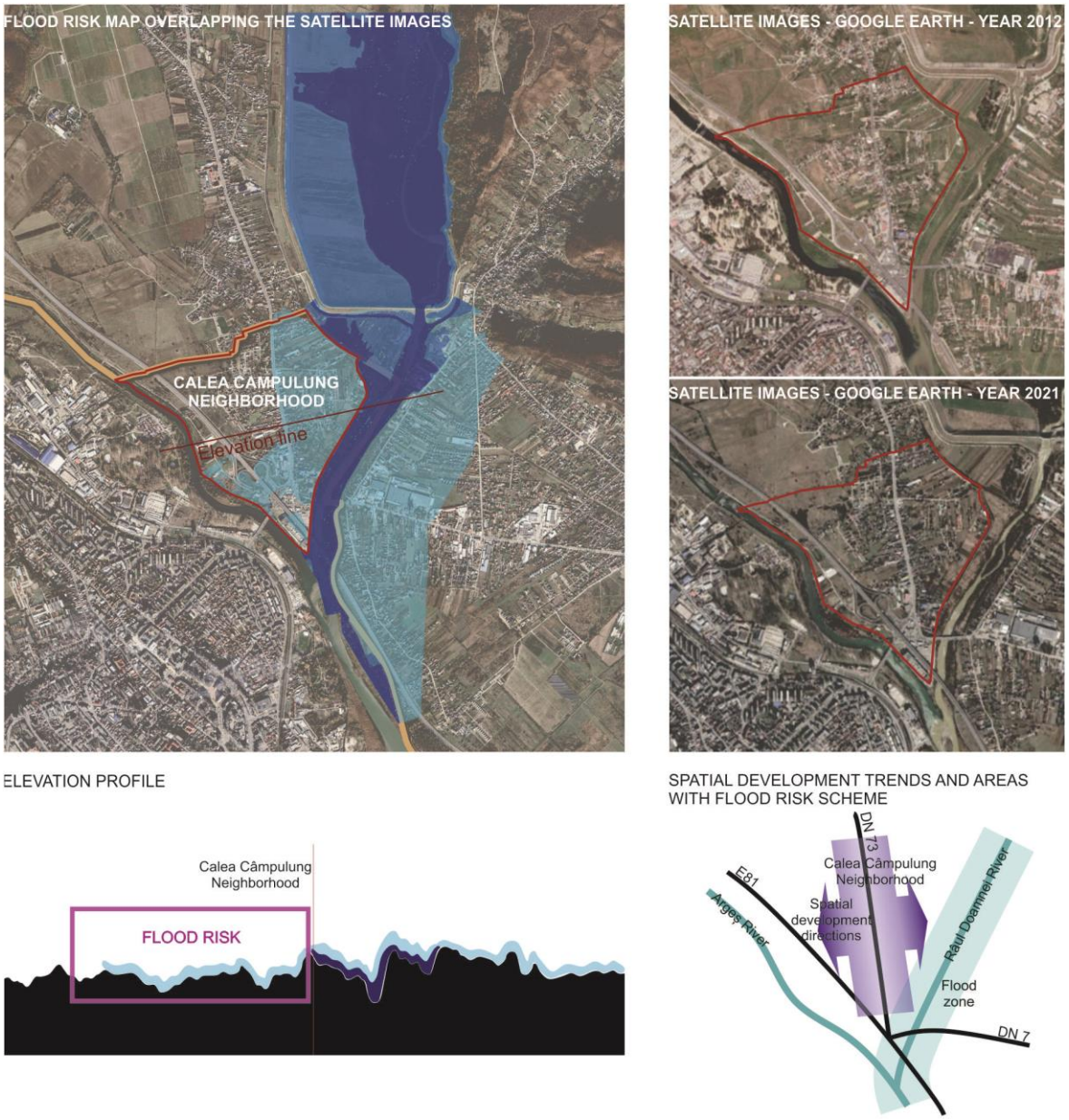


***Figure 49 –*** *Flood risk map overlapping the satellite images (up, left). Comparison between satellite images from 2012 and 2021 (up, right). Elevation profile (down, left). Spatial development trends and areas with flood risk scheme (down, right).*

*Source: Flood risk map. Pitești General Urban Plan in progress. World's Bank processing of Google Earth Satellite View image*

**Prundu Neighborhood**

The neighborhood is located on the west side of Argeș River and overlaps the flood risk territory over a limited area. It is divided by the railway which connects the city with the Capital and includes residential buildings, institutions, but also industrial units and technical equipment and utilities constructions.

Analyzing the risk map, it is observed that the east of the regulated built area is under the threat of floods, in an area where the urban documents in progress regulate technical equipment, utilities constructions and industrial units.



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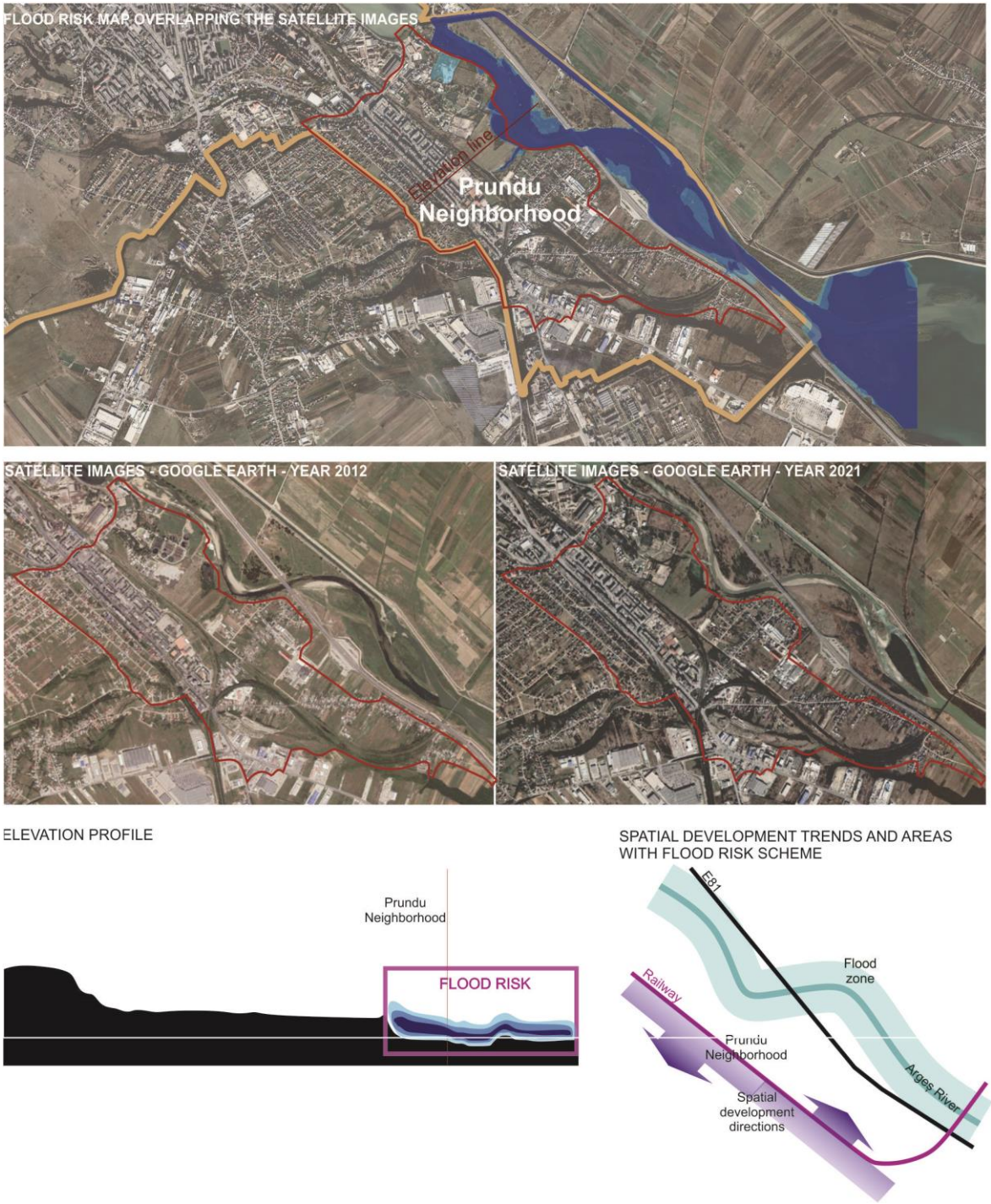


***Figure 50 –*** *Flood risk map overlapping the satellite images (up, left). Comparison between satellite images from 2012 and 2021 (up, right). Elevation profile (down, left). Spatial development trends and areas with flood risk scheme (down, right).*

*Source: Flood risk map. Pitești General Urban Plan in progress. World's Bank processing of Google Earth Satellite View image*



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## C.3. Integration of hazard and flood risk maps and flood risk management measures into spatial and urban planning

### C.3.1. Spatial and urban planning plans analysis

#### C.3.1.1. Argeș Territorial County Plan

The County Territorial Development Plan (PATJ) is a type of urban planning documentation that is elaborated at the request of the County Council, more precisely by he Urban Planning, Spatial Planning and Public Works Department within the institution. This is prepared according to the methodology of the Framework Content of the urban planning and spatial planning documentation in accordance with the provisions of Law 350/2001 and it represents the planning of the county's territory strategy.

The purposes of drawing up this urban planning documentation are the spatial development of Argeș County's territory, the establishment of objectives, directions and measures for the development of Argeș County's territory, the formalizing of the development strategy in the territory, the substantiation of the development plans in the territory, to contribute to the solution of some specific problems in Argeș region, and correlation with the previous Spatial Planning plans drawn up: PATN and PATZR.

The initiation of PATJ was approved by the Argeș County Council Decision number 267/October 26, 2018, which also designated the persons responsible for informing and consulting the public. It also established the structure of the working group which includes representatives of the Argeș County Council and local public administrations in the county and neighboring counties, representatives of the relevant departments of the Development Ministry and of other interested institutions at central, regional, county or local level, of the business environment and of the academic environment.

#### C.3.1.2. Sustainable Development Strategy of Pitești Municipality, Argeș County

Within the Sustainable Development Strategy of Pitești Municipality, there is a chapter dedicated to environment risks.

The documentation also mentions the flood risk among the natural risks. The flood risk maps and management has been approved by the Local Council and it sets out the measures and actions in case of emergency situations.

In the diagnosis part of the strategy, in the SWOT analysis, flood risk is mentioned. Two projects were mentioned in the proposal part of the Strategy. These two are included in *Specific objective no. 1 – Urban rehabilitation by increasing the quality of life and ensuring the necessary conditions for connecting the citizen to public utilities, modern road networks, leisure and sport:*

- 1.6. Improving the urban infrastructure – 1.6.4. Creating special housing systems for emergency situations;
- 1.7. Decreasing the risk of natural disaster – 1.7.1. Rehabilitation, consolidation and regularization in the Pârâul area and Zamfirești street in order to ensure the elimination of risks.

#### C.3.1.3. Pitești General Urban Plan

According to the M*ethodology Guide on the elaboration and the framework content of the General Urban Plan*, approved by Order no. 13N/10.03.1999, the **General Urban Plan is the main tool of operational planning and has a directorial, strategic and regulatory character**. Thus, the purpose of the P.U.G. is:

- establishing the directions, priorities and regulations for spatial planning and urban development of localities;



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- ensure the rational and balanced land use, necessary for urban functions;
- areas susceptible to natural hazards will be marked and specified (landslides, floods, geological inhomogeneities, vulnerable existing built-up areas);
- to highlight the valuable built-up area and to specify the way of its capitalization for the benefit of the commune;
- to ensure an increase in the quality of life, especially when it comes to housing and services;
- to ensure the basis of the realization of some investments of public utility;
- to ensure the regulatory support for the issuance of town planning certificates and building permits;
- to ensure the correlation of the collective interests with the individual ones in the land use.

Also, the **goals** pursued by the General Urban Plan are:

- optimizing the relations between the localities and their administrative and county territory;
- capitalizing on the natural, economic and human potential;
- different routes development and organization;
- establishing and delimiting the regulated built-up area;
- establishing and delimiting buildable areas;
- establishing and delimiting areas with a temporary or permanent construction ban;
- establishing and delimiting the protected areas and their protection zones;
- modernization and development of the water, sewer, electricity, gas and telecommunications networks;
- highlighting the land holdings in the regulated built-up area;
- setting public utility objectives;
- establishing the land use and the conditions of conformity and construction.

After approval in accordance with the existing law, the General Urban Plan becomes an act of authority belonging to the Local Public Administration's authority.

According to the National Territory Development Plan – Section IV – Network of localities, Pitești Municipality is a rank II locality. In addition to this, Pitești Municipality is the capital of the Argeș County.

According to the National Territory Development Plan – Section V – Natural risk areas, Pitești municipality fits into the category of *no fluvial flood risk*.

According to Order no. 233/February 26, 2016 for the approval of the *Methodological Norms for the application of Law no. 350/2001 regarding the spatial planning and urbanism and for the elaboration and updating of urban planning documents,* the list of preliminary studies necessary for a locality of rank II includes the following:

1. Analytical studies:
   - Preliminary Study regarding the updating of the Topographic Support;
   - Preliminary Study regarding geotechnical and Hydrological Preliminary Study;
   - Preliminary Study regarding peri-urban relations;
   - Preliminary Study regarding organization of roads and transport;
   - Preliminary study on Environmental protection, Natural and Anthropogenic risks;
   - Historical preliminary study / Landscape preliminary study;
   - Preliminary study regarding the identification of property types;
   - Preliminary study regarding the utility network;
2. Advisory studies:
   - Preliminary study on stakeholder analysis and social surveys;


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3. Prospective studies:
   - Preliminary study regarding the economic activities' evolution;
   - Preliminary study regarding socio-demographic evolution;
   - Preliminary study regarding urban mobility and transport;
   - Preliminary study regarding the impact of climate change;

The working team has not yet received the preliminary studies mentioned above from Pitești Municipality City Hall, neither the natural risks study. The Preliminary study on Environmental protection, Natural and Anthropogenic risks and the Preliminary study regarding the impact of climate change were not provided, but could have helped to identify recommendations on the issue of floods in the city.

Despite the fact that none of the preliminary studies required according to Order 233/2016 were provided, in the memoir of the General Urban Plan of Pitești Municipality, they are all mentioned.

The preliminary study of the General Urban Plan in progress specifies the analysis and the conclusions of the Geotechnical and Hydrological Preliminary Study and enumerates the critical points on the watercourses which are mentioned in the Accidental flood, frost and pollutions protection plan on the watercourses by the Local Committee for Emergency Situations during the period 2018-2021.

In the proposal part, there is a number of measures needed for natural risk areas, specifically for flood risk areas. Specific measures are still needed to prevent flooding:

- watercourses protection zone will be taken into consideration;
- development of defense plans against floods, dangerous meteorological phenomena and accidents at hydrotechnical constructions in accordance with the National Territory Development Plan, in compliance with the construction regime restrictions and through consultation of individuals and legal persons;
- controlled flooding of the areas established by the defense plan and of the dammed areas;
- closing the riverbeds that are now open, in natural regime, of Valea Rea and Trivale stream;
- proper maintenance of drainage and repair the damaged ones;
- strict control over the soil extractions from the dams and their protection area and over the tree planting on the dams.

These measures will be implemented through:

- resizing the bridges;
- resizing the drainage section and creating a unitary system of ditches and drains in order to collect the rainwater excess;
- resizing the rainwater drainage network to cover the whole territory;
- bank raising in weak riverbed cases;
- widening riverbeds and eliminating meanders;
- tributary riverbed regularization;
- river banks rehabilitation in cases of intense erosion.

In order to realize the future development program of Pitești Municipality it is necessary to achieve the general and priority objectives set out in the action plan. The updating process of PUG started three years ago and it is in the approval process. This is also the reason why the working team did not receive the action plan related to the General Urban Plan of Pitești Municipality.

The prescriptions of the Local Urban Regulation propose that terrains located in the area with flooding risk to have temporary building bans until the development of specialized preliminary studies.


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The prevision map included in Pitești General Urban Plan contains the flood risk zones, and all scenarios can pe located on the map as they appear on the flood hazard and risk maps (high scenario – 10%, medium scenario – 1% and low scenario – 0,1%) but there are no building bans imposed in high-flood risk areas or other necessary measures.

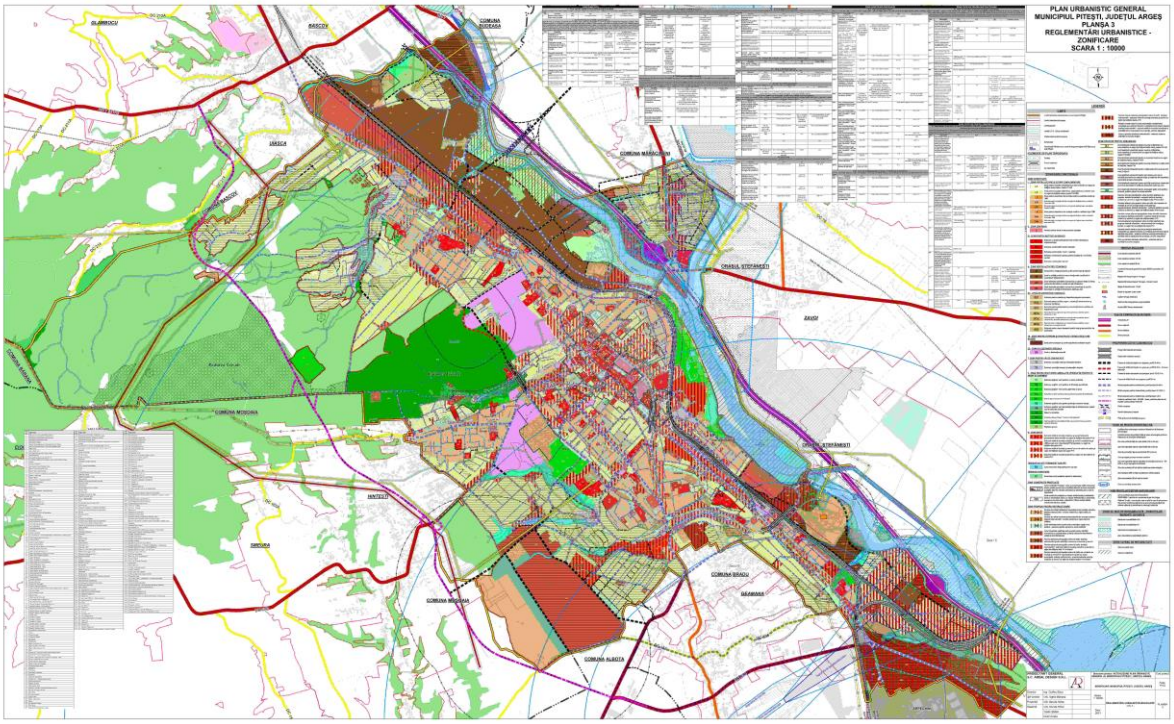


***Figure 51** – The General Urban Plan's provisions*
*Source: Pitești General Urban Plan*

## C.3.1.4. Conclusions

### Main gaps

The main gap in the Pitești pilot study is the **lack of data**: there are few spatial development plans available, including Argeș Territorial County Plan and even the complete General Urban Plan of Pitești. Both documentations are in work, not having been completed yet. **Long development periods for territorial and urban plans are a problem** which generates lack of coordination in spatial planning at all territory scales. The work for Argeș Territorial County Plan has begun in 2018, but there is no section of it available yet. This creates **a gap between the planning process on county and local scale**. The only intermediate level planning documentation is The Development Strategy of Pitești 2014-2020 which, regarding flood risk, is vague and it doesn't take flood risk in to consideration. Therefore, flood mitigation is affected by both lack of data and overlooking of flood risk in spatial planning documentations.

The Development Strategy of Pitești 2014-2020 proposes a series of measures for the rehabilitation and extension of the sewerage system. These are small-scale interventions which are **not addressing the catchment area of Argeș River** and are not part of a **coherent and integrated approach** towards flood risk. Moreover, the written strategy is not completed by a spatialization of the proposed projects and flood prevention is not at all clearly approached.

**The PUG does not correlate with the broader scale documentations** because there is no available data coming from institutions with role in the management of emergency situations generated by floods, preliminary studies or specialized. The approach to planning and flood mitigation is not multi-scalar in Pitești Municipality and Argeș County and this is also due to the **absence of intermediary**


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**administrative structures like a metropolitan area**. Even though it is the capital city of the county, Pitești does not have a metropolitan area.

Regarding flood risk measures, the drawn part of Pitești General Urban Plan maps flood risk areas in the regulated built area but **it does not feature proposed measures for flood mitigation or any spatialization of it**. In the absence of flood data and available specialized flood studies, the only proposed measure by the General Urban Plan of Pitești is temporary building ban in flood risk areas. Furthermore, **other types of flood sources (pluvial, groundwater etc.) are not mentioned** nor in the written or drawn part.

### Lessons learned

The long development and approval time of territorial and urban spatial plans is also a major gap in the flood risk prevention on Argeș River. Most of the proposed measures presented in the analysed documentations are structural flood prevention measures and they have a small-scale approach. Technical documentations and spatial planning documentations should be intercorrelated – the preliminary studies for the Argeș Territorial County Plan and Pitești General Urban Plan should be site-specific and also taking into account the catchment area, having a global, multi-scale approach. Additionally, on a more general level, **flood risk studies should be a mandatory part of any spatial planning documentation, with a pre-regulated content** (Geotechnical and Hydrological Preliminary Study, Study on Environmental Protection or Natural and Anthropogenic Risks). This could help the intercorrelation of plans on multiple scales regarding flood mitigation.

Argeș River is not the only water track in Pitești Municipality – the water system in the city is much greater, with Râul Doamnei River, Bascov River, Geamăna Mică stream. **All local waterways should be studied thoroughly in order to determine their flood risk, possible measures and also their potential**, but this must be done by professional engineers in collaboration with the local administration, urban planners and other professionals. The necessity of these studies stands in the mutual necessity of developing spatial planning plans, at territorial and urban scale.

The land resources on both banks of Argeș River can be emphasized only by clarifying landownership withing the flood risk area and this should be done for areas with 10% exceedance probability of floods. This might reveal **an opportunity for using nature-based solutions** regarding flood mitigation and also a great potential for leisure activities and improvement of the urban landscape of Pitești.

## C.3.2. Spatial and urban planning plans elaboration, approval and enforcement

### Main gaps

#### *The municipalities meeting*

There were two interviews with Pitești Municipality, on 15th and 25th of November, both having three main topics: historical floods, the General Urban Plan's update status and integration of flood hazard prevention in future planning practices.

**Main gaps regarding local flood risk**

Pitești urban area is exposed to flood risk mainly due to the large built areas located in floodplain of Argeș River. Flood risk is increased by the additional presence of small rivers with non-permanent water flows (Valea Rea, Trivale or Zamfirești) and the other two main rivers in the area, Râul Doamnei River and Bascov.

Fluvial flood risk maps have been developed but there is no spatial data regarding pluvial and flash flood risk, neither are there flood risk maps for the forementioned small rivers. Moreover, there is no GIS data for the entire sewerage system in the Municipality.

**Main gaps regarding spatial and urban planning**

The Pitești General Urban Plan in force has been approved in 1999 but due to the continuous urban development of the city, it is outdated. In the absence of an integrated vision, the development of Pitești has been incoherent, based mainly of Urban Zoning Plans (PUZ) which are hard to be corelated and integrated in the municipal development. Most of the PUZ are not improving the permeability of the urban tissue.

The second attempt to update the PUG has started in 2019 and the document currently is in the consultation phase. The development of the PUG has faced multiple issues as: low funding due to single-sourced funds (the municipality), legal difficulties in land uses and environmental issues (forestry in the regulated built area), incompatibilities with the citizen's needs or lack of data from the Water Company. According to the municipality, the PUG has to include flood studies for all the watercourses within the city, even though this request is not part of the legal framework.

**Main gaps regarding the integration of flood hazard and risk maps and flood risk management measures to reduce the flood risk into spatial and urban planning**

There is an urgent need for framework regarding flood studies and flood mitigation measures, according to the expressed needs of urban planners and other professionals. Flood risk measures that are proposed in spatial planning practices are not specific enough.

***National Romanian Waters and Rivers Basin Administrations meeting***

The interview with the River Basin Administrations took place with all the three institutions: Argeș-Vedea, Banat and Siret River Basin Administrations. It happened on 9th of February (09.02.2022) and it had three topics: spatial and urban planning in the absence of risk maps and flood studies, integration of FRM (flood risk management), RBM (river basinal management) and environmental aspects in spatial and urban planning and interinstitutional cooperation. The interview and its conclusions (**the main gaps**) for the three topics have been further presented previously in *SECTION B: Timișoara city pilot area, Timiș County.*

***County Inspectorate for Emergency Situations meeting***

The interview with the **County Inspectorate for Emergency Situations** (**IJSU Argeș**) was held through an official address on 21st of February 2022 (21.02.2022). The interview consisted of 4 questions regarding integration of flood risk mitigation in emergency situations plans.

**Main gaps regarding integration of flood hazard and risk maps and flood risk management measures to reduce the flood risk into spatial and urban planning**

Emergency situation evacuation areas are designated by the Local Committee for Emergency Situations (CLSU), supported by the Argeș-Vedea River Basin Administration. This data is included in the Local Flood Mitigation Plans and it is based on the Hazard and Flood Risk Maps.

Fast Intervention Centers' locations are included in the Local Flood Mitigation Plans but these points and other emergency infrastructure are not part of the flood risk plans.

**Main gaps regarding interinstitutional cooperation**

Risk receptors that are featured in the Local Flood Mitigation Plan are shared with the Local Council and urban planner and the County Council has to disseminates to the Local Council the Hazard and Risk maps and the Local Council has the legal obligation to request introducing this data in PUG.

**Main gaps regarding permits and authorizations**

The involvement of IJSU Argeș in the planning process only refers to prohibition of building in certain areas. According with the Romanian Water Law, it not permitted to build in the flood risk areas and Argeș-Vedea River Basin Administration will not issuing permits in such cases.

## Lessons learned

### *The municipalities meeting*

**Lessons learned regarding local flood risk**

Due to the high density of buildings in the floodplain, flood risk can only be mitigated through small-scale local interventions and building of sustainable flood protection infrastructure on the smaller rivers in the area and the non-permanent streams. Apart from structural measures like sewerage system, dams, embankments or waste water plants, green infrastructure could also be a feasible solution for flood risk mitigation in Pitești Municipality. Green corridors can work as buffer zones and a permeable tissue for water collecting and runoff reduction.

More attention should be paid to small rivers, not only to bigger ones (Argeș or Râul Doamnei Rivers). Flood risk should be approached in an integrated manner, being aware that rivers are part of a complex hydrographic system, therefore there should also be macro-territorial measures.

**Lessons learned regarding integration of flood hazard and risk maps and flood risk management measures to reduce the flood risk into spatial and urban planning**

Pluvial and flash flood risk must be mapped and the data should be available for urban planners and other involved professionals; also very important is the coordination of flood mitigation measures between institutions.

Local flood studies should be site-specific, following a regulated framework, and the content should also vary regarding the type of documentation: civil infrastructure, buildings, territorial or urban spatial planning. The legal framework should also define who is responsible for the development of these studies and they should be foreseen in the PUG budget.

### *National Romanian Waters and Rivers Basin Administrations meeting*

The interview with the River Basin Administrations took place with all the three institutions: Argeș-Vedea, Banat and Siret River Basin Administrations. It happened on 9$^{th}$ of February (09.02.2022) and it had three topics: spatial and urban planning in the absence of risk maps and flood studies, integration of FRM (flood risk management), RBM (river basinal management) and environmental aspects in spatial and urban planning and interinstitutional cooperation. The interview and its conclusions (**lessons learned**) for the three topics have been further presented previously in *SECTION B: Timișoara city pilot area, Timiș County.*

### *County Inspectorate for Emergency Situations meeting*

**Lessons learned regarding the integration of flood hazard and risk maps and flood risk management measures to reduce the flood risk into spatial and urban planning**

Emergency and evacuation areas maps have been developed and mapped at a local level, following the flood risk areas' limits and are mapped on local emergency documents. The local authorities should include the emergency areas in the PUG and in other local and territorial documentations.

**Lessons learned regarding interinstitutional cooperation**

IJSU Argeș has constant communication with many relevant institutions (in conformity with the legislative roles), and with Argeș-Vedea RBA have the best institutional communication for protecting Pitesti Municipality in case of flooding.



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# SECTION D: Reșița city pilot area, Caraș-Severin County

## D.1. General description

### D.1.1. Territorial context

Reșița Municipality is located in Caraș-Severin County (in the Western area) and it is the capital of the county. It has developed along the Bârzava River and the National Roads DN58 (Caransebeș-Reșița-Anina route) and DN58B (Reșița-Timișoara route).
The territory of the municipality and its borders:

- in **North-West** with Bocșa Municipality;
- in **North-East** with Ezeriș and Buchin Communes;
- in **North** with Târnova and Păltiniș Communes;
- in **South-East** with Văliug Commune;
- in **South-West** with Carașova and Lupac Communes.

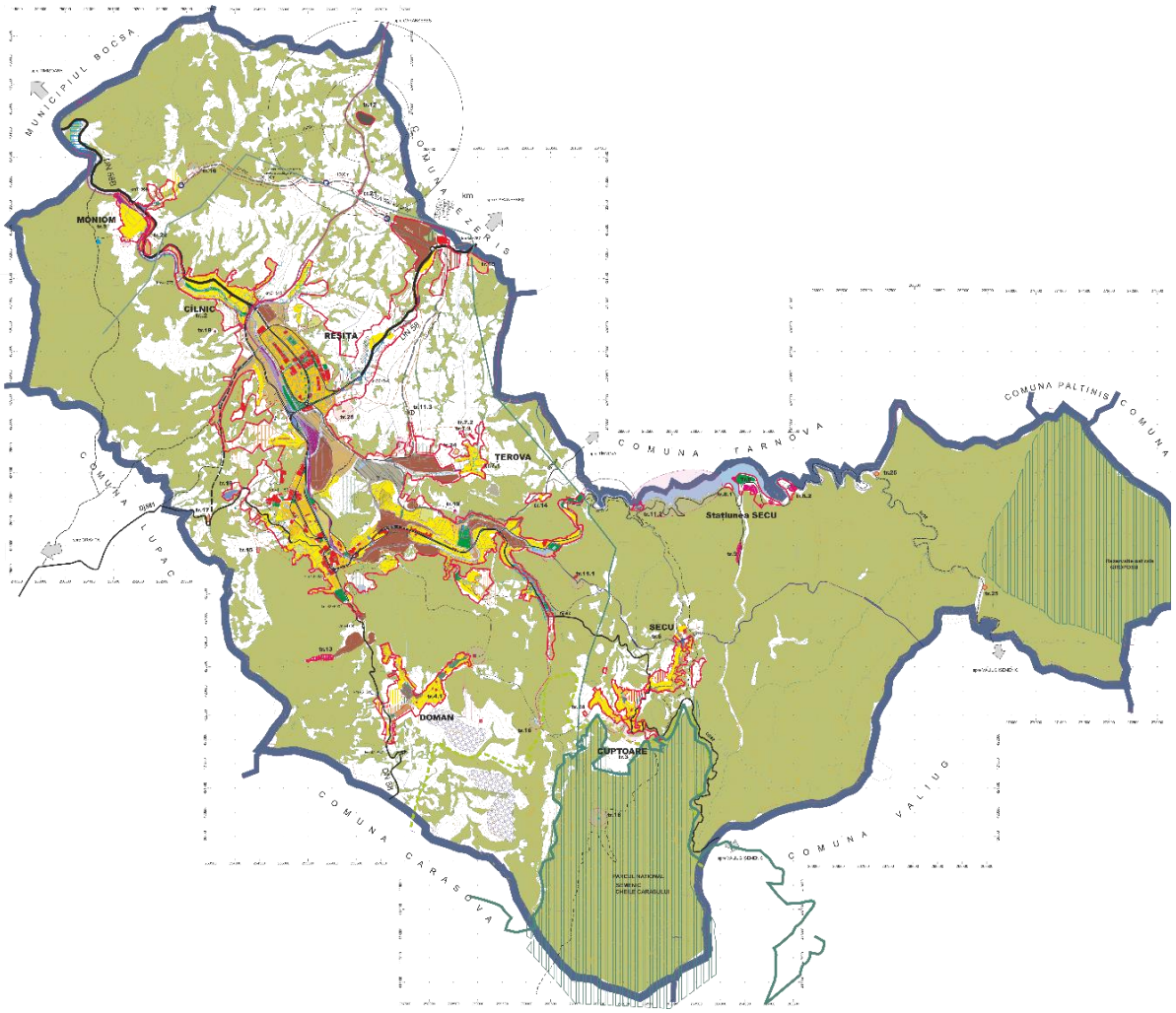


***Figure 52*** *– Reșița Municipality and component villages*
*Source: Reșița Municipality General Urban Plan*

The administrative territory of the Municipality includes **one city (Reșița)** and **five villages**: **Cânlic, Cuptoare, Doman, Secu**, **Țerova** and **Moniom**.

Given the vicinity of Timișoara Municipality (to the West) and Caransebeș City (to the East), road accessibility to Reșița is increased because of the two national roads that connect the city to the


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neighbouring cities. The main roads that cross Reșița are **DN58**, which connects it with Caransebeș and **DN58B** which connects it with Timișoara and crosses Câlnic and Moniom (North-West of the municipality) and Doman (South of the municipality). County Road DJ 582 connects the central area of the municipality – Reșița to Secu and Cuptoare villages.

The regional connections of Reșița Municipality are as it follows:

- with the other communes and cities, through the existing national and county roads and by railway;
- with Timișoara and Caransebeș Municipalities, through the existing national roads and by railway – the networks are based on different motivations like work, education, supply of consumer goods or industry.

Reșița Municipality connects with the neighboring administrative units by road and railway. The latter is a branch of the **M900** București-Caransebeș-Timișoara main rail line. Communications are provided by road traffic systems telecommunications.

## D.1.2. Geographical description

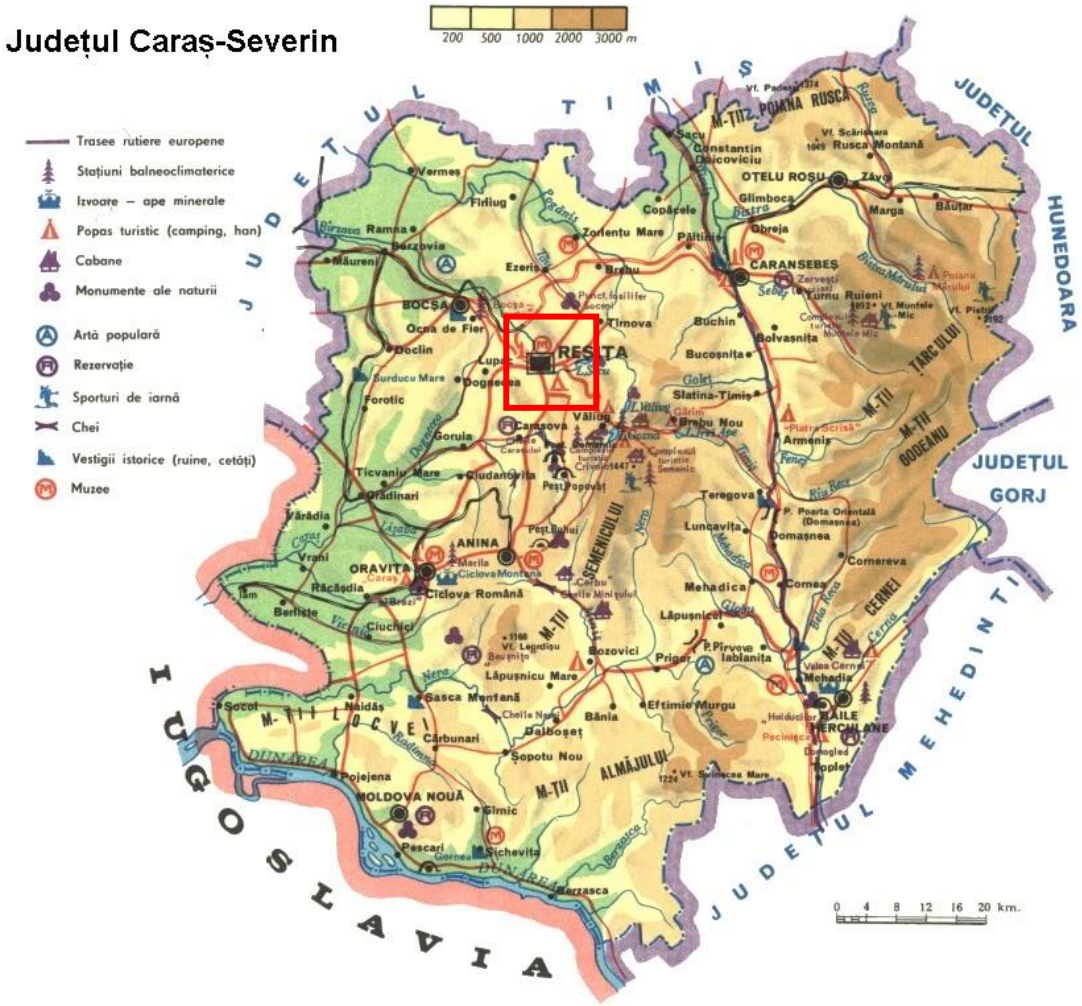


***Figure 53*** *– Placement of Reșița Municipality in Caraș-Severin County*

*Source: Harta Județului Caraș-Severin [online]. Available at: https://pe-harta.ro/caras-severin/ (Accessed: 31.03.2022)*

Reșița Municipality is located on both riverbanks of Bârzava River which crosses the center of the city on a length of 18 km and Câlnic and Moniom villages. The river springs in Semenic Mountains and flows from East to West, through the city, the two villages and later to The



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Western Plain. The river bed has a dynamic width which has influenced the development of the human settlements.

The topography of the area, within the North-Western area of The Semenic Mountains (with a medium height between 400 and 500 m), offers protection against the winds during spring and autumn. Reșița is placed in a valley along the meanders of Bârzava River.

There are three tributary rivers which flow into the main valley: Doman Creek, Țerova Creek and Sodol Creek. Țerova village has developed along the Valley of Țerova which is characterized by a low-altitude sloping terrain, with a medium height of 245 m.
The hydrographic network of Reșița Municipality consists of the Bârzava Valley, with the eponymous river, and the other three small valleys, Doman, Țerova and Govândari, with the eponymous creeks. Along Bârzava River there are four anthropogenic lakes, created for metallurgical industry purposes and for water suppliance for the villages: Breazova Lake, Gozna Lake, Trei Ape Lake and Secu Lake.

Bârzava River is a tributary of Timiș River which springs from the Semenic Mountains and has a length of 224 km on the Romanian territory, before it crosses in the Serbian territory. Bârzava has a length of 154 km and an area of 1202 $km^2$ on the Romanian territory. The segment between Reșița and Gătaia (to the North-West) is prone to great floods.

The area can be divided into four landscape sections:

- **Mountainous Reșița**
  The housing area is developed at the foot of the wooded hills and has a high area of urban green spaces like the „Ioan Crișan" Zoo Park and the hiking trails on the hills. The leisure area continues to the Secu village.
- **Central Area**
  It is placed along The Bârzava Valley, between two hills (Dealul Gol and Dealul Crucii) which are connected through an old disabled industrial funitel which was used for limestone transportation. The Southern hill, Dealul Gol, is covered with a pine forest and it also includes a vista point which offers a panoramic view of Reșița. The Northern hill, Dealul Crucii, is characterized by erosion processes, covered with deciduous trees. On the top of the hill there is a Memorial Cross for the soldiers fallen in the First World War.
- **Pomostului Meadow and Moroasa**
  The landscape is defined by the presence of the Southwestern hill (Dealul Ciorii) and Parcul Ateneului, a local leisure landmark which is placed on higher terrain than the housing area.
- **Govândari**
  A high-density collective housing area which is low in green spaces. The North-Eastern limit is represented by hills which are not connected with the urban area.

**Reșița City** is located in the central area of the administrative territory of the municipality, on the higher basin of Bârzava River, on both sides of the river, along Bârzava Valley. The built area of the city (both housing and industrial area) occupies the entire riverbed and part of the mountainsides.

**Moniom village** is the most Northern village of the Reșița Municipality, located 10 km to the North-West from the center of Reșița and it is geographically attached to Câlnic village. The village has developed on the left bank of Bârzava River, South from the main road, DN58B National Road, at the foot of the hills.

**Câlnic village** is situated in the North-Western area of the administrative territory of Reșița, on the higher basin of Bârzava River and it is an extension of the city built-up area. The village is crossed by the DN58B National Road and it had developed especially on the right bank of the river, along the main road.

**Cuptoare village** is located 7 km South-East from Reșița, in the Semenic Mountains, on the left bank of Secu Creek, at the foot of Ciopeasca Peak (616.1 m). It has been a commune along with Secu village,


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until 1968, when both villages went under the administration of Reșița City. It is crossed by the DJ582 County Road. The medium height of the territory is 400-500 m.

**Doman village** is situated in the vicinity of DN58 National Road, East from it, on the Bârzava Valley, in the Southern area of Reșița Municipality. Doman Creek is in the North-West of the built area, where it creates a meander. The total length of the creek is 5 km, with an area of 16 km$^2$. In the South of the village there is Doman Lake, a reservoir for metallurgical industry purposes and for water suppliance. The anthropogenic lake is also used for the limestone extraction.

**Secu village** is positioned in the South-Eastern area of the administrative territory of the municipality, 7 km from Reșița City center, near Cuptoare village. It was established at the end of the XVIIIth century simultaneously with the opening of two coal mines. The industrial area was completed with an aqueduct which is connected through the Secu Creek to the Secu Lake, located 4 km to the North. The lake also supplies the village with water and it is used for leisure activities especially by the inhabitants of Reșița Municipality.

**Țerova village** is located on the eponymous valley, on the right bank of the Țerova Creek, a tributary to Bârzava River. It is crossed by the Communal Road DC91 which leads to Reșița, to the West. The medium height of the area is 200 m.

### .1.3. Demographic data

According to the National Institute of Statistics, Reșița Municipality had 82,222 inhabitants in 2021[88].

*The Local Development Strategy of Reșița 2015-2025* conducted in 2015 an analysis of the socio-demographic evolution of the municipality in the past 8 years. The analysis shows that the total population number of the 7 settlements decreased in the 8-year horizon with 6.1%, from 95,356 to 89,626 inhabitants. According to the *Statistical Yearbook* (National Institute of Statistics), the number of inhabitants in 2020 was 82,969, lower than the number in 2015.

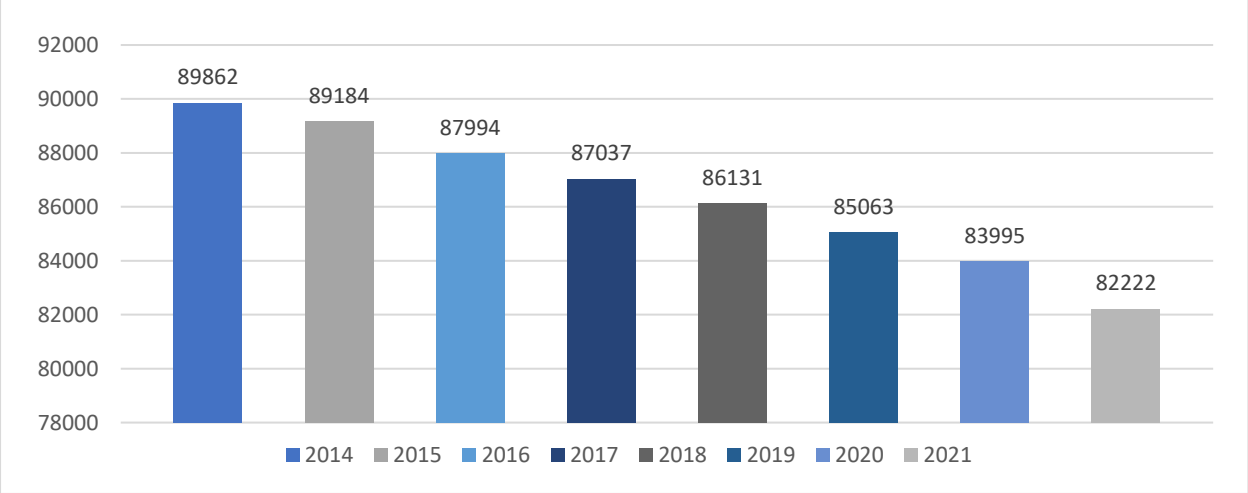


***Figure 54 –*** *The evolution of inhabitants' number between 2014-2021 – at the level of the entire Municipality*

*Source: National Institute of Statistics [online]. Available at: https://insse.ro/cms/ (Accessed: 31.03.2022)*

The decreasing numbers are caused by the migration that characterizes the Romanian former industrial towns and areas, which undergo a shrinking phenomenon. This process is also powered by the vicinity and easy access of Timișoara, one of the most important urban centers in the Western area of Romania, which attracts a great number of people from the region. In the analyzed time

[88] National Institute of Statistics, *POP108D – Populația după domiciliu la 1 iulie pe grupe de vârstă, sexe, județe și localități* [online]. Available at: https://insse.ro/cms/ (Accessed: 30.03.2022)



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horizon, 2018 recorded the highest rate of exterior migration[89], which has been increasing since 2013. However, the trend is decreasing, with a number of 1,565 residents leaving Reșița in 2020.

In comparison, the interior migration[90] rate is lower, recording small fluctuations in the number of people moving to Reșița between 2013 and 2020. In this period, the interior migration peaked in 2018 (912 people), then had a dramatic fall between 2019 and 2020 (698 people).

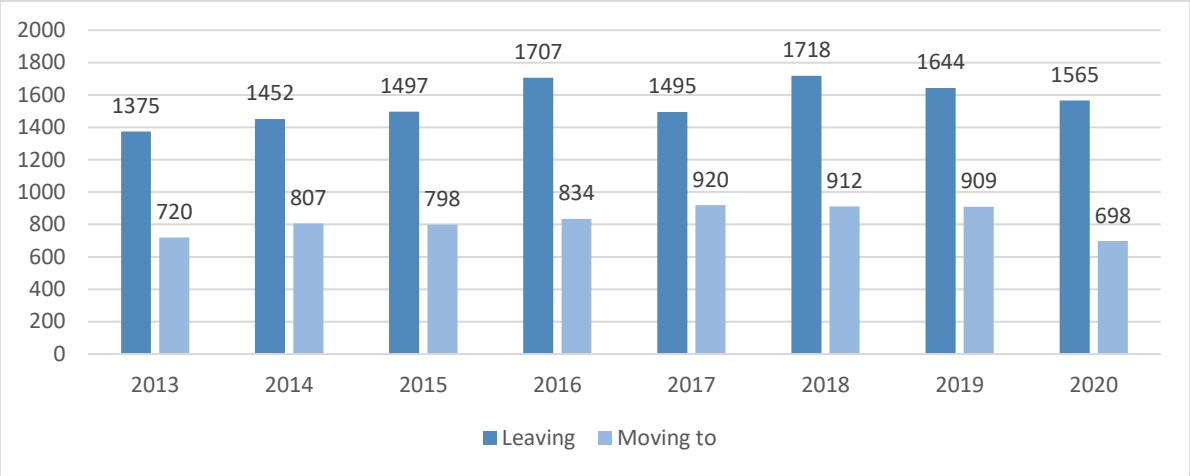


***Figure 55** – The evolution of residents leaving and people moving to Reșița between 2013-2020*
*Source: National Institute of Statistics [online]. Available at: https://insse.ro/cms/ (Accessed: 31.03.2022)*

Regarding the age groups and structure of the local population[91], most of the residents are aged between 50 and 54 years old, while the number of elders (between 60 and 70 years old) is bigger than of younger people (under 30 years old).

The analysis of the 2011-2021 period shows that there is a slight decrease in the number of births and an increase in the number of elder residents. This reveals a growing ageing population – another proof of the shrinking process the city is going through.

[89] National Institute of Statistics, *POP308A – Plecări cu domiciliul (inclusiv migrația internațională) pe județe și localități* [online]. Available at: https://insse.ro/cms/ (Accessed: 31.03.2022)
[90] National Institute of Statistics, *POP307A – Stabiliri cu domiciliul (inclusiv migrația internațională) pe județe și localități* [online]. Available at: https://insse.ro/cms/ (Accessed: 31.03.2022)
[91] National Institute of Statistics, *POP108D – Populația după domiciliu la 1 iulie pe grupe de vârstă și vârste, sexe, județe și localități* [online]. Available at: https://insse.ro/cms/ (Accessed: 31.03.2022)


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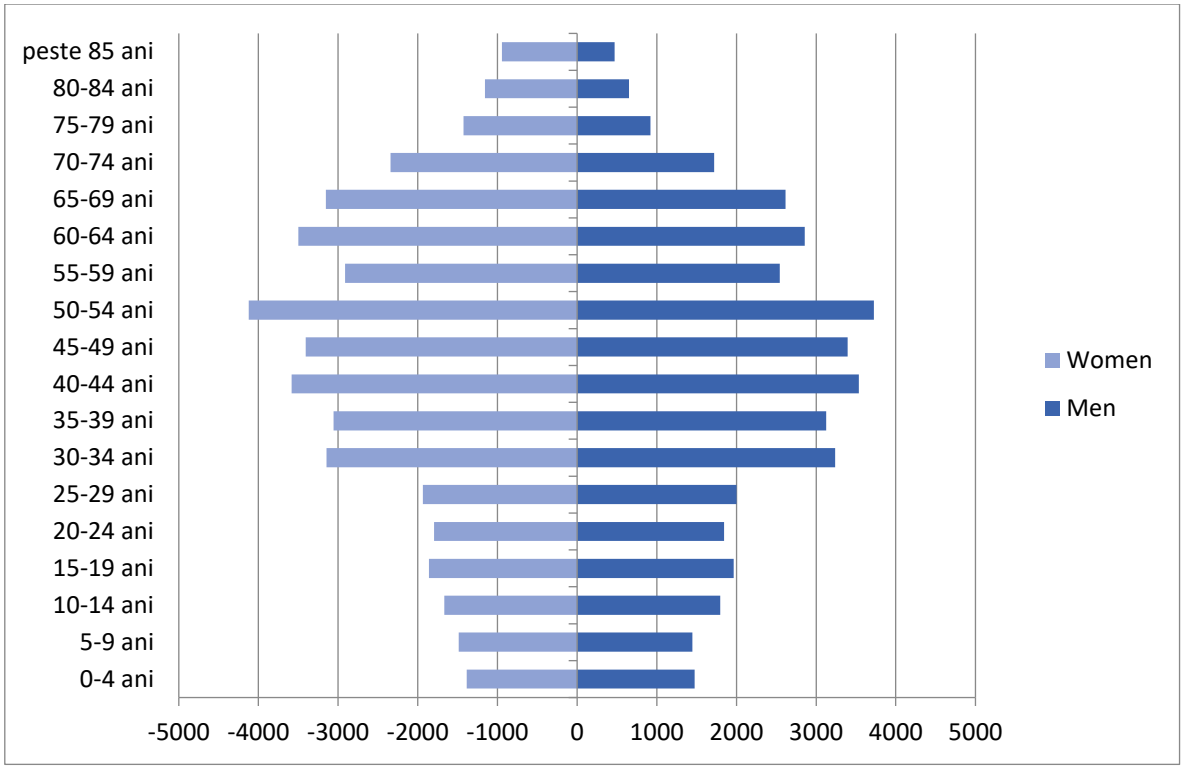


***Figure 56** – Population structure by age groups (2021)*
*Source: National Institute of Statistics [online]. Available at: https://insse.ro/cms/ (Accessed: 31.03.2022)*

The ethnic structure of the city is mainly made up of Romanians. Other ethnicities like Hungarians, Germans, Croats, Czechs, Roma or Slovaks are evidence of the past multiculturalism that was typical to the area. The number of Serbian, Croat, Czech and Slovak inhabitants has decreased between 2002 and 2011 and is expected to decrease even more significantly in the future.

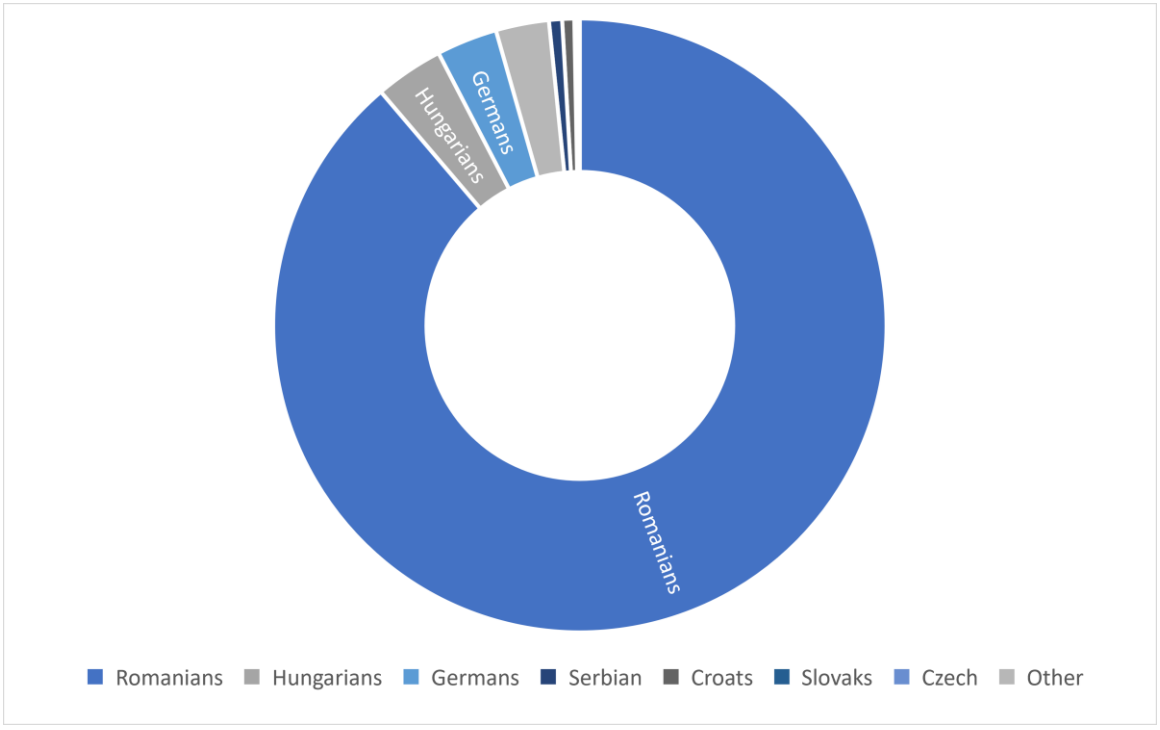


***Figure 57** – Ethnic structure of Reșița inhabitants in 2002*
*Source: 2002 Census, National Institute of Statistics*


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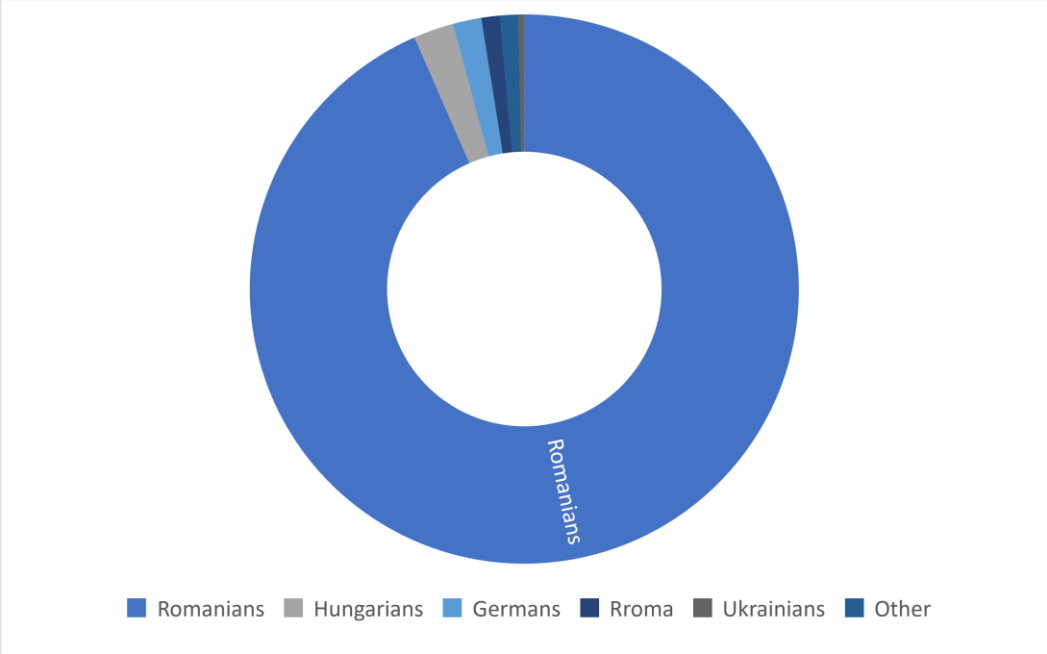


***Figure 58 –*** *Ethnic structure of Reșița inhabitants in 2011*

*Source: 2011 Census – 8. Populația stabilă după etnie – Județe, 117ndustry117, orașe, commune, National Institute of Statistics [online]. Available at: https://www.recensamantromania.ro/rpl-2011/rezultate-2011/ (Accessed: 31.03.2022)*

## D.1.4. Economic data

The Municipality of Reșița has a total area of 19.765,00 ha, from which 2.420 ha is located in the regulated built area (12.24% of the territorial administrative unit), from which 359 ha are arable land. The regulated built area has multiple land uses: housing and complementary uses (32.64%), industrial area and warehouses (14.04%), agro-industrial area (1.56%), public administration (9.47%), transportation (9.78%), green and leisure area (13.52%), utilities (10.37%), cemeteries (0.84%), special destination (0.27%), forestry (6.25%), water areas (1.27%). The outfield includes the following land uses: arable land (1056 ha), pastures (3650 ha), meadows (2520 ha), orchards (130 ha) and forests (9638 ha). In the area, the arable land has low productivity, being used only for growing vegetables, corn and for orchards.

**The primary economic sector** plays an important role in the local economy of Reșița, which is strongly connected to the natural landscape and resources. Reșița's heavy industry is dependent on the local natural resources: rocks which are used for metallurgy practices and for building materials (e.g., limestone in the area of Doman – Colțan). The exploitation of bituminous coal is also practiced in Doman and Secu villages. These kind of land uses determine the industrial profile and legacy that Reșița has. This is closely connected to the natural elements like forests and rivers that have played rather an utilitary role rather than an aesthetic one. However, after 1990, the metallurgy sector has fell to a secondary role, with a decreasing turnover, from 42% in 2000 to 30% in the local economy in 2002.

*The Local Development Strategy (SDL) of Reșița 2015-2025* shows a change in the local economic field, which is **shifting from a mono-industrial landscape to a diversified economy**. In the context of globalization and the global decline of the metallurgical industry, Reșița Municipality as well confronts with a decline of the metal processing activities and their rentability, despite its deeply industrial profile.

Carried out within the SDL of Reșița 2015-2024, the study of the economic sector reveals that, in 2015, the local economy was composed of: 9% primary activities (agriculture, forestry, fishing), 35% secondary activities (manufacturing industry and constructions), 56% tertiary activities (sales and



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service). According to the SDL of Reșița[92], in 2012 the metallurgical sector had the highest income and number of employees in the local economy, being the most profitable activity in the municipality. The legacy of industry had an impact on the spatial structure of the city, which is divided in four areas, based on the type of industrial activity:

- **Northern area** – machine and car building and light industry (Northern area, near Lunca Bârzavei neighborhood);
- **Triaj-Mociur area** – heavy metallurgical industry and machine building (central area, at the foot of Dealul Crucii);
- **Valea Țerovei industrial area** – unused industrial buildings and areas (Țerova village);
- **Old industrial area** – metallurgical industry (South-Eastern area, in Mountainous Reșița).

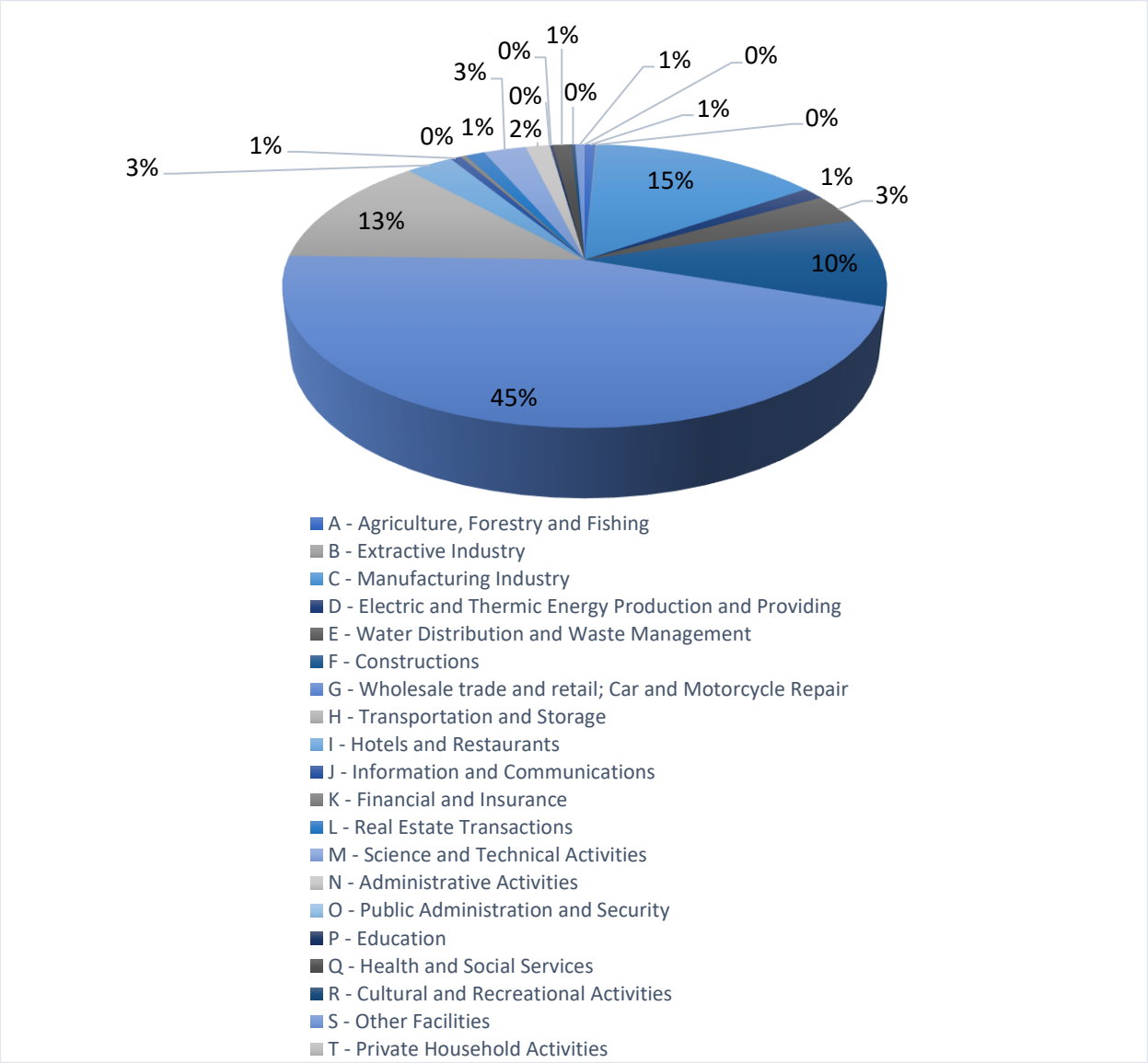


***Figure 59** – Total fiscal value of enterprises in Reșița, by field of activity (CAEN)*
*Source: Lista firmelor din România – Reșița, Județul Caraș-Severin [online]. Available at: https://membri.listafirme.ro/statistici-economice.asp#selectie (Accessed: 01.04.2022)*

[92] Reșița Local Development Strategy 2015-2025 – Denkstatt România, Reșița Municipality City Hall, p. 59


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Gathered data[93] shows that in 2020 the most important activity sector, using the total fiscal value index, is *Wholesale trade and retail; Car and motorcycle repair (G)*, representing 45% of the total fiscal value in Reșița. This shows a dramatic shift to **the tertiary economic sector**, while **the secondary economic sector** holds the second place: *Manufacturing Industry (C)* is 15% of the total fiscal value in Reșița. **The primary economic sector** (*Extractive industry (B)* ) is the third main contributor to the local economy, being 13% of the total local fiscal value.

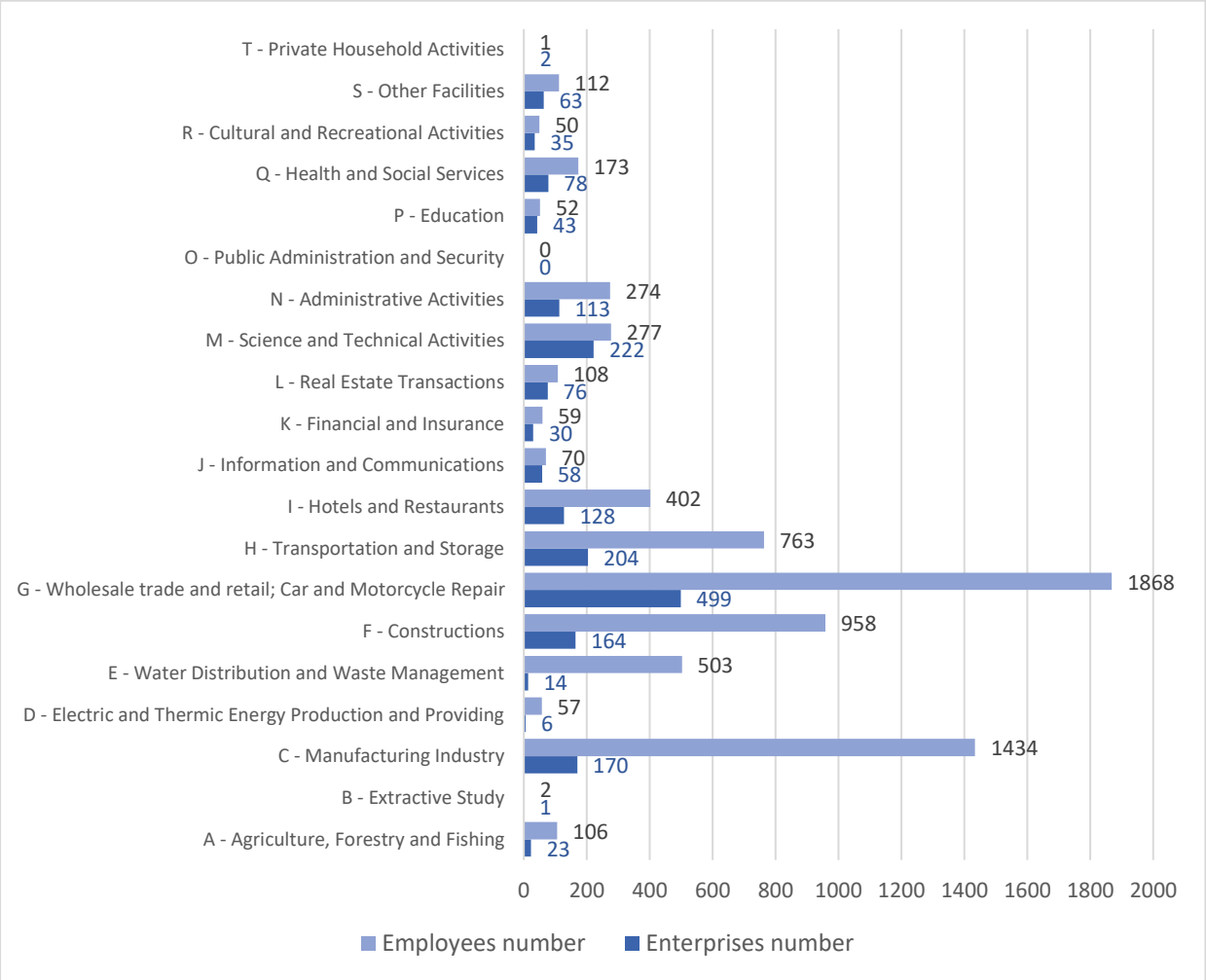


***Figure 60 –*** *Total numbers of enterprises and employees in Reșița, by field of activity (CAEN)*

*Source: Lista firmelor din România – Reșița, Județul Caraș-Severin [online]. Available at: https://membri.listafirme.ro/statistici-economice.asp#selectie (Accessed: 01.04.2022)*

The workforce statistics indicate a growing number of employees in the 2010-2015 time horizon, with Reșița holding 5.43% of the employees in the Western Area. However, the workforce in Reșița is growing smaller due to the exterior migration of the inhabitants to other cities or to the member states of the EU. Moreover, the unemployment rate is increasing due to the closing of metallurgical factories.

Regarding the number of enterprises and employees in Reșița in 2020, classified by activity sectors, even though *Wholesale trade and retail; Car and motorcycle repair (G)* has the greatest number of enterprises, along with the *Manufacturing industry (C)*, *Constructions (F)* and *Transportation and*

[93] Lista firmelor din România – Reșița, Județul Caraș-Severin [online]. Available at: https://membri.listafirme.ro/statistici-economice.asp#selectie (Accessed: 01.04.2022)



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*storage (H)*, the biggest employers are *Wholesale trade and retail; Car and motorcycle repair (G)*, *Science and Technical Activities (M)* and *Transportation and Storage (H)* sectors.

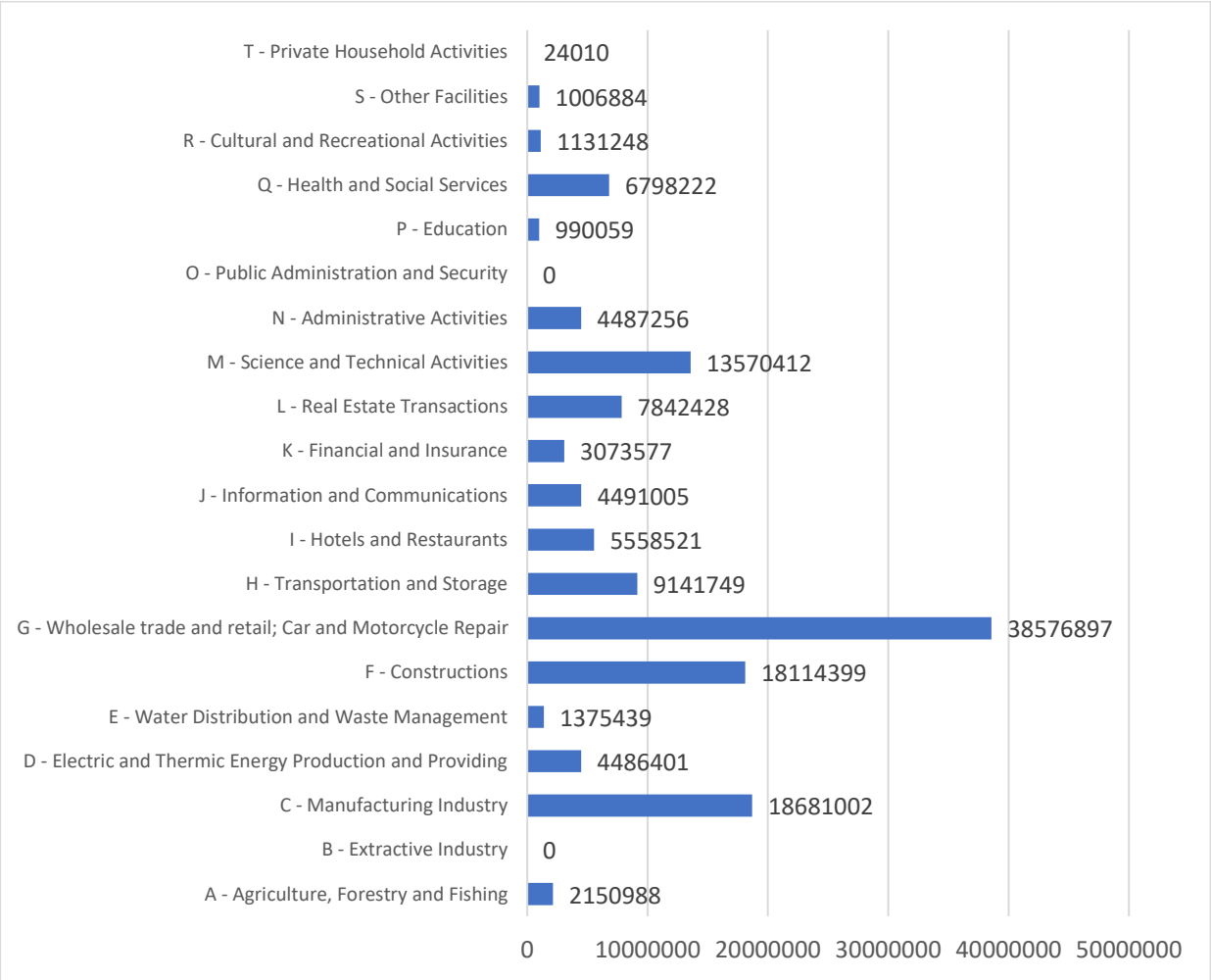


***Figure 61 –*** *Total net income in Reșița, by field of activity (CAEN)*
*Source: Lista firmelor din România – Reșița, Județul Caraș-Severin [online]. Available at: https://membri.listafirme.ro/statistici-economice.asp#selectie (Accessed: 01.04.2022)*

*Wholesale trade and retail; Car and motorcycle repair (G)* is the most stable activity sector in Reșița, not only having the greatest fiscal value and being the biggest employer, but also having the greatest total net income in the local economy. The *Manufacturing Industry (C)* and *Constructions (F)* are also profitable sectors. This shows the **micro-economic** profile of Reșița, going from a heavy industrial to a service-oriented profile. While having a big fiscal value, the *Extractive industry (B)* is one of the least profitable sectors in the municipality, which is a proof of the great decline Reșița's industry is going through.

The local economy is slowly shifting towards the **tertiary economic sector**, through tourism. Touristic activities are supported by Reșița's geographical position in the Semenic Mountains and the high number of natural protected areas in the close territory: Cerna-Domogled National Park, Cheile Nerei – Beușnița Natural Park, Dunăre-Porțile de Fier National Park and Cheile Carașului – Semenic National Park. Reșița's administrative territory contains a part of the Semenic National Park (a total area of 36119.6 ha), around Secu village: Groposu Natural Reserve, in the North-Eastern area of the municipality, which represents 2.44% (883.6 ha) of the natural protected area.


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**Tourism** is a growing sector of the local economy, considering the high potential Reșița Municipality and the neighboring areas behold: natural protected areas, natural landmarks, historical and industrial sites.

The development of tourism can diversify the economic landscape of Reșița, which holds a wide range of touristic attractions like: County Historic Museum, Steam Locomotives Museum, Culture Palace, Kinetic Fountain, Industrial Funitel and Furnace or the „Ion Crișan" Zoo. Besides these landmarks, there are **71 historical landmarks** in Reșița Municipality that are registered in the Historical Landmarks List from 2015. In the close area of the city there is a wide range of natural landmarks: Bigăr and Beușnița Waterfalls, Semenic Mountains, Breazova, Gozna, Trei Ape and Secu Lake or Carașului Ravine.

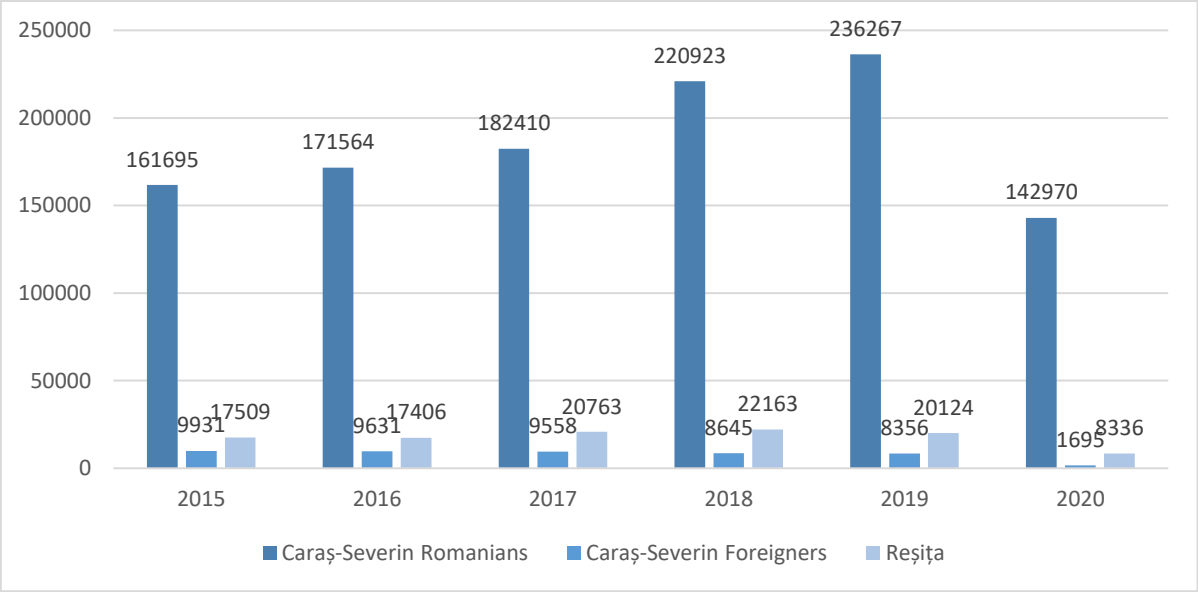


***Figure 62 –*** *Tourist arrivals in Caraș-Severin County and Reșița Municipality (2015-2021)*
*Source: National Institute of Statistics [online]. Available at: https://insse.ro/cms/ (Accessed: 28.01.2022)*

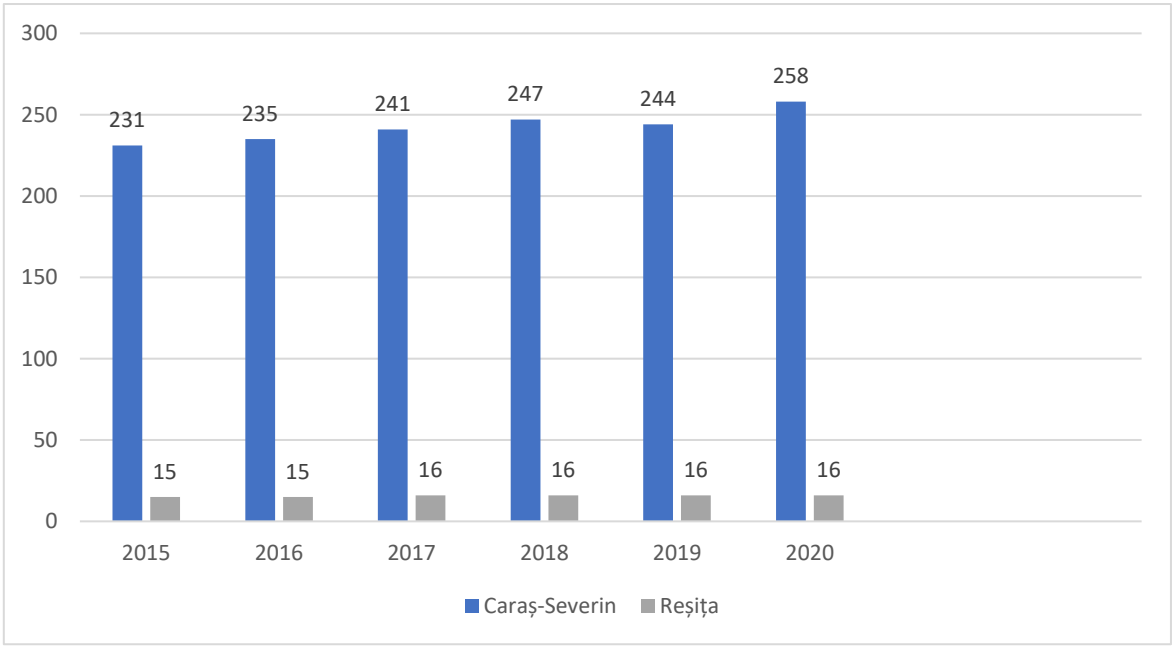


***Figure 63 –*** *Accommodation structures in Caraș-Severin County and Reșița Municipality (2015-2021)*
*Source: National Institute of Statistics [online]. Available at: https://insse.ro/cms/ (Accessed: 28.01.2022)*



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At a county level, tourist arrivals have increased in the 2015-2020 interval, with a significant fall since the beginning of the COVID-19 Pandemic. Compared to the number of Romanian tourists per year, the number of foreign tourists is little. Nevertheless, the number of tourists in Reșița Municipality has been constant, until 2019, around 20,000 tourists per year, completed by a constant number of 16 accommodation structures.

## D.1.5. Environmental data

### D.1.5.1. Geology

The geographical landscape of the county, through the landforms as well as through the very large number of karst phenomena, with a special geological structure and with a climate with Mediterranean shades, determined the maintenance and development of a varied and rich biodiversity.

Almost the entire territory of Caras-Severin County belongs as a geological structure to the orogene of the Southern Carpathians, which consists of two main geotectonic units: the Local Danubian and the Getic Crystalline which supports sedimentary blankets.

The area of Resita – Moldova Noua, oriented NNE-SSV, is made up mainly of Jurassic and Lower Cretaceous limestones, and in the carboniferous and liasic are quartered important coal deposits.

### D.1.5.2. Soils

The soils in the Banat hydrographic area vary to the same extent as the landforms, namely:

- skeletal soils and high-rise podzols – on the heights of the mountains;
- podzols, brown or reddish-brown soils – in the hilly area;
- alluvial soils – in depressions;
- with excess water on the surface and in their mass – at the low plain;
- chernozem soils, predominantly those of chocolate – on the high forms of the low plain[94].

### D.1.5.3. Flora, fauna and forests. Protected areas

The hill and mountain region includes: − the forest area is well represented and differentiated tiered. In the composition of forests, the proportion of different species and groups of species is: 14,6 % resinous (fir, spruce, pine, etc.), 53,5 % beech, 15,4 % various hard species (sycamore, ash, hornbeam, etc.), 13,0 % oak (oak, sessile oak, sky, gooseberry) and 3,5 % various soft species (poplars, willows, linden); - the alpine area consists of two floors – subalpine and alpine. In the Banat Mountains, the forest fund is high (in Semenic Mountains the degree of afforestation reaches 65%), here predominating the beech forests.

The subalpine floor is between the upper limit of the forests (1700 – 1800 m altitude) and is characterized by grass associations among which predominate the meadows with the grass of the field (Agnostis. Sp.), the red fescue (Festuca rubra ssp. Rubra), the thorn (Nardus stricta), the meadows characteristic of the spruce floor (Festuca rubra ssp. Commutata) and the juniper (Festuca ovina ssp. Sudetica), the fir (Poa violacea, Poa alpina), mountain carnation (Dianthus sp.) and other species characteristic of the area. According to the estimates made and included in the substantiation studies of the national and natural parks, it results that the mushrooms comprise 297 taxa – of which: Sphaerotheca erodii, Urocystis agropyri, Ranularia atropae), and lichens include 17 taxa. The flora of the cormophytes totals 1,086 vegetal taxa and is extremely diversified, the largest number of taxa belonging to the European element.

[94] *Flood Risk Management Plan Banat River Basin Administration*, RBA Banat



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The geographical space in this part of the country preserves ancient elements, some of which have the status of glacial relics, such as: yew (Taxus baccata), white ivy (Daphne laureola), as well as endemic species, rare and very rare, vulnerable and endangered.

Due to some human activities carried out over time, it is highlighted today the decrease in the number of species or individuals, as well as the reduction of the species' resistance to some harmful abiotic and biotic factors. This also explains why many species are in a vulnerable state and even threatened with extinction. Among the species of plants threatened with extinction, those that are in a situation of the most unfavorable are: Ruscus hipoglossum (Cornişor), Fritillaria meleagris (Variegated Tulip), Anntenaria dioica (Semenic Flower), Daphne laureola (White Ivy), Pinus nigra ssp. Banatica (Banat Black Pine), Taxus baccata (Tisza) etc.

The main species of animals of hunting interest that inhabit the county's territory are: - bear, wolf, lynx, Carpathian deer, fallow deer, chamois, deer, wild boar; fox, wild cat, stone marten, weasel, otter, wild rabbits, - capercaillie, pheasant, quail, partridge, ducks, geese, coots, becatians.

Reptile fauna – is represented by thermophilic elements, many of which are vulnerable and rare such as: Lacerta muralis, Testudo hermanni, Vipera ammodytes ammodytes, Emys orbicularis.[95]

A SCI protected area was identified in the Barzava River floodplain (map a), as well as upstream locality in the Semenic- Cheile Caraşului National Park (PN) – see the maps in the figure below, including Reşiţa administrative territory in the natural protected area.

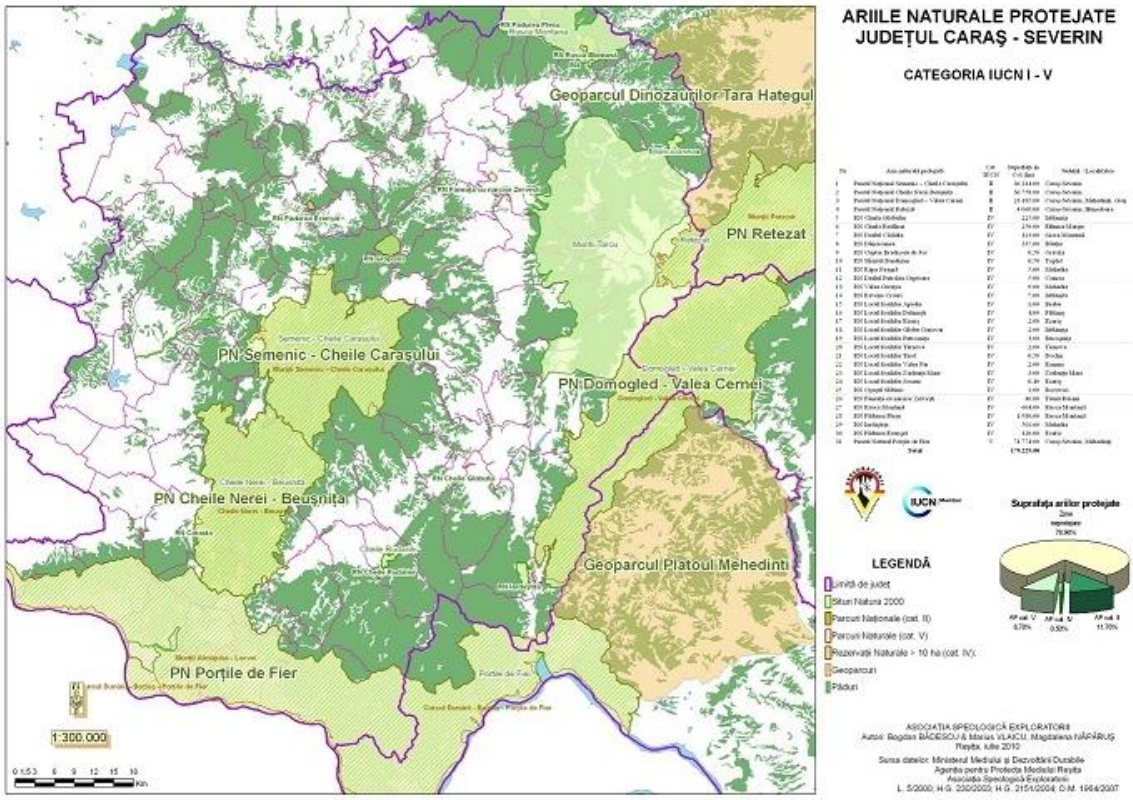


***Figure 64*** *– National parks and natural protected areas in Caraş-Severin County and Resiţa administrative area in the context of the natural protected areas (green marked territory)*
*Source: http://turism.cjcs.ro/en/harta-parcurile-nationale-si-naturale-din-caras-severin.php*

[95] Local Environmental Action Plan (PLAM) of Caraș-Severin County 2022-2025



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### D.1.5.4. Climate and climate change impact

The climate of the Bârzava river basin is continental – moderate, falling within the Banat subtype, with sub-Mediterranean nuances.

The multiannual average temperature is between 10° and 11°C, in the plain areas, the Western Hills and the Dognecei Mountains, between 9° and 4°C in the Poiana Ruscă and Semenic Mountains. Along with the altitude, the values gradually decrease, reaching 3.7°C at Semenic Station (1,400 m) and -0.5°C at Țarcu Station (2,180 m).

The average annual rainfall increases from 700-800 mm/m$^2$ in the lowlands, registering up to 1,400 mm/m$^2$ in the Țarcu Mountains. The pluviometric optimum is situated at average altitudes (1,200-1,600 m), especially if the slopes have western exhibition. This explains the high precipitation values from Semenic Station – 1,259 mm, respectively Țarcu Peak – 1,151 mm. Precipitations decrease to higher altitude.

The dominant wind is the one from the west and north-west, the disposition of the mountainous relief causing local changes of the atmospheric circulation.

As shown in the ***Figure 17*** – *Annual temperature increase 2021 – 2050 (compared to the reference range 1961 – 1990)(B.1.5.3. Climate and climate change impact*), it is forecasted that in the period 2021 – 2050 the average annual temperature recorded in Reșița will increase by 1.0 °C compared to the reference range 1961–1990[96]. Regarding the annual precipitation (***Figure 18*** – *Increase in average annual precipitation 2021 – 2050 (compared to the reference range 1961 – 1990) – B.1.5.3. Climate and climate change impact*), in the period 2021 – 2050, it is forecasted an increase of the average annual amount of precipitation by 1 ÷ 2 % in Caraș-Severin County compared to the reference interval 1961 – 1990.

In Barzava river basin, one of the most significant consequences of the increase in air temperatures is the increase in the magnitude and frequency of negative events related to the extreme precipitation generated by the increase in the humidity level of the atmosphere. This induces an increase in the frequency and intensity of floods. Even the total amount of the seasonal precipitation is slightly increased, the maximum daily precipitation is on an increasing trend during autumn, winter, and even summer, in Bârzava river basin. During spring, the trend shows a decrease in the maximum daily precipitation.

As shown in the ***Figure 19 –*** *Climate change classes: Regional changes of the maximum instantaneous 1% AEP flows for 2021-2050, compared to the reference period 1971-2000 in Romania (in black is Bega River, crossing Timișoara – red spot)* (*B.1.5.3. Climate and climate change impact*), Bârzava river basin is under a stationary scenario of no increase of the maximum discharges with different AEP. Considering Alfieri' study[97], even if even the maximum discharges will not change on Bârzava river, the flood frequency could be double increased.

[96] Bojariu, Bîrsan, Cica, Velea, Burcea, Dumitrescu, Dascălu, Gothard, Dobrincu, Cărbunaru, Marin (2015) *Schimbările climatice – de la bazele fizice la riscuri și adaptare*, Bucharest: Editura Printech

[97] Alfieri, Feyen, Dottori, Bianchi (2015) „Ensemble flood risk assessment in Europe under high end climate scenarios" in Global Environmental Change, Vol. 35, pp. 199-212

### D.1.5.5. Water resources

Bârzava has its source on the north-western slopes of the Semenic Mountains, in its upper course being arranged the storage lakes made for the purpose of water supply or for the production of energy: Văliug, Gozna, Secu and Breazova (on Bârzava) and Trei Ape (on The Timis), which supplement the flows on the Barzava during the small water period. The maximum flow rate of 1% at the Partos hydrometric station is presented in *Table 24.*

The groundwater layer (used in the countryside as drinking water – wells) occupies especially the plain areas of the Banat space, climbing only on the floodplains of the rivers, on their upper courses. In the limestone areas, the infiltration waters and the underground courses predominate. A conclusive example is represented by the groundwater stationed in the Mesozoic limestones from the Reşiţa – Moldova Nouă band and the Cerna Mountains, which come from the meteoric water that circulates through the fissure-karst network, re-appearing up to date at lower levels in the form of springs.

Bârzava River is crossing Reșița Municipalty.

| Nr. crt. | River | Hydrometric station | F ($km^2$) | H (m) | Qmax 1% ($m^3/s$) |
|---|---|---|---|---|---|
| 5 | Bârzava | Partoș | 933 | 293 | 205 |

***Table 24*** *– The maximum flow rate of 1% at the Partos hydrometric station*

*Source: INHGA data*

The Bârzava river is trans-boundary river, about 20% of its catchment area being in Serbia. The integrated flood management concept was applied for this river. Generally, this concept:

a. identifies all water-related problems in the potentially flooded area;
b. takes into account relevant local conditions;
c. achieves a number of objectives within the global water resources management strategy (flood protection, water supply, drainage, etc.);
d. makes an assessment of environmental impacts (water quality, ecosystem, ambient quality), and
e. considers public and social aspects of the proposed technical solutions.

Specifically, three alternatives of flood control were considered, with the following main objectives:

- protection of farmland, villages, mills, road and railway infrastructure;
- preservation of surface water and groundwater quality;
- preservation of the river ecosystem;
- upgrading possibilities for recreation and tourism.



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## D.2. Flood risk management

### D.2.1. Flood hazard and risk information for Reșița Municipality

**Preliminary Flood Risk Assessment**

**During the cycle 1 of the Floods Directive implementation,** for Banat RBA 2 significant flood events were identified and 46 fluvial APSFRs.[98]

Reșița Municipality has territories located in the catchments of 1 river designated as APSFR: Bârzava (r. Bârzava - av. confl. Secul). Bârzava river was designated APSFR based on the consequences of the floods from February 1999, April 2000, 2005 and 2006.

**During the 2nd cycle of Floods Directive implementation,** 8 significant flood events (4 fluvial and 4 pluvial) have been identified during the period 2010 – 2016 and 9 future floods for Banat RBA. 22 new APSFRs from fluvial source and 4 from pluvial source were designated. 1 of the new APSFRs is of interest for Reișița Municipality: r. Terova - loc. Țerova - loc. Reșița. The new APSFR on Terova river was identified based on the consequences of the floods from June 2016. Reșița Municipality has been identified as pluvial APSFR after being affected by the significant flood event from June 27, 2016[99].

*Table 25* is detailing the sources, mechanisms and characteristics of flooding and the type of consequences of the APSFRs of interest for Reșița Municipality.

| APSFR name | APSFR code | Length/ Surface (km/sq. km) | Flood source | Mechanism of flooding | Characteristics of flooding | Type of consequences |
|---|---|---|---|---|---|---|
| r. Bârzava - av. confl. Secul 1 | RO1-05.02.038....-02A | 114,21 | Fluvial | A21 | A35 | B11; B12; B41; B42; B43; B44 |
| r. Terova - loc. Reșița - loc. Țerova | RO1-05.02.038.03...-01A | 4,98 | Fluvial | A21 | A33 | B11; B12; B31; B41; B42; B43; B44 |
| loc. Reșița – pluvial floods | RO1-05.02.038....-50807-P-A | - | Pluvial, artificial blockage | A21 | A35 | B11; B23; B41; B42; B43; B44 |

***Table 25** – APSFRs – source, mechanisms and characteristics of flooding and type of consequences Criteria considered to establish the flood risk*

*Source Floods Directive, Cycle 2 Preliminary Flood Risk Assessment Report for Banat RBA*

Legend[100]:
A21 - Natural Exceedance;
A33- Other rapid onset; A35 - Slow onset flood
B11 - Human Health; B12 - Community; B23 - Pollution Sources; B31 - Cultural assets; B41 - Property; B42 - Infrastructure; B43 - Rural Land Use; B44 - Economic Activity

[98]https://rowater.ro/despre-noi/descrierea-activitatii/managementul-situatiilor-de-urgenta/directiva-inundatii-2007-60-ce/epri/
[99]https://rowater.ro/despre-noi/descrierea-activitatii/managementul-situatiilor-de-urgenta/directiva-inundatii-2007-60-ce/epri/
[100] https://cdr.eionet.europa.eu/help/Floods/Floods_2018/GuidanceDocuments/FD_ReportingGuidance.pdf


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***Figure 65 –*** *Floods in Reșița Municipality*

*Source: https://www.youtube.com/watch?v=mFVI9wbHsP0* *Source: https://www.radioresita.ro/actualitate/bilant-caras-severin-800-de-locuinte-au-fost-inundate-si-peste-300-de-persoane-evacuate*

For the period 2016 – 2020, the Synthesis Reports elaborated after flood events occur, mention that Reșița Municipality has been affected 1 event in February 2017, 6 events in 2018 (1 in January, 1 in May, 2 in June, 2 in August), 2 events in 2019 (1 in February and 1 in May), 1 event in June 2020 *(Table 26).*

| No. of the Synthesis Report | Municipality | Event starting date | Cause of floods | Affected assets |
|---|---|---|---|---|
| 1/16.02.2017 | Resita | 06.02.2017 | infiltrations, landslides | 50 m of streets, 16 m of retaining wall |
| 1/12.02.2018 | Resita | 17.01.2018 | runoff from the slopes | 0.02 km of county roads |
| 6/20.06.2018 | Resita | 27.05.2018 | runoff from the slopes | 1 economic activity, 0.02 km of riverbank protections |
| 7/02.07.2018 | Resita | 19.06.2018 | Barzava river, runoff from the slopes | 1.54 km of streets, 0.01 km of riverbank protections |
| 8/06.07.2018 | Resita | 19.06.2018 | runoff from the slopes, heavy rainfall | 0.004 km of riverbank protections, 1 car |
| 11/14.08.2018 | Resita | 01.08.2018 | runoff from the slopes, heavy rainfall | 25 cubic meters landslides |
| 13/17.09.2018 | Resita | 25.08.2018 | runoff from the slopes, heavy rainfall | 72 pcs gym mattresses |
| 3/22.02.2019 | Resita | 01.02.2019 | runoff from the slopes, heavy rainfall, snow melting | 0.01 km of riverbank protections, 0.02 km of dikes |
| 8/10.06.2019 | Resita | 28.05.2019 | runoff from the slopes, heavy rainfall | 1 damaged house, 0.34 km of streets, 1 car |
| 3/08.07.2020 | Resita | 10.06.2020 | Barzava river, heavy rainfall | 1 support wall |

***Table 26*** *– Flood events in the period 2016 - 2020*

*Source: ANAR, Summary tables containing the Synthesis Reports information*

**Flood Hazard and Risk Maps**

**During the cycle 1 of the Floods Directive implementation,** flood hazard and risk maps were developed for 3 AEPs (10%, 1% and 0.1%), using the methodology described in Chapter 2.6 of the FRMPs. The flood hazard pas are a result of a national program *Plan for Prevention, Protection and Mitigation of Flood Effects*, which was initiated before the Floods Directive to enter into force. The qualitative flood risk maps were developed by ANAR and INHGA[101].

In case of Reșița Municipality, the fluvial flood hazard results from cycle 1 are shown in *Figure 66*. These results were shared with Timiș County Council in 2014 by MEWF.

During the 2nd cycle of Floods Directive implementation, the pluvial flood hazard and risk maps for 6 AEPs (33%, 10%, 1%, 1%+CC, 0.5% and 0.1%) for Reșița Municipality will be published in September 2022. The fluvial hazard maps for Bârzava river will not be updated in this cycle, but for Terova river flood hazard maps for 6 AEPs will be elaborated. New flood risk maps will be done and published in September 2022 for both APSFRs.

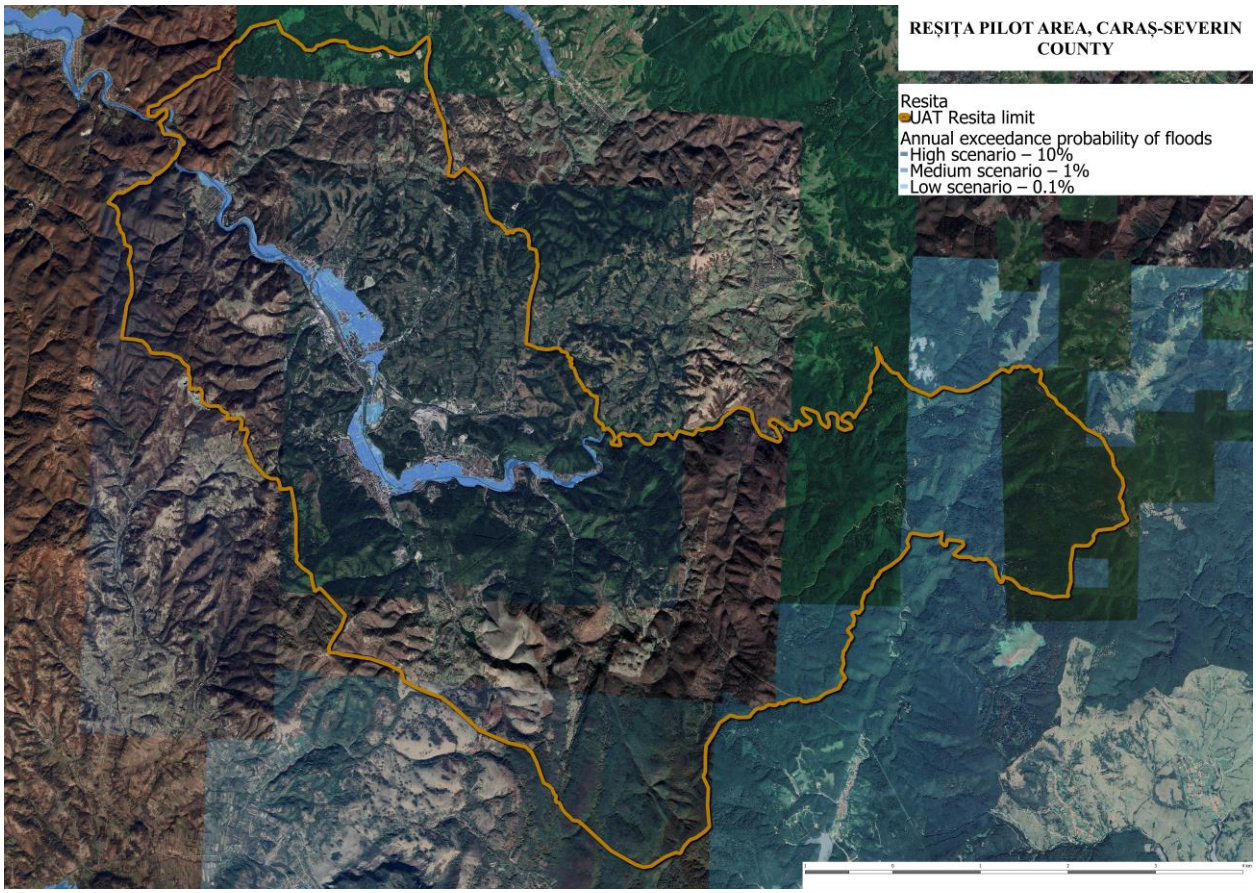


***Figure 66 –*** *Flood hazard areas in UAT Reșița*

*Source: World Bank by using the Flood Directive Cycle 1 Report scenarios (high scenario, medium scenario, low scenario)*

[101]http://www.inhga.ro/documents/10184/121027/4+PMRI+Banat.pdf/3478b866-1a2c-4e55-9eb2-7892a664c534



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## D.2.2. Flood risk management infrastructure

Reșița Municipality is well protected against fluvial floods by a complex hydrotechnical system along Bârzava river. The water management scheme existing in Bârzava river catchment is shown in *Figure 67*[102].

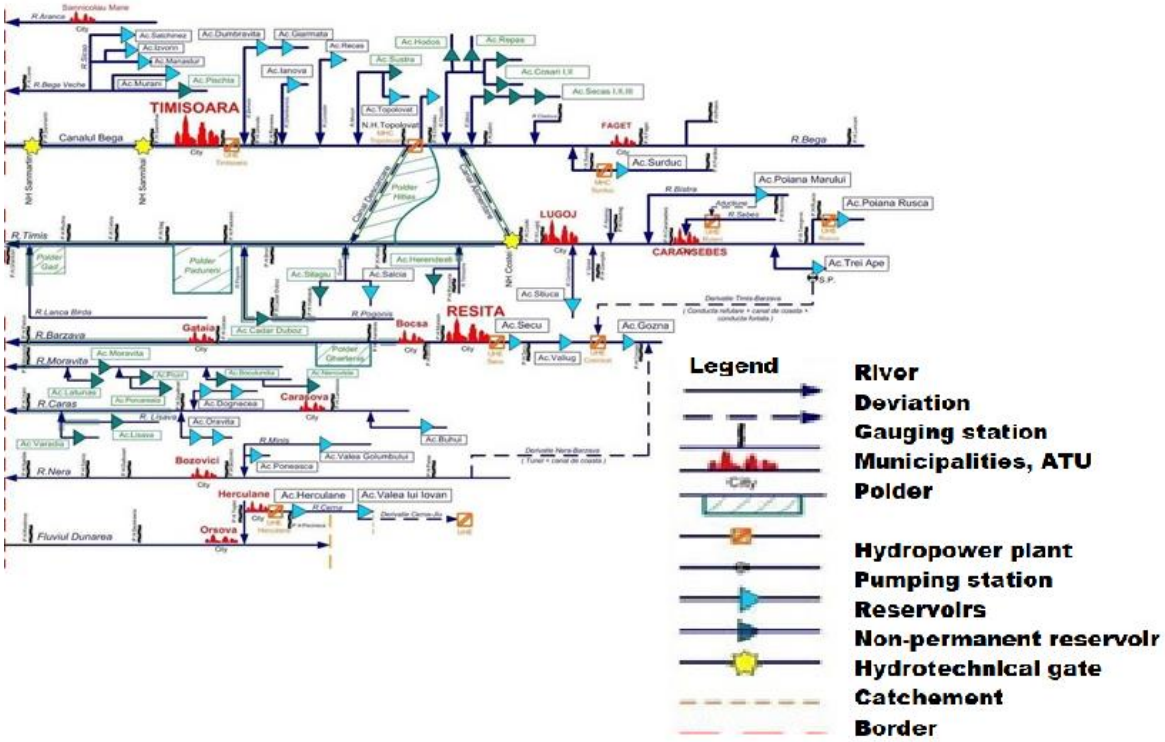


***Figure 67*** *– The existing water management scheme for Bârzava river*
*Source: Flood Risk Management Plan for Banat River Basin Administration*

Bârzava, the river that passes in the middle of Timișoara Municipality is very well equipped with water management and flood mitigation infrastructure, as well as for drought risk management in the city and in agricultural land. The existing infrastructure and its characteristics are presented in the following *Tables (27, 28)*[103].

| Dike code | Dike Name | Location | Purpose or function of defense | Design AEP |
|---|---|---|---|---|
| V-2.38_MD_55+871-56+396_ZidBeton | Bârzava Reșița – Câlnic dike (concrete wall), right riverbank | Reșița Municipality / Câlnic | Defense against overflow; towns protection / agricultural lands | - |

[102]http://www.inhga.ro/documents/10184/121027/4+PMRI+Banat.pdf/3478b866-1a2c-4e55-9eb2-7892a664c534#page=156&zoom=100,90,152
[103]http://www.inhga.ro/documents/10184/121027/4+PMRI+Banat.pdf/3478b866-1a2c-4e55-9eb2-7892a664c534


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| Dike code | Dike Name | Location | Purpose or function of defense | Design AEP |
|---|---|---|---|---|
| V-2.38_MD_56+814-57+953_DL | Bârzava dike at Călnic, right riverbank | Reșița Municipality / Călnic | Defense against overflow; towns protection / agricultural lands | - |

***Table 27*** *– Bârzava Defense dikes within the area of Reşiţa Municipality*

*Source: Flood Risk Management Plan for Banat River Basin Administration*

| No. | Name of dam/ reservoir | River | County | Volum NNR (mil. $m^3$) | Attenuation Volum (mil.$m^3$) | Rate for attenuation Vatt /V NNR | Property of |
|---|---|---|---|---|---|---|---|
| 1 | Văliug | Bârzava | CS | 1.20 | 0.12 | 10 | SC Tmk Hydroenergy Power SRL, Reșița |
| 2 | Gozna | Bârzava | CS | 9.92 | 2.13 | 21 | SC Tmk Hydroenergy Power SRL, Reșița |
| 3 | Secul | Bârzava | CS | 8.00 | 6.30 | 78.75 | SC Tmk Hydroenergy Power SRL, Reșița |

***Table 28*** *– Permanent Reservoirs, with a role in flood protection, with a possible impact on Reşiţa Municipality area*

*Source: Flood Risk Management Plan for Banat River Basin Administration*

### D.2.3. Sewerage network

In Reșița Municipality, there is a combined system for collecting sewerage (domestic waters) and pluvial waters. For 80% of the locality the collection system is separative and for 20% of the locality the system is unitary, collecting both domestic and pluvial waters in the same collectors. The collected water is discharged in the wastewater treatment plant, which can treat up to 600 l/s (being the maximum treatment capacity).

#### D.2.3.1. Collection of domestic water

Collection of the domestic waters is done centralized. The operator of the sewerage system is the Regional Operator AQUACARAS SA.

The sewerage network has a total length of 112,495 m, and the collectors are made of PVC and concrete, with diameters between 200 and 1,200 mm, also includes 4.398 manholes for intersection or change of direction, which are of precast concrete, with inner diameter of 800 or 1000 mm and 6,398 sewer connection manholes. The sewerage network in the Reșița agglomeration works gravitationally. There are no pumping stations on the existing network, but through the POS Environment Programme, a number of 9 wastewater pumping stations are executed. The main collector has a length of 8.500 m and the transport capacity of 1,000 l/s[104].

[104] Data provided by the Water Company AQUACARAȘ SA through the address no. R3985/21.12.2021 in Presentation sheet for Water supply and sewerage systems (*Fișă de prezentare alimentare cu apă și canalizare, REȘIȚA 2021*)



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### D.2.3.2. Sections with problems and streets without networks

In the combined sewerage system in Reșița there are some critical areas (5-6 areas) where the sewerage system is pressurized and pluvial floods occur. Some of the issues were solved by the water company[105].

There are also some streets without sewerage networks, but most of them were proposed for extension in the *Feasibility Study Regional project for the development of water and wastewater infrastructure in Caraș-Severin County / West Region, in the period 2014-2020*, which is implementing in the present (10,840 m).

### D.2.3.3. Treatment of wastewater

For Reșița agglomeration, composed of the Reșița City and the localities of Câlnic and Terova, there is a centralized sewerage system that discharges domestic wastewater into an existing treatment plant.

The wastewater treatment plant (WWTP) of Reșița municipality is located on the bank of Bârzava river, in the northern part of the city, in Câlnic district. Reșița's WWTP was rehabilitated with ISPA funding in 2010 (capacity: 125,000 i.e., respectively: 26,075 m3/day – average daily flow), and with financing through SOP Environment were made facilities conditioning of sludge with lime to obtain a sludge with a dry solid content of 35%. Also, a platform which assures storage facilities for 14 days was built.

The wastewater treatment plant is using mechanical and biological processes and advanced treatment, is designed for 125,000 inhabitants (26,075 mc/day) and consists of[106]:

- Mechanical Stage: admission chamber, 2 automated coarse screens, a by-pass channel, a stormwater reservoir, 2 fine screens, grease separators, intermediary pumping station;
- Biological stage, which assures is a process with continuous operation, with activated sludge, with separate, anaerobic stabilization of the sludge;
- Sludge processing stage (static sludge thickening, anaerobic fermentation of excess primary and biological sludge, fermented sludge concentrator, mechanical dehydration of fermented sludge storage area to store dehydrated sludge until disposal – concrete platforms with a total area of 129 $m^2$).

The treated effluent is gravitationally discharged to the emissary-Bârzava River. Flow rate is measured using an electromagnetic flow meter. An automatic sampler is installed for the online measurement of the treated water quality.

In the rainy periods the flows are approximately 30,000 $m^3$ /day and in the periods without rain the flows entering the station are 15,000-18,000 $m^3$ /day. In these situations when the flow exceeds the WWTP's capacity, the bypass is used for discharging a small volume directly into the emissary.

Some examples recorded in 2020 of direct discharges – by bypass and the corresponding flows:

- July 3, 2020 – overflow / bypass evacuation – 437 $m^3$;
- July 4, 2020 – overflow / bypass evacuation – 1030 $m^3$;
- Flow entered the station 30,000 $m^3$/day;
- May 20, 2020 – overflow / bypass evacuation – 840 $m^3$;
- May 21, 2020 – overflow / bypass evacuation – 576 $m^3$;
- Flow entered the station 35,000 $m^3$/day.

[105] Data provided by the local authorities in the meeting with the Municipality of Reșița from 22.11.2021

[106] Data provided by the Water Company AQUACARAȘ SA through Chapter 4 - Analysis of the current situation and forecasts, volume I, Feasibility Study Regional project for the development of water and wastewater infrastructure in Caras-Severin County / West Region 2014-2020

***Figure 68*** *– Reșița Wastewater Treatment Plant*
*Source: Google Maps*

### D.2.3.4. Deficiencies of the wastewater treatment plant

Occasionally, the treatment of sewage may be insufficient, pollutants such as suspension solids, CBO5, NH4, phenols are found in the effluent[107].

The wastewater treatment plant (WWTP) is situated in a floodable area, near Bârzava River, which is also the emissary of the WWTP's effluent. The most sever flood occurred in 2015, when the wastewater plant was flooded, as well as some floodplain buildings (informal settlements) of the vulnerable population[108]. In the last 5 years, the Reșița treatment plant has been flooded only once due to a dike breach; during June-July 2016 due to heavy rainfall[109].

### D.2.3.5. The stormwater system

The stormwater system consists in collectors made of concrete, with a total length of 53.39 km[110].

The stormwater is collected in the combined system of sewerage (40%) and through separate systems – closed canals buried in the ground or ditches and open street ditches – initially administered by the Reșița town hall and discharged directly into the emissary. In 2020, the management of stormwater network was also delegated to AQUACARAS SA[111].

[107] Data provided by the Water Company AQUACARAS SA through Chapter 4, volume I, Feasability Study Regional project for the development of water and wastewater infrastructure in Caraș-Severin County / West Region 2014-2020
[108] Data provided by the local authorities in the meeting with the Municipality of Reșița from 22.11.2021
[109] Data provided by the Water Company, e-mail from 21.12.2021
[110] Data provided by MP AQUACARAȘ Reșița – *The presentation memoir for the issuance of the environmental agreement*
[111] Approval report regarding the completion of HCL no. 119/20/03/2020 regarding the approval of the tariffs for the public water supply, sewerage and pluvial services charged by the operator SC AQUACARAȘ SA


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In the *Local Development Strategy of Reșița Municipality* was proposed creating a network of rainwater collection with discharge in a landscaped area (artificial lake), for retain and storing it for subsequent use. The realization of a feasibility study was proposed in this regard, using funds from the local budget.

Within the Development and Urban Revitalization Pole, the following Objective was proposed: Retain, storage and reuse of stormwater, for which at least 40% of the amount of rainwater should be collected from the city area. It was proposed to increase the amount of rainwater recovered and reused. Out of the total of 4,200,000 $m^3$ captured and introduced in the treatment plant in 2015, it is desired that at least 1,680,000 $m^3$ be captured and reused in 2025[112].

### D.2.4. Flood Risk Management Tools

**The National Strategy on Flood Risk Management has as specific objective on long term: to protect localities against floods of 1% to 0.01% AEP**, depending on the rank of the locality. Reșița is a rank II locality. This implies for the defense structures to be designed for at least 0.2% AEP floods.

**Flood Risk Management Plans**

In line with the flood risk management objectives, the cycle 1 FRMP of Banat RBA (2016) contains proposal of measures to reduce the fluvial flood risk along Bârzava river APSFR (*Table 29*)[113]:

| APSFR name | EC measure code | Name of the measure | Implementation status |
|---|---|---|---|
| r. Bârzava-av. confl. Secul, sect. îndig. | M31 | Maintaining the forest area in the Bârzava river basin for 30200,9 ha | - |
| | M31 | Improving the management of forests in the floodplains of Bârzava river for 200.61 ha | - |
| | M33 | Retaining wall in Resita, Caraș-Severin county, right bank and left bank for 20,34 km | - |
| | M35 | Maintenance of flood protection infrastructure on Bârzava river and tributaries, manual mowing for 24000 x 100 sq m, mechanical mowing for 570 ha, manual deforestation for 1200 x 100 sq m | 100% |
| | M35 | Maintenance of Bârzava river and tributaries: stone masonry 500 cubic meters, local materials 150 cubic meters, gabions 1000 cubic meters, manual deforestation for 1200 x 100 sq m | 100% |

***Table 29** - Measures proposed in cycle 1 FRMP of Banat RBA*
*Source: Flood Risk Management Plan for Banat River Basin Administration*

[112] Local Development Strategy of Reșița Municipality 2015-2025
[113] https://rowater.ro/despre-noi/descrierea-activitatii/managementul-situatiilor-de-urgenta/directiva-inundatii-2007-60-ce/epri/


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An integrated project was proposed in cycle 1 FRMP of interest for Reșița Municipality: *The complex arrangement of the Bârzava river and tributaries for defense against floods of riparian localities* and is in a mature stage of development.

Under the 2nd cycle FRMPs, for Terova river APSFR and for the pluvial APSFR – Reșița, a strategy will be developed to reduce the flood risk at APSFR level.

**The River Basin Management Plan of Banat RBA (2022)** indicates as water bodies along the APSFRs of interest for Reșița Municipality the following (*Table 30*)[114]:

| Water Body name | Water Body Code | Category | Status/ Potential (S/P) | Water body typology code | Class of the ecological status/ potential | Chemical status |
|---|---|---|---|---|---|---|
| Bârzava - ac. Secul | ROLW5-2-38_B2 | LW | P | ROLA05 | 2 | 2 |
| Bârzava - ac. Secul - cf. Sodol | RORW5 - 2 -38_B3 | RW | P | RO01CAPM | 2 | 2 |

***Table 30*** *– Water bodies of interest for Reșița Municipality*
*Source: Updated River Basin Management Plan for Banat RBA 2022 - 2027*

Legend:
RW - natural river / CAPM river / artificial river
LW - reservoirs
S/ P – ecological status/ ecological potential
Water body typology code: Natural rivers: RO01-RO19; Strongly modified rivers: RO01CAPM-RO19CAPM; Artificial rivers: RO01CAA-RO19CAA; Reservoirs: ROLA01-ROLA07
Classes of the ecological status/ potential: 1- very good ecological condition/ 2- good ecological status/ / maximum and good potential/ 3- moderate ecological status / moderate potential; 4- poor ecological status / potentially weak

When elaborating the strategies at APSFR level, the characterization of the water body should be considered.

Parts of **Reșița Municipality Flood Defence Plan against floods, ice and accidental pollution (2022-2025)**[115] is published on the municipality website and contains prevention, response and recovery measures in case floods occur.

### D.2.5. Areas developed in floodplain

To identify areas developed in floodplain were considered flood hazard and risk maps developed in the first cycle by the Government of Romania for the EU Floods Directive.

[114]http://banat.rowater.ro/wp-content/uploads/2022/03/Anexele-Planului-de-Management-Actualizat-al-Spatiului-Hidrografic-Banat-2022-2027.pdf
[115]
https://www.primariaresita.ro/portal/cs/resita/portal.nsf/allbyunid/CEF28AAB561E9910C22581DB004D44AD/$FILE/Masuri%20de%20aparare%20la%20inundatii.pdf


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**Reșița City**

The floodplain analysis of Bârzava River shows that the hazard and flood risk areas of the river can deeply impact the existing city built-up area. The linear development of the city along Bârzava River determines an overlapping of risk areas with the built areas which include housing, administrative activities and industry. The level of flood risk is different by the frequency of the risk – one in 10, 100 or 1000 years – and the largest identified risk area is prone to one flood in 100 years.

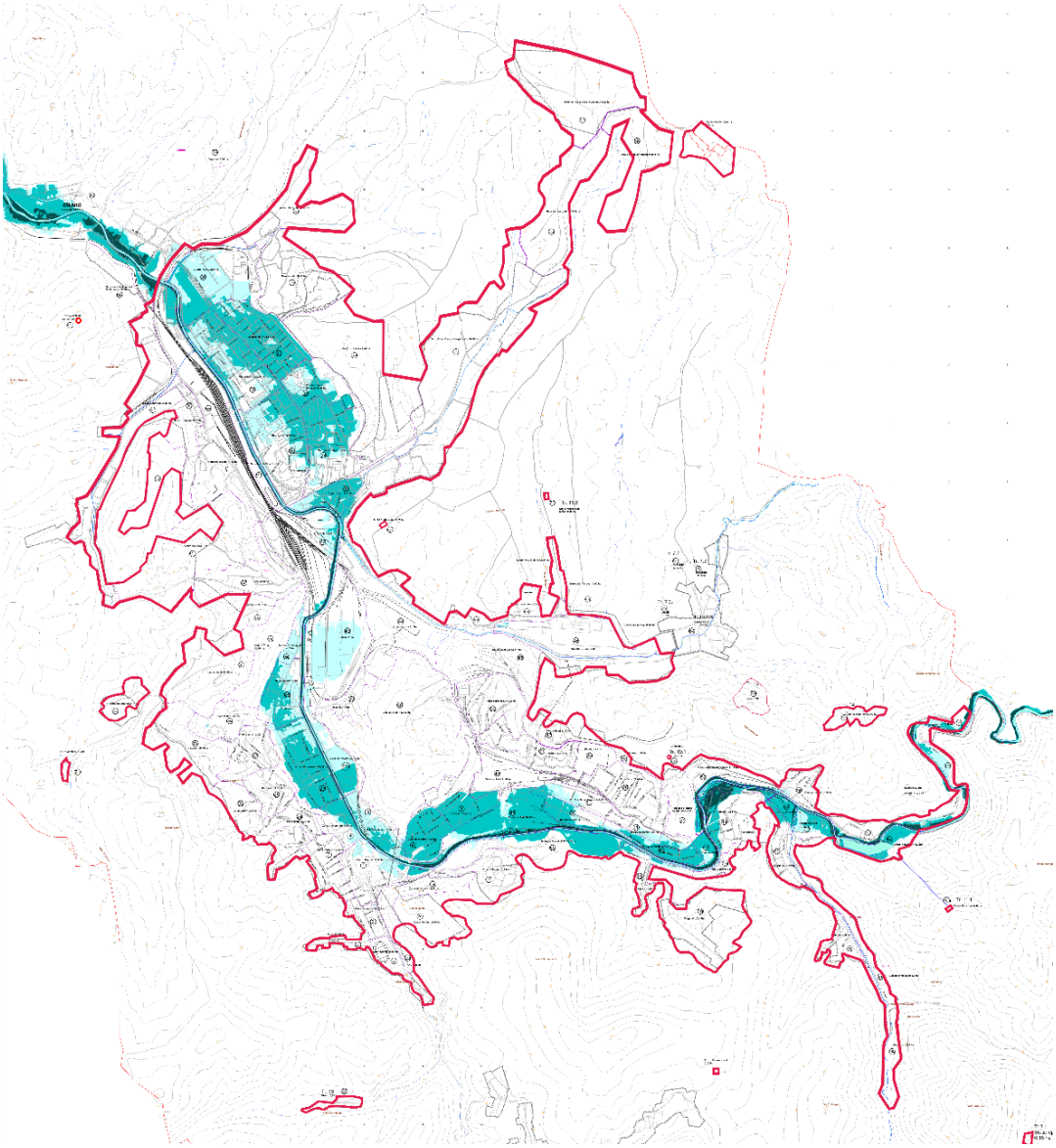

***Figure 69 –*** *Hazard and flood risk map on Bârzava River – administrative territory of Reșița City*
*Source: Flood risk map. Approved Reșița General Urban Plan*



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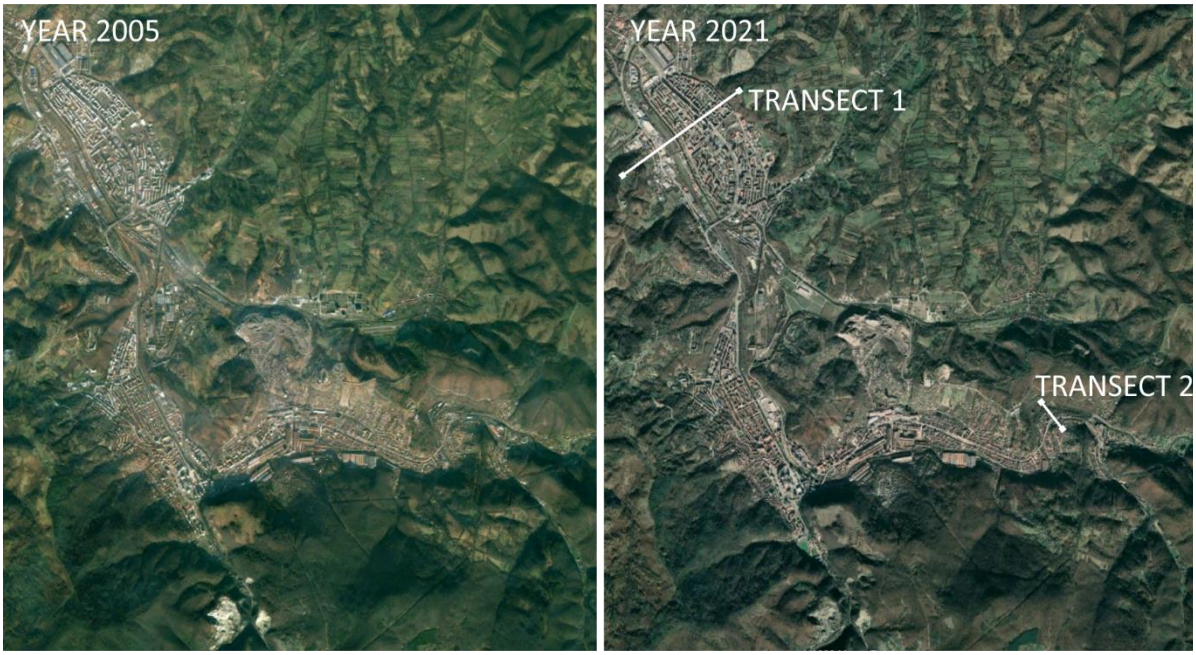


***Figure 70** – Comparison between satellite images of Reșița City (2005, 2021)*
*Source: World's Bank processing of Google Earth Satellite View image*

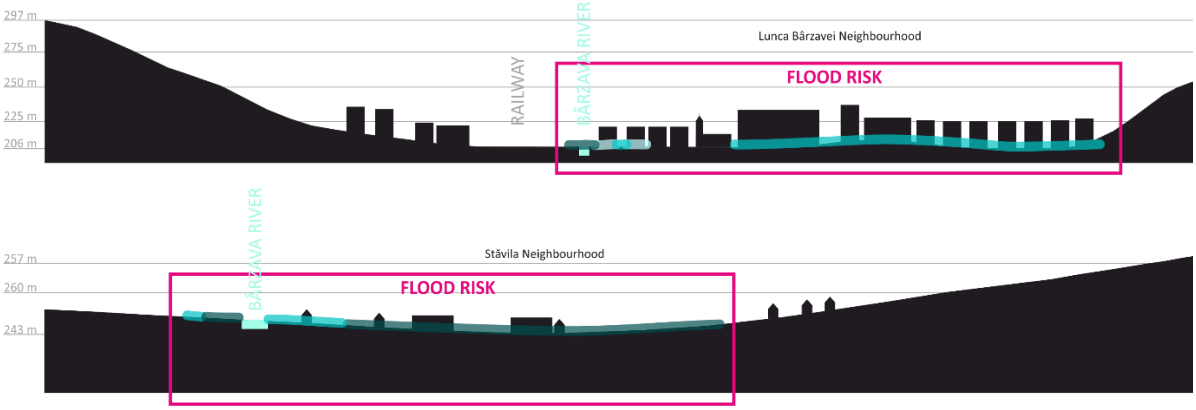


***Figure 71** – Transects of Bârzava River's floodplain in Reșița City*
*Source: World Bank*

A comparison of the urban development of Reșița City in 2005 and 2021 shows very little difference in the structure and area of the urban built-up area, due to the geographical context (the mountainsides are physical limits to the city) and the decline of the industrial sector. The city is going through a shrinkage process which can be seen in the economy and demographic dynamics.
The transects show that much of the built area of the city is in the floodplain of Bârzava River. The right bank of the river is more exposed to flood risk, especially in Lunca Bârzavei Neighborhood, where the flooding area is extending to the North-East.


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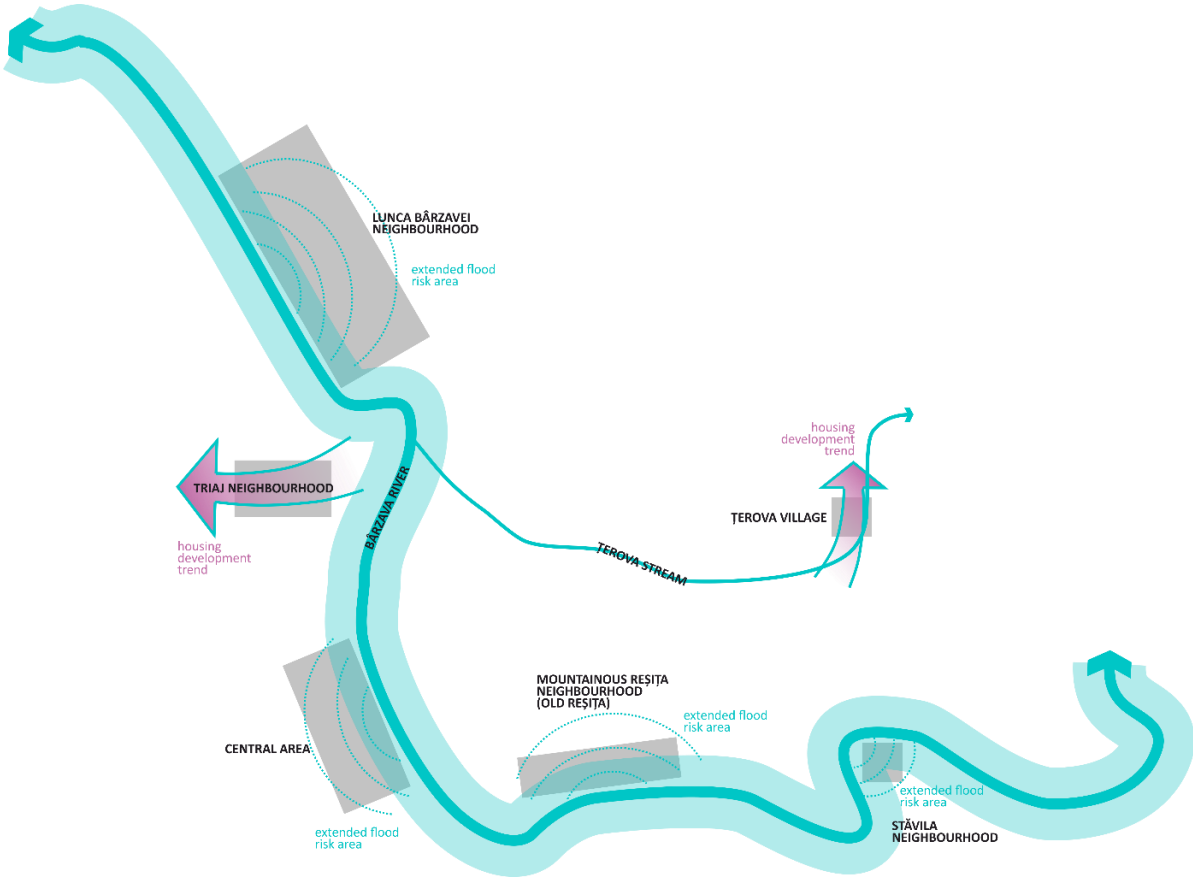


***Figure 72 –*** *Development trends in Bârzava River's floodplain in Reșița City*
*Source: World Bank*

The floodplain extends to the built area and is a risk to neighborhoods like Lunca Bârzavei, Central Area, Mountainous Reșița (Old Reșița) and Stăvila. Among these, the highest risk of hazard can be found in Stăvila Neighborhood, with a flood frequency of 10 years in a densely built housing area.

Given the geographical context, development trends in Reșița focus on the valleys of Semenic Mountain, along the little rivers and creeks, but they are not poignant. Țerova Village is one of the settlements which recorded a slight change in the urban built-up area, with an expansion of the housing area to the North-West, along the creek.

**Moniom Village and Câlnic Village**

Moniom and Câlnic Villages are located in the North-Western area of Reșița Municipality, along Bârzava River and DN 58B National Road. As in the case of Reșița City, the expansion of the urban built-up area is limited by the mountainsides to both North and South in Moniom and Câlnic.

The area prone to a frequent flood risk (one flood in 10 years) is bigger in Câlnic Village than in Moniom and includes dense housing areas on both banks of the river. Moniom is less exposed to floods because of the reduced risk area and because of the low density of the buildings.


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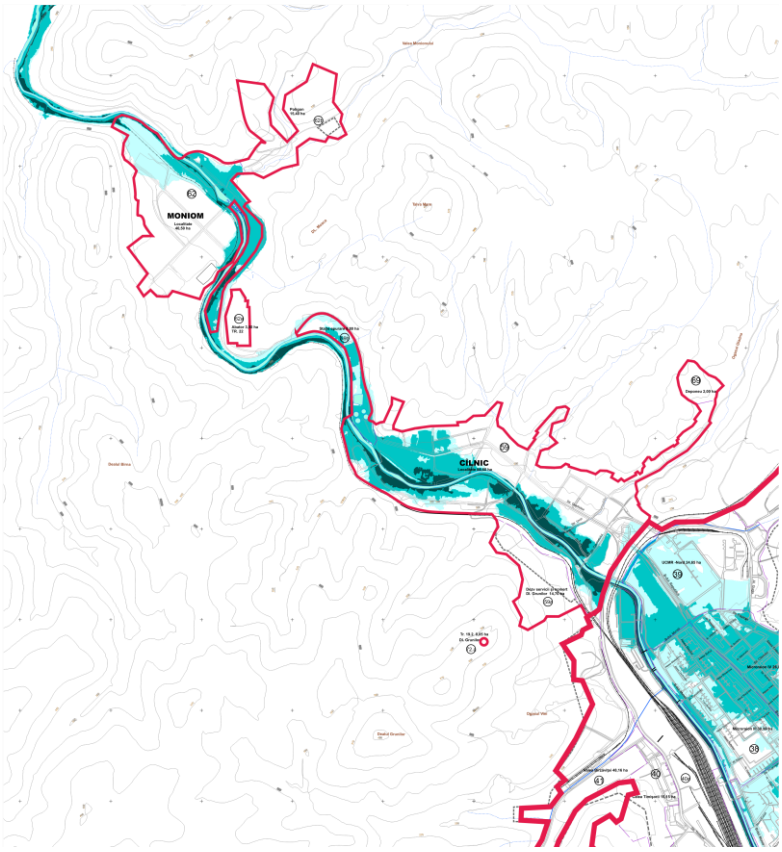


***Figure 73 –*** *Hazard and flood risk map on Bârzava River – administrative territory of Moniom and Câlnic*

*Source: Flood risk map. Approved Reșița General Urban Plan*


***Figure 74 –*** *Comparison of satellite images of Moniom and Câlnic (2005, 2021)*

*Source: Flood risk map. Approved Reșița General Urban Plan. Google Earth*



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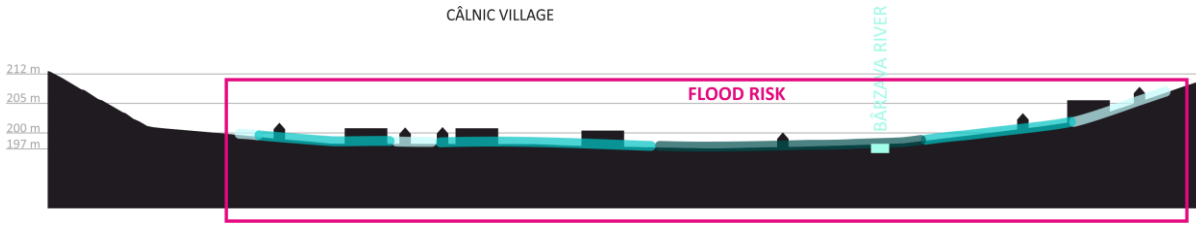


***Figure 75** – Transects of Bârzava River's floodplain in Câlnic Village*
*Source: World Bank*

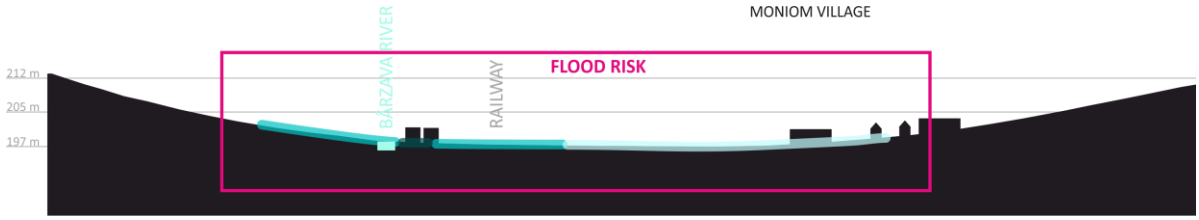


***Figure 76** – Transects of Bârzava River's floodplain in Moniom Village*
*Source: World Bank*

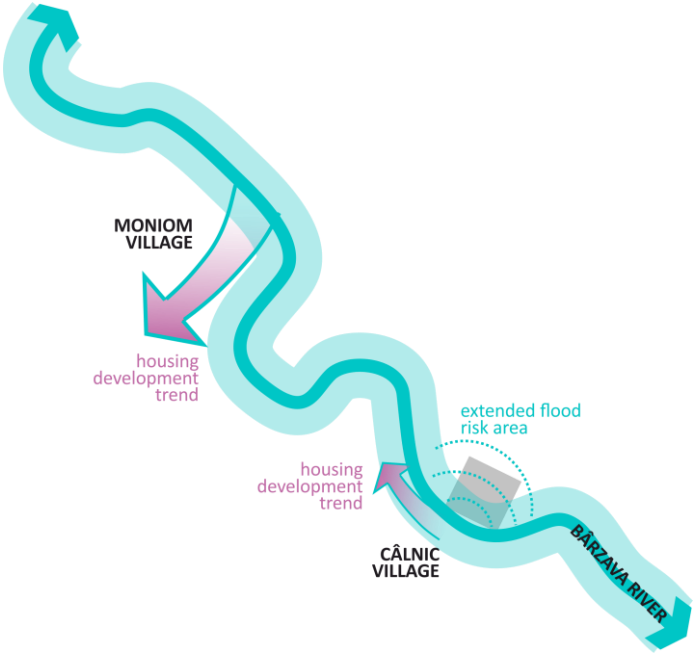


***Figure 77** – Development trends in Bârzava River's floodplain in Moniom and Câlnic*
*Source: World Bank*

Compared to Moniom, Câlnic Village has undergone a slightly more significant development in the 2005-2021 period of time. There is a trend of developing an informal settlement on the left bank of the river, in the Bistra Street area, where the flood risk is medium (a flood in 100 years). There is also room for development along the North-Eastern valley (Râului Street), foreseen in the PUG Reșița Municipality 2011.

Between 2005 and 2021, there is a slight growth of the housing area in Moniom Village, to the South-East, at the foot of the hills, where there is no flood risk. The foreseen limit of the regulated built area also allows a development in the South-Western area.


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## D.3. Integration of hazard and flood risk maps and flood risk management measures into spatial and urban planning

### D.3.1. Spatial and urban planning plans analysis

#### D.3.1.1. Caraș-Severin Territorial County Plan

The Territorial County Plan (PATJ) is a planning tool which plans the large-scale territory of a county, focusing on the main development directions of the area: economy, society and demographics, natural environment, accessibility and culture. This kind of approach has an impact on the medium- and small-scale territory, on urban settlements like Reșița City, **improving the quality of life, the cooperation between administrations, protecting or capitalizing on material and intangible elements of the county in a sustainable manner**.

Caraș-Severin Territorial County Plan is based on 8 main studies which analysis the following subjects: economic and agricultural potential, forestry potential, socio-economic potential, hydrography, natural risk areas, mineral resources, touristic potential of Cerna Valley, demographics and urban settlements network. The goals are improvement of life quality, development with respect for the geographical and cultural features, sustainable use of land and infrastructure, improvement of ecological balance, capitalizing on the touristic and leisure potential, facilitating a participative approach between regional administration and local community, cross-border cooperation.

Caraș-Severin County is located in the South-Western area of Romania, with a various **natural landscape** composed of mountains, hills, valleys, plains, floodplains and great layers of forests which are 48.27% of the county area. The major natural elements of the county are Danube River (in the South), Semenic and Retezat Mountains (65.4% of the county is mountainous landscape). The county holds 4 national parks and reserves: Domogled-Valea Cernei, Porțile de Fier, Cheile Nerei-Beușnița, Semenic-Cheile Carașului. Furthermore, there are 46 reserves and natural monuments, from which one is on the administrative territory of Reșița Municipality and is part of the natural reserve Semenic-Cheile Carașului: Groposu Natural Reserve.

**The hydrographic network** of the area is made of **5 river basins (Timiș, Nera, Cerna, Caraș and Bârzava), natural lakes, reservoirs, thermal springs and drinking water springs**. Moreover, the water system is completed by a series of hydrotechnical infrastructure like Trei Ape Lake which redirects a part of the Timiș waterflow to the Bârzava River. The main river basin of the county is Timiș, which springs from Semenic Peak (1410 m) which has a surface of 5795 $km^2$ from which 2745 $km^2$ are on the right bank (47%) and 3050 $km^2$ are on the left bank (53%). Cerna River basin is directly connected to the Danube River and has a surface of 1380 $km^2$, springing from Godeanu Mountain (2070 m) going from North-East to South-West in the Eastern area of the county. Nera River basin is located entirely on the territory of Caraș-Severin County and has a total surface of 1400 $km^2$. Caraș River basin is also located entirely on the territory of the county and it springs from Semenic Mountains, 1 km away from the spring of Bârzava River.

Bârzava River basin has three main divisions: high mountains division (height over 1200 m), in Semenic Mountains, with deep and rough valleys; low mountains division (1200-600 m) which is characterized by plateaus, gorges and young valleys; Banat piedmont division (200-600 m) in the medium and lower basin of the river, where it merges with the West Plain. The analysis of the hydrographic area of Caraș-Severin County shows that the creeks and rivers downstream from Reșița, in the Bârzava river basin, do not hold great flooding risk due to the river flood prevention infrastructure and Secu, Văliug and Gozna Reservoirs. In the Reșița-Carașova area there are also 2 main underground karst springs: Doman Spring (60 L/s) and Carașova Spring (60 L/s).

**Natural risks** in Caraș-Severin County are represented by **earthquakes, landslides and floods**.



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Earthquakes in the area are of small-depth, superficial, with a maximum magnitude of VII M.M., generated by a West to East-oriented plate motion, in contrast with the East to West-oriented plate motion in the Eastern Romania. The activity of tectonic movement is not monitored in the area, as the Șușara seismic station (Sasca Montană Commune) is dilapidated. The county plan advises an extended expertise of buildings that have been built before 1977 without seismic risk prevention regulations and also better control of current building practices.

Landslide risk is mostly generated by geologic reasons, but also hydrologic and climate, seismic, forestry and anthropogenies reasons. In Caraș-Severin County there are 16 major groups of heave movements, from which 5 are in the Reșița area:

- **Lupacului Hill Landslide** – on the Western slope of the hill there are three sections of landslide which constantly damage the DJ581 County Road in the area of Lupac Village;
- **Ranchina Hill Landslide** – in the South-Eastern territory of Reșița City, where the damage of the Văliug-Reșița water supply infrastructure and the water dynamics of the creeks produce landslides causing damage on DJ582 County Road;
- **Driglovățul Vechi Hill Landslide** – excessive rain in 1997 determined soil erosion and subsequent landslides in the Driglovăț Neighbourhood of Reșița;
- **Bașovăț Valley Landslide** – in the South-Eastern territory of Reșița City, in the Minda Neighbourhood, along the Bașovăț Valley and the Valea Mare Creek where vertical erosion produces landslides in the housing area.

**The proposal for landslide prevention is changing water dynamics**: draining surface water and infiltrations from the heave, afterwards intaking the springs from the landslide to redirect them to a non-damaged area. The following prevention intervention is the correction and reinforcement of the landslide and also building a better water management infrastructure.

Flood risk analysis is minimal in the Caraș-Severin Territorial County Plan, presenting an inventory of the flood risk areas – Reșița has a surface of 105 ha floodable area, caused by the Bârzava River**. The proposal for flood prevention foresees river embankments, regularizations, improvements and rehabilitations**. Reșița City is also included in the proposal, with improvement of Bârzava River and its tributaries.

**Water pollution – risk areas and environment protection**

The water quality in Caraș-Severin County is high (1$^{st}$ class quality) on all 3 river basins. However, given the industrial profile of the mountainous area of the county, **technological hazards** are likely to happen, producing water pollution along rivers like Caraș, Bârzava, Bistra Mărului, Danube and smaller creeks like Rusca. The five rivers are directly connected to industrial sites like metallurgy (Reșița – Bârzava River), mining (Oravița – Caraș River) marble exploitation (Ruschița – Rusca Creek) and complex ores processing (Moldova Nouă – Danube River). These activities generate pollution that damages both surface water and groundwater.

The pollution of Bârzava river is created not only by industrial activities and water management in Reșița, but also by the pollution of the four reservoirs located upstream from Reșița: Secu, Gozna, Trei Ape and Văliug Lakes. The risk is caused by wood exploitation, unsustainable tourism practices and buildings that do not have an ecological water management system.


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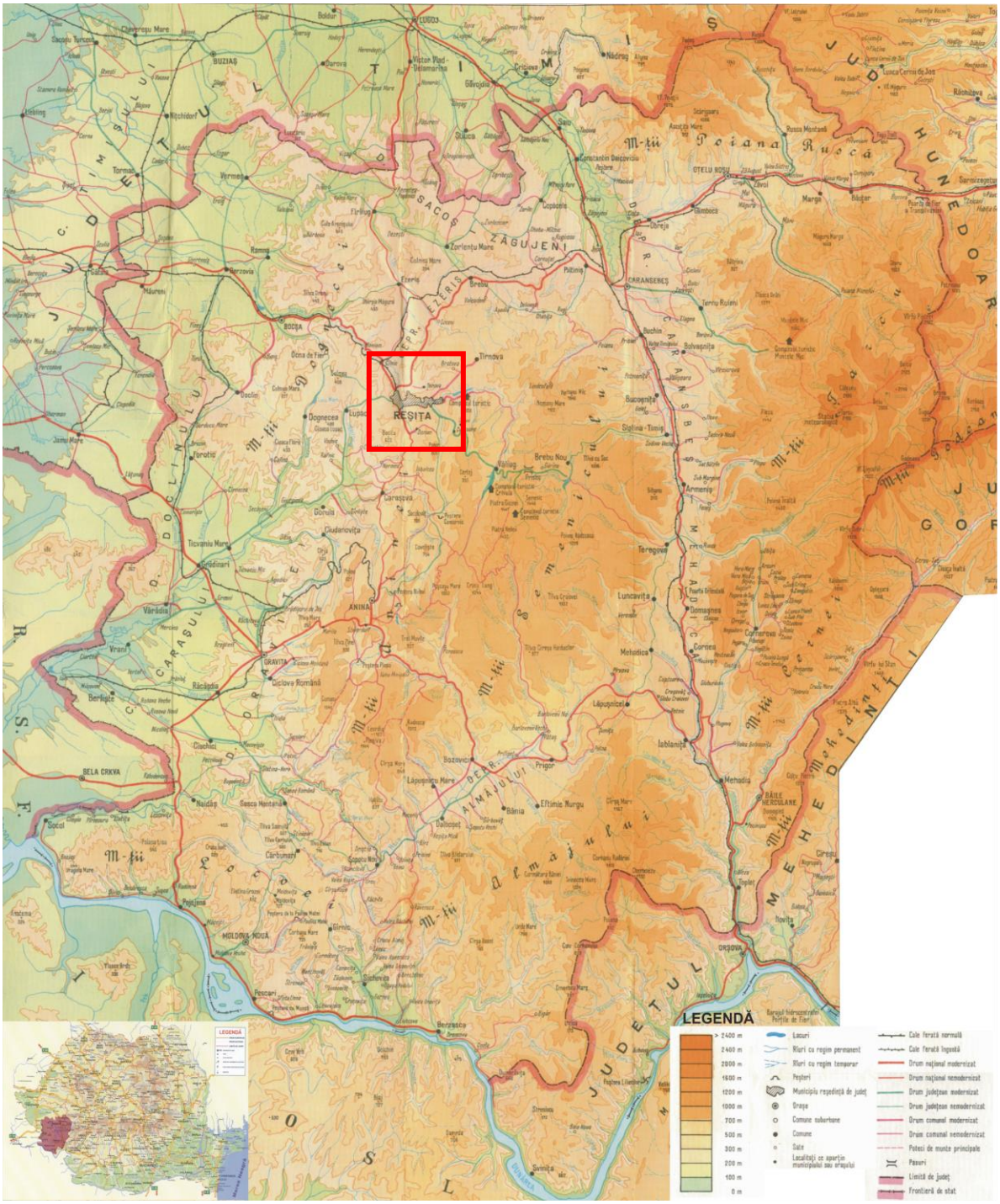


***Figure 78*** *– Hydrology and natural landscape of Caraș-Severin County*
*Source: Caraș -Severin Territorial County Plan (PATJ Caraș-Severin)*



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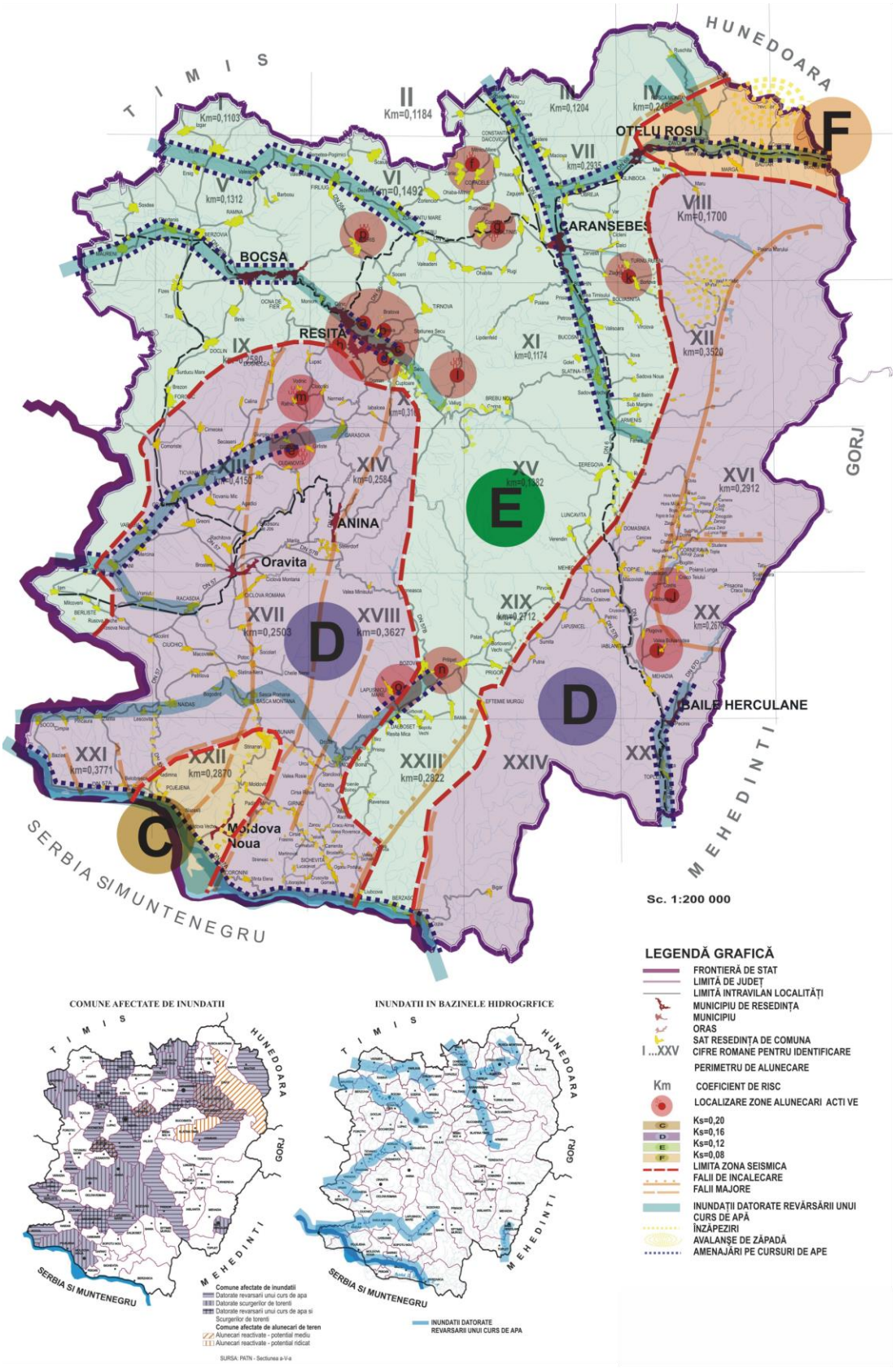


***Figure 79*** *– Hazard and natural risk map of Caraș-Severin County*

*Source: Caraș -Severin Territorial County Plan (PATJ Caraș-Severin)*



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### D.3.1.2. Local Development Strategy of Reșița 2015-2025, Caraș-Severin County

The Local Development Strategy of Reșița is focusing on the revitalization of Reșița through capitalizing on its potential, by creating job opportunities in the production industry and in sales and service and tourism as well. By transparent decision-making and better planning tools, the Strategy aims at 7 local development goals for the 2015-2025 horizon:

1. Urban development and renewal;
2. Sustainable urban mobility;
3. Sustainable economy and tourism;
4. Green city, energy efficiency and low carbon emissions;
5. Better life quality and social responsibility;
6. Education and culture development;
7. Efficient and democratic management.

Regarding flood risk prevention, the Strategy aims to raise the area of public green spaces, improve the quality of life in the city and create new leisure areas:

- Feasibility study for the regularization of 15 stream channels and clogging of existing channels;
- Redesign green spaces on the banks of Bârzava River;
- Rehabilitation of public green squares;
- Rehabilitation of Tricolorului, Cărășana and Moroasa Parks.

### D.3.1.3. Reșița Municipality General Urban Plan (PUG Reșița)

According to the current laws and regulations in Romania[116], Reșița is a 2nd rank city – municipalities with county importance which maintain a balance in the settlement network. With a population between 5.000 and 30.000 inhabitants, the city has an influence area of 10 to 20 km. According to the law in force[117], in order to develop a General Urban Plan for a 2nd rank city like Reșița, there is a series of preliminary studies needed:

1. Analytical studies:
   - Preliminary Study regarding the updating of the Topographic Support;
   - Preliminary Study regarding geotechnical and Hydrological Preliminary Study;
   - Preliminary Study regarding peri-urban relations;
   - Preliminary Study regarding organization of roads and transport;
   - Preliminary study on Environmental protection, Natural and Anthropogenic risks;
   - Historical preliminary study / Landscape preliminary study;
   - Preliminary study regarding the identification of property types;
   - Preliminary study regarding the utility network;
2. Advisory studies:
   - Preliminary study on stakeholder analysis and social surveys;
3. Prospective studies:
   - Preliminary study regarding the economic activities' evolution;
   - Preliminary study regarding socio-demographic evolution;
   - Preliminary study regarding urban mobility and transport;

[116] The Law no. 351/2001 for the approval of the National Territorial Plan – Section IV – The localities network
[117] Order no. 233/February 26, 2016 for the approval of the Methodological Norms for the application of Law no. 350/2001 regarding the spatial planning and urbanism and for the elaboration and updating of urban planning documents


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- Preliminary study regarding the impact of climate change;

For the Reșița General Urban Plan there have been developed 8 preliminary studies:

1. Socio-demographic study of Reșița Municipality
2. Peri-urban relations and areas
3. Touristic areas and development opportunities
4. Natural reserves and protected areas
5. Protected built area
6. Economical evolution of Reșița
7. Risk areas (landslide and flood)
8. Mobility study (vehicle, railway, public transport)

From the forementioned list, the following studies that were used for the Reșița Municipality General Urban Plan were provided by the City Hall: Geotechnical and Hydrological Preliminary Study, Historical study regarding the delimitation of protected areas and monuments protection / Landscape study, Preliminary study regarding the water, sewer, electricity, gas and telecommunications networks.

Regarding the flood risk prevention, the general report of the PUG approaches natural risks and hazards potential in a minimal manner. According to the data provided by OGA Reșița, **there is no considerable flood risk on the main course of Bârzava River** *(„Chapter 2.7. Measures in natural risk areas")* due to the hydrotechnical infrastructure composed of 3 reservoirs located upstream: Secu, Văliug and Gozna Lakes. However, there have been floods brought out by the minor streams and creeks located in the mountainous area: Sodol and Budnic Creek. Apart from Bârzava River, there has not yet been any conducted analysis on flood risk of the local creeks and small rivers.

However, in the analysis part, the General Urban Plan maps the flood risk areas in Reșița City, with additional data on flood parameters from a study carried out in year 1985 on 9 areas in Reșița (*„2. Studii de fundamentare: Zone cu riscuri naturale – Inundații"*). There is also a mapping of unregularized creeks, temporary streams and valleys which carry alluvium: among them, Țerova, Sodol, Bașovăț and Budinic creeks.

In addition to the General Urban Plan, there is a study on the **informal settlement developed in Câlnic Village**, in the Bistra Street area, on the left bank of Bârzava River, in a floodable area. Aiming to protect the inhabitants, the study presents 5 measures of legal nature: leasehold estate for the community members, recognition of property on the used land, recognition of a form of land use if the parcel is either in public or private property.

On the other hand, the proposal and regulations feature a series of flood and landslide prevention measures, taking into consideration a medium risk of flooding especially in the central area of Reșița (Mind and Central Area). The peripheries of Reșița are presented as risk areas as well, because they are set at the foot of the mountains and can be affected by the creeks and temporary streams (*„ogaș"*) which bring alluvium and overwork the sewage system, creating floods. Therefore, the PUG presents **3 types of recommendations**: **small-scale infrastructure interventions** (building of water collecting infrastructure in pedestrian areas near the mountain), **rules and regulations in building practices** (reducing the density of buildings) and **cause-solving solutions** (regularization and improvement of temporary streams near central area).


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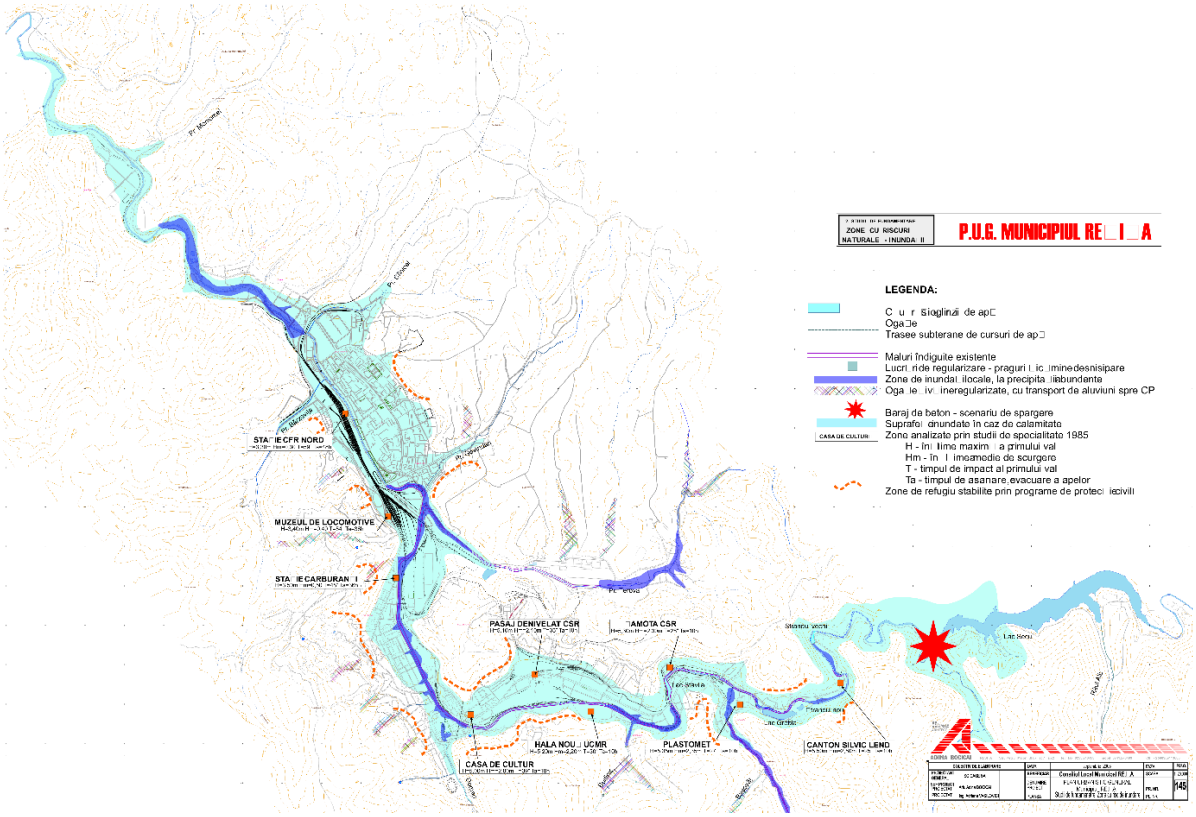


***Figure 80*** *– Hazard and natural risk map of Reșița: flooding risk*

*Source: Reșița Municipality General Urban Plan 2011*

Regulations of the territorial administrative units (UTR) of Reșița City have two types of approach to flood risk prevention: reporting dysfunctions and improvement proposals for local rivers and creeks. The most common dysfunctions are the unregularized water streams (Doman Village, Reșița – *UTR17*). The improvement proposals are as it follows:

- Sand traps of temporary streams and valleys (Reșița – *UTR3, UTR20, UTR21*);
- Regularization of temporary streams and creeks (Moniom Village, Reșița – *UTR13, UTR19*);
- Alluvium collector basin (Reșița – *UTR13, UTR19*);
- Regularization works on Bârzava River (Reșița – *UTR24, UTR25, UTR26, UTR27, UTR27a*);
- Building of pluvial gutters (Reșița – *UTR20, UTR21*);
- Piers and hydrological protection (Secu Village).

Although Reșița General Urban Plan has a preliminary study regarding the flood risk areas, the information provided are not taken over in the PUG's drawn pieces. The only thing mentioned in PUG's prevision map refers to the torrents arranging works and alluvium capturing (structural measures).

The Reșița Municipality General Urban Plan does not have an action plan included in the memoir provided by the City Hall to the working team, but there is a plan with intervention areas located on map. The intervention list does not include anything referring to flood risk.



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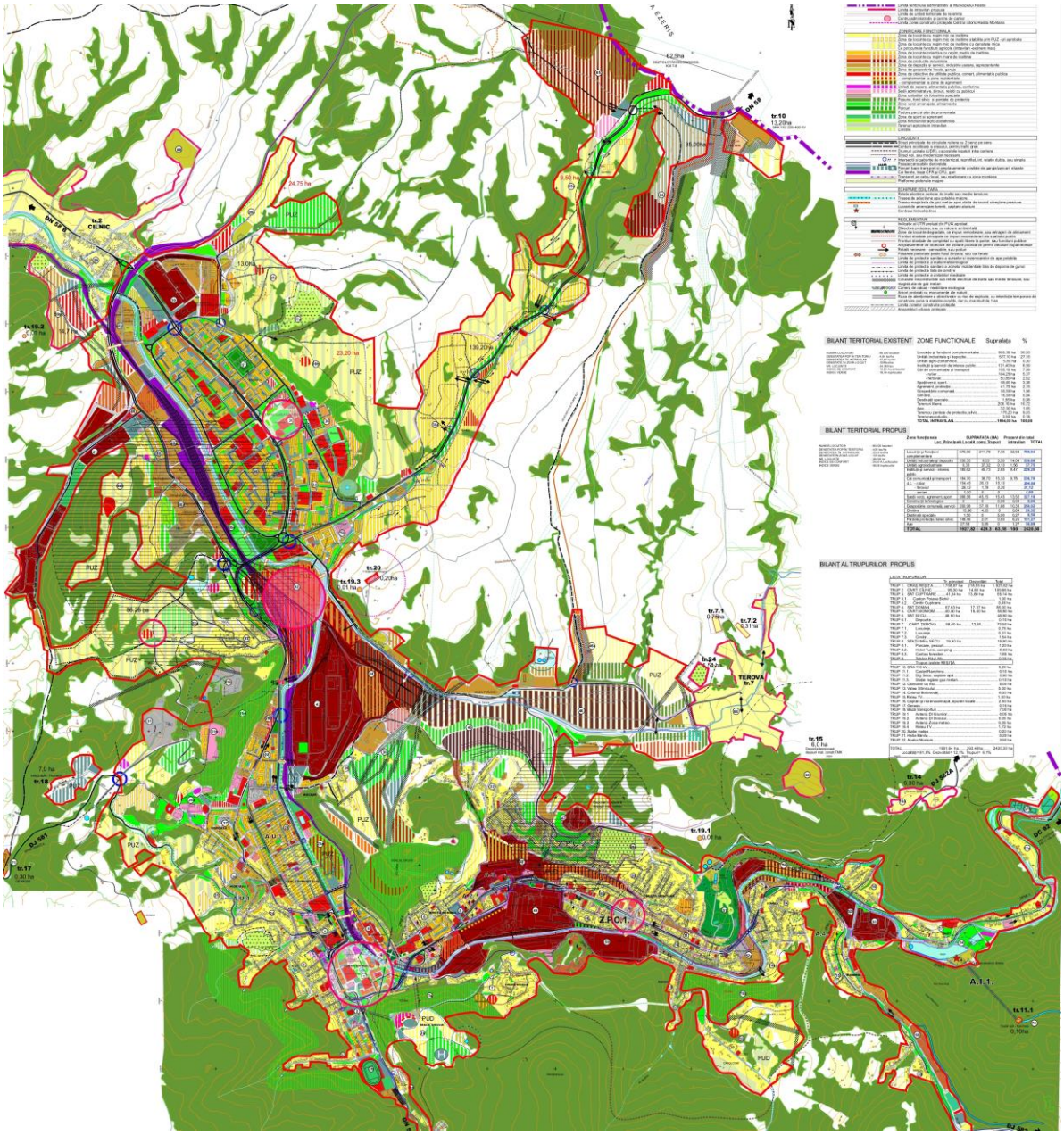

***Figure 81 –*** *The General Urban Plan's provisions*
*Source: Reșița General Urban Plan*

### D.3.1.4. Conclusions

Concerning flood risk, the urban and territorial plans of the studied area are intercorrelated, connecting the different scales of territory: Caraș-Severin Territorial County Plan (regional territory), Local Development Strategy of Reșița (local territory), General Urban Plan of Reșița Municipality (local territory). In the forementioned documents, landslide risk is usually given more importance than the flood risk due to the presence of structural flood infrastructure which is an important part of flood mitigation. The analysed documents don't include flood risk analysis or flood mitigation in the drawn parts of the documentations. Moreover, **this approach is not accurate because it does not take into consideration the local streams from the mountainous area, neither the pluvial flood risk**.

Existing infrastructure plays an important part in flood prevention in Reșița Municipality: embankments, dams, reservoirs etc. These elements are a functional system which is periodically improved through the spatial development plans proposals. The proposed measures usually have a



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**small-scale approach**, focusing on **building flood prevention infrastructure** like regularization, embankments, improvements and rehabilitation of Bârzava River and other local creeks.

Among the territorial and urban spatial development plans, **The Local Strategy** takes a step further into flood prevention, with intervention proposals on urban green spaces in the urban area and on the banks of Bârzava River. However, these measures are not mapped, neither integrated in the General Urban Plan regulations as a flood management system.

### Main gaps

**The lack of data** is one of the main identified problems in flood risk analysis, leading to a rather generic perspective in urban and territorial development strategies and plans. Flood risk areas are marked in the Caraș-Severin Territorial County Plan but they are **not specifically enough determined in order to be useful for the small-scale territory and for Reșița City**. The preliminary studies for Caraș-Severin Territorial County Plan approach natural risks area in a general manner, as well as proposed measures, which are **not spatialized or site-specific**.

Flood risk is minimally approached in urban development plans as Reșița Municipality Local Development Strategy 2015-2025 or Reșița Smart City Strategy 2027. There is **no spatial visualization of the potential measures**, regardless of their specific.

At a local level, there is a study for multiple natural risks in Reșița Municipality General Urban Plan from 2011 which also shows the flood risk scenario in the case of Secu Dam breaking. This preliminary study thoroughly maps flood risk area of Bârzava River in the regulated built area of Reșița Municipality. On the other hand, it **does not include flood risk areas for the adjacent streams**. Moreover**, the PUG does not include flood risk areas in the proposal**, but a series of structural measures on Bârzava River and on the adjacent small streams which come from the mountainous area.

### Lessons learned

In order to have a **multi-scale approach**, flood risk preliminary studies for all types of spatial planning documentations (Geotechnical and Hydrological Preliminary Study, Preliminary Study on Environmental Protection or Natural and Anthropogenic Risks) should have a **mandatory content developed by hydrotechnical engineers**. The preliminary studies for Caraș-Severin should include specific measures for the catchment area of each main river of the county, including Bârzava River. This should be done on multiple levels because floods are not only a local problem and the entire catchment area should have specific flood-mitigation measures through territorial development plans.

It is also important to create intermediate levels in the spatial planning. The metropolitan level can have a significant role in creating flood mitigation measures, as Reșița does not have a metropolitan area or a peri-urban plan, even though it is a 2nd rank city and the most important economic center in Caraș-Severin County. A regulated metropolitan area and a development plan would improve the multi-scale and holistic approach of flood mitigation in Reșița area.

Reșița Municipality PUG proposal features structural flood mitigation measures on Bârzava River in the central area of the city and on the adjacent small streams (Doman Creek, Țerova Creek and Sodol Creek) which come from the mountainous area. Flood mitigation should have a **holistic approach**, in addition to the structural measures being a series of **nature-based solutions which must also be mapped** in the local development spatial plans. It is also important for Reșița City to have a clear approach to multiple types of flood risk (fluvial, pluvial, flash floods etc.) due to the density of built area on both banks of Bârzava River and adjacent streams, where **land use should be regulated and**

**landownership clarified**. Nature-based solutions can be an important part of Reșița's local development due to its natural landscape which rules the urban cityscape.

## D.3.2. Spatial and urban planning plans elaboration, approval and enforcement

The analysis of the territorial and urban plans was completed by interviewing stakeholders involved in the flood risk management in the area. The interviews were conducted on-line, by several meetings and questionnaires sent by e-mail. The interviewed stakeholders were **Reșița Municipality**, **The Regional Basinal Administration** (RBA) and **The Inspectorate for Emergency Situations**.

### Main gaps

#### *The municipalities meeting*

The meeting with **Reșița Municipality** was held on 22nd November 2021 (22.11.2021). The matters discussed were historical floods data, General Urban Plan status and including flood hazard and risks in future planning practices.

The interview revealed that along Bârzava River **flood risk is not significant**, due to the flood management infrastructure existent upstream, made up of three reservoirs: Văliug, Secu and Gozna Lakes. However, there is a history of flash flood hazard, the most recent one being **the 2015 flood**, when the waste water plant was flooded and it damaged areas built in floodplain, especially the **vulnerable communities** from the informal settlement of Bistra Street. The most vulnerable areas concerning flood risk are the **peripheral ones**, located at the limit of the mountain, near the valleys which hold temporary streams (torrents). Heavy precipitation fuels the streams, leading great amounts of water into the valleys and then into the city area, which pressures the sewage system and generated pluvial floods. There are between **5 to 6 critical areas** of this kind.

The General Urban Plan of Reșița Municipality in use is the one approved in 2011, leading to the use of out-of-date information. The update procedure has not yet started. The most important local masterplan currently in phase of development is a Zonal Urban Plan for the informal settlements located in the flood risk area.

**Main gaps regarding local flood risk**

Flood risk in Reșița is mainly caused by **flash floods which cannot be carried by the local sewerage system**. It is a mixed sewer system which has 5-6 weak points which have been identified in the past but they have not yet been completely remediated. The waste water plant is also vulnerable because of its position – it is located in the floodplain, near Bârzava River.

Therefore, floods are managed through the local sewerage system, the waste water plant and the reservoirs located upstream. **Alternative prevention measures like green spaces are not developed** because of legal reasons regarding The Green Areas Registry which is not completed yet. Green areas on the banks of Bârzava River could be used for leisure, sports and economic purpose, but this implies a change of land use in future urban planning documents.

**Main gaps regarding spatial and urban planning**

**Spatial planning is not approached in an integrated manner**, not only concerning flood risk prevention, but also concerning the development of neighboring territorial administrative units. At the moment, the General Urban Plan of Reșița Municipality is not coordinated with the future development of neighboring communes like Văliug, Carașova or Târnova. The validity of the General Urban Plan was extended in order to have the necessary time to develop the ToR and eventually the new General Urban Plan. **The lack of trained staff in urban planning software** like GIS is also a gap in the development and use of the upcoming General Urban Plan.

**Main gaps regarding the integration of flood hazard and risk maps and flood risk management measures to reduce the flood risk into spatial and urban planning**

**Flood hazard is not integrated in the current General Urban Plan regulations**, even though there is a brief analysis of the floodplains and existent flood prevention infrastructure. The future Plan will embody measures to rehabilitate the water retention system. Nonetheless, the forthcoming planning of Reșița Municipality is in need of flood hazard risk maps and measures, also including spatial planning measures for vulnerable communities located in the floodplain of Bârzava River.

### *National Romanian Waters and Rivers Basin Administrations meeting*

The interview with the River Basin Administrations took place with all the three institutions: Argeș-Vedea, Banat and Siret River Basin Administrations. It happened on 9th of February (09.02.2022) and it had three topics: spatial and urban planning in the absence of risk maps and flood studies, integration of FRM (flood risk management), RBM (river basinal management) and environmental aspects in spatial and urban planning and interinstitutional cooperation. The interview and its conclusions (**the main gaps**) for the three topics have been further presented previously in *SECTION B: Timișoara city pilot area, Timiș County.*

### *County Inspectorate for Emergency Situations meeting*

Interview with the **County Inspectorate for Emergency Situations** (**IGSU Semenic**) took place through an official address, on 21st of February 2022 (21.02.2022). Its aim was to understand the inclusion of flood risk measures in emergency situations plans.

**Main gaps regarding the integration of flood hazard and risk maps and flood risk management measures to reduce the flood risk into spatial and urban planning**

Flood risk is foreseen and tackled through a measure plan developed by the Reșița Local Committee for Emergency Situations. However, the IGSU does not develop certain measures or plans which have to be implemented, but they should be submitted by urban planners or architects in new spatial and urban plans. IGSU does not provide data regarding flood risk areas or any other kind of risk areas.

The submitted documentations should include a proposal and a localization of risk and evacuation areas and accessways to these areas, using different methods: GIS plans, blue corridors for flood risk mitigation, sewerage system and risk receptors.

**Main gaps regarding the interinstitutional cooperation**

The interview revealed that the cooperation between IGSU and the local administrations is reduced. Specifically, the county plan for flood risk management does not include Fast Intervention Centers (CIR) or other emergency areas and measures. Each of the institutions – IGSU, local administrations or county administration – does not provide emergency measures or areas data and does not take responsibility for a certain localization of these areas.

**Permits and authorizations**

The IGSU issues authorizations following the submission and evaluation of spatial and urban plans. Regarding flood risk, the attributions of IGSU only include verifying that the emergency situations measures are included in the documentation, during the approval process. The institution does not make recommendations of emergency measures.

## Lessons learned

### *The municipalities meeting*

**Lessons learned regarding local flood risk**

The interview with Reșița Municipality showed that the area has well-developed infrastructure for flood risk management and it is mainly made of structural measures like local sewerage system, a waste water plant and three reservoirs located upstream on Bârzava River. It is, however, important to shift to **more sustainable measures**, for both fluvial and pluvial floods.

Traditional measures like pluvial sewage rehabilitation, building limitations, should be enhanced by additional measures like **resilient green spaces** which have the aim of increasing city resilience and fighting climate change through **integrated measures** (e.g., Reșița Verde Project). In order to plan a more resilient city, there should be flood risk management measures included in the proposal that should also take into consideration vulnerable sites like informal settlements located in Bârzava's floodplain. It is essential to rehabilitate the local sewerage network in order to help it collect torrents water (flash floods and temporary streams from the mountain valleys), thus reducing the pluvial floods risk.

**Lessons learned regarding the integration of flood hazard and risk maps and flood risk management measures to reduce the flood risk into spatial and urban planning**

In an effort to plan a more resilient city, it is important to **update the General Urban Plan and develop the preliminary studies**. The preliminary studies can be elaborated by applying for different kinds of funding methods, local and national.

The process of updating the General Urban Plan and the future development of Reșița Municipality should have **an applied approach, taking into consideration possible measures and interventions**. These should be elaborate, not only showing the necessity of flood and hazard map integration into planning, but also include a detailed procedure which would help to mitigate flood risk.

### *National Romanian Waters and Rivers Basin Administrations meeting*

The interview with the River Basin Administrations took place with all the three institutions: Argeș-Vedea, Banat and Siret River Basin Administrations. It happened on 9$^{th}$ of February (09.02.2022) and it had three topics: spatial and urban planning in the absence of risk maps and flood studies, integration of FRM (flood risk management), RBM (river basinal management) and environmental aspects in spatial and urban planning and interinstitutional cooperation. The interview and its conclusions (**lessons learned**) for the three topics have been further presented previously in *SECTION B: Timișoara city pilot area, Timiș County.*

### *County Inspectorate for Emergency Situations meeting*

**Lessons learned regarding the integration of flood hazard and risk maps and flood risk management measures to reduce the flood risk into spatial and urban planning**

The County Inspectorate for Emergency Situations does not have the necessary data to actively mitigate flood risk. Emergency situations, including floods, should be approached in an integrated manner and the management plan should be developed including all the main regional stakeholders. Regional and local institutions cannot approach flood risk without a central plan and without cooperation.

# SECTION E: Săucești commune pilot area, Bacău County

## E.1. General description

### E.1.1. Territorial context

Săucești commune is located in Bacău County (in North), at the north-eastern limit of Bacău Municipality, along the Siret River and the European Road E85 (on the Bacău-Roman route).

Săucești is part of Bacău Metropolitan Area according to a local project developed to create an integrated administrative unit between Bacău city and neighboring communes: Bereşti-Bistriţa, Buhoci, Faraoani, Filipeşti, Gioseni, Hemeiuş, Iteşti, Izvoru Berheciului, Letea Veche, Luizi-Călugăra, Măgura, Mărgineni, Garleni, Odobeşti, Prăjeşti, Sărata, Săucești, Secuieni, Tamaşi, Blagesti, Horgesti şi Traian.

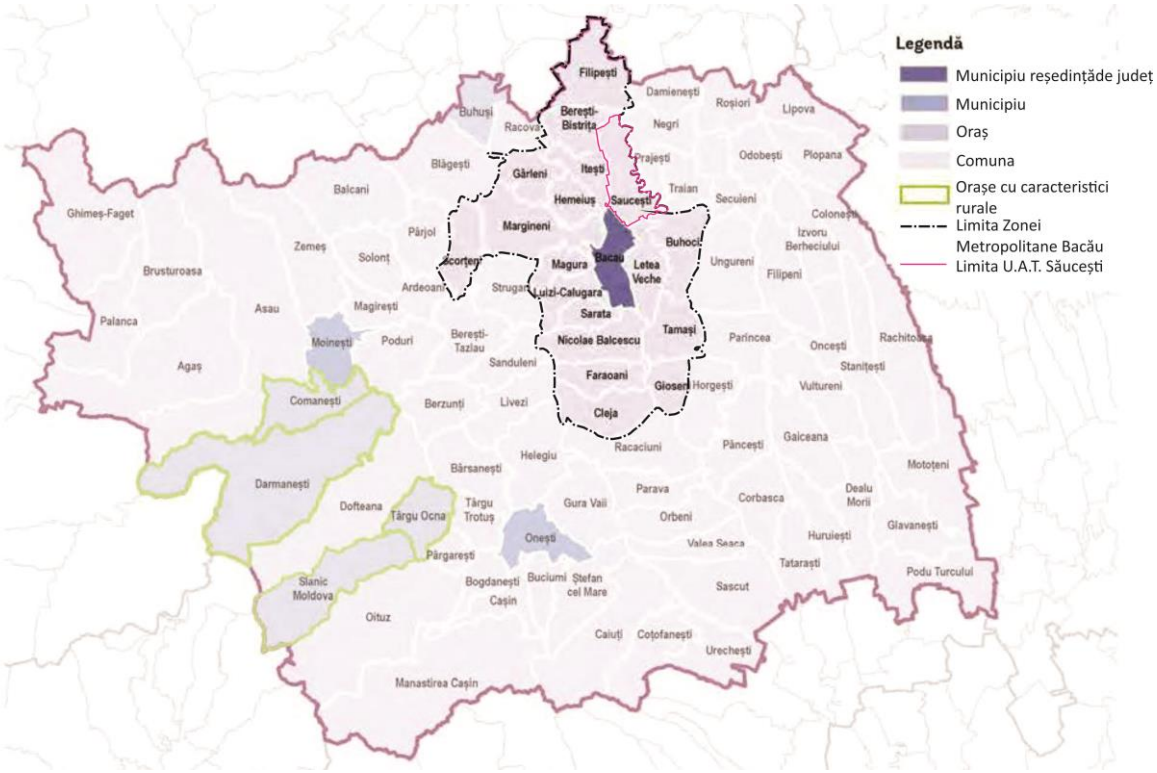


***Figure 82** – Bacău Metropolitan Area*

*Source: Processed by World Bank by using the map from The Sustainable Development Strategy of Bacău County (https://www.csjbacau.ro/dm_cj/portalweb.nsf/AllByUNID/strategia-de-dezvoltare-durabila-a-judetului-bacau--instrument-de-lucru-pentru-administratie-000042b6?OpenDocument)*

The territory of the commune borders:

- in **North** and **North-West** with Bereşti-Bistriţa commune;
- in **West** with Iteşti and Bereşti-Bistriţa communes and Bacău city;
- in **South** with Bacău city and Letea-Veche commune;
- in **South-East** with Buhoci and Traian communes;
- and with Prăjeşti and Negri communes to **East**.

The administrative territory of the commune includes five villages: **Săucești, Schineni, Siretu** (former Cățelești village), **Şerbeşti** and **Bogdan-Vodă**. Given the location of the commune near Bacău, road accessibility in the area is increased. The main roads that serve Săucești commune are the national road DN2 (E85), which crosses Bogdan-Vodă village, connecting Săucești commune with Bacău and



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Roman municipalities, county road DJ207F and a series of communal roads DC14, DC12, DC15 and DC16.

The relations in the territory of the commune are:

- with the other communes, through the existing roads;
- with Bacău and Roman through relations consisting of travel for purposes as work, education, supply of products consumer goods, or for the marketing of agri-food products.

The Săucești commune connections with the other administrative units are made exclusively by road, and communications are provided by road traffic systems telecommunications.

### E.1.2. Geographical description

Săucești commune is located within the Siret-Bistrița interfluve from within the Roman-Adjud depression corridor. The territory of the commune occupies both the riverside relief on the right bank of the Siret River as well as the terrace steps common to the two rivers. The surface of the river meadow has a terraced appearance.

The 3-5 m high riverside terrace forms a low relief with an accentuated unevenness. These terraces are marked by large wetlands with high humidity, areas that have been improved in the past but where drainage works and sanitation works only partially or not at all.

The entire Săucești commune territory has an area of 5345 ha, of which 4408 ha is infield (82,46 % of total area of the territorial administrative unit). The infield is divided into the following categories of use: 3559 ha of arable land, 825 ha of pastures, 20 ha of vineyards, 4 ha of orchards. Regarding the elements of natural environment, the forest area occupies 80,95 ha of the total.

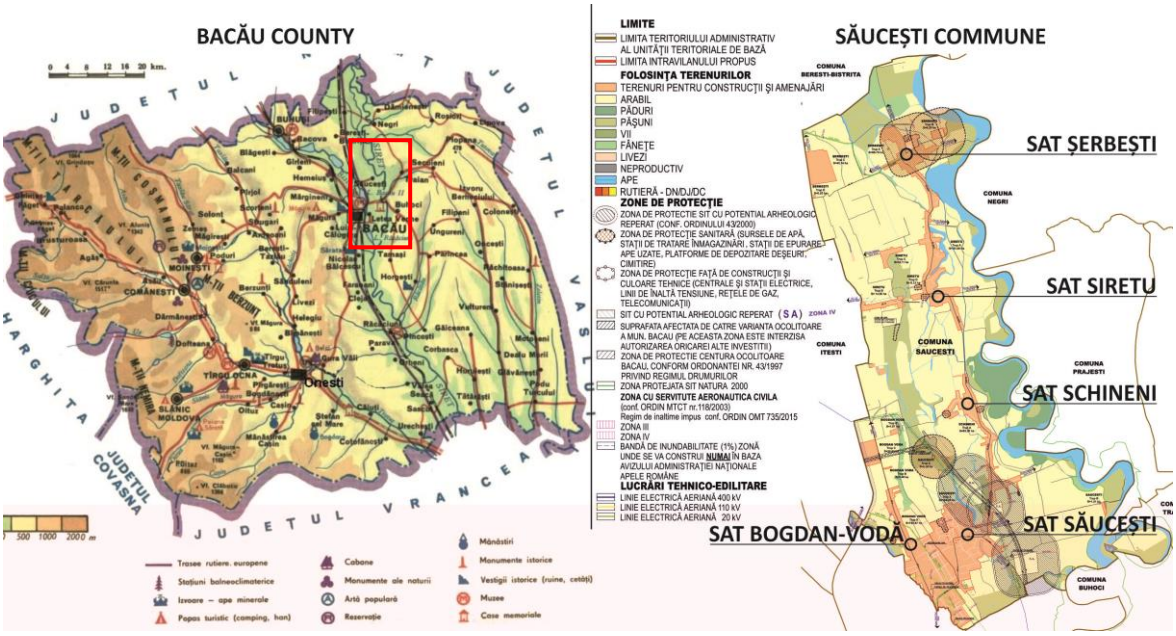


***Figure 83 –*** *Location in Bacău County (**Left**). The component villages of Săucești Commune (**Right**)*
*Source: Harta Județului Bacău [online]. Available at: https://pe-harta.ro/bacau/ (Accessed: 28.03.2022) (**Left**)*
*Săucești Commune General Urban Plan – in progress (**Right**)*

The regulated built area of the commune is located in flat perimeters or with smooth and stable slopes. Over time, there have been no major landslides in the area on the territory of the commune affecting the built-up areas. The lands situated outside the regulated built-up area are generally stable



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(agricultural land). Although there have been no landslides over time on the territory of the commune, there are some sensitive areas from this point of view.

In sloping areas, where water has puddled for a long time, the Quaternary-Holocene deposits are muddy-clayey or clayey. Most of the commune's surface is occupied by the relief of the terraces of riverside, alluvial steps sedimented as a result of the deposition activity especially a Siret River. The areas corresponding to these terraces are characterized by areas in generally flat and horizontal, with some microrelief irregularities and are favorable for constructions.

The geographical area of Săuceşti commune is characterized by a smooth terrain, having the villages exposed on the lower terrace of Siret River, except for Bogdan-Voda village which is located on the higher plateau between Bistrița and Siret.

**Săuceşti village** is located in the south of the commune, on the right bank of Siret River, on the 3-5 m high meadow terrace. To the west, the locality is limited by the terrace of 35-40 m altitude. To the west are the arms of the Turbata brook (Precista and Rogoza). Their riverbed has undergone clogging processes to varying degrees. To very high rainfall causes floods that affect the outskirts but also some households (north and northeast). The groundwater in the settlement area is at a depth of 2-3 m.

**Bogdan-Vodă village** is located on the west side of Săucești village, on the border of Bacău city. It was formed on both sides of the national road DN2 (E85) Bacău-Roman. Related to the hydrographic network, Bogdan-Vodă village is located on the upper terrace between the Siret and Bistrița rivers (the interfluve between them). The terrain is flat and horizontal. In the west the village is bordered by the craggy slope with heights of 10–25 m, through which the terrace connects with the major riverbed and the river meadow on the left side of the Bistrița River. Except for the slope towards the Bistrița River, which is affected by the collapse phenomena because of dusty rocks, no morpho-dynamic phenomena are reported in either proximity of the locality and built area.

**Schineni village** is located on the right Siret River shore, along the county road DJ207F. The village is located on the bridge of the 3–5m altitude riverside terrace, in the vicinity of the floodplain of the river (east of the village). The conformation of the land is flat and horizontal, the western limit of the village being represented by the cumulative plain of Turbata river. The area is characterized by excess humidity. However, the soil is not affected by active morphodynamic phenomena, except the eastern extremity of the regulated built-up area where strong erosion happens on the right Siret River shore and affects the stability of the major riverbed, favoring the production of some floods after very significant rainfall.

**Siretu village** is a locality developed in two directions, north-south along the county road DJ207F and east-west along the communal road DC12 (the development along the communal road DC12 has the shape of an isolated body). The village is located on the right Siret River shore, within the meadow, on terrace step of 3-5 m altitude. The locality is crossed by the Turbata brook's major riverbed, which on this section has numerous pond arms. On the west side, the village is bordered by a large area with excess humidity that discharges into the Turbata brook riverbed. The regulated built area is not affected by active morpho-dynamic phenomena.

**Șerbești village** is the northernmost village of Săucești commune, delimited to the south-west by the county road DJ207F. Like the other villages, Șerbești village is located on the right side of Siret River, in the meadow area. Compared to the major bed of Siret River, existing at approx. 1 km east of the village, the regulated built area rises to a height of approx. 6m, through lightly mild slope near the village. To the west, the village is bordered by an area with excess humidity due to the existence of secondary arms of the Turbata brook. The regulated built area is not affected by active morphogenetic phenomena.


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### E.1.3. Demographic data

According to the National Institute of Statistics, Săucești commune had 5547 inhabitants in 2021[118] and in 2020 it had 5459, more than the number of inhabitants recorded in 2014. The demographic trend is an ascending one, the number of populations increasing by 252 inhabitants between 2014 and 2021.

As can be seen in the following figure, in the period between 2015 and 2020 the number of inhabitants does not undergo significant changes, slightly abrupt increases can be observed though from 2014 to 2015 and in the last analyzed period, 2020-2021. The increasing numbers may reflect the recent preference of the people to move from the big urban areas to the neighboring localities. This is because of the relatively easy access to the various options offered by the city but also from the clean air with less pollution and less urban noise.

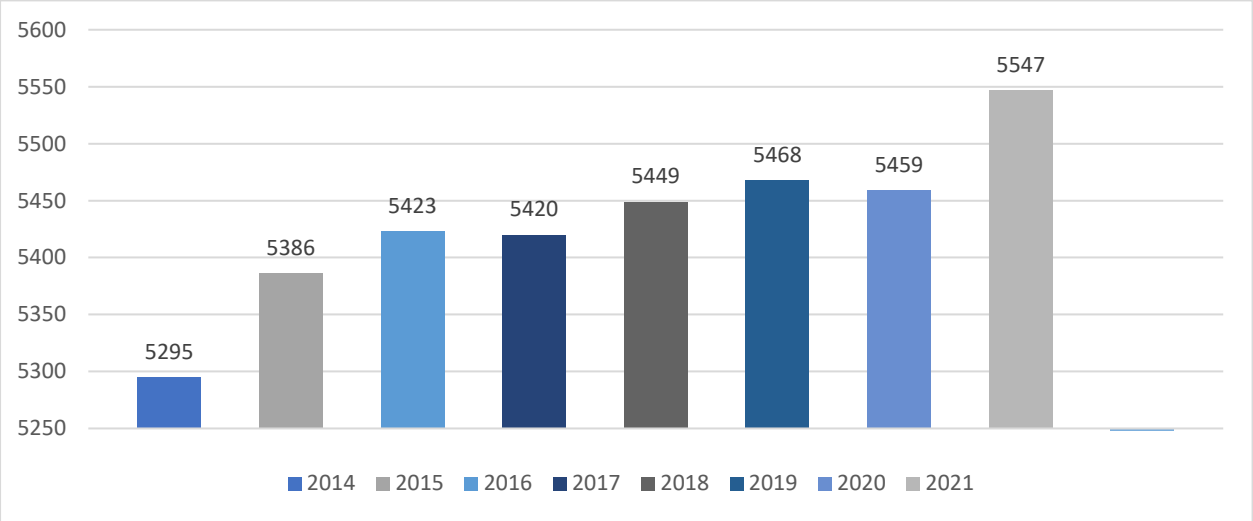


***Figure 84 –*** *The evolution of the number of inhabitants between 2014-2021 – at the level of the entire commune*

*Source: National Institute of Statistics [online]. Available at: https://insse.ro/cms/ (Accessed: 28.03.2022)*

Regarding the migration of the population inside the commune, there is a large number of people leaving the commune compared to those moving to the Săucești commune (according to the National Institute of Statistics), especially in 2017 (52 inhabitants leaving - 6 moving to). At the level of 2020 there is a recalibration of this difference, which is reduced to 50 inhabitants who leave and 33 who move to the commune.

[118] National Institute of Statistics, *POP108D – Populația după domiciliu la 1 iulie pe grupe de vârstă, sexe, județe și localități* [online]. Available at: https://insse.ro/cms/ (Accessed: 28.03.2022)



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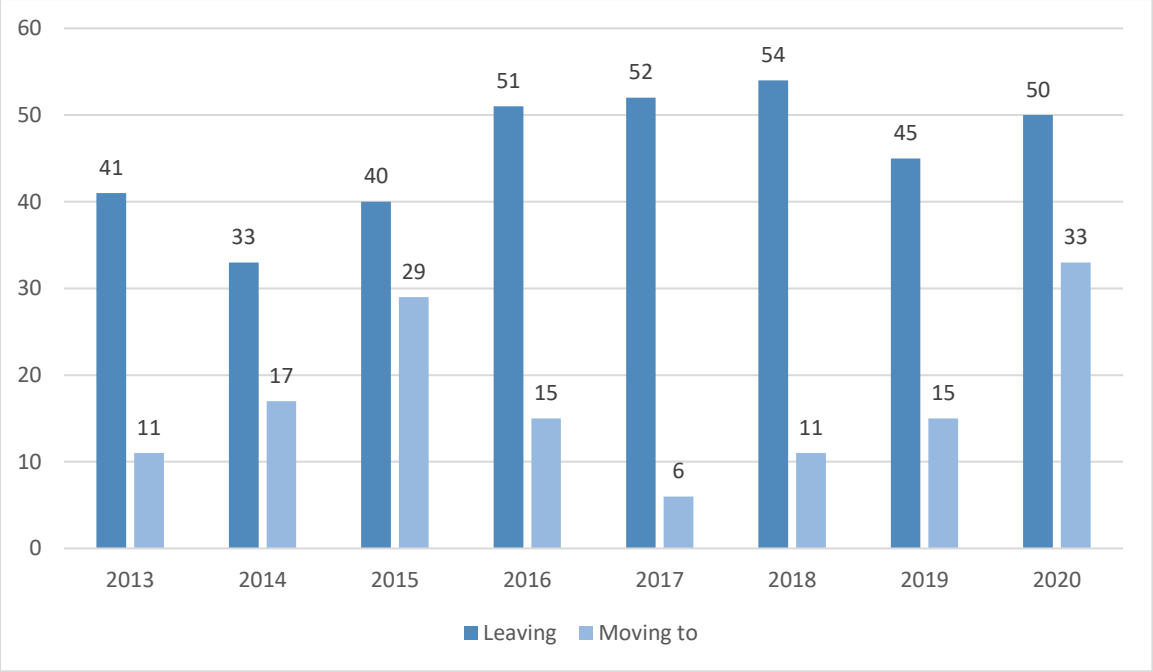


***Figure 85 –*** *The evolution of residents leaving and people moving to Săucești between 2013-2020*
*Source: National Institute of Statistics [online]. Available at: https://insse.ro/cms/ (Accessed: 28.03.2022)*

The interior migration[119] rate is lower, recording small fluctuations in the number of people moving to Săucești between 2013 and 2020.

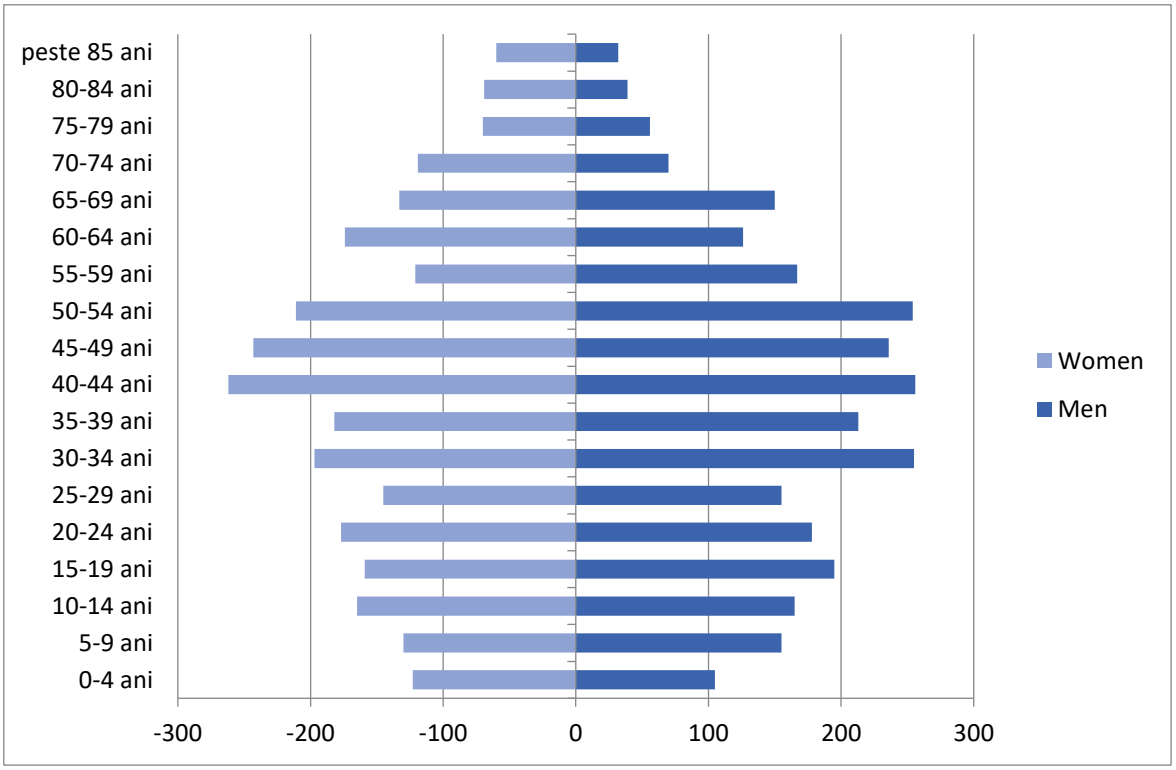


***Figure 86 –*** *Population structure by age groups (2021)*
*Source: National Institute of Statistics [online]. Available at: https://insse.ro/cms/ (Accessed: 28.03.2022)*

[119] National Institute of Statistics, *POP307A – Stabiliri cu domiciliul (inclusiv migrația internațională) pe județe și localități* [online]. Available at: https://insse.ro/cms/ (Accessed: 28.03.2022)



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Regarding the age groups and structure of the local population, most of the residents are aged between 40 and 54 years old, while the number of elders (between 60 and 74 years old) is similar to the younger people (under 25 years old).

The analysis of the 2011-2020 period shows that there is a slight increase in the number of births and a decrease in the number of elder residents. This reveals a growing younger population – another proof of the increasing demographic trend the commune is going through.

The effects of the close location close to Bacău City are also reflected in the growth of the number of households. According to Ivanov, I. (2016) *The Integrated Urban Development Strategy of Bacău city* it can be observed how from 2010 to 2016 the number of inhabitants increased by 10-15%. Săucești is one of the most dynamic communes from Bacău Metropolitan Area, as it can be seen from the figure below – *Figure 87.* Only Hemeiuș and Letea Veche commune have a higher population growth (15-18,8%). These can be seen also from the evolution of the built-up areas: new developments occures mostly in 4 communes: Hemeiuș, Letea Veche, Săucești and Măgura (see the figure below – *Figure 87*).

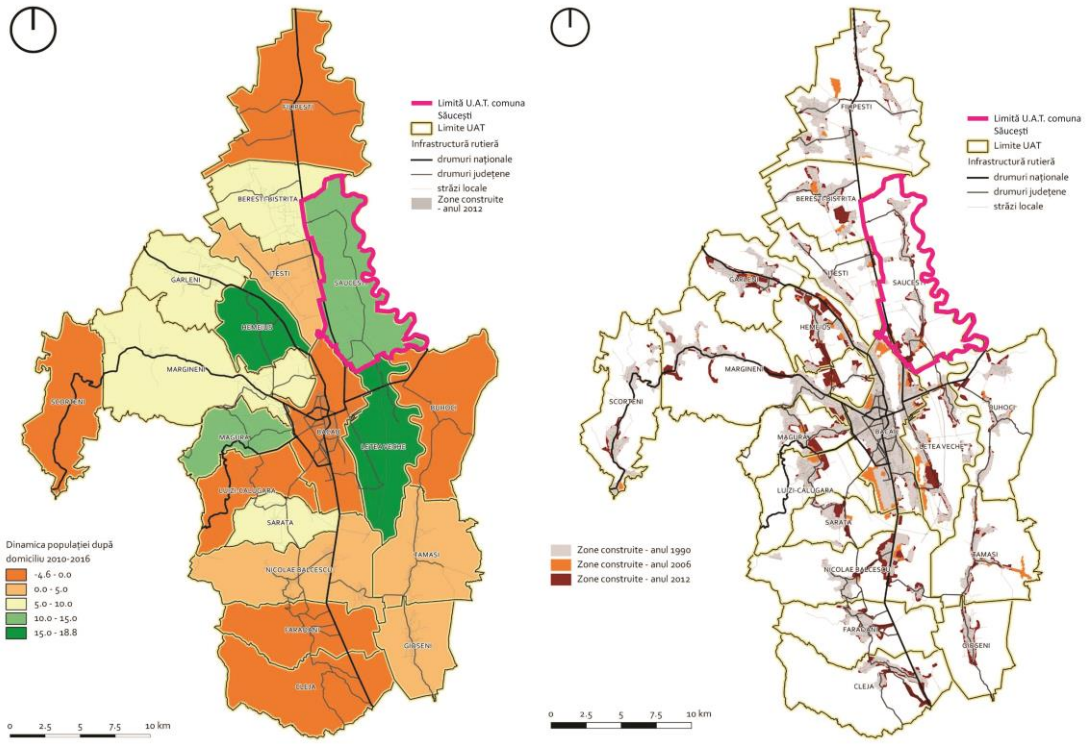


***Figure 87 –*** *Săucești demographic evolution by reference to other administrative units from Bacău Metropolitan Area (on the left side). Săucești built area development by reference to other administrative units from Bacău Metropolitan Area (on the right side)*

*Source: Ivanov, I. (2016) The Integrated Urban Development Strategy of Bacău City, SC GEA Strategy & Consulting SA*



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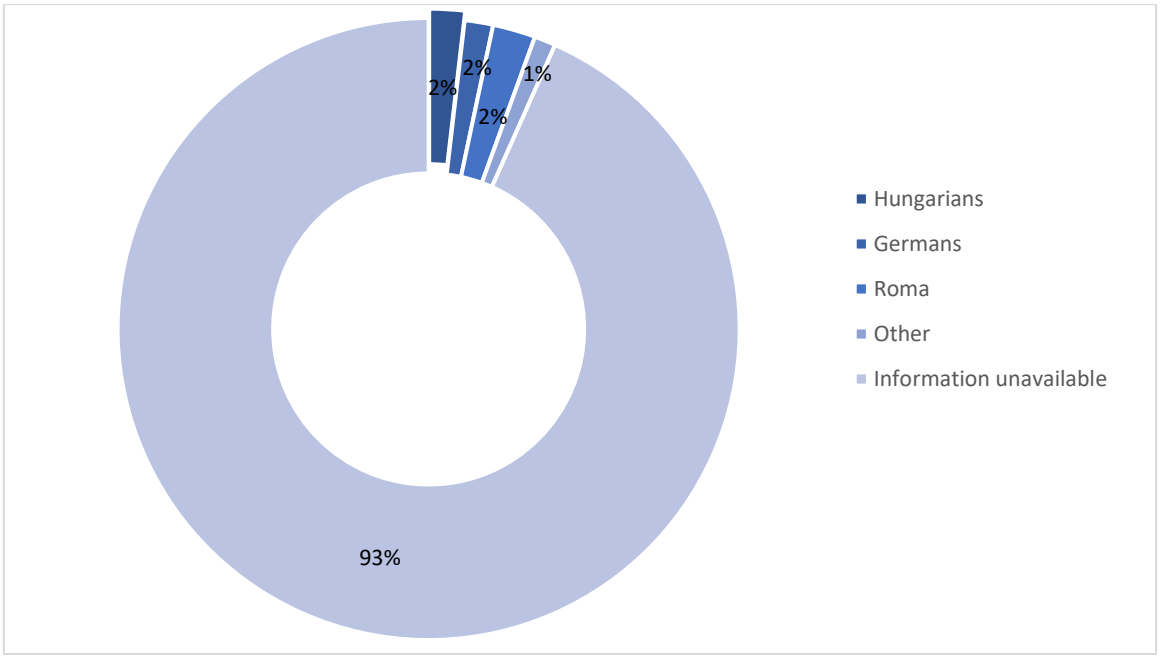


***Figure 88 –*** *Ethnic structure of Reșița inhabitants in 2011*

*Source: 2011 Census – 8. Populația stabilă după etnie – Județe, municipii, orașe, commune, National Institute of Statistics [online]. Available at: https://www.recensamantromania.ro/rpl-2011/rezultate-2011/ (Accessed: 28.03.2022)*

The ethnic structure of the commune is mainly made up of Romanians (4498 Romanian inhabitants in 2011). Other ethnicities like Hungarians, Germans or Rroma totals only 15 inhabitants. There are also 252 inhabitants for whom there is no information available about their ethnicity according to the 2011 Census of Population. There are no data on the ethnic structure of Săucești commune since the 2002 population census.

### E.1.4. Economic data

According to Lef Proiect SRL, architect Cristian Lefter (2018), *Study on the evolution of economic activities*, preliminary study for the General Urban Plan, the economic activities identified in Săucești commune are largely dependent on existing natural resources, socio-economic conditions (level of training, investment opportunities, options, relations with other surrounding localities).

**The primary economic sector** of the commune is represented by agricultural activities (cereals, vegetables, gardening) and raising domestic animals and birds both in personal households and in commercial companies, gravel and sand extraction and land preparation works.

**The secondary economic sector** includes the manufacturing of various products such as: milling products, wood products, construction of sports boats, furniture, soaps, detergents, plastic packaging, dairy products, road construction and others. **The tertiary economic sector** is related to the revival of traditions and customs, consultancy, transport of people and goods, accommodation, food and non-food trade, repair and maintenance of vehicles, hairdressing, human and veterinary practices and others together with the activity of local public administration, education, worship, health and security and protection.

**The economic profile of Săucești commune is mostly agro-micro-industrial** with agriculture as the main activity, followed by farming.



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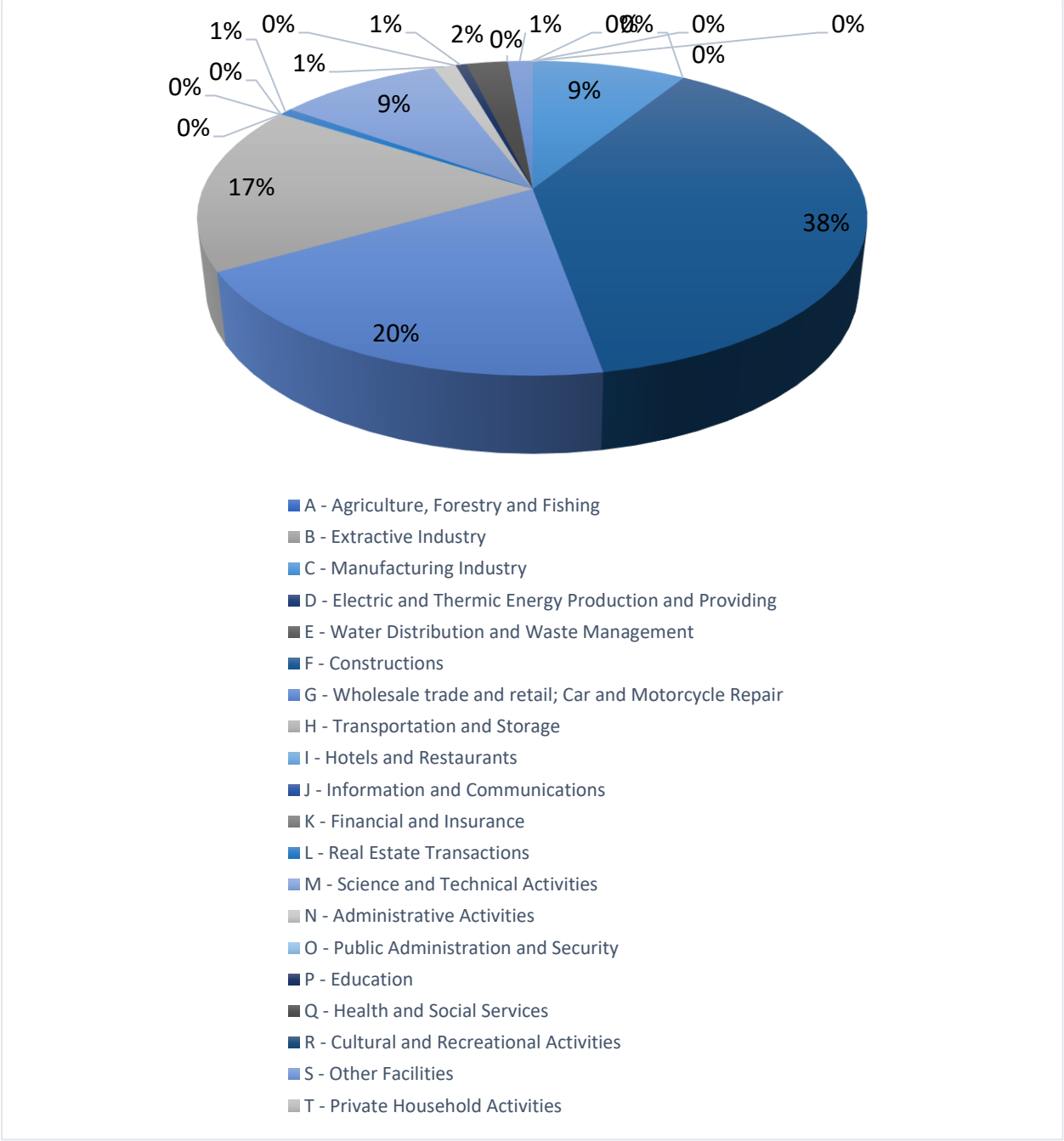


***Figure 89 –*** *Total fiscal value of enterprises in Săucești commune, by field of activity (CAEN)*
*Source: Lista firmelor din România – Săucești, Județul Bacău [online]. Available at: https://membri.listafirme.ro/statistici-economice.asp#selectie (Accessed: 28.03.2022)*

Gathered data[120] shows that in 2020 the most important activity sector, using the total fiscal value index, is Constructions (F), representing 38% of the total fiscal value in Săucești, followed by Wholesale trade and retail; Car and Motorcycle Repair (G), representing 20% of the total fiscal value in Săucești, and then by Transportation and Storage (H), representing 17% of the total value in Săucești. This shows that the secondary economic sector holds the first place.

[120] Lista firmelor din România – Săucești, Județul Bacău [online]. Available at: https://membri.listafirme.ro/statistici-economice.asp#selectie (Accessed: 28.03.2022)



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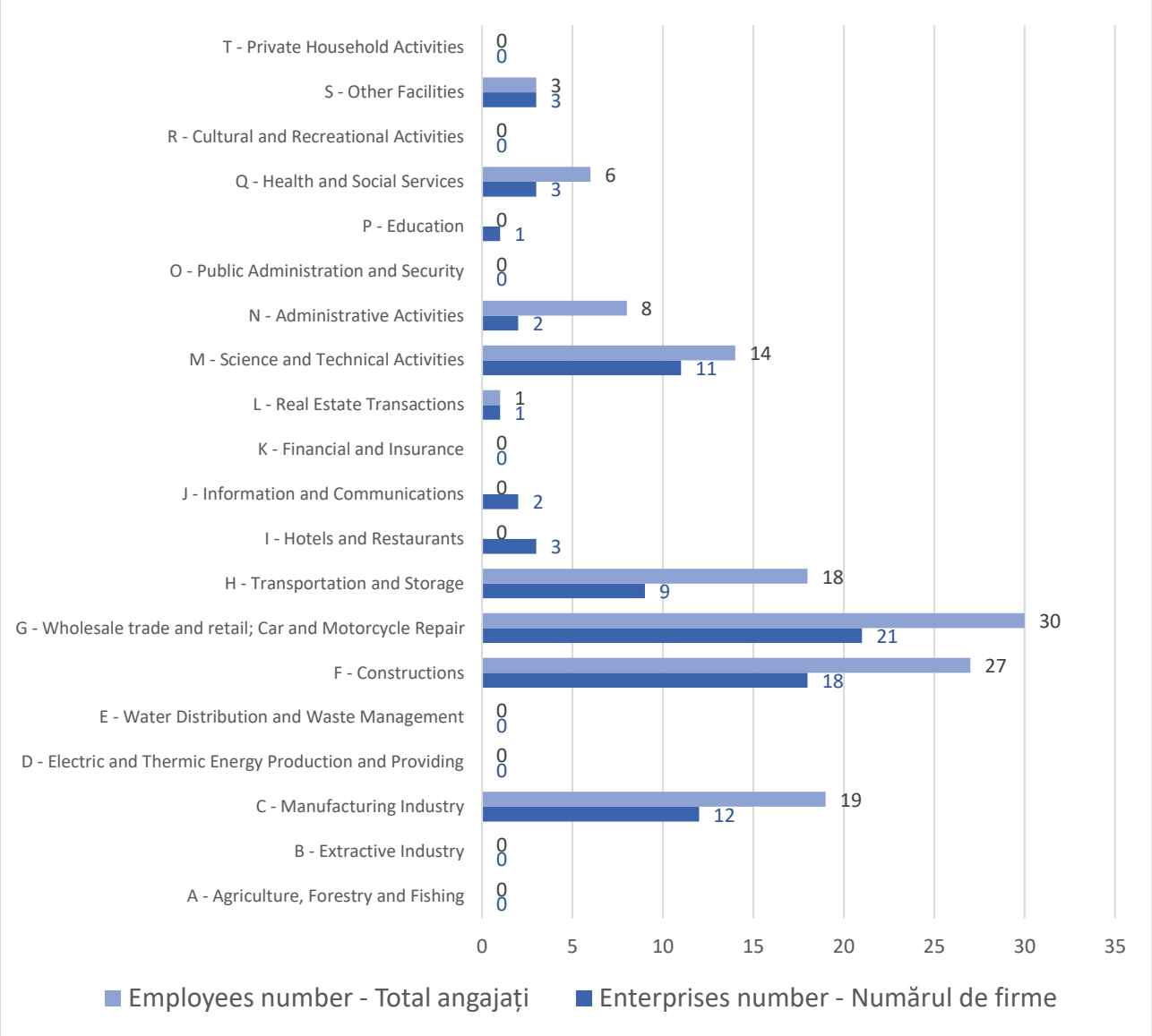


***Figure 90 –*** *Total numbers of enterprises and employees in Săucești commune, by field of activity (CAEN)*

*Source: Lista firmelor din România – Săucești, Județul Bacău [online]. Available at: https://membri.listafirme.ro/statistici-economice.asp#selectie (Accessed: 01.04.2022)*

Regarding the number of enterprises and employees in Săucești in 2020, classified by activity sectors, Wholesale trade and retail; Car and motorcycle repair (G) has the greatest number of enterprises (21), along with Constructions (F) (18), Manufacturing industry (C) (12), and Science and Technical Activities (M) (11). These activity sectors have also the largest number of employees: Wholesale trade and retail; Car and motorcycle repair (G) (30), Constructions (F) (27), Manufacturing industry (C) (19), Transportation and Storage (H) (18) and Science and Technical Activities (M) (14).



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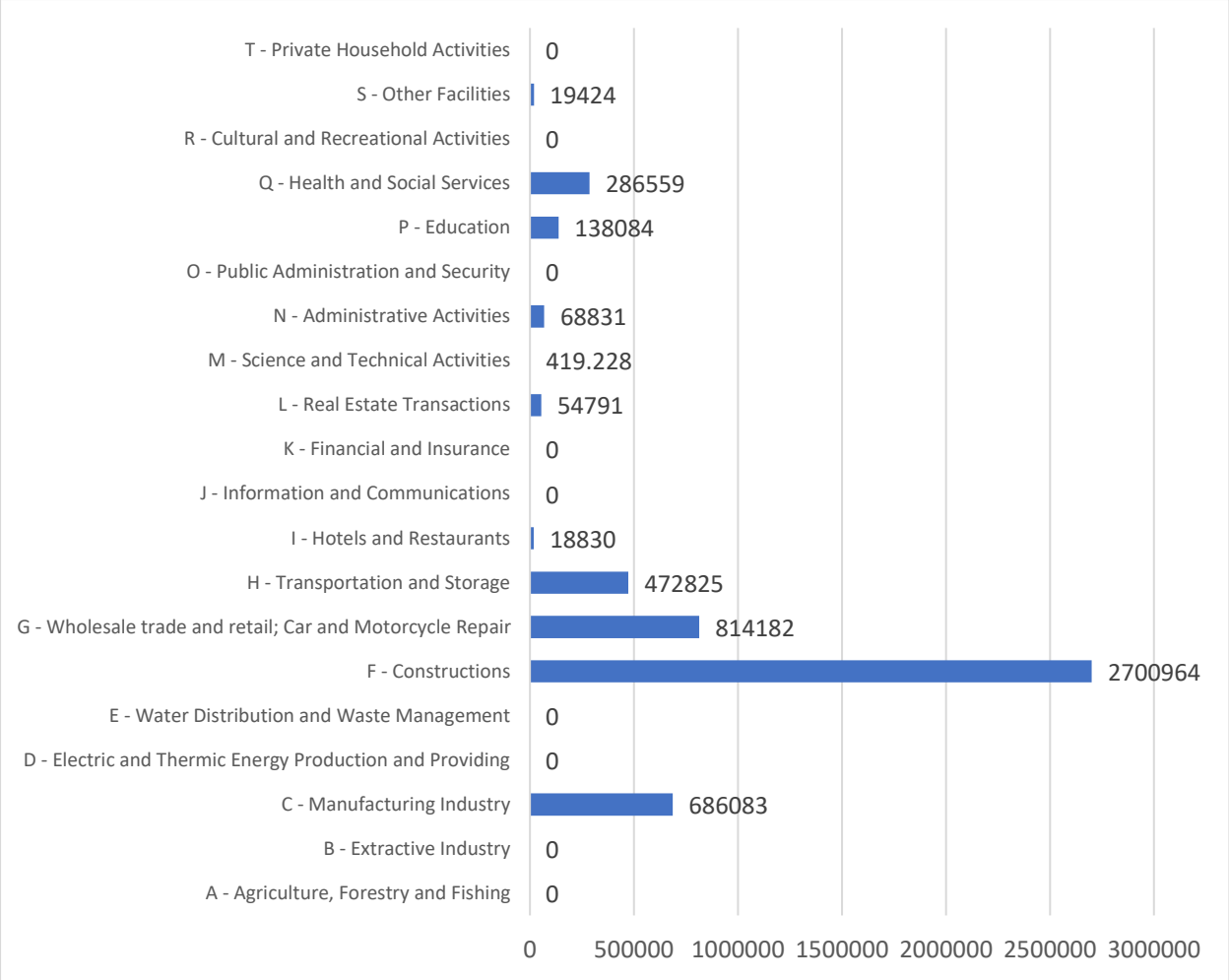


***Figure 91 –*** *Total net income in Săucești, by field of activity (CAEN)*

*Source: Lista firmelor din România – Săucești, Județul Bacău [online]. Available at: https://membri.listafirme.ro/statistici-economice.asp#selectie (Accessed: 01.04.2022)*

Constructions (F) is the most stable activity sector in Săucești, not only having the greatest fiscal value and being one of the biggest employers in commune, but also having the greatest total net income in the local economy. The Manufacturing Industry (C), Wholesale trade and retail; Car and motorcycle repair (G) and Transportation and Storage (H) are also profitable sectors.

## E.1.5. Environmental data

### E.1.5.1. Flora, fauna and forests. Protected areas

The natural vegetation of the Săuceşti commune – corresponding to the Eco-region of the Eastern Plain – was mostly removed, a result of the urbanization that led to the artificialization of the environment. Natural specific vegetation of the area (forest-steppe, steppe, meadow, lattice) can still be found in peripheral areas, through meadows, wicker and mesohydrophilic plant formations, especially in the northern, southern and south-eastern parts of the administrative territory, where is a Natura 2000 SCI, with a surface of 2.969,01 ha. At the administrative limit area of Săucești is another Natura 2000 SCI – Buhuși – Bacău – Berești Reservoirs, where have been reported significant populations of large cormorant (Phalacrocorax carbo). *Figure 92* presents the peri-urban Bacău area (Bacău functional area), where are marked all protected areas and their spatial distribution, as:

(a) Natura 2000 SPA: Reservoirs Buhuși – Bacău – Berești (5.576ha), Bacău, Hemeiuș, Itești, Letea Veche, Tamași, Nicolae Bălcescu, Faroani, Gioseni, Cleja, Lunca Siretului



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Mijlociu (10,455 ha), Filipești, Piatra Șoimului – Scorțeni – Gârleni (37.445 ha), Scorțeni, Gârleni, Mărgineni, Hemeiuș;

(b) Natura 2000 SCI: Culmea Cucuieți (6.449,23 ha), Buhoci, Tamași, Gioseni (avifaunistic areas) and

(c) Nature Monuments: “Cineritele de la Nutașca” –Ruseni, “Punctul fosilifer Cârligata”, “Strate tip pentru Formațiunea de Pietrosu”, “Puncte fosilifere în conglomeratele de Pietricica”.

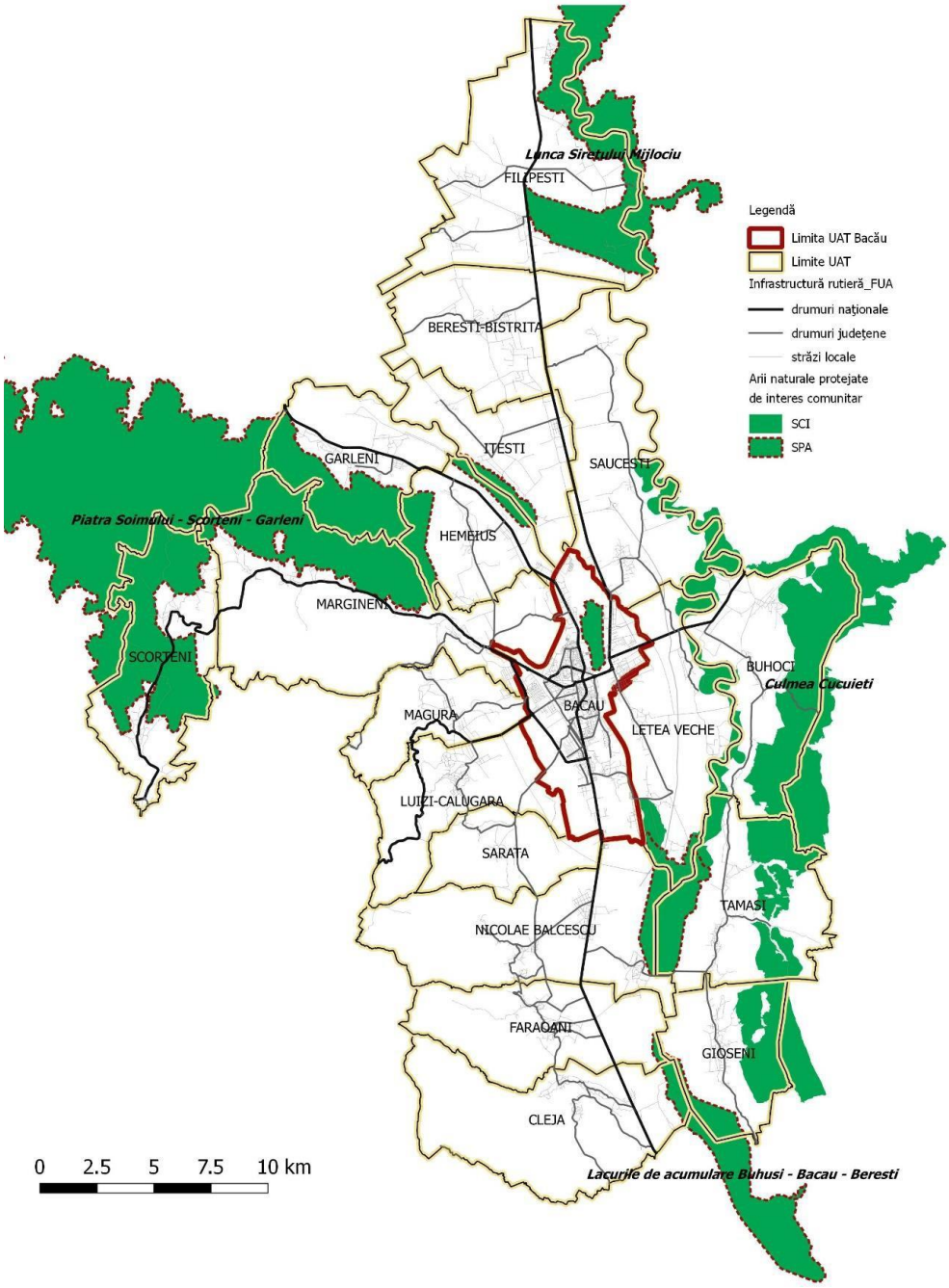


***Figure 92 –*** *Protected natural areas of community interest from the Urban Functional Area Bacău*
*Source: Țarălungă, N. (2016) The Sustainable Development Strategy of Bacău County, Institute for Housing and Urban Development Studies Romania SRL*



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In Bacău County there are over 2000 species of wild flora, among which protected are: Centaurea pugioniformis, Hepatica transilvanica, Saxifraga cymbalaria, Astragalus pseudopurpureus, Trollius europaeus.

Forest ecosystems through their ecological functions provide a wide range of goods (production of wood, berries, support for biodiversity, etc.) and services (local climate regulation, air quality regulation, soil erosion control, mitigation of the effects of climate change and extreme phenomena, cultural and recreational services, etc.) accessible to socio-ecological complexes.

### E.1.5.2. Climate and climate change impact

From the climatic point of view, Săuceşti commune is characterized by cold winters and dry and hot summers, being located in a territory with a high continental temperate climate. The penetration of cold continental air from the north-east and east during winter causes deviations from the annual average of - 4.1°C, and in summer, by the penetration of warm continental air from the east and especially from the south, the average temperature of July, in recent years approaches 23°C. The lowest temperature was recorded in Bacau (- 32.5°C on February 20, 1954), which created the ice dams on Siret River and ice gems on Bistrița River.

According to the data from *Țarălungă, N. (2016)*[121]*,* the multiannual average annual temperature recorded at Bacău Meteorological Station during 2006 - 2012 was 10.5°C. In terms of atmospheric precipitation, the multiannual average was, in the same period, 620.3 l / year. The average wind speed is not too high, the highest being recorded in the case of winds from the north-west and north. Climatic factors have seen important changes over the last 20 years.

The average annual rainfall varies between 500 and 1,100 mm/m$^2$. The predominant direction of the winds is from the north and northwest.

As shown in the ***Figure 17*** *– Annual temperature increase 2021 – 2050 (compared to the reference range 1961 – 1990)(B.1.5.3. Climate and climate change impact),* it is forecasted that in the period 2021 – 2050 the average annual temperature recorded in Bacău county will increase by 1.5 ÷ 1.7 °C compared to the reference range 1961–1990[122]. Regarding the annual precipitation (***Figure 18*** *– Increase in average annual precipitation 2021 – 2050 (compared to the reference range 1961 – 1990)– B.1.5.3. Climate and climate change impact*), in the period 2021 – 2050, it is forecasted an increase of the average annual amount of precipitation by 2 ÷ 3 % in Bacău County compared to the reference interval 1961 – 1990.

One of the most significant consequences of the increase in air temperatures is the increase in the magnitude and frequency of negative events related to the extreme precipitation generated by the increase in the humidity level of the atmosphere. This induces an increase in the frequency and intensity of floods.

### E.1.5.3. Water resources

The **hydrographic network** of the commune Săucești contains the rivers Bistrița and Siret which create a natural limit from the eastern and western communes. Besides the two main rivers, the commune is also crossed on the north-south direction by the Turbata river which has a low flow (except for the rainy periods during summer and the beginning of spring when snow melts). In years of heavy rainfall,

[121] Țarălungă, N. (2016) *The Sustainable Development Strategy of Bacău County,* Institute for Housing and Urban Development Studies Romania SRL

[122] Bojariu, Bîrsan, Cica, Velea, Burcea, Dumitrescu, Dascălu, Gothard, Dobrincu, Cărbunaru, Marin (2015) *Schimbările climatice – de la bazele fizice la riscuri și adaptare*, Bucharest: Editura Printech

the Siret River reaches extreme flows, flooding the villages of Schineni and Săucești (in 2008 and 2010 the flow registered on Siret was 2887 m3/s).

| No | River | Gauging station | F | Hmean | Hydrological parameters | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Qmean | Qmax 1% | Qmean monthly. min.95% | R |
| | | | km² | m | m³/s | m³/s | m³/s | kg/s |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1. | Siret | Lespezi | 5899 | 513 | 36.60 | 1825 | 3.55 | 67.60 |
| 2. | Siret | Drageşti | 11899 | 525 | 77.10 | 2650 | 7.50 | 126.00 |
| 3. | Siret | Lungoci | 36095 | 539 | 212,00 | 3950 | 33.30 | 349.00 |
| 4. | Suceava | Itcani | 2299 | 629 | 16.50 | 1725 | 1.75 | 11.30 |
| 5. | Moldova | Roman | 4285 | 678 | 32.50 | 1925 | 3.40 | 40.00 |
| 6. | Bistrita | Frumosu | 2860 | 1172 | 37.90 | 1320 | 6.79 | 8.76 |
| 7. | Trotuş | Vrânceni | 4077 | 734 | 34.90 | 2500 | 3.43 | 46.80 |

***Table 31** - Preliminary hydrological parameters discharges and sediments at the representative gauging stations in Siret*

*Source: Flood risk management plan Siret Water Administration, RBA Siret [online]. Available at: http://www.inhga.ro/documents/10184/121027/9+PMRI+Siret.pdf/c4fc27dc-aa01-4460-9327-adaea2848bca (Accessed: 28.03.2022)*

The values of the hydrological parameters of the liquid and solid leakage in the sections of the main hydrometric stations in the Siret hydrographic basin district are presented in *Table 31.*

According to *River Basin Management Plan for Siret River Basin Administration*[123], the body of groundwater ROSI03 – Lunca Siretului and its tributaries is located on the administrative territory of Săuceşti commune and of the Bacău Municipality. It is a body of groundwater, porous, having a thickness of the covering layers that vary between 2 and 10 m. The ROSI03 body is mainly used for the water supply to the population (56.865,46 thousand cubic meters/year – 90% of the total volume of water used). In the peri-urban functional area of Bacau municipality (of which Săuceşti is a part), there is the system on wells Hemeiuș 1+2, with (18 boreholes) and a captured volume of 2,206 thousand cubic meters / year. Other wells in-flow is at Mărgineni, with a discharge of 415l/s, delivering water for Bacău and surrounding localities.

The changes in the hydro morphological characteristics of the watercourses (changes in the natural courses, changes in the hydrological regime, the deterioration of the aquatic biodiversity, etc.) are the result of the presence of hydro morphological pressures that produce an impact on the state of the aquatic ecosystems and contribute to the failure to achieve the environmental objectives of the water bodies. The hydrotechnical constructions with transverse barring (dams, staving, bottom thresholds) interrupt the longitudinal connectivity of the rivers with effects on the hydrological regime, the transport of sediments, but especially on the migration of the biota. Works along the river (impoundments, works of regularization and consolidation of banks) interrupt the lateral connectivity of water bodies with floodplains and spawning areas that result in the deterioration of the state of the ecological system. Thus, the impact of hydro morphological alterations on the state of water bodies can be expressed by affecting the migration of migratory fish species, the decline of natural reproduction of fish populations, the reduction of biodiversity and abundance of species, as well as the alteration of the composition of populations[124].

[123] *River Basin Management Plan for Siret River Basin Administration*

[124] *Annual Report on the state of the environment in Bacau County 2020,* [online]. Available at: http://www.anpm.ro/web/apm-bacau/rapoarte-anuale1 (Accessed: 29.03.2022)



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The quality of the surface and underground waters is at risk due to the pollution of the soils through oil exploitations and also through agricultural activities. In case of intensive rains and runoff, pollutants are transported in rivers and infiltrated in the groundwaters. Other risk of pollution of rivers is due to:

- the discharge of untreated or improperly treated domestic water resulted from wastewater treatment plants in urban areas (human agglomerations of over 2000 e.p.);
- the discharge of untreated domestic water from areas not connected to the sewerage networks in rural localities of the county (agglomerations of less than 2000 e.p.) – as in case of Săuceşti.



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## E.2. Flood risk management

### E.2.1. Flood Hazard and risk information for Săucești commune

**Preliminary Flood Risk Assessment**

**During the cycle 1 of the Floods Directive implementation,** for Siret RBA 7 significant flood events were identified and 53 fluvial APSFRs.[125]

Săucești has territories located in the catchment of an APSFR: Siret river (r. Siret - av. granita - am. loc. Movileni, sect. indig.) and Bistița river (r. Bistrița - av. loc. Piatra Neamț). Siret river was designated APSFR based on the consequences of the floods from July 2005, July 2008 and June 2010 and Bistrița river based on the consequences of the floods from May 1970.

**During the 2nd cycle of Floods Directive implementation,** 4 significant flood events have been identified during the period 2010 – 2016 and 4 future floods for Siret RBA. 18 new APSFRs from fluvial source and 3 for pluvial source were designated. None of the new APSFRs are of interest for Săucești UAT.

*Table 32* is detailing the sources, mechanisms and characteristics of flooding and the type of consequences of the APSFRs of interest for Săucești UAT:

| APSFR name | APSFR code | Length/ Surface (km/sq. km) | Flood source | Mechanism of flooding | Characteristics of flooding | Type of consequences |
|---|---|---|---|---|---|---|
| r. Siret - av. loc. Movileni, sect. îndig. | RO10-12.01.....-02A | 122,21 | Fluvial | A21; A22; A23 | A32; A35; A38 | B11; B12; B31 |
| r. Bistrita-av. Loc. Piatra Neamț | RO10-12.01.053....-02A | 81,91 | Fluvial | A21; A22 | A32; A34 | B11; B12 |

***Table 32** – APSFRs – source, mechanisms and characteristics of flooding and type of consequences*

*Source Flood Directive, Cycle 2 Preliminary Flood Risk Assessment Report for RBA Siret*

Legend[126]:
A21 - Natural Exceedance; A22 - Defence Exceedance; A23 - Defence or Infrastructural Failure
A32 – Snow Melt Flood; A34 -Medium onset flood; A35 - Slow onset flood; A38 - Deep Flood
B11 - Human Health; B12 - Community; B31 - Cultural assets

[125]https://rowater.ro/despre-noi/descrierea-activitatii/managementul-situatiilor-de-urgenta/directiva-inundatii-2007-60-ce/epri/

[126] https://cdr.eionet.europa.eu/help/Floods/Floods_2018/GuidanceDocuments/FD_ReportingGuidance.pdf



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***Figure 93** – Floods in Săucești Commune*

*Source: https://ziaruldebacau.ro/foto-saucesti-inundatii-si-emil-boc/bacau-saucesti-inundatii/*

*Source: https://www.youtube.com/watch?v=-HuZFzyFsEs*

For the period 2016 – 2020, the Synthesis Reports elaborated after flood events occur, mention that Săucești Commune has been affected by 1 event in June 2016, 2 events in 2017 (1 in May and 1 in July), 2 events in 2018 (1 in June and 1 in July), 1 event in June 2019 and 1 event in June 2020 *(Table 33)*.

| No. of the Synthesis Report | Commune | Event starting date | Cause of floods | Affected assets |
|---|---|---|---|---|
| 4125/21.07.2016 | Săucești commune (Siretu village) | 24.06.2016 | runoff from the slopes, internal waters | 19.7 ha arable land |
| 1/22.05.2017 | Săucești commune (Șerbești village) | 13.05.2017 | runoff from the slopes, heavy rainfall | 4.25 km of communal roads, 50 m of streets, |
| 4/25.08.2017 | Săucești commune (Siretu village) | 06.07.2017 | runoff from the slopes, heavy rainfall | 1 damaged household annex, 0.30 ha arable land, 0.30 km of clogged canals, 1 km of drainage channel |
| 3816/09.07.2018 | Săucesti (Săucești) | 15.06.2018 | heavy rainfall | 55.67 ha arable land |
| 4622/07.08.2018 | Săucesti (Siretu, Șerbești) | 05.07.2018 | runoff from the slopes | 1 damaged house, 4.6 km of communal roads, 3.20 km of streets, 0.82 ha of arable land, |
| 4263/24.06.2019 | Săucesti commune (Săucești, Siretu, Șerbești, Schineni villages) | 06.05.2019 | runoff from the slopes | 12 km county roads, 3.15 communal roads, 13.12 ha arable land, |
| 3943/02.07.2020 | Săucești commune (Săucești, Bogdan Vodă villages) | 01.06.2020 | runoff from the slopes | 1.33 communal roads, 13.12 ha arable land |

***Table 33** – Flood events in the period 2016 - 2020*

*Source: ANAR, Summary tables containing the Synthesis Reports information*





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**Flood Hazard and Risk Maps**

**During the cycle 1 of the Floods Directive implementation,** flood hazard and risk maps were developed for 3 AEPs (10%, 1% and 0.1%), using the methodology described in Chapter 2.6 of the FRMPs. The flood hazard maps are a result of a national program *Plan for Prevention, Protection and Mitigation of Flood Effects*, which was initiated before the Floods Directive to enter into force. The qualitative flood risk maps were developed by ANAR and INHGA[127]

In case of Săucesti commune the fluvial flood hazard results from cycle 1 are shown in *Figure 94.* These results were shared with Bacău County Council in 2014 by MEWF.

During the 2nd cycle of Floods Directive implementation, no revision of the fluvial flood hazard maps for Siret River and Bistrița river will be done. New flood risk maps will be published in September 2022

[127] https://rowater.ro/wp-content/uploads/2020/11/PFRA_Report_RO10_2019-08-30.pdf



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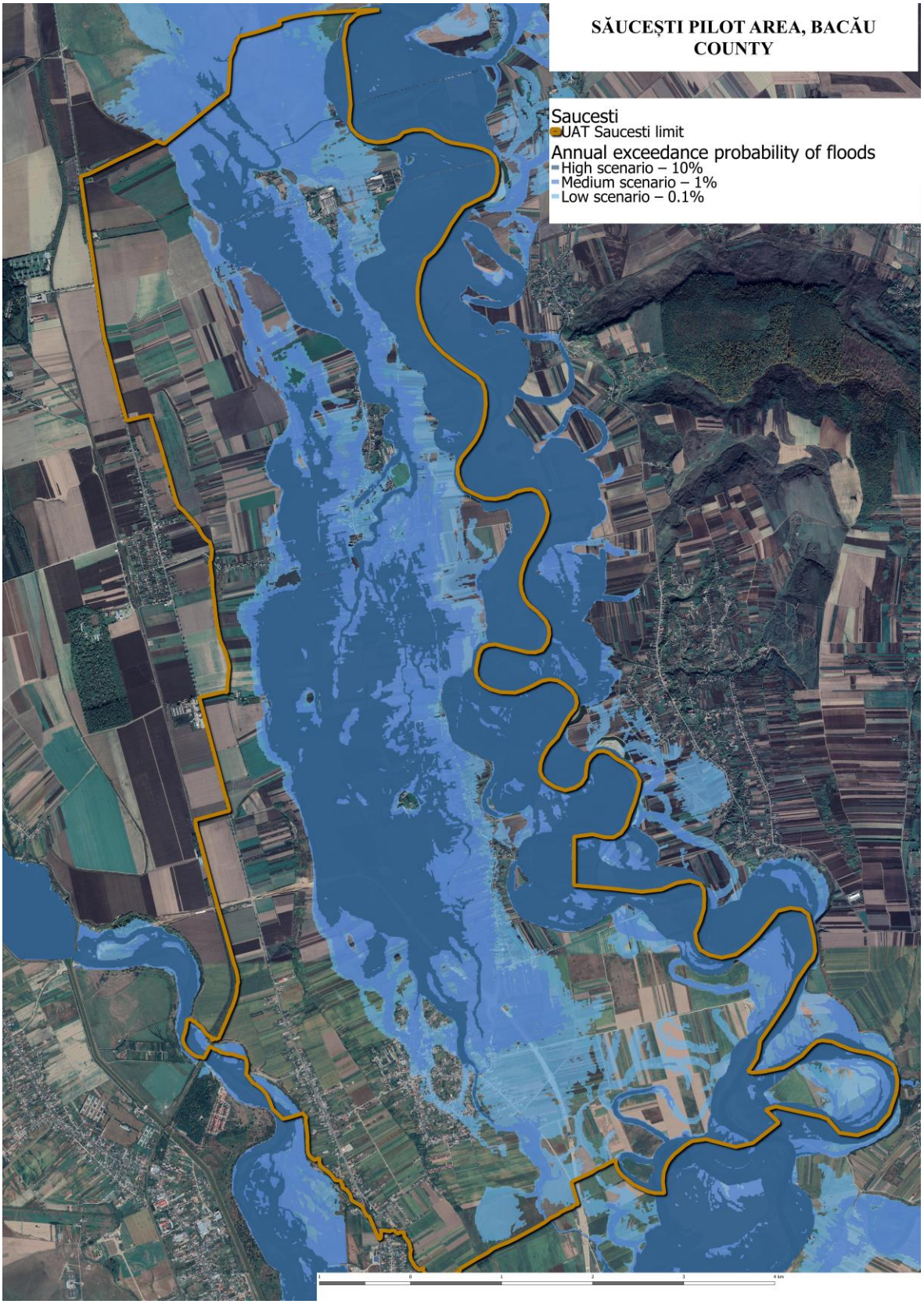


***Figure 94 –*** *Flood hazard areas in Săucești commune*

*Source: World Bank by using the Flood Directive Cycle 1 Report scenarios (high scenario, medium scenario, low scenario)*



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## E.2.2. Flood risk management infrastructure

Săucești commune is well protected against fluvial floods by a complex hydrotechnical system along Siret river. The water management scheme existing for Siret river is shown in *Figure 95*[128].

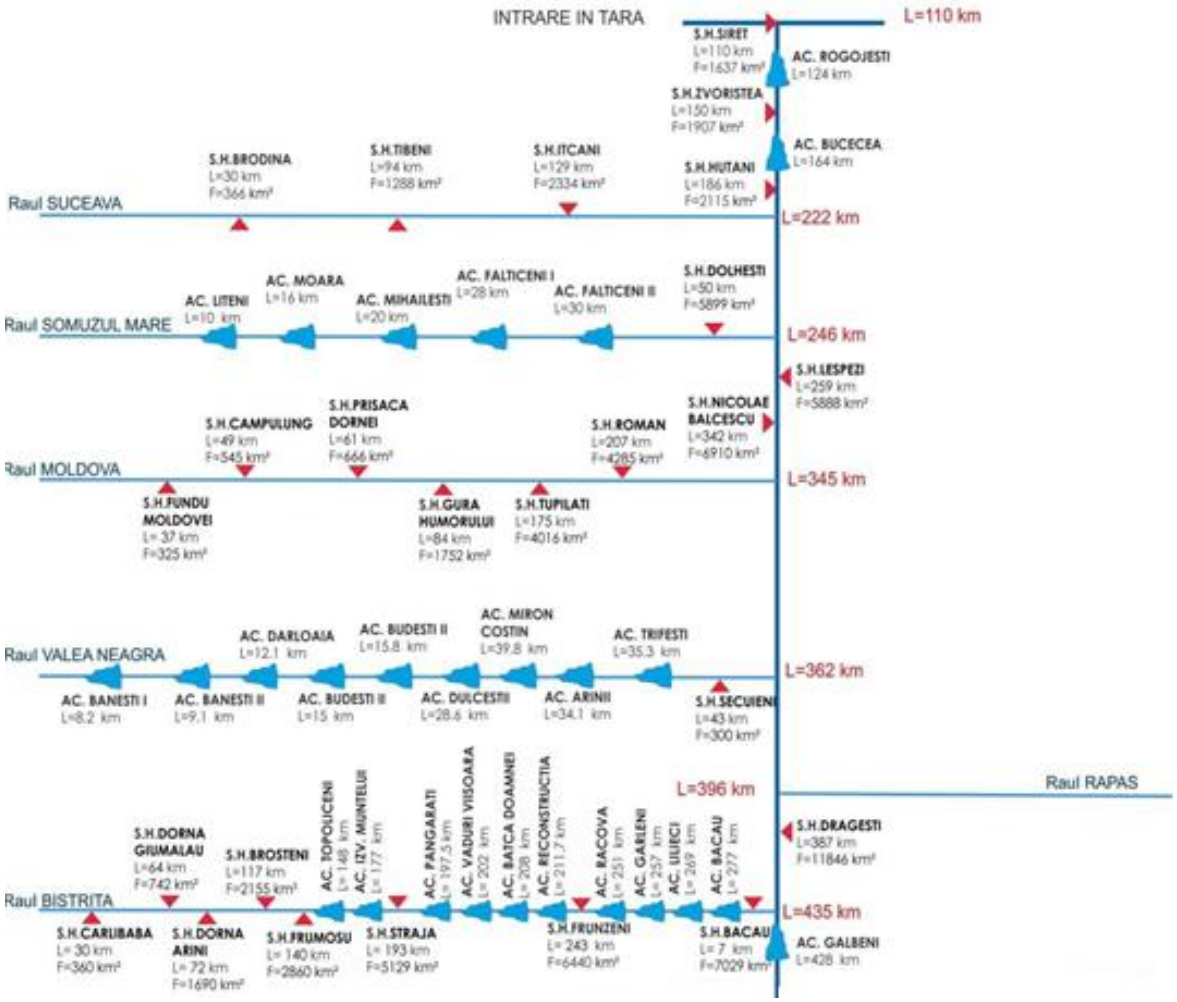


***Figure 95 –*** *The existing water management scheme for Siret river, with possible impact on Săucești commune*

*Source: Flood risk management plan Siret River Basin Administration, RBA Siret*

On the territory of the Siret hydrographical area, a number of **18** category A and B dams are in operation, respectively a number of **120** dams of category C and D. Some of them with a high capacity of flood mitigation on Siret are located upstream of Săucești commune – i.e., Rogojești Reservoir, and on Bistrița – i.e., Izvorul Muntelui (*Table 34*). The hydrologic regime of Bistrița River, downstream of the Izvorul Muntelui Reservoir is controlled in line with the needs imposed by the hydropower plants.

Most of the existing reservoirs in Siret River basin mainly ensure the transit of the floods through mobile evacuators (staves, flaps), lateral dischargers of large waters and in case of necessity by using bottom emptiness, contributing indirectly (without exception) to the mitigation of flood flows.[129]

[128]http://www.inhga.ro/documents/10184/121027/4+PMRI+Banat.pdf/3478b866-1a2c-4e55-9eb2-7892a664c534#page=156&zoom=100,90,152

[129] The status of the main components of the national water management system with the role of protection against floods, respective dams, permanent / non-permanent accumulations, can be found at the address: http://www.rowater.ro/

| No. | The accumulation name | County | Water Course | Normal Level of Retention Volume (thousand $m^3$) | Flood Attenuation Volume (thousand $m^3$) | % of the Attenuation Volume from the Normal Level of Retention Volume (%) |
|---|---|---|---|---|---|---|
| 1 | Rogojeşti | SV – BT | Siret | 37,300 | 17,400 | 46.65 |
| 2 | Izvoru Muntelui | NT | Bistrița | 1,122,000 | 100,000 | 8.91 |
| 3 | Pângărați | NT | Bistrița | 6,750 | 850 | 12.59 |
| 4 | Vaduri | NT | Bistrița | 5,070 | 830 | 16.37 |
| 5 | Bâtca Doamnei | NT | Bistrița | 7,250 | 1,850 | 25.52 |
| 6 | Reconstrucția | NT | Bistrița | 390 | 140 | 35.9 |
| 7 | Racova | BC | Bistrița | 8,660 | 2,900 | 33.49 |
| 8 | Lilieci | BC | Bistrița | 7,400 | 2,600 | 35.13 |
| 9 | Bacău II | BC | Bistrița | 4,030 | 2,000 | 49.63 |

***Table 34** – Reservoir with a role in flood protection, with possible impact in Săuceşti area*

*Source: Flood risk management plan Siret River Basin Administration*

After 2005 and 2010 floods a defense dyke was built on the Serbeşti, Siretu, Schineni, Săuceşti, Letea Veche, Holt sector, as a matter of urgency. Its characteristics are shown in *Table 35.*

| No. | Dike name | County | Water Course | Location | Purpose or function of defense | Design AEP |
|---|---|---|---|---|---|---|
| 1 | Dike on right riverbank on Siret river on the sector Șerbești, Siretu, Schineni, Săucești, Letea Veche, Holt | BC | Siret | Șerbești, Siretu, Schineni, Săucești, Letea Veche, Holt | Protection against fluvial floodings for urban and rural settlements and agricultural land | 1% |

***Table 35** – Siret flood protection dikes within Săuceşti commune*

*Source: Flood risk management plan Siret River Basin Administration, RBA Siret*

### E.2.3. Sewerage network

In the territorial administrative unit Săucești, there is a separative system for collecting sewerage (domestic waters) and for pluvial waters, but the sewerage network is not covering all the localities (Siretu and Șerbești).

#### E.2.3.1. Collection of domestic water

Collection of the domestic waters is done centralized, for three villages (Săucești, Bogdan Vodă and Schineni) form a cluster. The operator of the sewerage system is the Regional Operator SC CRAB SA.

The sewerage network has a total length of 24.500 m. The collectors are made by plastic, PVC SN8 with diameters between 250 and 350 mm. The sewerage network also includes 476 manholes, of



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which 128 are of precast concrete and 376 are of HDPE (High density polyethylene), 6 energy dispersal manholes constructed of monolithic reinforced concrete and 10 wastewater pumping stations (SPAU), 3 in the village of Bogdan- Voda, 4 in Săuceşti and 3 in Schineni. The pumping stations are Glass (fiber) Reinforced Plastic (GRP) with a diameter of 1,800 mm and H = 7,000 mm equipped with pumps for domestic water with crushing disc.

### E.2.3.2. Sections with problems and streets without networks

The sectors with problems during the heavy rains from Săucești sewerage network are the ones on the street Salciei (related to the wastewater pumping station (SPAU) 5), street 1 Decembrie (related to SPAU 6) and street Mare-from Schineni village (related to SPAU 7). The streets where new sewerage collectors should be extended (as water networks are already available) are identified as: in Săucești (Crinului Street, Izvoarelor Street, Prelungirea Apusului Street, Viilor Street), in Schineni – Principală Street, in Bogdan Vodă, Calea Romanul[130].

### E.2.3.3. Treatment of wastewater

For Săucești cluster, the wastewater from the three localities – Săucești, Bogdan Vodă and Schineni – is treated in the same wastewater treatment plant, using mechanical and biological processes. The wastewater treatment plant (WWTP) is designed for 5,100 inhabitants[131] (540 $m^3$/day) and consists of:

- Pumping tank equipped with submersible pumps with crushing disc;
- Screw grill and 2 mm filtration system;
- Reinforced concrete leveling tank equipped with submersible pumps with crushing disc;
- Aerobic compartment 1;
- Aerobic compartment 2;
- Compartment with SAM and mixer;
- Lamellar decanter.

The effluent is discharged in Siret River.

### E.2.3.4. Deficiencies of the wastewater treatment plant

There are no facilities for sludge treatment and disposal. The bypass from the wastewater treatment plant has never been used in the last years.

### E.2.3.5. The stormwater system

The stormwater system in Săucești commune consists in rainwater collection devices, as open channels, ditches and culverts corresponding to the flow rates resulting from the calculations. Materials used (sand, ballast, crushed stone, cement, asphalt concrete, cement concrete) were approved in accordance with the European Union legislation and with GD 766/97 and Law 10/95 which provide the obligation to use materials approved for the execution of the works. The elements of the stormwater system were designed and built in stages, partially from the funds for local development, together with the modernization of the roads and from the local budget. The stormwater system is operated by the Local Council.

[130] Data provided by the Bacău Regional Water Company through the address no. 1587/15.02.2022

[131] Resourcing Environmental Consulting (2017) *Updated Master Plan in the water and wastewater field in Bacau County* [online]. Available at: https://municipiulbacau.ro/wp-content/uploads/2018/01/hcl-nr.-19-din-31.01.2018.pdf (Accessed: 01.03.2022)

There are some areas in which during the extreme rain events the water puddles on the ground for a long time. Also, erosions occur locally, on high banks, but does not endanger the stability of neighboring lands.

### E.2.4. Flood risk management tools

**The National Strategy on Flood Risk Management has as specific objective on long term: to protect localities against floods of 1% to 0.01% AEP**, depending on the rank of the locality. Săucești locality is a rank IV locality and Schineni, Siretu, Șerbești and Bogdan Vodă localities are a rank V. This implies for the defense structures to be designed for 1% AEP floods.

**Flood Risk Management Plans**

In line with the flood risk management objectives, the cycle 1 FRMP of Siret RBA (2016) contains proposal of measures to reduce the fluvial flood risk along Siret River APSFR in the area of Săucești commune (*Table 36*)[132]:

| APSFR name | EC measure code | Name of the measure | Implementation status |
|---|---|---|---|
| R. Siret - aval graniță, am. loc. Movileni, sect. îndig. | M31 | Maintaining the forest area in Siret river basin for 88,303.47 ha | - |
| | M31 | Improving forest management in the floodplains of the Siret river basin for 2,053.94 ha | |
| | M33 | Dyke on the right bank of Siret river at Letea Veche, Bacau county:<br>- defense dyke for 1,435 km<br>- consolidation of river banks for 0.900 km | - |
| | M35 | Dyke on the right bank of Siret river near Filipești commune, Bacău County, removal of the vegetation for 1.4 ha, landscape arrangements for 2.7 ha | - |
| r. Bistrița - av. loc. Piatra Neamț | M31 | Improving forest management in the floodplains of the Bistrița river basin for 32.76 ha | - |
| | M31 | Maintaining the surface of the forests in the Bistrița river basin for 213,176.37 ha | - |
| | M33 | Bistrita riverbed re-profiling, Bacău municipality for a volume of terracing of 30000 cubic meters | - |

[132] *http://www.inhga.ro/documents/10184/121027/9+PMRI+Siret.pdf/c4fc27dc-aa01-4460-9327-adaea2848bca%20*



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| APSFR name | EC measure code | Name of the measure | Implementation status |
|---|---|---|---|
| | | Bistrita riverbed re-profiling, Letea Veche for a volume of terracing of 10000 cubic meters | |
| | M33 | Increasing the transit capacity of the reservoir UHE Bacau II, Bacău Municipality by dradging 4,250,000 m3 | - |
| | M33 | Maintenance works at reservoir UHE Bacău II for its safe operation | - |

***Table 36** – Measures proposed in cycle 1 FRMP for Siret RBA which could have an influence on Săucești commune*

*Source: Flood Risk Management Plan for Siret River Basin Administration*

An integrated project was proposed in cycle 1 FRMP of interest for Săucești UAT: Bistrița River basin arrangement in order to defend against floods the counties Neamț and Bacău.

Under the 2nd cycle FRMPs, for Siret and Bistrița APSFRs a strategy will be developed to reduce the flood risk at APSFR level.

**The River Basin Management Plan of Siret SH (2022-2027)** indicates as water bodies along the APSFRs of interest for Săucești commune the following (*Table 37*)[133]:

| Water Body name | Water Body Code | Category | Status/ Potential (S/P) | Water body typology code | Class of the ecological status/ potential | Chemical status |
|---|---|---|---|---|---|---|
| Siret (cf Moldova - ac Galbeni) | RORW12 - 1_B5 | RW | P | RO11CAPM | 2 | 2 |
| Bistrița (baraj Bâtca Doamnei - ac Racova) | RORW12-1-53_B6 | RW | P | RO11CAPM | 3 | 3 |
| Lac agrement Bacău | ROLW12-1-53_B7 | LW | P | RO11CAPM | 2 | 2 |

***Table 37** – Water bodies of interest for Săucești commune*

*Source: Updated River Basin Management Plan for Siret River Basin Administration 2022 - 2027*

Legend:
RW - natural river / CAPM river / artificial river

[133]http://siret.rowater.ro/abas/wp-content/uploads/2022/06/Planul-de-management-actualizat-al-spatiului-hidrografic-Siret-2022-2027_ANEXE.pdf



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LW - reservoirs
S/ P – ecological status/ ecological potential
Water body typology code: Natural rivers: RO01-RO19; Strongly modified rivers: RO01CAPM-RO19CAPM; Artificial rivers: RO01CAA-RO19CAA; Reservoirs: ROLA01-ROLA07
Classes of the ecological status/ potential: 1- very good ecological condition/ 2- good ecological status/ / maximum and good potential/ 3- moderate ecological status / moderate potential; 4- poor ecological status / potentially weak

When elaborating the strategies at APSFR level, the characterization of the water body should be considered.

Currently, **Siret Flood Defence Plan against floods at the river basin level (2018-2021)**[134] is published on RBA Siret website.

### E.2.5. Areas developed in floodplain

To identify areas developed in floodplain flood hazard and risk maps developed in the first cycle by the Government of Romania for the EU Floods Directive were considered. Hazard and risk maps developed in cycle 2 are still in progress and can not be considered in this stage.

It is important to mention that after 1st cycle of hazard and risk maps were delivered a dike was built in Săucești commune. Thus, the flood hazard and risk maps from the 1st cycle do not reflect the current situation of the flood risk in Săucești commune.

**Bogdan-Vodă village**

Bogdan-Vodă village does not have flood risk areas although it is located on the eastern shore of Bistrița River. The explanation for this lies in the higher altitude of the village than the river altitude.

The trend of territorial expansion of the village is predominant along the main road - the national road DN2 (E85) - but there is also a development trend towards the east, towards the village of Săucești. This can be seen in the satellite images (Google Earth) but also in the approved P.U.G. and the one in progress.

**Săucești village**

The northwest and the center of the regulated built area of Săucești village are under the threat of floods. This is favored by the location of the village on the western side of the Siret River.

Following the analysis of the urban planning documents, approved and in progress, it is proposed to extend the regulated built area towards west, towards Bogdan-Voda village, and not towards east, taking into account the risk of floods.

The densification of the regulated built area between the two villages from the south of Săucești commune takes place in an area free from flood threat and is the consequence of the proximity to Bacău Municipality.

[134] https://www.primariatm.ro/transparenta/strategii-si-planuri/plan-local-de-aparare/


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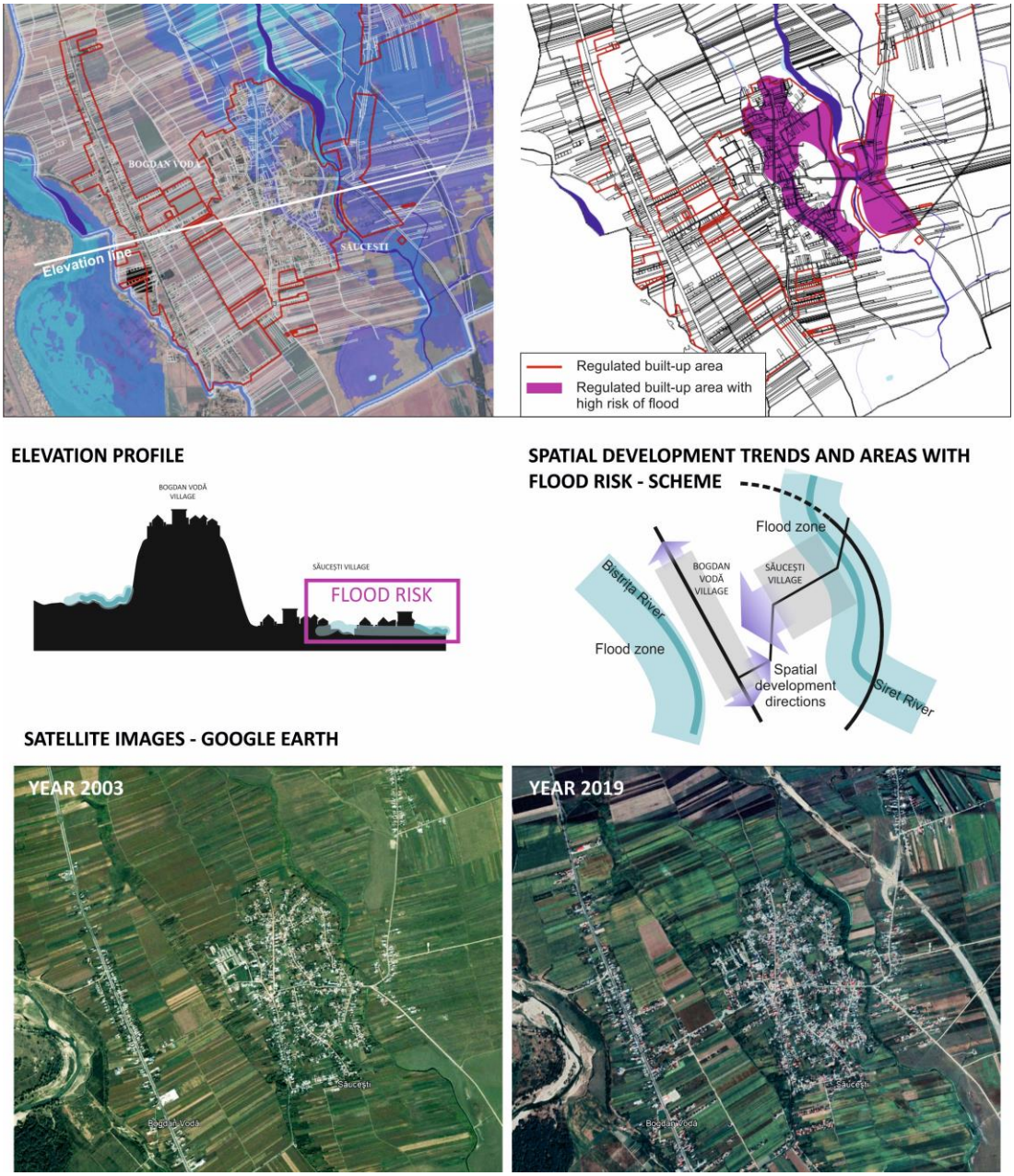


***Figure 96 –*** *Floodplain map overlapping the topographic survey that contains the regulated built-up areas for Bogdan-Vodă and Săucești villages. Elevation profile. Spatial development trends and areas with flood risk scheme. Comparison between satellite images from 2003 and 2019*

*Source: Flood risk map. Săucești General Urban Plan in progress. Google Earth*

**Schineni village**

The Schineni village is located in an unfavorable location, on the west side of the Siret River and on the east side of the Turbata Brook. The consequence of this location is the fact that over 80% of the built area of the village is in the flood risk zone. Over time, discreet territorial expansions along the streets could be observed, this trend being limited by the risk of flooding.



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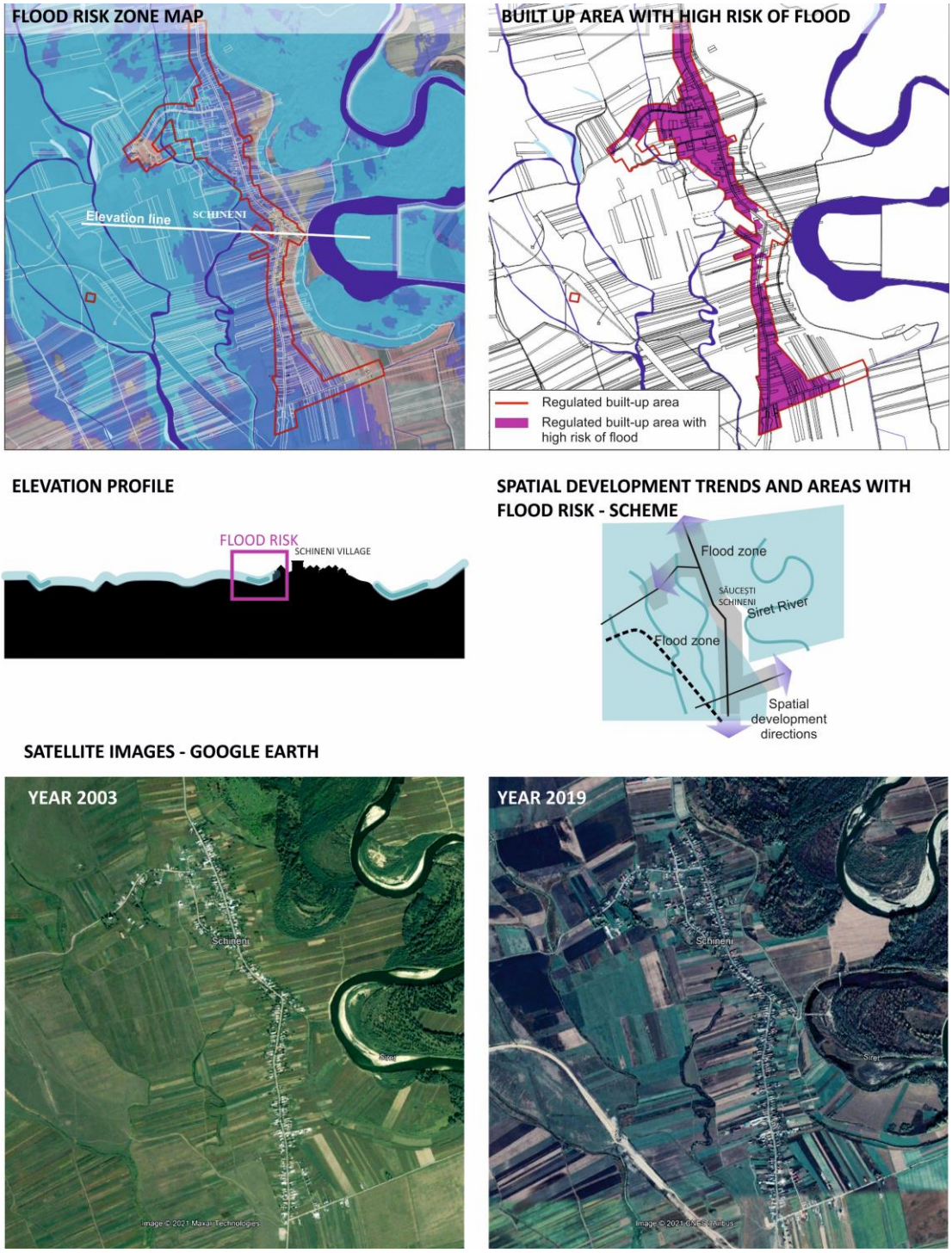


***Figure 97 –*** *Floodplain map overlapping the topographic survey that contains the regulated built-up areas for Schineni village. Elevation profile. Spatial development trends and areas with flood risk scheme. Comparison between satellite images from 2003 and 2019*

*Source: Flood risk map. Săucești General Urban Plan in progress. Google Earth*

**Siretu Village**

As in the case of Schineni village, a large part of the regulated built-up area of Siretu village is in the flood zone, being also a village located on the bank of Siret River. Unlike the Bogdan-Vodă village, the Siretu village is not located at a higher altitude than the floodplain. Thus, the village is at risk of flooding.



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In the main village south side, but also in the case of the western body, there are slight tendencies to densify the number of constructions, an aspect that can be observed from the analysis of satellite images. Inside the village there are small changes in the construction density, without noticing a new direction of development.

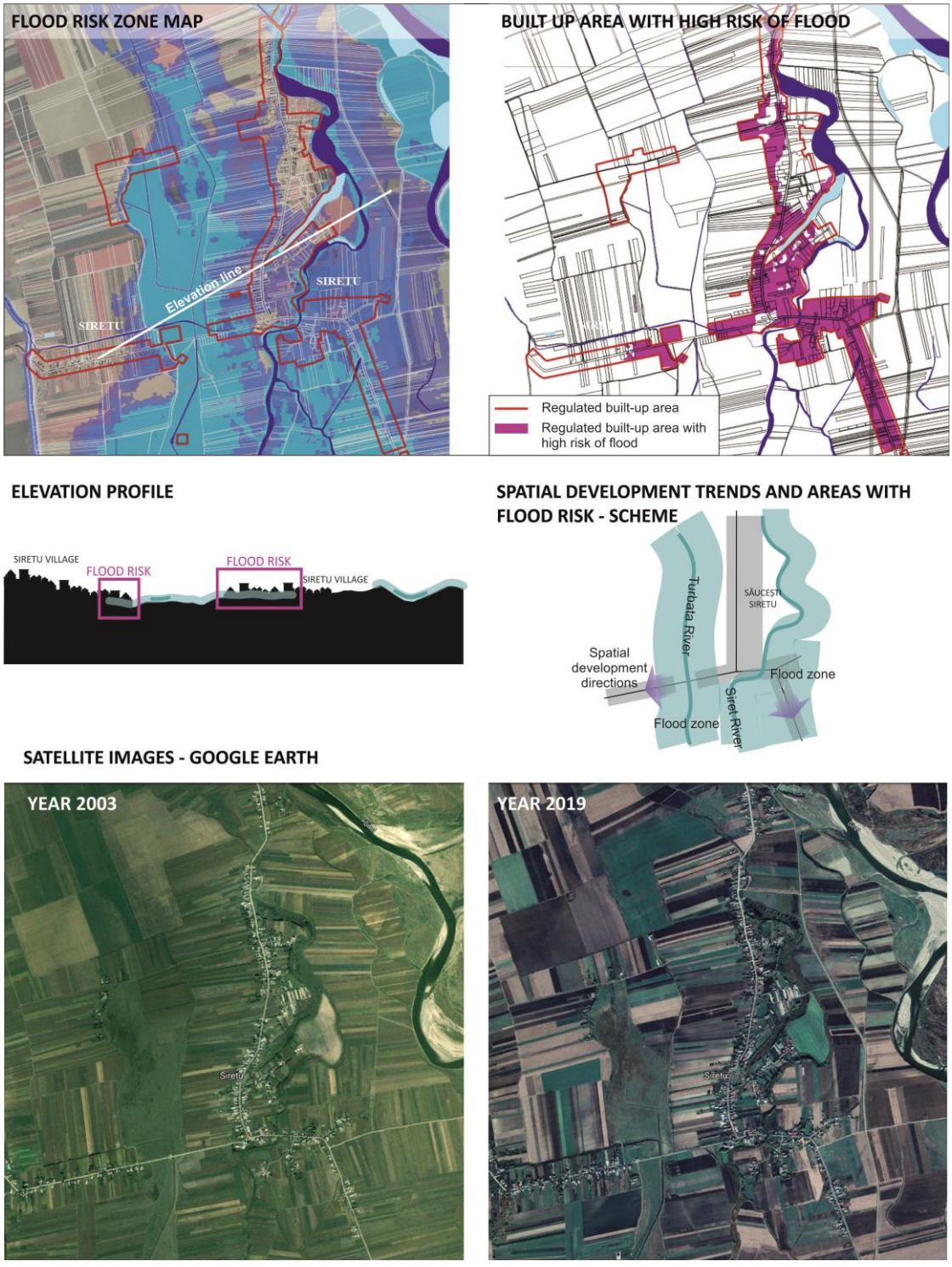


***Figure 98** – Floodplain map overlapping the topographic survey that contains the regulated built-up areas for Siretu village. Elevation profile. Spatial development trends and areas with flood risk scheme. Comparison between satellite images from 2003 and 2019*

*Source: Flood risk map. Săucești General Urban Plan in progress. Google Earth*



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**Șerbești Village**

Șerbești village is located in the north side of the commune, on the west side of Siret River and on the east side of Turbata Brook (Precista branch). It presents a high flood risk, according to the flood risk map from the 1st cycle. The entire regulated built-up area of the village is under threat of flooding, with the exception of the two areas intended for agricultural units. This is the effect of the higher altitude at which the two areas are located. Despite the fact that the risk of flooding is high, there is a slight densification of the built-up area in the center of the village and in south, towards Siretu village.

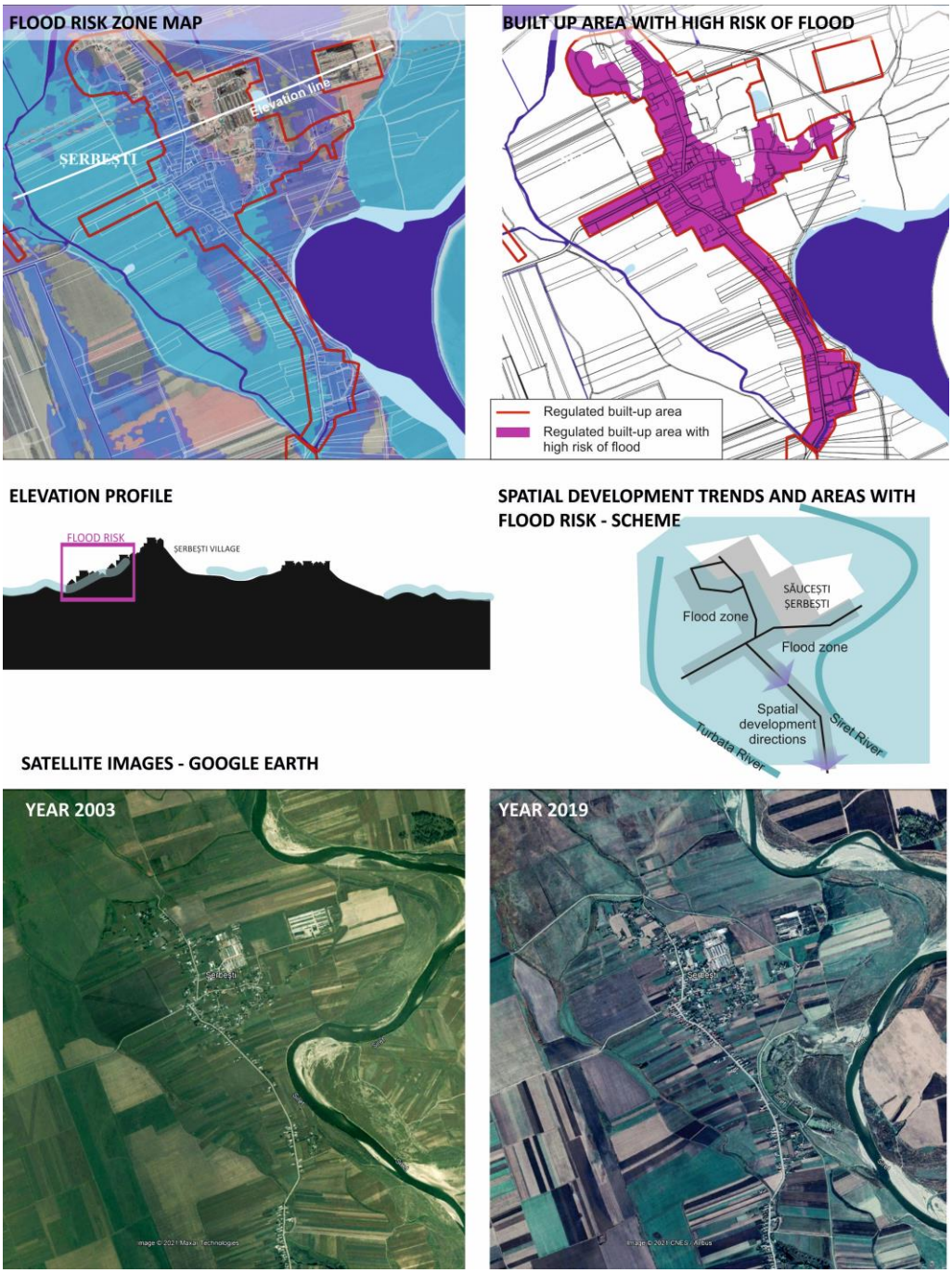


***Figure 99 –*** *Floodplain map overlapping the topographic survey that contains the regulated built-up areas for Șerbești village. Elevation profile. Spatial development trends and areas with flood risk scheme. Comparison between satellite images from 2003 and 2019.*

*Source: Flood risk map. Săucești General Urban Plan in progress. Google Earth*



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## E.3. Integration of hazard and flood risk maps and flood risk management measures into spatial and urban planning

### E.3.1. Spatial and urban planning plans analysis

#### E.3.1.1. The Sustainable Development Strategy of Bacău County

The Sustainable Development Strategy of Bacău County in the time horizon 2009-2021 includes Stage B which represents the actual strategy elaboration and the monitoring mechanisms.

The vision part regarding this sustainable development strategy defines four sectoral development directions: economic infrastructure, society and population structure, its environment and quality, and spatial development. Of all these, the third sectoral direction of development is considering to adapt to climate change and ensure flood prevention.

In addition, the strategy presents a series of types of projects in order to achieve the strategic objective by implementing the **Policy 4.4.** „Increasing the resistance capacity of the territorial administrative units to natural disasters":

**Program:** Prevention and protection measures against floods, landslides, fires, snowfalls and earthquakes

**Projects for the county territory**:

- Investments for the prevention of emergency situations (barrage, dikes);
- Afforestation of areas with a high degree of erosion;
- Equipping with machinery and equipment for prevention and intervention in emergency situations;
- Preparation of surveillance plans for protected sites, with measures to prevent the risks of floods and fires.

**Projects for communes and belonging villages**:

- Equipping with machinery and equipment for prevention and intervention in emergency situations;
- Creation of forest curtains to protect agricultural land;
- Realization of audible warning-alarm systems for the population and targets in potentially affected areas;
- Expansion and refurbishment drought irrigation systems.


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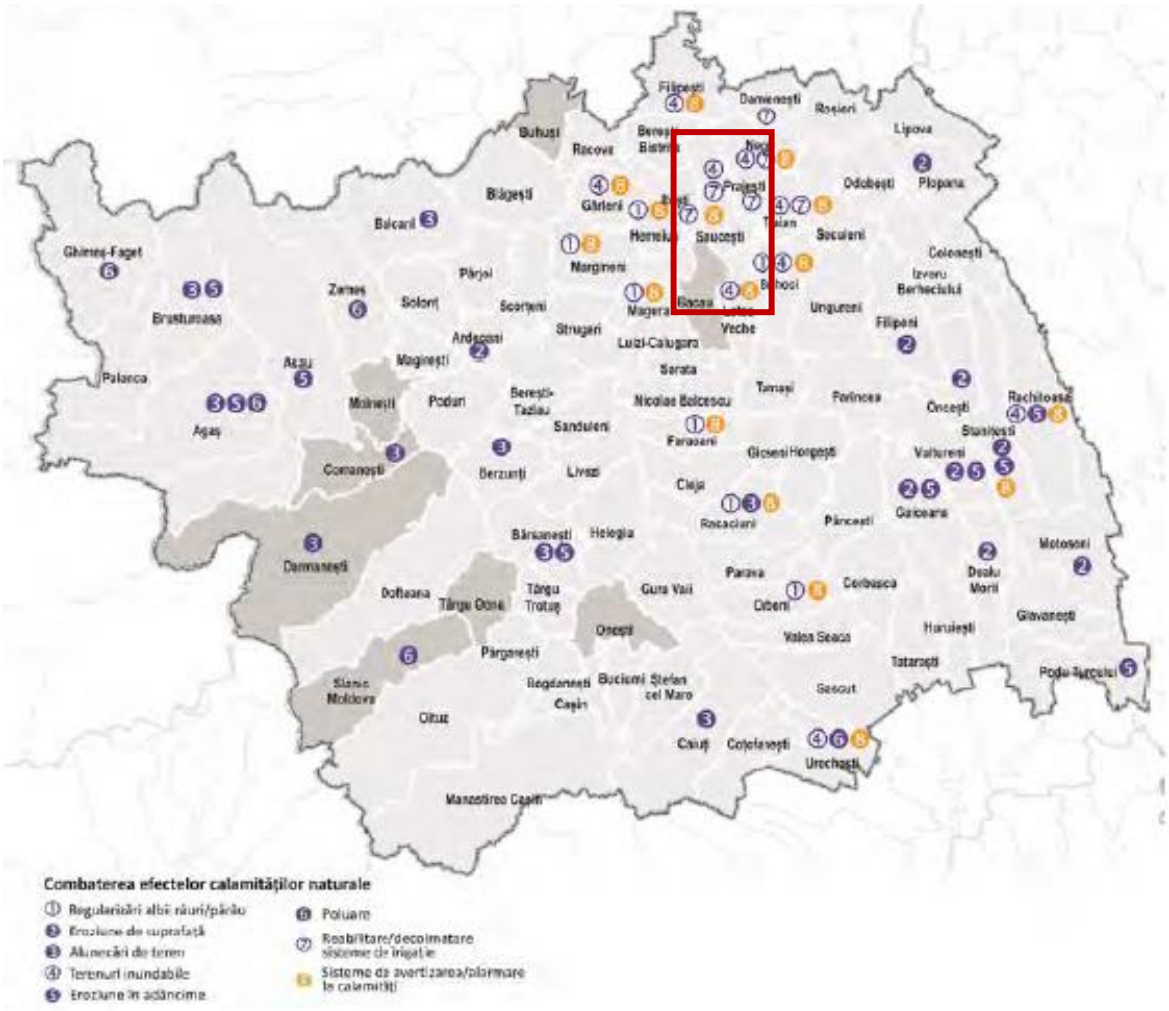


***Figure 100 –*** *Spatial distribution of projects proposed for preventing/combating risk situations.*
*Source: The Sustainable Development Strategy of Bacău County 2009-2021. Version 2016. Stage B - Strategy elaboration and monitoring mechanisms, p. 74*

The previous figure illustrates the spatial distribution of the proposed projects for preventing/combating risk situations. For the commune of Săucești in particular, the following are marked:

1. Floodplains (No. 4);
2. Rehabilitation/unclogging the irrigation systems (no. 7);
3. Disaster warning/alarm systems (no. 8).

The priority projects regarding the fulfillment of the strategic objective valid for Săucești commune are the following:

1. Rehabilitation/unclogging of irrigation systems. The responsibility for formulating the financing request lies with the Local Council of Săucești Commune, the financing source is National Rural Development Program measure 16 (PNDR / M 16), and the implementation period is 2017-2023;
2. Land improvements for floodplains. The responsibility for formulating the financing request belongs to the Local Council of Săucești Commune, the financing source is Large Infrastructure Operational Program (POIM), and the implementation period is 2017-2023.


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The strategy lists a series of expected results following the implementation of objectives and programs and establishes a series of indicators through which these results can be measured:

1. a community better prepared to approach/implement measures to reduce the natural risk:
    a. Homes / households at risk;
    b. Buildings with public functions exposed to risk;
    c. Areas at risk;
    d. Loss recovery costs;
    e. The population that benefits from prevention measures.
2. there is the ability to prevent and intervene to protect people and property:
    a. Capacity building for prevention and management disaster;
    b. Use of post-accident measures.

### E.3.1.2. Bacău Territorial County Plan

The County Territorial Development Plan (PATJ) is elaborated at the request of the County Council. This is prepared according to the *Law 350/2001 for territorial and urban planning* and *Order 233/2016 for the approval of the Methodological Norms for Law 350//2001 regarding the territorial and urban planning and for elaboration and updating of the urban planning documentations.* The County Territorial Plan it represents the planning of the county's territory strategy.

The purposes of drawing up this territorial planning documentation are the spatial development of Bacău County's territory, the establishment of objectives, directions and measures for the development of Bacău county's territory, the concretization of the development strategy in the territory, the substantiation of the development plans in the territory, to contribute to the solution of some specific problems in Bacău region, and correlation with the previous Spatial Planning plans: National Development Territorial Plan (PATN) and Regional Zonal Development Territorial Plan (PATZR).

Bacău PATJ spatial development policies include the following topics and tasks:

1. Improving the spatial structure by reducing regional disparities through global and regional policies, establishing new relations between urban and rural localities for an integrated development, diversifying the economic structure of mono-oriented areas;
2. Modeling the development of human settlements;
3. Transformation of rural areas (elaboration of strategies targeting simultaneously the economic, social and ecological aspects to improve the life in rural environment);
4. Development of transport and telecommunications;
5. **Environmental protection** and natural and cultural heritage management.

The elaboration of the present Territorial County Plan was done without the elaboration of the study regarding the delimitation of the natural risk areas (floods and landslides) and technological risks but an Environmental Report has been prepared and it presents the existing natural risks at the county level.

According to the **Environmental Report** prepared for PATJ, from the point of view of the geographical location, Bacău County faces natural risks (erosion phenomena) and anthropogenic risks (lack of dams, deforestation, torrentiality, etc.). There is a connection between these two categories of risks. This means that non-compliance with urbanization rules and improper urban planning may favor or accentuate the extent of natural hazards.


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One of the types of natural risk identified in Bacău County refers to landslides that occur due to heavy and prolonged rains, which cause high soil humidity and its erosion in depth. The Environmental Report identifies 13 areas affected by this natural risk, but Săucești commune is not among them.

In addition to the landslide problem, Bacău County is also facing floods due to overflows and areas with floods due to torrent leaks. The floods caused by overflowing happen mainly due to non-development of major riverbeds and due to shore erosions. This does not ensure large water runoff and safe overfloods, which would avoid going beyond the major riverbed and, implicitly, the production of floods.

The rough terrain determined the torrential nature of the river basin. Non-compliance with urbanization rules and improper urban planning may favor or accentuate the production of natural risks.

After this analysis, the following **problems** were identified in the Environmental Report:

- large agricultural areas and numerous localities are exposed to flood risk;
- erosion intensification and land degradation;
- difficulties in mitigating the drought effects due to the impossibility of using the whole designed for irrigation surfaces;
- the danger generated by major accidents involving dangerous substances;
- the non-existence of an optimal National and County Monitoring System.

Flood-related malfunctions have been identified:

- abundant atmospheric precipitations produce floods and landslides (dysfunction generated by climatic factors);
- the lack of delimitation of the protection zones and surfaces occupied by the natural zones cadasters, thing that complicates the decision process regarding the constructions and the zoning of the territory; lack of delimitation of protection areas and areas occupied by cultural heritage cadasters; non-performance of defense works or inadequate defense works in the flood affected lands (dysfunction related to the natural risks of the area);
- Siret and Bistrița rivers require flood protection works, bank consolidation, regularization and damming and also studies are needed to reconsider the importance class of flood defense works (technical infrastructure dysfunction).

The Environmental Report prepared for Territorial County Plan mentions the establishment of protection areas and spatial planning rules (protection against landslides and against floods for development areas of the locality). For the constructions that will be located outside the regulated built-up area, but also for the constructions that will be located in the meadow area, it is proposed to carry out a Geotechnical Study. A temporary construction ban is imposed in the immediate vicinity of the streams and in areas with a level difference of less than 1.00 m from the major riverbed streams and with a riverbed opening of at least 3.00 m. If it is necessary to extend the regulated built-up area on larger areas, hydrological studies will be carried out for de natural risk areas, specifying the exceptional flows and their time of appearance. The Local Councils must establish maintenance and control programs for riverbed section within the regulated built-up area.

The PATJ **general objectives** related to flood risk management refer to:

- defending the population and property against floods;
- combating torrents, soil erosion and land degradation, mitigating the effects of the drought phenomenon;


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- the national surveillance and meteorological and hydrogeological forecast system modernization;
- the National Waters Administration monitoring system modernization.

The PATJ **specific goals** related to flood risk management refer to:

- reassessment of areas at risk of flooding (Siret, Trotuș, Bistrița and Tazlău and their tributaries);
- improving the concept of flood protection;
- rehabilitation and carrying out of flood defense work (dams, regularization, shore defenses);
- stabilization of active landslides;
- stabilization of the land erosion evolution and land ecological restoration;
- securing the existing flood works, correction of torrents (afforestation - rational exploitation re-commissioning of the forest fund);
- humidity excess lands conservation, construction and maintenance of draining works made for lands with excess moisture;
- re-commissioning of the surfaces planned for irrigation;
- flood risk maps elaboration and inclusion them into the Territorial County Plan;
- updating internal and external emergency plans;
- updating security reports;
- at the revision of the Onești and Bacău General Urban Plans, there will be established construction restricted areas around high-risk objectives;
- high risk units will execute permanent applications under the coordination of ISU;
- development of methods and means for prognosis of climatic and meteorological hazards and of hydrodynamic and aerodynamic predilection of pollutant dispersion processes;
- modernization of the current information system in the field of water for flood events, accidents at hydrotechnical constructions and accidental pollution - The Integrated Disaster Water Management System project – WATMAN;
- updating the Disaster Protection and Intervention Plan (earthquakes, landslides and ground collapse, floods, epidemics and epitaphs, chemical accidents, biological or nuclear, etc.) and the action procedures implementation;
- information system for warning and population alarming modernization;
- realization of the National and County Soil Monitoring Program – *land for agriculture* as a part of the National Integrated Environmental Monitoring System.

The problem of floods is mentioned in the Bacău Territorial County Plan, the list of localities where risk areas have been inventoried mentioning the Săucești commune with two of its villages, Săucești and Schineni (overflows). The risk of landslides is a main problem of the county, generated by heavy rains and excess humidity. The declivous, hilly terrain is the erosions' and the landslides' object thus affecting large zones, in Bacău county on the left shore of Siret (the exposed areas are in the central and northern part of the county).

In order to alleviate these problems and to eliminate the flood risk, river embankment and regularization works have been carried out. These works ensure the protection of human settlements, industrial objectives and agricultural land, roads and railways. The length of regularizations and dikes, at the county level is 113.43 km. Through these works, 40 localities and industrial objectives as well as 7.55 million ha of terrain are defended against floods. The Siret River was dammed and regularized over a length of about 27.7 km, 12.3 km on Bistriţa River and 10.96 km on Trotuş Brook. The effect of


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these works is to defend a number of 23 localities and industrial objectives as well as 6.16 thousand ha of land.

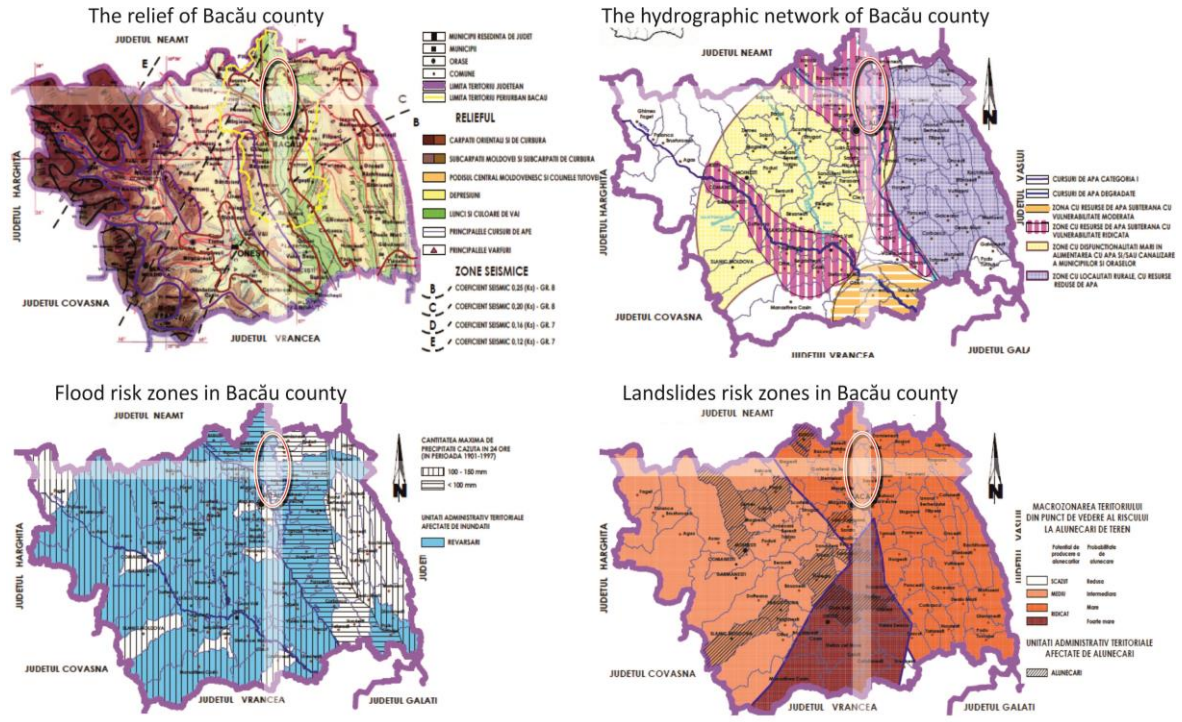


***Figure 101 –*** *The geography of Bacău County, the hydrographic network of Bacău County, the flood risk zones existing in and the landslides risk zones in Bacău County*
*Source: Bacău Territorial County Plan*

At the level of 2003, during the period when the Bacau Territorial County Plan was drawn up, regularizations and dams along the Siret River were carried out only on the Filipești-Onișcani sector, in the north of Săucești commune.

Following the analysis of the existing situation, it is found that one of the threats felt at the county level is the risks of floods and landslides. This major threat, coupled with the massive deforestation that is taking place in the county, amplifies the damage caused by torrents and landslides.

Drawing no. 6 that refers to Technical Infrastructures – River basins betterment and land improvements illustrates some projects, two of which are also proposed for the territory of Săucești commune: **the first project represents works to regulate the Siret watercourse and dams**, and **the second refers to the land surfaces for which the betterments with drainage works are necessary**.


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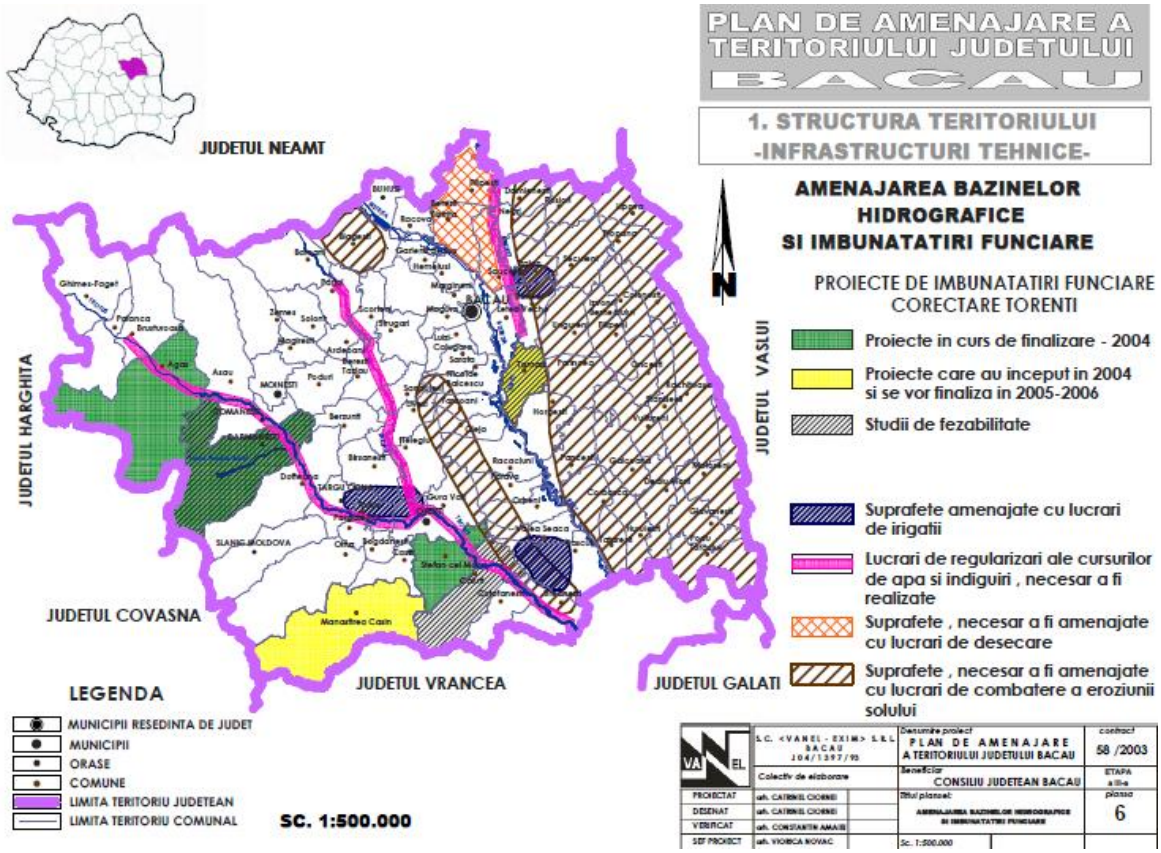


***Figure 102 –*** *The technical infrastructures – river basins betterment and land improvements*
*Source: Bacău Territorial County Plan*

Within the third stage of Bacău Territorial County Plan - Dysfunctions and Priorities - Diagnostics, are scanned the main characteristic elements regarding the quality of the factors medium. Critical issues are organized by areas of pollution, as follows:

- **Surface water**: The general pollution coefficient is exceeded on the rivers Bistrița, Siret, Trotuș and on the lakes Poiana Uzului and Lilieci;
- **Groundwater**: Recorded pollution from industrial and agricultural activities and from and industrial and household waste landfills;
- **Wastewater**: Exceedances are recorded for all analyzed indicators;
- **Soil**: Category III pollution is registered, with the degraded classification (pesticides, heavy metals, chemical, bacteriological);
- **Air**: No exceedances of the maximum permitted concentrations of the main pollutants, but high - frequency emissions of pollutants from industrial sources, road transport activities (heavy traffic) and aerial;
- **Emergencies**: (1). **floods** caused by heavy rainfall, rapid snowmelt, blocking of rivers with ice on the Siret, Trotuș, Bistrița rivers and their tributaries, on the streams that cross the localities in the mountain area; (2). possible **earthquakes** of 6-7 degrees on Richter scale in the South and South-West area of the county with the epicenter in Vrancea county; (3). **Landslides**; (4). **Large fires** - in forests, urban areas, warehouses oil mills, wood processing plants, etc.; (5). **Dams breaking** because of the accumulation: Valea Uzului Dam, hydropower dams on the river Bistrița - the flood wave can affect the localities downstream.
- **Technological risk**: (1). **Chemical accidents** can occur on the important roads or on the railway in the county, during the transport of some dangerous substances, (2). **chemical accidents** at companies what produce or use large quantities of substances in the production process.


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Pollution and risk factors limitation are based on the principle of precaution, preventive action, subsidiarity, source damage rectification and correction. The sectoral development objective is to improve air quality, soil and ecosystems using scientific and technical data and minimize the effects of floods and drought.

In the third stage of Bacău Territorial County Plan, in the chapter on the Formulation of development policies there are a series of policies, programs and projects that have as subject the environment:

**Policy no.1**: Central and local authorities activity coordination in environment protection, noise, air, water and soil pollution, industrial pollution control and risk management implementation.

**Programs:**

1.2. Elimination / mitigation of natural and technological risk factors as well as those resulting from anthropogenic pressure by proactive planning

**Projects**

1.2.1. The territorial risks scheme elaboration by each institution/sources of natural and/or technological hazards identification existing on the county's territory
1.2.2. Loss and damage estimation (by type of risk)
1.2.3. Localities and economic agents' classification (from the civil protection point of view)
1.2.4. Development of "Risk analysis and coverage plans" regarding risk areas/types
1.2.5. Prohibition by the General Urban Plans to place functions in natural risk areas
1.2.6. Interdiction of any building in natural risk areas (placing new functions) through PUG
1.2.7. Institutional coordination of emergency prevention and management.

The proposals of Bacău Territorial County Plan were graphically illustrated on drawings. For Săucești commune the establishment of flood prevention measures was proposed. This implies the improvement and preservation of the ecological stability of the forests with safety role.

The Development Strategy part of Bacău County also proposes territorial programs that will improve the management of water resources. Thus, measures for the irrigation and drainage systems are proposed for Săucești commune.


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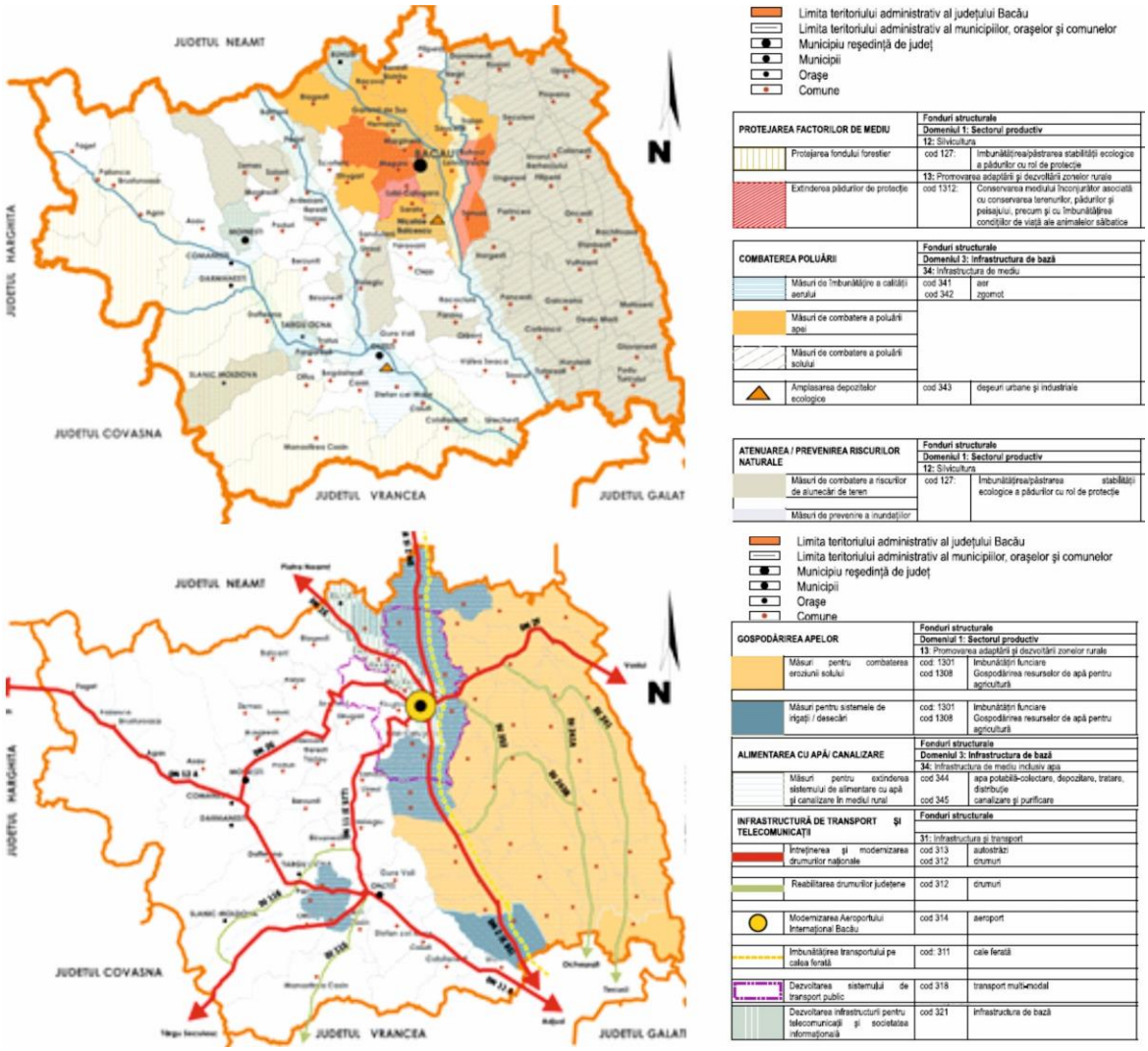


***Figure 103** – Environment projects (above); Localities network projects (below)*
*Source: Development Strategy – part of Bacău Territorial County Plan*

### E.3.1.3. The Sustainable Development Strategy of Săucești commune, Bacău County

Within the Sustainable Development Strategy of Săucești commune, there is a chapter dedicated to Emergency Situations.

In 2007, the Local Committee for Emergency Situations was set up in the commune and it includes the Volunteer Service for Emergency Situations, consisting of 26 volunteers, a service structured in 5 intervention teams, depending on the types of risk. In case of floods and snowfalls they have the following responsibilities:

- rescue persons, animals and material goods caught by water or underwater and / or snowed;
- supporting the forces involved in strengthening the dams;
- participation in the closure of breakwaters;
- participation in the actions of removing hard objects in the water near vulnerable areas or points;
- snow or ice plugs removal;
- cleaning (clearing) drains or areas affected by floods and / or ice.


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This documentation also mentions the flood risk as one of the main problems of the commune (risk determined by the periodic floods of the Siret River – 1991, 2005, 2008, 2010 are the years when the floods caused disastrous damage).

The bed of the Siret River is constantly changing due to erosion, amplified by the presence of gravel pits. Thus, the Schineni village is in danger, the major riverbed reaching very close to the northern extremity of the village. In order to reduce the effects of increasing Siret River flows, the National Administration Romanian Waters has made the investment *„Damming the right shore of Siret River and cutting the bend and raising de dam".* The dike has a height of over 2 meters and a width of 4 meters. Minor riverbed corrections were also made in the Șerbești and Schineni villages.

In the diagnostic part of the strategy, in the SWOT analysis, the risk of floods is not mentioned, thus not being considered a threat, and neither their effects a weak point for living in these villages. However, two measures considered necessary to prevent floods are mentioned in the proposal part. These two are contained in *Direct no. 1 – Infrastructure development and environmental protection* (and they belong to *Objective 1.3 – Extension of the utility network,* respectively to *Objective 1.5 – Environmental management and protection*).

The first measure represents *the arrangement of rainwater collection channels on the commune territory to prevent floods*. For this measure is assigned a project with a deadline of 2015 (*Construction of stormwater collection channels*).

The second measure represents the reduction of natural disasters risk that affect the population and it has 4 projects:

- Project 1. Arrangement works against torrents for the protection of floodable agricultural lands;
- Project 2. Informing and training the population in the emergencies' domain;
- Project 3. Equipping the situations of emergency voluntary service with all the necessary means for specific interventions;
- Project 4. Establishment of a Center for emergencies monitoring and warning (floods, water, air, soil pollution).

### E.3.1.4. Săucești General Urban Plan

According to the National Territory Development Plan – Section Network of localities, Săucești commune falls into the category of rank IV localities. In addition to this, due to its position in the territory, Săucești commune is part of the Metropolitan Area of Bacău, along with 23 other communes.

According to Order no. 233/February 26, 2016 for the approval of the *Methodological Norms for the application of Law no. 350/2001 regarding the spatial planning and urbanism and for the elaboration and updating of urban planning documents,* the list of preliminary studies necessary for a locality of rank IV located in the metropolitan area includes the following:

1. Analytical studies:
   - Preliminary Study regarding the updating of the Topographic Support;
   - Preliminary Study regarding geotechnical and Hydrological Preliminary Study;
   - Preliminary Study regarding peri-urban relations;
   - Preliminary Study regarding organization of roads and transport;
   - Preliminary study on Environmental protection, Natural and Anthropogenic risks;
   - Historical preliminary study / Landscape preliminary study;
   - Preliminary study regarding the identification of property types;
   - Preliminary study regarding the utility network;

2. Advisory studies:
   - Preliminary study on stakeholder analysis and social surveys;
3. Prospective studies:
   - Preliminary study regarding the economic activities' evolution;
   - Preliminary study regarding socio-demographic evolution;
   - Preliminary study regarding urban mobility and transport;
   - Preliminary study regarding the impact of climate change;

Of all these preliminary studies, the World Bank team received from the City Hall of Săucești Commune the following studies:

- Preliminary study regarding the economic activities' evolution;
- Preliminary study regarding socio-demographic evolution;
- Historical study;
- Geotechnical and Hydrological Preliminary Study;
- Preliminary study on stakeholder analysis and social surveys;
- Pedological Study.

The studies that could have helped identifying the natural risks of the commune are missing (*Preliminary study on Environmental protection, Natural and Anthropogenic risks*).

The Geotechnical and Hydrological Preliminary Study highlights the problems of the inside and outside the regulated built-up area, related to the active physical-geological phenomena that could manifest in the area: erosion, landslides, the presence of areas with excess humidity or flooding, and others.

It is also mentioned that the document does not analyze the phenomena of instability, therefore the constructive measures necessary for the consolidation of the lands in the problem areas (landslides, areas with excess of humidity or with risk of flooding) are not recommended either. The study only identifies the problem areas (indicates their existence). In order to draw up the natural risk maps (for floods or landslides) it is needed to carry out studies with concrete data on flows, hydraulic calculations, geotechnical drilling performed in the area of landslides and which presents the necessary solutions (according to GD 447 / 10.04.2003).

The *Geotechnical and Hydrological Preliminary Study* captures the current situation of the commune, and of the hydrographic network in particular. Thus, it is specified that the Bistrița River and Siret River borders the west and the east side of Săucești commune.

In addition to the two rivers, the Turbata stream is mentioned, which crosses the commune from north to south. It has a low flow, but its flow increases during rainy summers and in spring when the snow melts. It is visible in the form of puddles and areas with moisture excess.

In the chapter on dysfunctions, it is mentioned that the perimeter of the commune has no significant restrictions in terms of buildability. About floodplains, or areas where water puddles on the surface of the land, it is specified that drainage will be required and construction will be allowed only based on geotechnical studies that will recommend special construction measures such as drainage, gutters and others.

The Geotechnical and Hydrological Preliminary Study includes three types of land:

- **buildable land, without restrictions**, where constructions can be located without problems, the land being stable;
- **buildable land but with restrictions**, with specific arrangements - these are restricted areas, where there is excess moisture or springs, but also areas with medium but stable slopes;
- **land unsuitable for construction** which are located in flooded areas and in the protection areas of catchments and water stations.


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These areas are graphically illustrated on a plan, but this was not provided by the City Hall.

The *Preliminary study on Environmental protection, Natural and Anthropogenic risks* and the *Preliminary study regarding the impact of climate change* were not provided, but could have helped to identify recommendations on the issue of floods in the commune. Despite the fact that only a part of the preliminary studies required according to Order 233/2016 were provided, in the memoir of the General Urban Plan of Săucești commune were all mentioned. Following these, a SWOT analysis was performed, the existence of flood defense works being listed as a strong point.

The memoir of the General Urban Plan in progress specifies the fact that it is elaborated following the local development strategy and wants to achieve the concept established through the strategy: **"Sustainable and balanced development of Săucești commune by creating and sustaining a competitive, stable, healthy economic and social environment diversified, to ensure continuous economic growth and increase the citizens life quality**". The present documentation studies the current state of development by updating the existing situation regarding the evolution of localities, the elements of the natural environment, relations in territory, economic potential, population and demographic and social elements. Based on analysis of the existing situation and in correlation with the Sustainable Development Strategy of Săucești commune and the Bacău Territorial County Plan, the proposals will underpin the regulate built-up area development for a period of 10 years.

In order to achieve the described vision based on the previously mentioned strategy, a series of priority interventions were established:

- **establishing measures to eliminate natural risks;**
- rehabilitation of health facilities;
- increasing the quality of green spaces and creating recreational areas;
- modernization of the road infrastructure;
- extension of the centralized water supply and sewerage system;
- construction of the natural gas supply network;
- optimizing the integrated management of household waste;
- organizing the selective collection of waste by building points of collection;
- increasing the supply of jobs by diversifying economic activities existing.

In the proposal part, there are a number of measures needed for natural disasters risk areas – flood risk areas. Specific measures are still needed to prevent flooding:

- reducing the rapid runoff on the territory of the commune by carrying out works of afforestation, sowing for the development of grassy vegetation, re-establishment orchards and vineyards, etc.;
- unclogging the bridges and ensuring the drainage section;
- permanent monitoring by Saucești Local Council for Emergency Situations of the phenomenon and the emergency information of the County Operational Center in the case the creation of emergency situations due to the uncontrolled evolution of the situation;
- maintenance of riverbeds and torrential valleys by caring for vegetation from the shores, by strict control over the garbage storage and other materials that can clog the drainage section;
- the steps initiation in order to obtain the necessary funds carrying out the works of arrangement of the affected areas (by the commune mayor's office);
- implementation of forecasting, warning and alarm systems for cases of floods;
- proper maintenance of ditches and drains in sections bridges and footbridges in localities;
- communicating with the population and educating them regarding behavior in floods situations;
- providing resources (material, financial, human) at local level for the intervention operational;

- considering the food risk areas as buildable land with restrictions generated only by specialized studies (making risk maps, embankment project approved under the law).

In addition, it is proposed to promote projects for eliminating the floods or puddles causes. These projects will provide data for flow control, dams construction, banks and slopes consolidation, other specific arrangements, or protective vegetation plantings.

The commune hall together with the competent institutions will ensure the implementation with priority of these categories of works and immediate intervention, as well as requesting funds for their realization. These measures will be implemented through:

- regularization of streams that cause material damage;
- streams clearing;
- bank consolidation;
- widening riverbeds and eliminating aggressive meanders;
- protective vegetation plantings.

In areas that are in danger of being flooded by heavy rains or snow melting it is proposed to recalibrate the watercourses in order to increase the capacity of water transport and the uplift of the banks along the affected areas.

Another measure to reduce flood damage is to establish protection areas along the watercourse on width of 5m (measured from the banks of the minor riverbed) and along the defensive dams against floods on a width of at least 4 m (measured from the foot of the slope the dam to the inside of the dam). Moreover, an important measure is to establish the surrounding protection area accumulation lakes between the normal retention level and the elevation of the canopy (according to the Water Law no. 107/1996). Regardless of the owner of the land, new buildings are forbidden in the protection areas until the River Basin Administration gives the approval.

In order to materialize the future development program of Săucești commune it is necessary to achieve the general and priority objectives set out in the action plan. This action plan includes a series of objectives, measures and projects, the subject of floods being also addressed.

| Strategic goal | Measures | Projects | Deadline |
|---|---|---|---|
| *Environmental management and protection* | Landscaping | Planting trees on the Siret River banks and along the other streams | 2024 |
| | Reducing the risk of natural disasters that could be affecting the population | Establishing a center for warning and monitoring the emergencies (floods, water, air, soil pollution) | 2022 |

***Table 38** - Action plan for project implementation and public investment program proposed by the General Urban Plan of Săucești commune - environmental management and protection part*

*Source: General Urban Plan of Săucești Commune – Memoir – in progress*

The prescriptions of the Local Urban Regulation propose that for the objectives that will be located in the area within the flooding to seek the approval of the competent institutions.

Analyzing the General Urban Plan compared to the higher order urban planning documents to which it must refer, a slight discrepancy in the importance given to the floods subject can be observed. This has an explanation: after 2016 floods, a dike was built to protect the commune from floods caused by the river. Therefore, PATJ and SIDU were prepared before this project was completed. However, the village of Siretu remains partially unprotected against floods, as the diking line should be connected/adapted to the ring road for Bacău.



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The updating process of PUG started in 2019 and it is in the approval process. But this process is currently stopped due to the infrastructure major projects that are crossing the administrative area and moreover the regulated built area (Bacău – Pașcani Express Road, Bacău Road Belt).

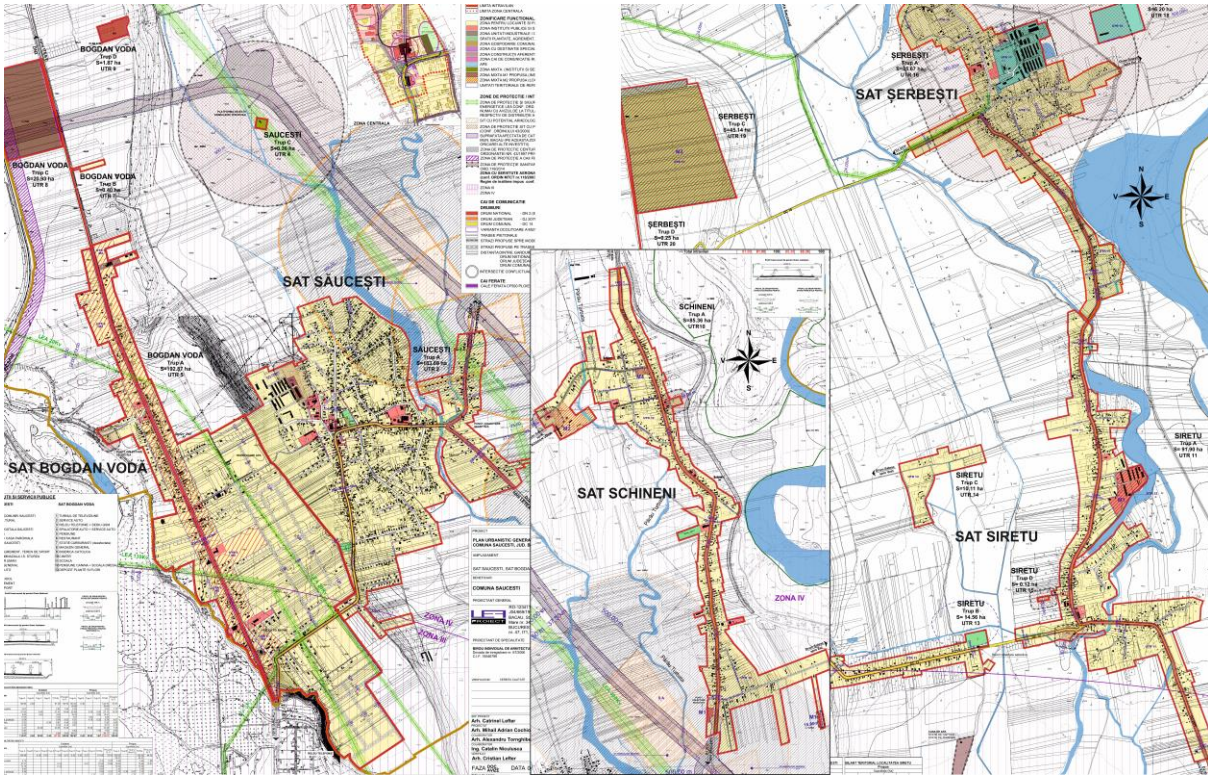


***Figure 104 –*** *The General Urban Plan's provisions*
*Source: Săucești General Urban Plan*

The drawn pieces of Săucești General Urban Plan appears located the area for which the medium scenario is valid (1%) as it is shown in the flood hazard and risk maps. For this area the PUG developer imposed a temporary construction ban until the approval of the "Romanian Waters" National Administration is obtained for each objective proposed in this zone.

### E.3.1.5. Conclusions

Concerning flood risk, the urban and territorial plans of the studied area are intercorrelated, connecting the different scales of territory: Territorial County Plan (regional territory), Sustainable Development Strategy of Bacău County (regional territory), Sustainable Development Strategy of Săucești commune (local territory), Săucești General Urban Plan (local territory). In the forementioned documents, landslide risk is usually given more importance than the flood risk and they are connected. The reason for this issue is that **the most important studies that should identify and study the natural risk areas** (*Geotechnical and Hydrological Preliminary Study and Preliminary study on Environmental protection, Natural and Anthropogenic risks*) **do not have a clearly definied structure, their content remaining to be established by its author**.

The problem of floods is mentioned in the Bacău Territorial County Plan, the list of localities where risk areas have been inventoried mentioning the Săucești commune with two of its villages, Săucești and Schineni (overflows). The PATJ presents a series of programs (Elimination / mitigation of natural and technological risk factors as well as those resulting from anthropogenic pressure by proactive planning) and projects regarding the flood problem, but these are not taken over at the level of the local strategy, although there are some projects regarding flood risk management mentioned which belong to two objectives (Objective 1.3 - Extension of the utility network, respectively to Objective 1.5


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– Environmental management and protection). In other words, **in all the spatial planning document there are various measures against floods mentioned, more or less detailed, but they are not all correlated with each other**.

### Main gaps

Săucești commune has been added to the list of pilot studies precisely because it represents a rural area. Analyzing the urban planning documents, **there is no adaptation of the measures against floods depending on the specifics of each area**. For example, the General Urban Plan proposes, through the *Geotechnical and Hydrological Preliminary Study*, measures such as temporary construction bans in the immediate vicinity of the of the streams but no rural specific measures to reduce the risk of floods in rural are mentioned (for example using the agricultural land as buffer zones for built-up areas).

**All the flood problems and measures proposed against floods mentioned in spatial planning documents, such as Territorial County Plan or Sustainable Development Strategy of the County, are general but as they reach the local scale, the documentation is not much more detailed, the flood problems are not concretely identified in the field, and consequently the measures are not spatialized or site-specific either.** Considering the fact that the General Urban Plan of Săucești commune that was in the approval process is currently stopped, the correlation will not be possible, the data risking to be outdated at the time the process will be resumed.

The measures mentioned in the previous urban planning document usually have a general specific, focusing on building flood prevention infrastructure like regularization, embankments, improvements and rehabilitation of Siret River and other Turbata creeks. However, the General Urban Plan of Săucești commune in progress takes a step further into flood prevention, with intervention proposals on green spaces on the banks of Siret River.

**The lack of data is one of the main identified problems in flood risk analysis**, leading to a rather generic perspective in urban and territorial development strategies and plans. Large-scale strategies are integrated in the local plans, but they are not enhanced in order to become more particular and to be of use in the proposal phase.

Although Săucesti commune benefits from flood hazard and risk maps, they are part of the first cycle of such maps, made before the construction of the dam in the commune and before the construction of the ring road of Bacău Municipality (the last one is still under construction). This is the reason why **these maps do not reflect the current situation, and the floodable areas takeover in the PUG is not relevant** (these existing flood hazard and risk maps are not relevant for the urban planning documents that are being developed nor in the approval process, nor for future urban planning documents). **Currently, there is no land use planning documentations or strategies to reflect de current flood situation in this area.**

Another problem is the taking over of the information regarding the floods in the written and drawn pieces of the PUG. Because the problem of floods is mentioned only in the written parts, and not in the drawn ones, the persons responsible within the local administration have difficulties in identifying the lands with problems and, therefore, in proposing restrictions through the offered urbanism certificates.

The multiple territorial and urban spatial plans, including metropolitan area spatial plans should integrate all fluvial, pluvial and groundwater flood risk of all types in order to have an integrated approach, with both local and catchement measures. The importance of including the problem of floods in the metropolitan territory development plans is a major one, because **it is necessary to correlate the situation on the entire river basin that generates this type of problems and not only at a local scale**.

### Lessons learned

Although not very detailed and site-specific, **the measures against floods proposed by the multi-scale urban planning documentations are both structural and non-structural**, which makes them more adaptable to various situations. The proposed measures refer to equipping the authorities with equipment for prevention and intervention in emergency situations, realizing audible warning-alarm system and to preventing the hazard, to solving in time a state of emergency of this type.

The General Urban Plan in progress takes a step further into flood prevention, with intervention proposals on green spaces on the banks of Siret River, trying to adapt the measures proposed to the rural specific of the locality.

In spite of the fact that the local approach is not site-specific as it should be within the PUG, the measures are largely correlated on multiple territorial and urban spatial plans.

## E.3.2. Spatial and urban planning plans elaboration, approval and enforcement

The analysis of the spatial and urban planning plans approval and enforcement process was based on interviews conducted in several meetings and questionnaires sent by e-mails. The following relevant stakeholders were interviewed: Săucești Municipality, The Siret Regional Basin Administration (Siret RBA) and The Inspectorate for Emergency Situations.

### Main gaps

***The municipalities meeting***

The meeting with Săucești Municipality was held on 17th November 2021 (17.11.2021). The matters discussed were historical floods data, General Urban Plan status and including flood hazard and risks in future planning practices.

The interview revealed that in 2008 and then in 2010, there were the most damaging historical floods, from the Săucești last General Urban Plan elaboration. Between these years significant damages have been registered that affected the houses but also the utility network and roads. After 6 years, in 2016 another flood impacted the communes' villages and after this flood, a dike was constructed on the right side of Siret River in order to protect the exposed villages. However, Siretu village still remains partially unprotected against floods, as the diking line should be connected/adapted to the ring road for Bacău.

The Săucești General Urban Plan (PUG) that is in use is the one approved in 2009, leading to the use of out-of-date information. The updating process of PUG started in 2019 and it is in the approval process. But this process is currently stopped due to the infrastructure major projects that are crossing the administrative area and moreover the regulated built area (Bacău – Pașcani Express Road, Bacău Road Belt).

**Main gaps regarding local flood risk**

After the 2016 floods a dike was built to protect the communes' villages from the future fluvial floods but it is not entirely effective because it doesn't close the protection line (in Siretu village there still are several streets with flooding problems). Because of this, new roads to be developed should help to finalize the locality protection.

Another problem regarding this flood risk problem it is that the local authorities are requiring, for building in area with flood risk, a hydrogeological and geotechnical study but not flood studies which would be more eloquent in this situation.

The floods from 2008-2010 revealed the sensitive areas where it is very difficult to issue building permits but the property between the dike and the river is still private property because ANAR did not make legal procedures to expropriate these lands.

In the present, Siret River is not used for leisure or sports activities inside Săucești commune, but it is used in the economic purpose by 2 or 3 gravel pits located on the river bank.

**Main gaps regarding spatial and urban planning**

The main problem with the urban planning documentations is that the approval period lasts too long. The actual General Urban Plan of Săucești commune was elaborated in 2002 and it was barely approved in 2007 (it lasted five years, a very long period of time).

The flood risk studies, others than the flood hazard and risk maps made in the first cycle, were not made for the General Urban Plan that is in progress, so that the areas with current flood risks were not taken into account nor have specific measures been taken to combat this problem.

Major infrastructure projects are in progress, such as Bacău – Pașcani Express Road, Bacău Road Belt. These infrastructure projects have direct influence on the administrative and regulated built-up area and blocked the General Urban Plan updating process.

**Main gaps regarding the integration of flood hazard and risk maps and flood risk management measures to reduce the flood risk into spatial and urban planning**

At the metropolitan or peri-urban level there is no territorial plan to coordinate the development of Bacău city in correlation with the near rural areas (including Săucești commune). Thus, flood risk management measures are proposed only at local level and not for the entire river basin or at least for the entire peri-urban area. Also, there is no information if or how the local strategies were considered at the county level.

The actual General Urban Plan does not have flood risk maps included because they were elaborated after the approving process ended. The current General Urban Plan, which is in the approval process, does not take into account measures such as lower percentage of built area, higher percentage of green areas.

### *National Romanian Waters and Rivers Basin Administrations meeting*

The interview with the River Basin Administrations took place with all the three institutions: Argeș-Vedea, Banat and Siret River Basin Administrations. It happened on 9$^{th}$ of February (09.02.2022) and it had three topics: spatial and urban planning in the absence of risk maps and flood studies, integration of FRM (flood risk management), RBM (river basinal management) and environmental aspects in spatial and urban planning and interinstitutional cooperation. The interview and its conclusions (**the main gaps**) for the three topics have been further presented previously in *SECTION B: Timișoara city pilot area, Timiș County.*

## Lessons learned

### *The municipalities meeting*

**Lessons learned regarding local flood risk**

The interview with Săucești Municipality led to conclusions related to the flood risk prevention infrastructure, the state of local development and integration of the flood risk measures in the spatial and urban planning. Therefore, it is essential to use non-structural measures (such as open channels for rainwater collectors) in order to significantly reduce the flood risk, whether it is fluvial of pluvial risk, but non-structural measures are not always enough to reduce flood risk.

**Lessons learned regarding spatial and urban planning**

Because one of the main problems identified in terms of spatial and urban planning, the elaboration of preliminary studies is obviously necessary and can be funded from both sources, national and local budget. For a successful updating process of any General Urban Plan a very good cooperation with other stakeholders is necessary.

In addition to measures to reduce floods, The General Urban Plan must also include measures to prevent them and landslides phenomenon caused by high soil moisture.

**Lessons learned regarding the integration of flood hazard and risk maps and flood risk management measures to reduce the flood risk into spatial and urban planning**

After a structural measure is implemented, such as dikes, new hazard and risk maps should be made, in order to identify if flood affected area are modified after the flood risk management measure implementation. In addition to this kind of measures, major infrastructure, such as road belts or express roads can be built from the beginning as a measure for flood protection.

Reforestation, new vegetation in the built-up area and on the private plots and many other non-structural measures are the kind of measures that could be proposed in the spatial planning plans and document in order to mitigate the flood risk. After adopting structural measures such as dikes, the hazard/risk maps provided for remanent risk evaluation should be included in the territorial plans (county level, peri-urban level) and in the local urban plans (General Urban Plan / Zonal Urban Plan – local level).

***National Romanian Waters and Rivers Basin Administrations meeting***

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# SECTION F: Challenges and potential areas of improvement resulted from the pilot areas analysis

As was mentioned in the previous chapters, the pilot areas analysis involved two main actions: the stakeholders' consultation during interviews, questionnaires or by phone, and the flood risk management and spatial and urban planning documents analysis. The results obtained from these 4 particular situations can be presented in two relevant sections:

1. **Challenges** in the integration process of flood risk management into urban and spatial planning documents and during the implementation phase that different stakeholders are facing:

   ***Flood risk management:***

   - **Hazard and risk maps are not elaborated for all the river courses** and **are only addressing the fluvial floods and flash floods in areas of potential significant flood risk;**
   - **The flood studies** meant to assess the flood hazard is done in the same way all over the country, for all uses. Thereby, **the flood studies do not propose specific measures**, only general approaches and some technical data related to water levels, velocities;
   - **The proposed measures usually have a small-scale approach**, focusing on building flood prevention infrastructure and are not addressing the catchment area;
   - **Proposed flood risk management measures are usually structural and few non-structural measures;**
   - **In the support studies done for urban and spatial documents, to landslide risk is usually given more importance than to the flood risk.** A possible cause of this situation could be the unspecified content of the two studies in which natural risks area studied: *Geotechnical and Hydrological Preliminary Study* and *Preliminary study on Environmental protection, Natural and Anthropogenic risks*;
   - **The land ownership within the flood risk area** is one of the main problems in the enforcement phase of the spatial and urban planning plans or flood risk management measures, limiting severely what often could be achieved. Moreover, the water cadaster is a very important issue that needs to be solved.

   ***Spatial planning plans:***

   - **Multi-scale plans** (territorial plans, urban plans, territorial strategies, urban strategies etc.) **are not always properly correlated,** mostly because of the outdated plans. This is because **of the long-approval and non-integrated process of the spatial and urban planning plans** which is an important impediment in updating all the multi-scales plans. Moreover, strategic plans do not have provisions with specific spatial locations;
   - **The lack of data or data provided in paper or non-editable** format (i.e., flood risk areas provided in .jpg format, impossible to be properly integrated into urban and spatial planning) and the lack of intercorrelation between various data bases, which can update daily the plans, is leading to challenges in application of the spatial and urban planning plans.
   - **There are no metropolitan or peri-urban planning plans made for at least big cities**, in which FRM measures for the catchment area can be proposed.
   - **Lack of** urban planners' **awareness** of the flood risks problematic and its implications, and of the potential sources for flood risk management data collection;
   - **Lack of integration** between different stakeholders' strategies, relevant plans, studies etc.
   - The entire spatial and urban planning approach **is more strictly regulated than permissive** for decision making with a specific approach.

***The integration of Flood Risk Management into Urban and Spatial Planning:***

- **Flood risk (mainly from the fluvial source) is usually mentioned** in spatial or urban planning documentations, but **few measures are proposed** to prevent or reduce it. Specific measures are not included/proposed unless the water authority has a project already promoted that can be carried out on a clear and agreed timescale. Even if there are dedicated **measures proposed** to reduce flood risk, they are usually **not integrated or correlated with other types of measures**. A **holistic approach is missing** in most of the plans. Furthermore, nature-based solutions are very rare integrated in spatial and urban planning plans;
- **Other types of flood sources (pluvial, groundwater, sea water, artificial water-bearing infrastructure etc.) are usually not mentioned** in the spatial or urban planning plans or are treated superficially and no measures are dedicated to reduce or to prevent this risk;
- **The unclear and uncorrelated provisions from the FRM and USP legal framework** concerning the **restrictions/ permissions in flood risk areas,** as well the responsibilities for the enforcement / implementation phase in spatial and urban planning;
- **The land situated in flood risk areas is not used in anyway and different uses are not allowed considering the potential risk caused by low AEPs** ;
- **The updated process of the general urban plans is not correlated with the timing of the updating the Flood Hazard and Risk Maps** (which occurs every 6 years) and due to the long and difficult elaboration and approval process, it makes almost impossible to revise the plans with newer flood risk data or measures.

2. **Areas of improvement** for a better integration of flood risk management into spatial and urban planning:

***Flood risk management:***

- **All watercourses and flood sources should be studied** and dedicated measures should be proposed, within specific site-locations. In this respect, **hazard and risk maps should be made for all river courses and for all flood sources**. These data should be made available to urban planners;
- **Flood risk studies should be site-specific** and integrated in the river basin's flood risk defense plan. A specific content for the necessary flood studies should be included in the legal framework covering both fields (flood risk management and spatial and urban planning);
- **Floods are not only a local problem**, so the solutions should start from the broad scale (regional river basins) and then go to the local scale (local rivers and creeks). Both large-scale interventions (county or national level) and small-scale interventions (local) should be correlated;
- **Combined non-structural and structural measures should be proposed** because they can substantially reduce the flood risk;
- **A specific content for *Geotechnical and Hydrological Preliminary Study* and *Preliminary study on Environmental protection, Natural and Anthropogenic risks* should be provided** and the involvement of hydrological engineers in these studies should be mandatory by law;
- **Proper resources should be allocated in order to resolve the water cadaster and the areas within the water protected zones according to the Water Law 107/1996.** Moreover, **compensatory measures** should be included in the legal framework for people living in the flood risk areas or for people asked to move in a safer location.

*Spatial planning plans:*

- **For a better correlation of multi-scales plans, the approval process of the spatial and urban planning plans should be more efficient** so that it would last less long. Also, all multi-scales strategies or plans should have specific site-located provisions;
- **Using GIS** in the elaboration and enforcement process of spatial and urban planning plans **is fundamental** to ensure a proper management of the territory. Thus, **training programs for the public institutions staff should be started**;
- Preparing **territorial plans for metropolitan or peri-urban areas can ensure a proper integration of the FRM measures** that are addressing to the catchment areas;
- **Dissemination process of flood risk management issues and measures** should be made for professionals and population in order to increase awareness and to ensure a proper integration into urban and spatial planning plans. Moreover, a database with all the useful sources in the integration process should be prepared;
- **Spatial and urban planning approach needs to be more flexible and adaptable** to all the rapid changes from our society (economic, environmental, demographic, social etc.);
- **Coherent spatial development can be done only with the cooperation of governmental institutions and clear communication between institutions and professional**s in order to obtain a proper correlation between different documents and strategies.

*The integration of Flood Risk Management into Urban and Spatial Planning:*

- **In urban areas, flood mitigation can be based on nature-friendly solutions** and these should be included in territorial and urban planning practices and plans. Addressing the urban flood risk management by **green measures** by integration in SUP proved to help for **a better adaptation to climate change of the urban and rural localities**. Moreover, **Green Areas Registry should be made for all urban and rural areas** in order to reserve spaces for FRM measures;
  Also, **Integration of flood risk management should be formalized at a large scale**, through territorial plans and strategies, **correlating them with urban and local plans** and detailed spatial plans through advocating specific measures.
- **Flood risk management measures should be dedicated and differentiated by types of flood sources** and should be properly integrated into urban and spatial planning;
- **The results of the flood studies should be included in the spatial and urban planning plans** in two ways: as interdictions and permissions and measures set into the Action Plans. **For the enforcement process** of urban planning plans, **specific actions should be proposed** in the Action Plan and detailed agenda of their implementation should be prepared. Moreover, clear **responsibilities for flood risk management measures` implementation**, with roles for specific stakeholders should be included. Strengthening the public policy and decision making so they "know how" to implement consistent measures in USP **to reduce flood risk** will build an increased urban flood resilience.
  **Therefore, an optimal integration** of Flood Risk Management into Urban and Spatial Planning can be done only through **an efficient interinstitutional cooperation**;
- **In the areas with flood risk less vulnerable developments should be proposed depending on the AEP of floods;**
- **Proper tools that could generate more faster elaboration and approval process** (GIS tools and data) should be adopted. Moreover, **a faster approval process** for the integration of the updated Flood Hazard and Risk Maps or FRM measures should be adopted;
- **A specific multi-disciplinary Handbook should be elaborated, through inter-institutional collaboration, to ensure that a step-by-step guidance is provided for urban planners and other stakeholders in the process of integration of flood risk management into urban and spatial planning.**

# ADDENDUM 1: The Methodology for the development of the pilot areas analysis

## 1.1. Introduction

**The purpose of the methodology** is to identify the following aspects related how the integration of flood risk management aspects are considered into urban and spatial planning procedures at a local (administrative- territorial unit UAT) and at higher administrative level (county level/ regional level):

- what are the relevant issues related to integration to be studied?
- what are the methods to assess the integration?
- which are the relevant pilots?
- which are the tools and the available sources of information to be analyzed?
- which are the stakeholders to be involved?
- what are the steps that should be followed to perform this analysis?
- what is the structure of the study?
- how to better disseminate the findings of the analysis and the way forward?

**The purpose of the analysis of the pilot areas** is to identify the challenges and required actions to improve the integration of flood risk management into urban and spatial planning at different levels of authority. The findings of the analysis will provide the direction for the content of the draft *Guidance document on the Integration of Flood Risk Management into Urban and Spatial Planning Practices*.

**Relevant issues related to integration to be analyzed**

The relevant aspects to be assessed within the pilot studies can be categorized in 2 main categories:

- the extent of FRM integration into USP;
- the existing capacities for FRM integration into USP.

On the extent of FRM integration into USP the focus will be on identifying how the FHRMs and flood prevention, protection and preparedness measures are considered into the USP documentation and what are the challenges related to this process.

The existing capacities for FRM integration into USP will assess the existing available information and tools, the exchanges between the relevant stakeholders, the knowledge base related to selection of the measures considering the floods sources, mechanisms and characteristics and the new approaches on international level on this field etc.

The analysis of these 2 main aspects will allow the identification of a practical tool to be developed to increase the capacities of Romanian authorities for integration of the FRM into USP and to identify those areas for improvements in the future.

## 1.2. Pilots' selection process

During the project designing phase, a number of 3 pilot urban areas was decided to deepen the analysis of the challenges related to integration of FRM into USP and to substantiate the Guideline.

In the stocktaking and preparatory phase of the project, a long list of 10 possible relevant urban pilots was identified out of 319 in total, considering 3 categories of criteria:

- Flood risk management criteria
    - Areas of Potentially Significant Flood Risk/ APSFR;

- Severe rainfalls and floods in the past 20 years;
- Inclusion in one of the urban typologies of vulnerability to floods;

- Spatial planning criteria
  - Old PUG (more than 5-6 years) or PUG in progress;
  - Cities with large area developed in floodplains;

- Integration criteria
  - Cities without flood risk management (FRM) measures integrated into spatial planning.

More details regarding the justification of the chosen criteria and the selection of the 10 possible relevant urban areas are provided in the *Stocktaking Report, Chapter 4*.

In the next phase of the project, the selection of the relevant pilots was improved by adding additional criteria to reflect also other possible challenges of FRM integration into USP:

- Flood risk management criteria
  - Percentage of people affected by fluvial floods;
  - Percentage of flood risk areas from the built area;
  - Percent of protected natural areas from the administrative area;

- Spatial planning criteria
  - Percentage of protected natural areas from the administrative area;
  - Available land for flood risk management measures (parks or large green areas).

In addition to these new criteria, as deviation from the designing phase of the project, an additional pilot was selected to reflect the challenges coming from the rural areas. Thus, the Report on the pilot studies will analyze 4 pilot areas (3 urban areas and 1 rural area).

More details regarding the justification of criteria, their scores and the selection of the 4 pilot areas are presented in *ADDENDUM 3: Criteria for choosing pilot areas.*

## 1.3. The pilot's analysis

**Methods to assess the integration**

Considering the duration of the project, the topic to be approached, the scope and the available resources, a transversal strategy was thought for this assignment, which allows a rapid usage of the results.

Since the designing of the project multiple case studies have been decided to base the development of the draft Guidance to allow a good generalization. Multiple case studies give more convincing conclusions, as they allow the individual study of each pilot, but as well the study of different characteristics in several cases.

For a deep understanding of the topic and identification of those particular areas where the Guidance can increase the capacities of the Romanian authorities to better integrate the FRM into USP, more methods are envisioned:

- The Interviews with the group of relevant stakeholders, as this method allows that the opinion expressed by each participant to be contradicted, supported, completed by the others.

Furthermore, the participant who has given a certain opinion can come back to it, depending on the words of the others. The interactive aspect is bringing a plus value to the analysis performed.

- The Questionnaire addressed to targeted stakeholders.
- Analysis of the documents and of the existing tools to verify and supplement data obtained by other methods.

**Steps to assess the integration**

Therefore, the pilot's analysis followed several steps as are described below:

**Step 1. The data collections process,** as a first step, is meant to identify all the data needed for a comprehensive analysis of the 4 pilots. After completing the list with needed data, different actions should be developed to collect them from open sources and from relevant stakeholders (City Hall, RBA, Water Companies etc.).

In order to understand the challenges and the potential areas of improvement in the integration process, both fields of interest should be analyzed individually and in correlation. Thus, flood risk management and spatial and urban planning data should be collected.

Data collection is a fundamental step in the pilot's analysis process and cand provide a full image of the actual problems that the integration process is facing.

**Step 2.** The second step is **the audit of the stakeholders** with a role in the integration process. This analysis should start from the Stocktaking Report findings and only stakeholders with direct role in the integration process should be selected. Although lots of stakeholders have different responsibilities either in flood risk management or in spatial and urban planning, few of them are having a relevant involvement and contribution in the integration of these two. Thereby, only the stakeholders that can essentially improve the integration process should be selected.

**Step 3. Interviews** should be conducted only after all the relevant stakeholders are identified, as was described in previous step. Considering the Covid Pandemic situation, these interviews can take place in virtual conferences, by phone or by e-mail.

The preparation for the interview is as much important as the interview itself and a framework for different types of stakeholders (for example from the FRM field versus USP fields) should be prepared. After this, the Inter-Institutional Coordination Group should be consulted in order to improve the interviews content.

The interviews with the relevant stakeholders should follow all these preparations and well-organized meetings should than be set-up. All the meetings should have dedicated report, in which the main challenges and potential areas of improvement should be highlighted.

Stakeholders to be considered in the selection process could be: Romanian Water Administration, River Basin Administrations, City Halls, General Inspectorate of Emergency etc.

**Step 4. Identify and analyze the relevant flood risk management tools** should be a different step, but can be conducted in parallel with the step described before. These documents are important to establish the flood sources, areas with flood risk and also flood risk management measures. These documents are vital in both cases: UAT with or without hazard and risk maps.

In some cases, these documents are not available online, thus dedicated requirements should be addressed to different stakeholders.

For each pilot current flood risk management tools used by different stakeholders should be identified and analyzed. The correlation of these documents should be a focus of the analysis.

Flood risk management tools to be considered could be: Flood Hazard and Risk Maps, Damage Assessment and urban risk maps, Flood Risk Communication Strategies for Emergency Situations Management, Flood Risk Management Plan etc.

**Step 5. Identify and analyze the relevant urban and spatial planning tools** is the 5th step and should follow the previous step due to its interdependence to flood risk management tools.

Approved spatial and urban planning tools are usually available online, but the documents that are in progress should be requested from the County Councils or Local Councils. These documents should be analyzed in all of the phases developed so far, in order to identify not only the integration of FRM into USP, but also the correlation between documents that are addressing different scales. It is very important that these documents should be analyzed among with the integration of the flood risk management studies / tools in the spatial and urban planning plans.

Spatial and urban planning to be considered could be: County Territorial Development Plan, Metropolitan or Peri-urban Territorial Plan, County Strategy, Metropolitan or Peri-urban Strategy, General Urban Plan, Local Development Strategy, Zonal Urban Plan etc.

**Step 6. Identify main gaps and lessons learned** from the spatial and urban planning plans analysis should be the final part of the analysis and should highlight the main challenges that relevant stakeholders are facing in the integration process of FRM into USP.

**Step 7. Identify main gaps and lessons learned** from the spatial and urban planning approval and enforcement process should highlight the main potential of improvement that relevant stakeholders should adopt in their integration process of FRM into USP.

A conclusion will follow all these steps in order to establish the way forward for the Guideline *document on the Integration of Flood Risk Management into Urban and Spatial Planning Practices.* Thus, the Guideline will be based on this Pilot Report analysis.

## 1.4. The dissemination processes

After the Pilots' analysis Report is finished a dissemination process should start in order to present the results of the analysis but mainly to raise awareness of the importance of the integration of flood risk management into urban and spatial planning.

In this phase all the stakeholders involved in the previous interviews should be invited in order to discuss the results. Moreover, other stakeholders, with indirect role in the integration process should participate in the dissemination meetings.

## 1.5. The way forward

The challenges and potential areas of improvement identified in the Pilot's analysis Report should be used as a foundation for future improvement for the integration process of flood risk management into urban and spatial planning not only in the all 4 pilot areas, but in the entire country.

Moreover, the results obtained through this analysis should be used to developed the Guideline applicable for all the urban or rural areas, that should be a step-by-step approach for all the relevant stakeholders described above.

# ADDENDUM 2: Data collected for pilot areas

For each pilot a set of data was collected from the relevant stakeholders (municipalities, water companies, River Basin Administrations etc.) as follows:

## Timișoara pilot area, Timiș County – data collected:

| Spatial and urban planning | | | | |
|---|---|---|---|---|
| **From the City Hall** | | | | |
| **No.** | **Data** | **Available (Yes / No)** | **Document format** | **Year of the document** |
| 1 | **General Urban Plan - old document** | Yes | pdf | 2002 |
| | *Written pieces (Memmoire and Urban Planning Local Regulation)* | Yes | pdf/doc | |
| | *Drawn piece* | Yes | pdf | |
| 2 | **General Urban Plan - in progess** | Yes | pdf | Started in 2010 and it is still in progress (final phase of approval) |
| | *Written pieces (Memmoire and Urban Planning Local Regulation)* | Yes | pdf | |
| | *Drawn piece* | Yes | pdf | |
| | *Preliminary study for flood risk area* | Yes | pdf | |
| 3 | **Zonal Urban Plans in flooded areas or which are increasing the land impermeability** | Yes | | |
| | *Preliminary studies made for Zonal Urban Plans in flood risk areas* | Yes | | |
| 4 | **Old cadastral plans drawn up for the entire administrative territory of the municipality** | Yes | | |
| 5 | **Topographic survey of the entire administrative territory** | No | | |
| 6 | **Land reserved for flood risk mitigation measures** | Yes (The river courses, marked in the General Urban Plan drawn pieces - in the zonning plan) | pdf | Started in 2010 and it is still in progress (final phase of approval) |
| 7 | **Public projects that increase the percentage of land occupation/land impermeability** | No | | |



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|---|---|---|---|---|
| 8 | **Informal settlements (if applicable)** | Yes | | |
| 9 | **Total number of inhabitants/number of houses in the whole municipality** | Yes / Yes | | |
| 10 | **Number of inhabitants/houses in flooded areas** | No / Yes | | |
| 11 | **Green space register** | No | | |
| **World Bank (downloaded from official sites - open source data)** | | | | |
| **No** | **Data** | **Available (Yes / No)** | **Document format** | **Year of the document** |
| 1 | **Timiș Territorial County Plan** | Yes | pdf | 2011 |
| | *Written pieces (development condition elements; dysfunctions and priorities - diagnoses; Timiș County development strategy; development policies formulation; implementation; environmental report)* | | | |
| | *Drawn pieces* | | | |
| 2 | **The metropolitan territorial plan** | No | | |
| 3 | **The urban development Strategy 2015-2020** | Yes | pdf | 2015 |
| 4 | **Timișoara's Green spaces Development Strategy 2010-2020** | Yes | pdf | 2010 |
| **Flood Risk Management** | | | | |
| **From the Water Company** | | | | |
| **No.** | **Data** | **Available (Yes / No)** | **Document format** | **Year of the document** |
| 1 | **Technical Data from the Water Company** | Yes | pdf | 2022 |
| 2 | **Water Permit for the General Urban Plan of Timișoara municipality, from 08 January 2016** | Yes | pdf | 2016 |
| 3 | **Water networks, Sewerage networks** | Yes | pdf | 2022 |
| **World Bank (from RAS project)** | | | | |
| 1 | **Water bodies** | Yes | shp | |
| 2 | **Territorial Administrative Units** | Yes | shp | |



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|---|---|---|---|---|
| 3 | **Annual flood exceedance of the floods (high risk scenario, medium risk scenario, low risk scenario)** | Yes | shp | |
| **World Bank (downloaded from official sites - open source data)** | | | | |
| **No.** | **Data** | **Available (Yes / No)** | **Document format** | **Year of the document** |
| 1 | **The urban development Strategy 2015-2020** | Yes | pdf | 2015 |
| 2 | **County Report on Environmental State, 2020, released by the Timiș Environmental Protection Agency** | Yes | pdf | 2020 |
| 3 | **Flood risk management plan – Banat River Basin Administration** | Yes | pdf | 2016 |
| 4 | **West Regional Development Plan 2021-2027** | Yes | pdf | 2021 |
| 5 | **National Climate Change Strategy** | Yes | pdf | 2013 |
| 6 | **The European Green Deal** | Yes | pdf | 2020 |
| 7 | **Annual report of the National Meteorological Administration** | Yes | pdf | 2020 |

## Pitești pilot area, Argeș County – data collected:

| **Spatial and urban planning** | | | | |
|---|---|---|---|---|
| **From the City Hall** | | | | |
| **No.** | **Data** | **Available (Yes / No)** | **Document format** | **Year of the document** |
| 1 | **General Urban Plan - old document** | No | | 1999 |
| | *Written pieces (Memmoire and Urban Planning Local Regulation)* | No | | |
| | *Drawn piece* | No | | |
| 2 | **General Urban Plan - in progess** | Yes | pdf | The updating process of P.U.G. started in 2019 and it is in the public consultation phase. |
| | *Written pieces (Memmoire and Urban Planning Local Regulation)* | Yes (only the RLU) | pdf | |
| | *Drawn piece* | Yes | pdf | |
| | *Preliminary study for flood risk area* | No | | |



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|---|---|---|---|---|
| 3 | **Zonal Urban Plans in flooded areas or which are increasing the land impermeability** | No | | |
| | *Preliminary studies made for Zonal Urban Plans in flood risk areas* | No | | |
| 4 | **Old cadastral plans drawn up for the entire administrative territory of the municipality** | No | | |
| 5 | **Topographic survey of the entire administrative territory** | No | | |
| 6 | **Land reserved for flood risk mitigation measures** | No | | |
| 7 | **Public projects that increase the percentage of land occupation/land impermeability** | No | | |
| 8 | **Informal settlements (if applicable)** | No | | |
| 9 | **Total number of inhabitants/number of houses in the whole municipality** | No | | |
| 10 | **Number of inhabitants/houses in flooded areas** | No | | |
| 11 | **Green space register** | No | | |
| **World Bank (downloaded from official sites - open source data)** | | | | |
| **No** | **Data** | **Available (Yes / No)** | **Document format** | **Year of the document** |
| 1 | **Argeș Territorial County Plan** | In progress – not available | pdf | |
| 2 | **The metropolitan territorial plan** | No | | |
| 3 | **The urban development Strategy 2014-2020** | Yes | pdf | |
| **Flood Risk Management** | | | | |
| **From the Water Company** | | | | |
| **No.** | **Data** | **Available (Yes / No)** | **Document format** | **Year of the document** |
| 1 | **Technical Data from the Water Company** | Yes | pdf | 2022 |



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|---|---|---|---|---|
| 2 | **List of extensions for 2022** | Yes | pdf | 2021 |
| **World Bank (from RAS project)** | | | | |
| 1 | **Water bodies** | Yes | shp | |
| 2 | **Territorial Administrative Units** | Yes | shp | |
| 3 | **Annual flood exceedance of the floods (high risk scenario, medium risk scenario, low risk scenario)** | Yes | shp | |
| 4 | **Shapefiles and excel files from IGSU with the urban floods from the last 15 years (2006-2020)** | Yes | Excel, shp | 2020 |
| **World Bank (downloaded from official sites - open source data)** | | | | |
| **No.** | **Data** | **Available (Yes / No)** | **Document format** | **Year of the document** |
| 1 | **Master Plan on the rehabilitation, modernization and extension of water supply and sewerage systems in Arges County - revised version - March 2017** | Yes | pdf | 2017 |
| 3 | **Flood risk management plan – Argeș-Vedea River Basin Administration** | Yes | pdf | 2016 |
| 4 | **West Regional Development Plan 2021-2027** | Yes | pdf | 2021 |
| 5 | **National Climate Change Strategy** | Yes | pdf | 2013 |
| 6 | **The European Green Deal** | Yes | pdf | 2020 |
| 7 | **Annual report of the National Meteorological Administration** | Yes | pdf | 2020 |

## Reșița pilot area, Caraș-Severin County – data collected:

| **Spatial and urban planning** | | | | |
|---|---|---|---|---|
| **From the City Hall** | | | | |
| **No.** | **Data** | **Available (Yes / No)** | **Document format** | **Year of the document** |
| 1 | **General Urban Plan - old document** | Yes | pdf | 2011 |
| | *Written pieces (Memmoire and Urban Planning Local Regulation)* | Yes | doc | |



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|---|---|---|---|---|
| | *Drawn piece* | Yes | pdf | |
| 2 | **General Urban Plan - in progess** | No | | The updating process of PUG did not start. The City Hall is currently preparing the ToR for the new PUG. |
| | *Written pieces (Memmoire and Urban Planning Local Regulation)* | No | | |
| | *Drawn piece* | No | | |
| | *Preliminary study for flood risk area* | No | | |
| 3 | **Zonal Urban Plans in flooded areas or which are increasing the land impermeability** | Yes | | There is a drawn plan that contains the interventions made through Zonal Urban Plans and Detailed Urban Plans between 1997 and 2010, but also with intervention proposed areas. Also, a Zonal Urban Plan is in progress for an area with informal settlements located in the flood risk area, but this Zonal Urban Plan was not provided by the City Hall. |
| | *Preliminary studies made for Zonal Urban Plans in flood risk areas* | No | | |
| 4 | **Old cadastral plans drawn up for the entire administrative territory of the municipality** | No | | |
| 5 | **Topographic survey of the entire administrative territory** | No | | |
| 6 | **Land reserved for flood risk mitigation measures** | No | | |
| 7 | **Public projects that increase the percentage of land occupation/land impermeability** | No | | |
| 8 | **Informal settlements (if applicable)** | Yes | pdf | Diagnostic analysis of the informal settlement in the area |



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|---|---|---|---|---|
| | | | | Bistra (Câlnic locality, Reșița Municipality) |
| 9 | **Total number of inhabitants/number of houses in the whole municipality** | Yes | | Document with the population on neighborhoods and streets |
| 10 | **Number of inhabitants/houses in flooded areas** | Yes | doc | Same document as in the previous point. Since having the population on neighborhoods and streets, the population in floodplains can be identified by overlapping |
| 11 | **Green space register** | No | | Green spaces register was not provided, but there were sent some drafts with proposals for green spaces and public spaces |
| **World Bank (downloaded from official sites - open source data)** | | | | |
| **No** | **Data** | **Available (Yes / No)** | **Document format** | **Year of the document** |
| 1 | **Caraș-Severin Territorial County Plan** | Yes | pdf | |
| | *Written pieces (development condition elements; dysfunctions and priorities - diagnoses; Caraș-Severin County development strategy; development policies formulation; implementation; environmental report)* | | | |
| | *Drawn pieces* | | | |
| 2 | **The metropolitan territorial plan** | No | | |
| 3 | **The urban development Strategy 2015-2025** | Yes | pdf | |
| **Flood Risk Management** | | | | |
| **From the Water Company** | | | | |
| **No.** | **Data** | **Available (Yes / No)** | **Document format** | **Year of the document** |



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|---|---|---|---|---|
| 1 | **Presentation sheet for Water supply and sewerage systems (Fisa de prezentare alimentare cu apă si canalizare RESITA 2021)** | Yes | pdf | 2021 |
| 2 | **Chapter 4- Analysis of the current situation and forecasts, volume I, Feasability Study Regional project for the development of water and wastewater infrastructure in Caras-Severin County / West Region, in the period 2014-2020** | Yes | pdf | 2016 |
| 3 | **Chapter 9- Presentation of the project, volume I, Feasability Study Regional project for the development of water and wastewater infrastructure in Caras-Severin County / West Region, in the period 2014-2020** | Yes | pdf | 2016 |
| 4 | **MP Aquacaras Resita PDF- The presentation memoir for the issuance of the environmental agreement** | Yes | pdf | 2016 |
| 5 | **MP Aquacaras Resita PDF- The presentation memoir for the issuance of the environmental agreement** | Yes | pdf | 2016 |
| 6 | **Approval report regarding the completion of HCL no. 119/20/03/2020 regarding the approval of the tariffs for the public water supply, sewerage and pluvial services charged by the operator SC AQUACARAS SA** | Yes | pdf | 2020 |
| **World Bank (from RAS project)** | | | | |
| 1 | **Water bodies** | Yes | shp | |
| 2 | **Territorial Administrative Units** | Yes | shp | |
| 3 | **Annual flood exceedance of the floods (high risk scenario, medium risk scenario, low risk scenario)** | Yes | shp | |
| **World Bank (downloaded from official sites - open source data)** | | | | |
| **No.** | **Data** | **Available (Yes / No)** | **Document format** | **Year of the document** |
| 1 | **The urban development Strategy 2015-2025** | Yes | pdf | 2015 |
| 2 | **Local Environmental Action Plan (PLAM) of Caras-Severin** | Yes | pdf | 2022 |

| | | | | |
|---|---|---|---|---|
| | **County, for the period 2022-2025** | | | |
| 3 | **Flood risk management plan – Banat River Basin Administration** | Yes | pdf | 2016 |
| 4 | **Caras-Severin County Sustainable Development Strategy 2007-2013** | Yes | pdf | 2007 |
| 5 | **West Regional Development Plan 2021-2027** | Yes | pdf | 2021 |
| 6 | **National Climate Change Strategy** | Yes | pdf | 2013 |
| 7 | **The European Green Deal** | Yes | pdf | 2020 |
| 8 | **Annual report of the National Meteorological Administration** | Yes | pdf | 2020 |

## Săucești pilot area, Bacău County – data collected:

| **Spatial and urban planning** | | | | |
|---|---|---|---|---|
| **From the City Hall** | | | | |
| **No.** | **Data** | **Available (Yes / No)** | **Document format** | **Year of the document** |
| 1 | **General Urban Plan - old document** | Yes | pdf | 2009 |
| | *Written pieces (Memmoire and Urban Planning Local Regulation)* | Yes | pdf | |
| | *Drawn piece* | Yes | pdf | |
| 2 | **General Urban Plan - in progess** | Yes | pdf | Started in 2019 and it is in the approval process. But this process is currently stopped due to the infrastructure major projects that are crossing the administrative area. |
| | *Written pieces (Memmoire and Urban Planning Local Regulation)* | Yes | pdf | |
| | *Drawn piece* | Yes | pdf | |
| | *Preliminary study for flood risk area* | Yes | pdf | |
| 3 | **Zonal Urban Plans in flooded areas or which are increasing the land impermeability** | No | | |
| | *Preliminary studies made for Zonal Urban Plans in flood risk areas* | No | | |



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| | | | | |
|---|---|---|---|---|
| 4 | **Old cadastral plans drawn up for the entire administrative territory of the commune** | Yes | dwg, bmp, pdf | Cadastral plans 1986 |
| 5 | **Topographic survey of the entire administrative territory** | Yes | dwg | for the PUG in progress, started in 2019 |
| 6 | **Land reserved for flood risk mitigation measures** | Yes | pdf | The dike was built in Șerbești, Siretu, Schineni and Săucești villages |
| 7 | **Public projects that increase the percentage of land occupation/land impermeability** | No | | |
| 8 | **Informal settlements (if applicable)** | No | | |
| 9 | **Total number of inhabitants/number of houses in the whole commune** | Yes / Yes | | 5701 residents/2376 households |
| 10 | **Number of inhabitants/houses in flooded areas** | Yes / Yes | | 4876 residents/1998 households (data related to Săucești, Schineni, Siretu and Șerbești villages that are affected during the floods registered in 2008 and 2010) |
| 11 | **Green space register** | Yes | pdf | Written piece - the Local Council decision no.18/2021 |
| **World Bank (downloaded from official sites - open source data)** | | | | |
| **No** | **Data** | **Available (Yes / No)** | **Document format** | **Year of the document** |
| 1 | **Bacău Territorial County Plan** | Yes | pdf | 2003 |
| | *Written pieces (development condition elements; dysfunctions and priorities - diagnoses; Bacău County development strategy; development policies formulation; implementation; environmental report)* | | | |
| | *Drawn pieces* | | | |
| 2 | **Sustainable Development Strategy of Săucești Commune, Bacău County 2014-2020** | Yes | pdf | |



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| Flood Risk Management | | | | |
|---|---|---|---|---|
| **From the Water Company** | | | | |
| **No.** | **Data** | **Available (Yes / No)** | **Document format** | **Year of the document** |
| 1 | **Data regarding the sewerage system** | Yes | pdf | 2022 |
| 2 | **Data regarding the sewerage system sectors with problems during heavy precipitations** | Yes | pdf | 2022 |
| 3 | **Potential extensions of the sewerage network** | Yes | pdf | 2022 |
| **World Bank (from RAS project)** | | | | |
| 1 | **Water bodies** | Yes | shp | |
| 2 | **Territorial Administrative Units** | Yes | shp | |
| 3 | **Annual flood exceedance of the floods (high risk scenario, medium risk scenario, low risk scenario)** | Yes | shp | |
| **World Bank (downloaded from official sites - open source data)** | | | | |
| **No.** | **Data** | **Available (Yes / No)** | **Document format** | **Year of the document** |
| 1 | **Local Strategy of Săucești commune regarding the acceleration of the development of the community services of public utilities 2014-2020** | Yes | pdf | 2014 |
| 2 | **Updated Master Plan in the water and wastewater field in Bacau County** | Yes | pdf | 2017 |
| 3 | **Flood risk management plan – Siret River Basin Administration Siret** | Yes | pdf | |
| 4 | **Preliminary Flood Risk Asssessment, Siret River Basin Administration** | Yes | pdf | |
| 5 | **National Climate Change Strategy** | Yes | pdf | 2013 |
| 6 | **The European Green Deal** | Yes | pdf | 2020 |
| 7 | **Annual report of the National Meteorological Administration** | Yes | pdf | 2020 |



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# ADDENDUM 3: Criteria for choosing pilot areas

Different criteria were established to be used to choose some of the urban and rural areas from Romania for more detailed assessments regarding integrating flood risk management into urban and spatial planning.

The first 5 criteria are related to flood risk management, followed by 3 criteria related to the spatial planning of administrative areas, one criterion regarding the integration of flood risk management into urban and spatial planning, and one tie-breaking criterion.

The last one is referring to the diversity of measures and solutions which can be applied. It is necessary to have different typologies of vulnerability to floods, to be addressed by different types of the flood risk measures.

A detailed analysis for the best qualified urban and rural areas candidate for pilot cities/areas is provided in **Annex A and B** using a systematic quantified scale (i.e., generally 0, 0.25, 0.75 to 1.0).

## CRITERIA RELATED TO FLOOD RISK MANAGEMENT

**Criterion 1 - Areas of Potentially Significant Pluvial Flood Risk/ APSFR**

The most important criterion is that the city is included in the list **of the Areas with Pluvial Potentially Significant Flood Risk: APSFR**.

Romania has reported the preliminary assessment of the risk of flooding for all types of flood that might be reasonably expected: fluvial, pluvial, seawater, artificial water-bearing infrastructure, according to the specific conditions of the sub-basins. In order to identify the APSFRs, the necessary information related to historic floods, future floods, impacts and consequences was considered. Also, besides the impact of climate change on the frequency of floods, long-term development projects were considered. Unlike the first cycle of implementation of the Floods Directive 2007/60 / EC, in order to assess the potential negative consequences of future floods on human health, the environment, cultural heritage and economic activity, in the second cycle a more detailed analysis of growth poles was carried out.

This criterion was used because in case of pluvial floods and in order to reduce pluvial risk many stakeholders are involved in the decision process.

For the first criterion, all cities received one point because they are in an area of potentially significant pluvial flood risk. Rural areas received zero points because they do not have pluvial risk. But all the 13 selected rural areas have fluvial risk.

**Criterion 2 - Severe rainfall and floods in the past 6 years**

A second criterion is that the **urban and rural areas had experienced severe rainfall and floods in the past 6 years,** with serious damages to personal property and critical public infrastructure or even suffered loss of lives.

The urban and rural areas received one point if they experienced severe rainfall and floods in the past 6 years and zero points if not.

**Criterion 3 - Inclusion in one of the typologies of vulnerability to floods**

The third criterion is the **inclusion in one of the typologies of vulnerability to floods from Romania.** The analysis of the causes that generated the extreme hydrologic events in Romania within the last years leads to the identification of five categories of towns related to flood vulnerability, based on the methodology for assessing vulnerability to floods in Romanian cities. This is influenced on one hand by the geographical position in relation to morphology and hydrography and on the other hand by likely human impact and influence (transport infrastructure; upstream hydrotechnical arrangements and especially sewerage systems). On this base, urban and rural areas were identified vulnerable to

floods having as characteristics: misfit sewerage systems; the accumulation of waters from nearby slopes; an inadequate drainage system; the overflowing of the neighbouring rivers and the consequence of some failures to the upstream hydro-technical works.

Typologies of vulnerabilities to floods are:

1. Vulnerability to floods occurred because of large amounts of water accumulation that cannot be taken by secondary hydrographic arteries or maladministration of flow control from upstream hydro-technical constructions;
2. Vulnerability to floods due to insufficiently sized or poorly maintained sewer systems;
3. Vulnerability to floods due to water intake from the adjacent slopes;
4. Vulnerability to floods due to the insufficient natural drainage;
5. Vulnerability to floods due to the overflowing of adjacent hydrographic arteries during large flash floods (over 1/3 of Romanian cities).

All of the urban and rural areas received one point for being included in one of the above typologies of vulnerability to floods.

**Criterion 4 – Percent of people affected by fluvial floods**

High-risk areas were identified from the risk maps. The existence of high-risk areas doubled by the desire to develop the city in those areas represents a borderline situation. The necessity is to find the best measures which can be applied and the best recommendations to be included as soon as possible in the spatial planning.

The municipalities received 0.25 points if there were from 0-1% of the total population affected, 0. 5 if there were from 1-3 % of the total population affected, 0.75 if there were from 3-5% of the total population affected and 1 if there were from 5-10% of the total population affected.

**Criterion 5 - Percent of flood risk areas from the built area**

This criterion refers to the affected area from the hazard maps from cycle one and of the hazard and risk maps provided by the pilot studies for FRMP2 Methodologies (WB Flood RAS Project, 2020-2021).

## CRITERIA RELATED TO THE SPATIAL PLANNING OF LOCALITIES

**Criterion 6 – Having a General Urban Plan (PUG) in progress**

The process of updating General Urban Plans has several phases, such as:

- The office phase / The preparedness phase: in this phase the procurement phase is taking place and also the contract with the urban planners is signed. The elaboration phase, which is part of this stage, consists in two important phases: the preliminary phase, when preliminary studies are made, and the planning phase when proposals are made.
- The outside the office phase / The approval phase: is the phase in which all the necessary approvals are obtained.

Having a General Urban Plan which is in progress, preferably at the beginning of the process, is essential here, because the process of integration can be observed and analyzed in real time. A PUG being at least in the elaboration phase should have integrated Flood Risk Hazard and Risk Maps and should have included flood risk management measures to reduce flood risk or the prepare the city for future flood events.

Also, a PUG in progress will ensure an efficient communication and collaboration with urban planners responsible with the process of updating this plan. Thus, urban planners can be interviewed in order to explain where flood risk management issues were integrated into spatial planning plans.

In the end, analyzing these general urban plans and their process of updating will lead to relevant conclusions for the final Guidance document.

The cities with the PUG in the planning phase received one point, the ones being in the preliminary phase received 0.75 points, the ones in the initial phase 0.5 points, and the ones in the approval phase received only 0.25 points.

Choosing pilots with a General Urban Plan (PUG) under elaboration or at the beginning of its development is more suitable for the integration exercise, so that some of the recommendations of the studies could be included in the final general urban plans.

The status of updating General Urban Plans of the potential urban and rural areas is as following:





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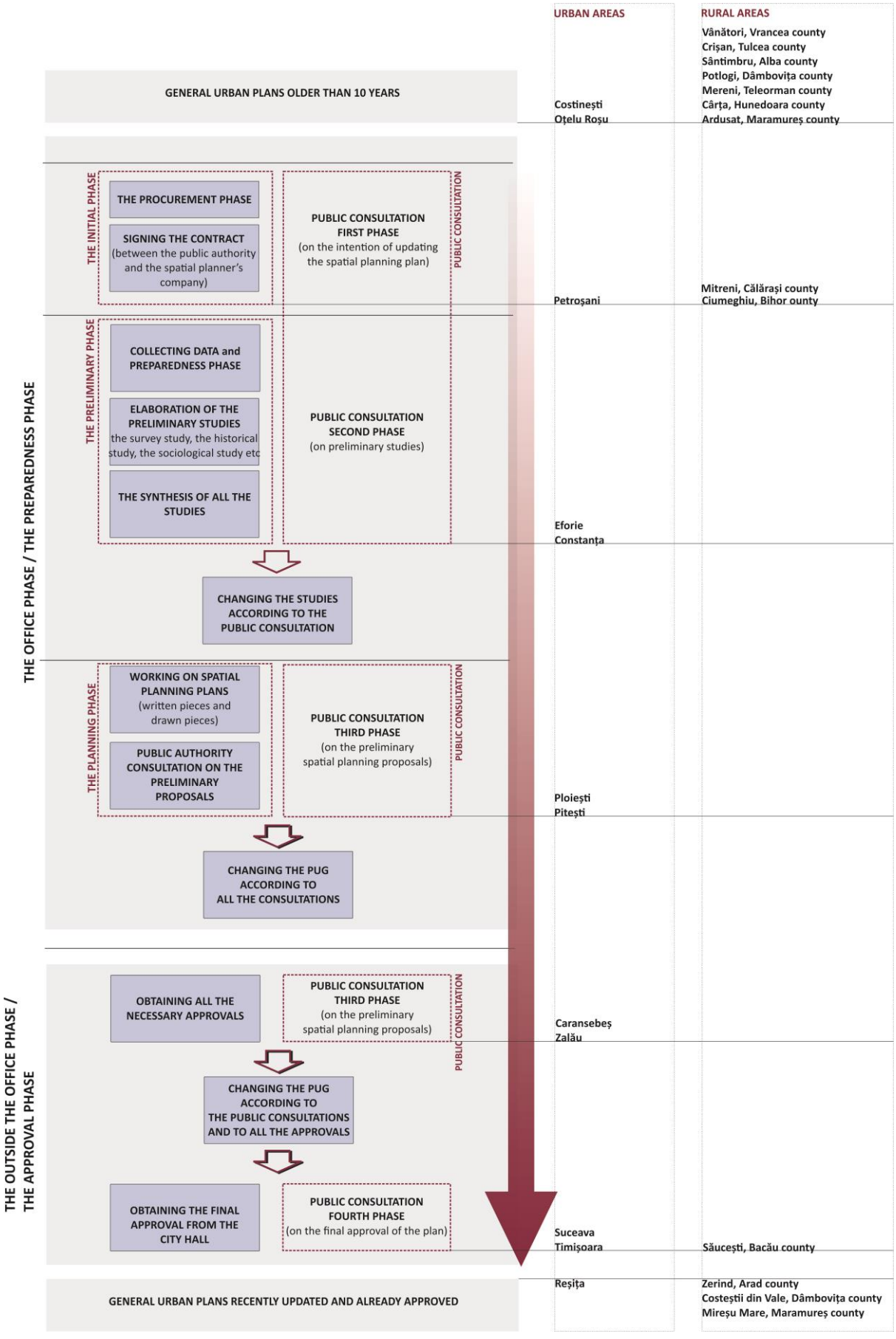




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**Criterion 7 - Percent of protected natural areas from the administrative area**

Natural protected areas are part of many administrative urban or rural areas. In some cases, part of these areas is in the floodplain and because of that many species are in danger of disappearing. Choosing pilot areas with high percentage of natural protected areas in administrative territory is an opportunity to research potential flood risk management measures that can reduce this risk.

The scores used for urban areas with natural protected areas are 0.25 for 0-1%, 0.5 for 1-2.5%, 0.75 for 2.5-5% and 1 for 5-10%. For rural areas scores are somewhat different because natural protected areas occupy a higher percentage from the administrative area. Thus, scores used are: 0.25 for 0-10%, 0.5 for 10-50%, 0.75 for 50-75% and 1 for 75-100%.

**Criterion 8 - Available land for flood risk management measures (parks or large green areas):**

The new approach in flood risk mitigation is the combined use of structural measures with non-structural measures. Some key non-structural measures are mostly nature-based solutions which need available land, mostly without buildings. Therefore, urban or rural areas with parks or large green areas (such as green areas adjacent to roads in case of rural areas) are most suitable to be our pilots due to the large areas where features such as wetlands, bio-swales, channels, raingarden ponds etc. could be arranged. Also, available land free from buildings near the river is an advantage, because only in this situation room for the river can be made.

Available land such as parks and large green areas is necessary to reduce pluvial risk, whilst available land near the river is necessary to mostly reduce fluvial risk.

The selected urban and rural areas received a point if had available land for green measures or zero points if not.

## CRITERION FOR INTEGRATION OF FLOOD RISK MANAGEMENT INTO URBAN AND SPATIAL PLANNING

**Criterion 9 – Cities/rural areas with FRM measures already integrated into SP or areas for which PUG can still integrate FRM measures**

In Romania, few urban or rural areas have integrated flood risk management measures into their urban and spatial planning. The main idea of using this criterion is to choose as pilots those areas that have integrated these measures in order to learn how this process was successful, if that is the case, or to identify integration problems.

Thus, it would be possible to identify optimal and customized flood risk management solutions that were proposed for a particular area. After that, the way these solutions were integrated into spatial and urban planning should be analyzed and proposals for a better integration could be made.

## TIE-BREAKING CRITERION

**To be different typologies of vulnerability to floods, to be addressed by different types of the flood risk measures**

To address many cities and communities which need to mitigate the effects of urban flooding and to cover as much as possible all kinds of risks we need to select the pilot areas carefully. The selection must be made such that different structural and non-structural measures can be checked. These measures can be applied to problems specific to different types of vulnerability to floods.

It is feasible to reduce the risk of flooding through practical combinations of measures in relation to the magnitude of the catastrophe and the degree of exposure and vulnerability of the community. A clear understanding of existing and potential flood risks is needed to establish risk mitigation measures, which is the modern approach to flood management.

Combining different vulnerabilities to floods, for example, Fluvial and Flash Floods or Pluvial, Fluvial and floods exceeding the capacity of the sewerage network ensures the testing of combinations of different measures.

*

* *

Following the suggestion to also consider a rural area/commune with high risk of flooding as a pilot, as different challenges are faced by authorities in urban and in rural areas, a list of 13 communes was selected from the tables provided by ANAR with frequent flooding in rural areas and high impacted populations.

In order to choose the most affected communes, were used 2 rules:

- First rule was the existence of detailed scale risk and hazard maps.
- Second, were selected the communes with great percent of the surfaces affected by floods, considering the percent of surfaces affected from the total surface of the territorial-administrative unit.
- Third, were considered the administrative units more populated, resulting in 13 communes being listed, as most affected by flooding.

For those 13 communes first were verified the number of people affected, after that the floodable areas, using the available maps.

After that, the choice of the commune for the pilot study was made similar with the selection of the pilot studies for the urban areas. The same criteria described above were used to the 13 communes.

The selected commune (from the proposed final 3 communes in Annex B) will be the 4$^{th}$ pilot study and will be studied in parallel with the three urban pilot cities (Reșița, Timișoara and Pitești).



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## ANNEX A - CRITERIA FOR URBAN PILOTS SELECTION

| CITY/CRITERIA | Flood risk management criteria | | | | | Spatial planning criteria | | | Integration criterion | TOTAL | Tie-breaking criterion - To be different urban typologies of vulnerability to floods, to be addressed by different types of the flood risk measures | FINAL PILOT CITIES |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Criterion 1** - Areas of Potentially Significant Pluvial Flood Risk | **Criterion 2** - Severe rainfall and floods in the past 6 years | **Criterion 3** - Inclusion in one of the typologies of vulnerability to floods | **Criterion 4** - % of people affected by fluvial floods | **Criterion 5** - % of flood risk areas (fluvial floos) from the built area | **Criterion 6** - Having a General Urban Plan in progress (% of the process conducted so far) | **Criterion 7** - % of protected natural areas from the administrative area | **Criterion 8** - Available land for flood risk management measures (parks or large green areas) | **Criterion 9** – Cities with FRM measures already integrated into SP or areas for which PUG can still integrate FRM measures | | | |
| Reșița | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | **7.00** | - | ✓ |
| Caransebeș | 1 | 1 | 1 | 0.25 | 0.25 | 0.25 | 0.75 | 1 | 0 | **5.50** | Fluvial Flood& Flash floods | |
| Oțelu Roșu | 1 | 1 | 1 | 0.25 | 0.5 | 0 | 0.25 | 0 | 0 | **4.00** | - | |
| Timișoara | 1 | 1 | 1 | 0.25 | 0.25 | 0.25 | 0.75 | 1 | 1 | **6.50** | Pluvial/ Sewerage& Fluvial | ✓ |
| Petroșani | 1 | 1 | 1 | 0.5 | 0.25 | 0.5 | 0.75 | 1 | 0 | **6.00** | Flash Floods | |
| Pitești | 1 | 1 | 1 | 0.25 | 0.25 | 1 | 0.75 | 1 | 1 | **7.25** | Fluvial/ Integrated Res Expl | ✓ |
| Ploiești | 1 | 1 | 1 | 0.25 | 0.25 | 1 | 0 | 1 | 1 | **6.50** | Fluvial &Pluvial | |
| Constanța, Eforie, Costinești | 1 | 1 | 1 | 0.25 | 0 | 0.75 | 0 | 1 | 1 | **6.00** | Pluvial/ Sewerage/ Coastal | |
| Zalău | 1 | 1 | 1 | 1 | 0.75 | 0.25 | 0 | 1 | 0 | **6.00** | Pluvial/ Sewerage& Fluvial | |
| Suceava | 1 | 1 | 1 | 0.5 | 0.25 | 0.25 | 0.25 | 1 | 1 | **6.25** | Flash floods/ Pluvial floods | |

**LEGEND:**

**Criterion 1 - Areas of Potentially Significant Pluvial Flood Risk:**
1 = yes; 0 = no.

**Criterion 2- Severe rainfall and floods in the past 6 years:**
1 = yes; 0 = no

**Criterion 3 - Inclusion in one of the typologies of vulnerability to floods:**
1 = yes; 0 = no

**Criterion 4 - % of people affected of fluvial floods:**
0-1% = 0.25;
1-3% = 0.5;
3-5% = 0.75;
5-10% = 1.00.

**Criterion 5 - % of flood risk areas from the built area:**
0-2.5% = 0.25;
2.5-5% = 0.5;
5-10% = 0.75;
10-20% = 1.00.

**Criterion 6 - Having a General Urban Plan in progress:**
0.25 points for the approval phase;
0.50 points for the initial phase;
0.75 points for the prelimminary phase;
1.00 points for the planning phase;
Note: The PUGs having an already approved plan and the ones that did not have started the procedure of updating are noted with 0.

**Criterion 7 - % of protected natural areas from the administrative area:**
0-1% = 0.25;
1-2.5% = 0.5;
2.5-5% = 0.75;
5-10% = 1.00.

**Criterion 8 - Available land for flood risk management measures (parks or large green areas):**
1 = yes; 0 = no.

**Criterion 9 – Cities with FRM measures already integrated into SP or areas for which PUG can still integrate FRM measures**
1 = they have FRM measures integrated into SP or they have potential to integrate these measures into SP because they have a PUG in progress;
0 = they have FRM measure integrated into SP.

## ANNEX B - CRITERIA FOR RURAL PILOTS SELECTION

| RURAL AREA/CRITERIA | Flood risk management criteria | | | | | Spatial planning criteria | | | Integration criterion | TOTAL | FINAL RURAL PILOTS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Criterion 1** - Areas of Potentially Significant Pluvial Flood Risk | **Criterion 2** - Severe rainfall and floods in the past 6 years | **Criterion 3** - Inclusion in one of the typologies of vulnerability to floods | **Criterion 4** - % of people affected by fluvial floods | **Criterion 5** - % of flood risk areas (fluvial floos) from the built area | **Criterion 7** - Having a General Urban Plan in progress | **Criterion 9** - % of protected natural areas from the administrative area | **Criterion 10** - Available land for flood risk management measures (parks or large green areas) | **Criterion 12 –** Rural areas with FRM measures already integrated into SP or areas for which PUG can still integrate FRM measures | | |
| Zerind, Arad county | 0 | 1 | 1 | 1 | 1 | 0 | 0.75 | 1 | 0 | **5.75** | |
| Costeștii din Vale, Dâmbovița county | 0 | 1 | 1 | 0.5 | 0.5 | 0 | 0.25 | 1 | 0 | **4.25** | |
| Vânători, Vrancea county | 0 | 1 | 1 | 0.5 | 0.5 | 0 | 0.5 | 1 | 0 | **4.50** | |
| Mireșu Mare, Maramureș county | 0 | 1 | 1 | 0.5 | 0.5 | 0 | 0.25 | 1 | 0 | **4.25** | |
| Crișan, Tulcea county | 0 | 1 | 1 | 0.75 | 1 | 0.25 | 1 | 1 | 0 | **6.00** | |
| Sântimbru, Alba county | 0 | 1 | 1 | 1 | 0.5 | 0.25 | 1 | 1 | 0 | **5.75** | |
| Potlogi, Dâmbovița county | 0 | 1 | 1 | 0.75 | 0.5 | 0.25 | 0.25 | 1 | 0 | **4.75** | |
| Ciumeghiu, Bihor county | 0 | 1 | 1 | 0.75 | 0.75 | 0.50 | 0.5 | 1 | 0 | **5.50** | |
| Mereni, Teleorman county | 0 | 1 | 1 | 0.5 | 0.5 | 0 | 0 | 1 | 0 | **4.00** | |
| Cârța, Harghita county | 0 | 1 | 1 | 0.75 | 0.75 | 0.75 | 0.5 | 1 | 0 | **5.75** | |
| Mitreni, Călărași county | 0 | 1 | 1 | 0.5 | 0.5 | 0 | 0 | 1 | 0 | **4.00** | |
| Săucești, Bacău county | 0 | 1 | 1 | 0.5 | 0.5 | 1 | 0.25 | 1 | 1 | **6.25** | ✓ |
| Ardusat, Maramureș county | 0 | 1 | 1 | 0.25 | 0.25 | 0.75 | 0.25 | 1 | 0 | **4.50** | |

**LEGEND:**

**Criterion 1 - Areas of Potentially Significant Pluvial Flood Risk:**
1 = yes; 0 = no.

**Criterion 2- Severe rainfall and floods in the past 6 years:**
1 = yes; 0 = no

**Criterion 3 - Inclusion in one of the typologies of vulnerability to floods:**
1 = yes; 0 = no

**Criterion 4 - % of people affected of fluvial floods:**
0-25% = 0.25;
25-50% = 0.5;
50-75% = 0.75;
75-100% = 1.00.

**Criterion 5 - % of flood risk areas from the built area:**
0-30% = 0.25;
30-50% = 0.5;
50-75% = 0.75;
75-100% = 1.00.

**Criterion 6 - Having a General Urban Plan in progress:**
0.25 points for the approval phase;
0.50 points for the initial phase;
0.75 points for the prelimminary phase;
1.00 points for the planning phase;
Note: The PUGs having an already approved plan and the ones that did not have started the procedure of updating are noted with 0.

**Criterion 7 - % of protected natural areas from the administrative area:**
0-10% = 0.25;
10-50% = 0.5;
50-75% = 0.75;
75-100% = 1.00.

**Criterion 8 - Available land for flood risk management measures (parks or large green areas):**
1 = yes; 0 = no.

**Criterion 9 – Rural areas with FRM measures already integrated into SP or areas for which PUG can still integrate FRM measures**
1 = they have FRM measures integrated into SP or they have potential to integrate these measures into SP because they have a PUG in progress;
0 = they have FRM measure integrated into SP.

# ADDENDUM 4: Interviews / questionnaires conducted during the pilot analyses

## The municipalities interview

The municipalities' interview was based on 14 questions:

1. Are you currently working with spatial planning plans which include the flood hazard maps?
2. Do you have preliminary studies for the General Urban Plan (GUP) that are addressing flood risk?
3. How were these recommendations implemented in GUP?
4. When was the GUP approved?
5. What funding methods did you use for the GUP (local, national)?
6. Did GUP have some spatial planning proposals with the purpose of decreasing the runoff or collecting it locally?
7. What were the main challenges of the GUP?
8. Do you have flood hazard information or flood risk management (FRM) measures included also in other types of spatial planning tools?
9. Do you have issues or difficulties in communicating with other public institutions or stakeholders in the process of including FRM measures in local spatial plans?
10. In the Territorial and Urban Planning Committee do you have discussion and recommendations to include FRM in spatial planning plans?
11. From your point of view, what are the main impediments to better integration of flood risk management into urban and spatial planning, and vice versa?
12. Do you have any evidence of historical fluvial floods events?
13. What is the configuration of the sewerage system (unitary or separative)? Do you have a record of the currently flooded streets?
14. Do you have data regarding the flows which enter the wastewater plant (night and day, rainy and dry weather, use of the bypass for intensive rain days)? Do you have underground reservoirs for collecting rainwater?

## The River Basin Administrations interview

The River Basin Administrations' interview was divided in 4 sections:

*Section 1 - Spatial & Urban Planning when flood hazard and risk maps are not available*

1. Based on what documents are decided the **potential flood risk** and the appropriate measures when **flood hazard and risk maps are not available** for PUG/PUZ/PUD? What sources of risk you analyze for these cases? Do you consider all the sources?
2. Do you have **any criteria** to **address the content of the flood studies** (apart from the Order 891/2019 for water management authorizations and Order 828/2019 for water management permits)? Do you have a **tool** or **procedure** in this regard or do you use only the result of the flood studies?
3. Would be good to have a **procedure of quality check** of those **flood studies based on hydraulic models,** (not using only calculations made with Chezy equations)?
4. Do you deliver a general content for the Flood Study (Flood Study) for PUG? Is this a condition for obtaining the water permit? What types of measures do you request / recommend to be included in this study? Are these measures included in the General Urban Plan?



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5. What specific studies/chapters will be requested to be included in the Flood Study (Flood Study) for an urban area historical developed in the floodplain to get water management permit for intensive development of that area?
6. There are recommended hydraulic models for the inundability study?

*Section 2 - The integration of FRM into Spatial & Urban Planning*

7. How is handled the flood risk management at the scale of the river basin when no spatial strategy for the river basin is in place?
8. **Are territorial and urban planning plans** usually **integrating flood risk management** in other way than including hazard maps and proposing restricted areas for future buildings in flood risk areas?
9. Are urban planners aware of the importance of FRM integration into SP?
10. Are flood protection measures being proposed / adopted in urban development areas with flood risk? If so, who initiated these measures?
11. What **flood risk management** measures **did you request to be integrated** in territorial and urban planning plans for pilot areas (Pitești, Timișoara, Reșița, Săucești commune)? Did urban planners include these requests in the spatial plan?
12. Is PUG Action Plan (Investment Plan FRM measures) integrated with RBA's FRMP and APSFR Strategy? Could be provided such an example?

*Section 3 - The Interinstitutional Cooperation*

13. After finalizing the flood hazard and risk maps how and when will these be delivered to county and local urban planning authority? How and when have they been provided in the past, after the 1st cycle of Floods Directive implementation? In what format?
14. Do you assist county and local administration (Chief Architect institution) to facilitate the integration of flood risk management measures at the river basin and urban levels into spatial and urban planning? Is there a continuum dialog between RBAs and county and local authority?
15. Have you in your area major transport infrastructure (road belts or express roads) which is used as second defense line against floods? Can you give us such an example of constructions for pilot areas? Is there a collaboration between relevant institutions to optimize the solutions for flood defenses measures? Is there such coordinated integrated collaboration for requests for water management permits?

*Section 4 - Permits and authorizations*

16. What are the constructions for which is required a flood study in your area (roads, bridges, wastewater treatment plants, water treatment plants, different types of buildings, fish ponds)?
17. For which annual exceedance probability are the existing constructions protected considering the fluvial risk?
18. Do you recommend mitigation measures for the existing buildings in the flood prone area?
19. In the case of new proposed constructions in the flooding area it is required a site permit. On which base are checked and approved or disapproved the works and measures proposed for flood protection or for the removal from flooding of the objectives in order to obtain the permit?


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20. Have technical documentation been submitted for the substantiation of the water management permit in case of the pilot areas? Is this documentation available for consultation?

*Note: Section 4 was not discussed during the meeting due to the lack of time, but these questions were sent to RBAs by e-mails after the meetings. RBAs sent the answers via e-mail.*

## The County Inspectorate of Emergency Situations

The County Inspectorate of Emergency Situations' interview was conducted by e-mail. Questions addressed to them were as following:

1. In the PUGs approval process do you deliver to urban planners the evacuation area / campus from the Flood Protection Plan (PAI) to be included? What restrictions are urban planners proposing on these areas?
2. Are plans available for the city critical infrastructure in the Flood protection plan (evacuation routs/roads)? Who do you deliver this data and in what format (GIS, dwg, pdf, jpg etc.)? Although according to the legal framework it is not an obligation, are in PUGs delineated protection areas to these critical infrastructure/evacuation roads or are these routs / roads treated / represented different in any way than other roads? Do you request these aspects to be included in the obtaining permit process for PUGs?
3. Are the Rapid Intervention Centers (CIR) locations available in the Flood Protection Plan (PAI)? Is this data delivered to urban planners? Do you request in spatial planning plans the integration of the location of these centers and the road access from CIR to areas with potential flood risk? What measures are urban planners proposing to protect CIRs and the linking roads to flood risk areas?
4. Is any link between PAI information and intervention needs and PUG plans?
   - GIS maps ☐
   - Risk receptors represented in maps ☐
   - Blue corridor and its flood attenuation capacity ☐
   - Sewerage system and pumping facilities location ☐
   - Other ☐

   (If other, please detail):



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# ADDENDUM 5: Bibliography

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